A Study on Future Trends and Taxation

Final Report

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Preface

This is the final report of the project “A Study on future trends and taxation”, Specific Contract no. 10 TAXUD/2018DE/339 implementing Framework Service Contract no. TAXUD/2015/CC/131 for the provision of economic analysis in the area of taxation. The project was being undertaken by the ETLA (Project Leader) and IHS (Consortium Leader) in collaboration with CASE, CPB, DONDENA and PwC.

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We also acknowledge discussions with several experts from DG TAXUD and other DGs who offered valuable comments and suggestions. All responsibility for the results and interpretation in each chapter of this report remains with the respective chapter authors.
Abstract

This report discusses the future of taxation. We consider four main areas of change, namely technology, demographics, globalisation and environmental externalities, and discuss how different trends and drivers of change in these areas can be expected to impact the main functions of taxation and tax administration. Our analysis is largely based on surveying existing research literature. We try to highlight the effects and mechanisms that should be the most important ones for taxation and provide references to the relevant literature. We complement the literature surveys with results from our own simulation analyses, expert interviews and scenario work that illustrates key uncertainties. The time frame we consider spans the following 20 years and we focus on EU countries. Many of the trends we describe create important challenges for taxation. However, we also identify plausible future developments, intermediating mechanisms and policy responses that may at least mitigate them.

Executive summary

This report discusses the future of taxation. We consider four main areas of change, namely technology, demographics, globalisation and environmental externalities, and discuss how different drivers of change in these areas can be expected to impact the main functions of taxation and tax administration. Our analysis is largely based on surveying existing research literature. We try to highlight the effects and mechanisms that should be the most important ones for taxation and provide references to the relevant literature. We complement the literature surveys with results from our own simulation analyses, expert interviews and scenario work. The time frame we consider spans the following 20 years and we focus on EU countries.

Many of the trends and possible future developments we describe may create serious challenges for taxation. However, we also identify plausible drivers of change, intermediating mechanisms and policy responses that may at least mitigate them.

Perhaps the most serious concern raised in the public debate related to technology is that new labour-saving technologies will result in mass unemployment, which would decrease tax revenues and increase social expenditures drastically. Fortunately, at least so far, automation of many tasks has not had a clear negative impact on employment at the economy-wide level. Theoretical research has identified various mechanisms that may compensate for the negative effects of labour-displacing technologies on employment. For instance, to the extent that automation results in lower wages, firms should have an incentive to create new tasks for workers.

A pervasive trend in the labour market has been job polarisation, i.e. decline in the share of middle-income occupations. At the same time, the capital share of income appears to be increasing in many countries (although there are serious data issues involved when measuring factor income shares). These trends have been associated with both technological change (the possibility to automate many relatively routine tasks in manufacturing) and globalisation (the reduction in the barriers to trade and to the mobility of firms and workers). Both trends are likely to increase income inequality making the redistributive function of taxation more important. It is possible, however, that technological advances will in the future allow
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automating also many tasks that are currently performed by relatively high-educated and well-paid workers. Such a process might start lowering wage inequality by reducing the demand for some high-skilled workers relative to other workers. This is one reason why the future effect of technological progress on inequality is unclear.

Another major technology-driven trend is digitalisation. One aspect of it is that it allows many businesses to operate in a particular country without necessarily having a taxable presence there. Digitalisation has also increased the importance of data and other intangible assets for firms’ profits. These developments create challenges for the taxation of multinational corporations, at least unless the current international nexus and profit allocation rules are modified.

Digitalisation has also led to the growth of online platforms. One tax-related challenge related to digitalisation is the difficulty of determining whether platform workers should be treated as employed or self-employed for tax and social security purposes. The rise of platforms could also promote barter transactions, which are challenging to tax from a VAT perspective. On the other hand, sharing of data between online platforms and tax administrations could lower compliance costs for platform workers and their customers, and help secure tax revenues.

There is little doubt that Europe’s population is ageing over the next few decades. The increase in the share of older people will pose challenges for the viability of public finances and is likely to require increases in tax rates to maintain current social welfare systems. At the same time, population ageing lowers the importance of labour income and increases that of pension income as tax bases. The tax implications of population ageing are especially important in member states that rely entirely on pay-as-you-go financing for their public pension systems. It should be kept in mind, however, that demographic projections are highly uncertain over a longer time frame (several decades) that is relevant when considering the sustainability of public finances.

Globalisation has created new opportunities for tax base erosion and profit shifting (BEPS) by corporations and for tax evasion by wealthy individuals, thereby making it more difficult to reduce economic inequality via taxation. Uncoordinated unilateral measures did not succeed in curbing BEPS as multinationals exploit tax differences between different jurisdictions through tax arbitrages. BEPS should be better addressed through coordination, which could be achieved either via unilateral implementation of the same measures in different countries at the same time, or via multilateral solutions. During the last decade and under the initiatives of both OECD and EU, the structure of the international tax regime has evolved indeed in a multilateral way in an attempt to deal with the challenges coming from BEPS and the rise of digital economy. However, it is not clear what the future steps in this regard will be.

With regard to the role of taxation in the field of environmental externalities, there is a strong case for increasing carbon taxes as part of climate policy at least outside the EU emissions trading system. Well-designed environmental taxes provide incentives for firms to develop new, greener technologies without a priori restricting technological choices. There is also an increasing need to stop biodiversity loss and a general degradation of ecosystem services. The measures could include land taxes that increase the price of converting natural land to other uses.
Higher carbon taxes should increase tax revenue in the short run. However, given climate policy goals, the tax base for carbon taxes, including current fuel taxes, should diminish already in the medium-term. Hence, carbon taxes cannot be relied on to solve fiscal sustainability issues related to e.g. population ageing. Climate policy and the climate change itself are also likely to increase the need for tax revenue. On the one hand, tightening of climate policy should involve more subsidies and other type of incentives towards the development of green technologies. On the other hand, part of the costs of adapting to climate change will inevitably be borne by the public sector.

Both climate change and population ageing raise difficult questions related to intergenerational equity. In the case of population ageing, these questions relate closely to the pay-as-you-go financing of pensions and old-age care and to choices related to the reforms that ensure the financial sustainability of the welfare state (such as raising contribution rates of the young versus lowering the benefits of the old).

Many of the future trends that may be relevant for taxation are uncertain. Rather than asking how to react to a specific trend, it therefore makes sense to first consider how to make public finances more resilient in the face of uncertainties. This could be done by trying to better align actual tax systems to general guidelines of good taxation that are not sensitive to these future trends.

In many cases, the best way to address current and future challenges requires enhanced international cooperation not just within the EU but also between the EU and the rest-of-the-world. Unfortunately, chances of achieving enhanced international cooperation could be weakened by recent political trends related to populism.

It would therefore be useful to also consider and prepare policies that can be applied if efforts to improve international coordination fails. As an example, the case for EU carbon tariffs increases if many of the EU’s trade partners follow lax climate policies while the EU and its member states tighten their own policies. The main rationale for such tariffs would be to limit carbon leakage and address concerns regarding the international cost competitiveness of European producers. In some cases, having a strategy that specifies what a large player like the EU would do if coordination fails may even help achieving desired international coordination. For instance, the option of imposing EU carbon tariffs may make other countries more willing to tighten their own climate policies.
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1 Introduction

Megatrends such as automation and digitalisation, population ageing, globalisation and climate change influence societies in many ways. However, there is marked uncertainty about many of these trends already over the next decade. Over the long term, uncertainty becomes fundamental and only alternative scenarios can be created. These trends may nevertheless require changes in policies to ensure the welfare of the citizens. Therefore, it is important to try to anticipate changes and to prepare for different possible outcomes.

This report focuses on the future of taxation. We consider four main areas of change, namely technology, demographics, globalisation and environmental externalities. Together they cover a wide range of societal changes that are potentially relevant for taxation. We discuss how different drivers of change in these areas can be expected to impact the main functions of taxation: i) raising tax revenue, ii) mitigating inequalities, and iii) correcting market failures. The third function includes taxing negative externalities such as pollution and providing tax subsidies to activities that may generate positive externalities such as research and development. In addition to these main functions of taxation, we consider issues related to tax administration.

Our analysis is mainly based on surveying existing research literature. We try to highlight the effects and mechanisms that should be the most important ones for taxation providing references to the relevant literature. We complement the literature surveys with results from our own simulation analyses and expert interviews. We also highlight uncertainties by presenting area specific “futures tables” displaying key dimensions of uncertainty within each four areas of change. In addition, we illustrate plausible correlations between different dimensions of uncertainty and their tax implications by constructing several scenarios covering all four areas of change.

The time frame we have in mind is about 20 years. In some cases, we refer to the medium-term, by which we mean up to 2030 or so, and the long-term (beyond 2030). Our focus is on EU countries.

The report is structured as follows. We first provide an overview and synthesis of the results by discussing the main challenges for tax policy we have identified and some options for policy responses that should be useful across various scenarios. We then discuss, in chapters 2-5, the four aforementioned areas of change independently of each other. Each of these chapters starts by describing the main drivers of change, then proceeds to discuss how they likely affect taxation via different direct and intermediating mechanisms and ends with a summary of the main tax implications. Chapter 6 focuses on selected interactions between different areas of change. Chapter 7 describes our scenario work that builds on the findings reported in chapters 2-6. Chapter 8 provides a synthesis of the result including a discussion of some relatively general policy options that should be useful across different plausible scenarios. Some of the more technical material is presented in end-of-chapter appendices.
2 Area of Technology

This chapter focuses on ongoing technological progress. The drivers of change include advances in robotics, artificial intelligence, digitalisation, and the decreasing cost of data analysis. They have tax implications via various intermediating mechanisms such as changing labour and capital income shares and the rise of platform economy. Some of the new technologies may also be used in tax administration.

It should be acknowledged that there are no exact definitions for some of these drivers. Robotics (or robots) and artificial intelligence are especially difficult to define. By robotics we mean the design, construction and use of robots, which in turn are often defined as reprogrammable devices that can sense their environment and perform tasks in a relatively autonomous fashion. Artificial intelligence is sometimes defined as the simulation of human intelligence processes by computers. One aspect of this is the ability to learn from data or experience. From our point view, a key implication of advances in robotics and artificial intelligence is that they allow automating increasingly complex tasks. Digitalisation refers to the increasing use of digital technologies and digitised (i.e. computer readable) data in business and public services. It is related to technological advances such as cloud computing, which lower the cost of data analysis.

The chapter is divided into three main parts. Section 2.1 discusses macroeconomic implications of technological change. It focuses on how and why technological progress is changing the division of national income between labour and capital and wage inequality.

Section 2.2 discusses how new technologies are changing the nature of employment and the way in which businesses generate value. Forecasting how new and existing technological innovation will affect the way in which businesses operate in the long-term is inherently challenging. As such, the literature we have reviewed tends to focus on how existing technologies will be adopted by businesses over the next 5-10 years. To complement the literature review in this section a small number of semi-structured interviews were conducted. The results of these interviews are presented in case study boxes throughout section 2.2.

Section 2.3 considers implications for tax policy and administration. We discuss separately how changing factor income shares (capital vs. labour) and wage inequality affect fiscal sustainability and the optimal tax structure, how new business models challenge current tax systems, and how new technologies can be used to improve tax administration and tax compliance. This section includes new simulation results on how changing factor income share affects public finances.

Section 2.4 provides a summary of the trends and the tax implications. The appendices provide details of the simulation model used in Section 2.3, discussion of the legal issues related to the employment status of platform workers and the value added tax treatment of online platforms and a brief overview of the expert interviews. The outputs of the interviews have also been developed into case study boxes in the main text.
2.1 Growth, factor income shares, and income inequality

Technological progress is often seen as the most important source of economic growth.¹ It can increase real wages and living standards for all if market competition translates firm-level increases in (total factor) productivity into lower prices for goods and services and/or higher wages.

However, an often-expressed concern is that the ongoing technological progress lowers the demand for all but the most highly educated labour, thereby reducing employment and the wages of many workers. In this Section, we describe the related empirical and theoretical evidence.

2.1.1 Empirical evidence

The labour share of national income (labour income share) seems to be on a downward trend in many advanced countries (Dao et al., 2017, Karabarbounis and Neiman, 2014). In other words, workers are receiving a smaller share of the total value added created in the economy, whereas capital owners are receiving a larger share. This is consistent with the view that technological progress is making labour in some sense less important in production relative to capital. As discussed in section 4.1.1 another explanation for the decreasing labour income share relates to globalisation. Of course, these two explanations are not mutually exclusive.

The evolution of the labour income share has not been uniform even among advanced countries. Between 1991 and 2014, the labour income share has increased (at least a little) also in some highly developed EU countries such as France, Sweden and Denmark (Dao et al., 2017). This suggests that the decline in labour share is by no means an inevitable trend. It should also be emphasised that there are important measurement issues involved in measuring factor income share.²

There is clear evidence of labour market polarisation, both for the US and many EU countries, where the share of employment in both relatively high-paying occupations and low-paying occupations increases at the expense of middle-income occupations (see e.g. Autor and Dorn (2013) for US evidence and Goos et al. (2014) for European evidence). One of the main explanations is technological progress in the form of increasingly efficient and sophisticated computers and physical robots that has allowed the automation of “routine” tasks that used to be characteristic of many middle-income occupations. Examples of these tasks include bookkeeping operations in administrative work and repetitive physical operations in manufacturing. By contrast, tasks that require direct contact and adaptability (e.g. cooking and cleaning services) or creative thinking (e.g. managerial roles) are much more difficult to automate (Autor, 2015). Whether or not firms will choose to automate a task also depends on the wage level, not just on the difficulty or cost of automation. This is point is discussed below in the next subsection.

¹ This is the usual conclusion stemming from the growth accounting framework. See, for instance, Acemoglu (2009).
² Gutierrez and Piton (2019) emphasise the importance of self-employment and housing services.
In addition, there is some more direct evidence of (relatively) new technologies having adverse effects on wages and employment at least in the short-run and in specific industries or regions. For instance, Acemoglu and Restrepo (2017) and Borjas and Freeman (2019) find that the increasing use of industrial robots had a negative impact on wages and employment at industry or regional levels in the US. Using cross-country and cross-sector data, Dao et al. (2017) show that the observed decline in labour share tends to be the largest in countries and industries that were initially specialized in routine intensive activities that should be automatable. Also using cross-country data, Autor and Salomons (2018) find that total factor productivity growth that is related to robot adoption or innovations (measured by patent flows) has a negative effect on both hours worked and wages in the same industry. Dauth et al. (2017) present similar results for Germany.

Moreover, the empirical evidence regarding the effect of robotisation on employment and wages is somewhat mixed. For instance, Graetz and Michaels (2018) find that the increasing use of industrial robots has had a positive effect on average wages and little or no effect for aggregate hours worked (both outcomes were measured at the country-industry level). Their results are based on a comparison of developments at the country-industry level across 17 developed countries (including several EU countries). Using Spanish firm-level panel data from the manufacturing sector, Koch et al. (2019) find that robot adoption leads to net job creation at the firm level. At the aggregate level, the adoption of robots has increased labour productivity largely because of reallocation of labour across firms from firms that have not adopted robots towards firms that have started to use them.4

More generally, it is very difficult to disentangle the long term and economy wide effects of specific technological changes from other factors influencing the economy. Both the decline in labour income share and job polarization have been attributed, at least partly, to factors other than technological change, such as increased offshoring of tasks (see section 4.1.1). Moreover, while technological progress has reduced employment in certain sectors or industries, new jobs have been created in other sectors, especially in the service sector. (For the German economy, this is well-illustrated in Dauth et al. (2017) using employer-employee data.) This is one key explanation why unemployment is not trending upwards despite e.g. advances in robotics.

2.1.2 Model-based analyses

There is also a growing body of literature that studies the impacts of ongoing technological progress using models of economic growth. The studies in this literature assume that technological progress makes it easier to replace workers with (production) capital - at least in

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3 Total factor productivity refers to how efficiently and intensely inputs (e.g. capital and labour) are used in production. Higher total factor productivity means that we can produce more without increasing any of the inputs.

4 Of course, firms that adopt robots may be in many ways different from other firms. This makes it difficult to draw conclusions regarding the causal effect or robot adoption by comparing e.g. job creation between the two groups. The empirical studies of the effect of robot adoption on the employment or wages mentioned in this subsection use different econometric techniques to tackle this problem. For instance, Graetz and Michaels (2018) instrument increased robot use with a measure of workers’ replaceability by robots in the industry in question. Koch et al. (2019) in turn match robot adopters and non-adopters along observable characteristics.
some tasks or occupations - and then proceed to analyse how the economy evolves under different assumptions regarding, for example, how investment and aggregate output are exactly determined. While the model-based analyses are speculative in the sense that some of the key underlying assumptions cannot be verified, they allow us to highlight key mechanisms and analyse policy options, which may be very useful.

Many of the models used in this literature have two types of production capital, often referred to as “robots” and “traditional capital”, and an aggregate production function specifying how aggregate output (value added) is determined based on the amounts of robots, traditional capital and labour used in production. A key assumption is that traditional capital is a complement to workers whereas robots are a substitute for them. Roughly speaking, this means that for a given wage level, more traditional capital increases the demand for labour, whereas more robots reduces it. Intuitively, the idea is that traditional capital makes workers more productive whereas robots can replace workers. Some analyses consider two types of workers, e.g. “high-skilled” and “low-skilled” or “well-educated” and “less-educated” workers. The assumption is then usually that at least for foreseeable future robots can substitute for less-educated workers only.

Technological progress may be modelled as a decline in the cost of producing robots relative to traditional capital, or as an increase in the productivity of robots relative to workers. The outcome is an increase in robots relative to labour and traditional capital, the so-called “robotisation”.

Berg et al. (2018) simulate the effects of robotisation on growth, wage level and labour share of income in a range of models that feature different assumptions regarding how exactly robots, traditional capital and labour are used in production. All the simulations predict that robotisation lowers the labour share of income and hence increases the capital income share. In model version with two types of labour, robotisation also increases wage inequality. This follows from the assumption that robots substitute for less-educated workers, which are paid less to start with, rather than well-educated workers. The model does not account for capital income inequality. However, an increase in the capital income share is likely to increase also overall income inequality because capital income tends to be both much more concentrated than labour income and positively correlated with overall income (Milanovic, 2017).

In theory, a decrease in the labour income share need not imply a decline in the wage level; it suffices that the aggregate wage bill grows at a lower rate than aggregate value added. However, in many simulations in Berg et al. (2018), robotisation also lowers the wage level, at least temporarily. In the model, the dynamics of the wage level depend on how investment in traditional capital evolves. Robotisation may decrease the wage level drastically if firms cut down investment in traditional capital in order to increase the stock of robots quickly.

On the other hand, in the model specifications analysed by Berg et al. (2018), robotisation tends to increase long-run economic growth. Importantly, the growth effect tends to be the strongest

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5 A commonly use definition for industrial robot is the one given by the International Federation of Robotics: “an automatically controlled, reprogrammable multipurpose manipulator programmable in three or more axes”. However, in this literature “robot” refers more generally to technologies that (loosely speaking) allow substituting workers with capital in production.
in cases where the labour’s share of income declines the most. This is because robotisation promotes growth especially when robots are a very close substitute for workers. In the extreme case where robots and all workers are perfect substitutes, labour becomes irrelevant as a factor production in the long run. Box 2.1 illustrates some of the mechanisms involved with an analytical example.

Perhaps the most alarming scenario has been produced by Sachs et al. (2015). In their model, robotisation may even lead to a permanent decline in aggregate output. In contrast to Berg et al. (2018), who consider models where savers and investors have an infinite decision horizon, Sachs et al. (2015) consider an overlapping generations model with working age households and retired households. In their model, only working age households save and their only source of income is labour income. Therefore, if wages fall following robotisation, also savings fall. This implies less investment in traditional capital, which further depresses the wage level and investment. The analysis suggests that to prevent this type of a vicious circle, we might need tax-and-transfer policies that shift resources from old capital owners, who benefit from robotisation, to young workers. However, the results of the model are likely to be overly pessimistic since they rely on the assumption that investment can be financed only by saving out of labour income, which seems unrealistic.

An aggregate production function with traditional capital, robots and labour is of course a simplifying assumption. Workers perform various tasks in different occupations and replacing workers by robots or other equipment embodying advanced technologies is easier in some tasks than in others. Moreover, while robots and computers have replaced and keep replacing workers in many tasks, entirely new tasks and occupations also emerge (think of personal trainers or mobile game designers).

The model developed by Acemoglu and Restrepo (2018a) accounts for this process. In their model, firms decide whether to automate existing tasks (replace workers with e.g. robots or computers) and whether to create new tasks for workers. The automation of existing tasks lowers the demand for labour whereas the creation of new tasks increases it. This provides one explanation on the stability of overall levels of employment. Humans have an advantage in “non-routine tasks” over machines. As long as new complex non-routine tasks will be created, there will be a shift from routine to non-routine jobs rather than a decline in employment. In the model, also the deepening of automation, i.e. increasing the productivity of already automated task, increases the demand for labour by increasing aggregate income.

In the model, the creation of new tasks and the deepening of automation may fully compensate the negative effect of automation on the labour income share. A key mechanism is that by lowering wages, automation also makes it more profitable to create new tasks for workers. The distributional effects of technological progress depend crucially on whether new tasks are suitable for low-skill workers or not. This emphasizes the importance of educational policies as a response to automation.

As mentioned above, it is common to assume that new technologies serve as complements to high-skill workers. While this is line with the empirical evidence, it seems possible that advances in AI will allow automating many tasks that are currently performed by high-paid workers e.g. in occupations like accounting or financial planning. This type of “high-skill automation” would likely reduce, rather than increase, wage inequality (Acemoglu and Restrepo, 2018b).
Box 2.1. Robots in growth models – an example

In what follows, we describe in some detail how robotisation affects the labour income share of national income in typical growth models. For simplicity, we make the extreme assumption that robots are perfect substitutes for labour. Most of the results we describe here would be qualitatively similar also in less extreme cases where robots and labour are imperfect substitutes (see e.g. Berg et al. 2018).

Let the production function of a representative firm be the following:

\[ Y = K^\alpha (L + R)^{1-\alpha}, \]

where \( Y \) denotes (the amount of) output (value added), \( K \) traditional capital, \( L \) labour, \( R \) robots and \( \alpha \) is a parameter between zero and 1. All three factors of production increase output. However, as far as robots and labour are concerned, the only thing that matters is their total amount. In this sense, robots can replace workers.

Let us assume that firms invest in traditional capital and robots trying to maximize their profits

\[ V = K^\alpha (L + R)^{1-\alpha} - rK - wL - rPR, \]

where \( r \) is the cost of capital (or the interest rate), \( w \) the wage rate and \( P \) the price of robots relative to the price of traditional capital. The first-order condition characterizing the demand for labour is given by

\[ (1 - \alpha)K^\alpha (L + R)^{-\alpha} = w. \]

In other words, firms employ labour until the marginal product of labour equals its marginal cost. This condition reveals that given the amount of labour, the wage rate is increasing in traditional capital and decreasing in robots. Intuitively, robots lower the wage rate (for a given stock of traditional capital and employment) because they replace workers in production.

The labour income share is given by

\[ \frac{wL}{Y} = (1 - \alpha)K^\alpha (L + R)^{-\alpha}L/K^\alpha (L + R)^{1-\alpha}. \]

If \( R = 0 \) (no robots), the labour income share is \( 1 - \alpha \). The capital share is then \( \alpha \). With \( R > 0 \), the labour income share is less than \( 1 - \alpha \). Thus, in this example robotisation increases the capital income share and decreases the labour income share.

The firm invests in robots, if their relative price is low enough relative to the wage rate. If the firm both invests in robots and employs workers, the wage rate must equal to (capital) cost of robots. Trying to protect workers by increasing minimum wages might accelerate robotisation and lead to unemployment. By contrast, a tax that increases the cost of robots may increase the demand for labour. It is crucial, however, that the tax falls on robots only and not traditional capital. That might be impossible to ensure in practice, because of the difficulty of distinguishing between robots and other types of capital in the tax code.

Robotisation tends to increase economic growth. In fact, in this example robots would allow for permanent economic growth even without technological progress. To see this, assume first that robots are not available. The output is then determined as \( Y = K^\alpha L^{1-\alpha} \). In this case, the output is constrained by the amount of labour. This is because the marginal productivity of capital
Future trends and taxation

decreases with the capital stock. Assume next that instead of labour, firms use robots. The output is then determined as $Y = K^\alpha R^{1-\alpha}$. In this case, we can have permanent economic growth that is based on investments alone. For instance, doubling both traditional capital and robots would always double output. (This extreme result requires the assumption that robots and labour are perfect substitutes. However, robotisation can increase economic growth for a long time even if robots and labour are imperfect substitutes in production.)

It is often assumed that robots can substitute only certain type of workers (less educated workers). A simple production function that would capture that assumption is of the following form:

$$Y = K^\alpha (L + R)^\beta S^{1-\alpha-\beta},$$

where $S$ refers to labour that cannot be replaced with robots. It is easy to show that robotisation tends to increase the wages of those workers that cannot be replaced with robots. However, robotisation still tends to increase the capital income share.

2.2 Changing business models

Technological innovation alongside decreases in the unit cost of data has triggered a transition to increasing levels of digitalisation across all aspects of life. This has generated profound changes to the way in which businesses operate.

The emergence of digitalised business models has been characterised by the Organisation for Economic Co-operation and Development (OECD) in the following way (OECD, 2018):

- **Scale without mass**: Digitalised business are able to operate across borders without necessarily having a physical presence in every jurisdiction they serve.

- **Reliance on intangibles**: The relevance of intangible assets, especially intellectual property (IP), is growing as a result of digitalisation. Businesses rely on IP assets, such as software and algorithms, for their platforms and they are investing rising shares of their revenues in this area.

- **Data and user contribution**: User-generated content and data is becoming fundamental for businesses and platforms. For example, almost all social networks would not be able to exist without the contribution of users (OECD, 2018).

In addition, the European Commission (2018) also highlighted the concept of “winner takes most dynamics” where a small number of “superstar” digital businesses dominate due to the existence of market dynamics that create a degree of path dependency (i.e. indirect network effects).

**Box 2.1. Engagement with stakeholders: Digitalisation and business models**

In interviews, industry stakeholders mentioned that as business models become increasingly digital, businesses are starting to trade more intangible assets, and this contributes to the blurring of jurisdictional borders. This makes it difficult for national tax authorities to tax digital companies. Technological innovation and digitalisation will have implications for how businesses operate and how they are taxed. While policymakers have developed initiatives for digital

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businesses such as the Digital Single Market, there is less focus on traditional businesses who are also digitalising. Although traditional businesses are progressing to the technological frontier, albeit at a slower pace, some industries face challenges in adopting the latest technological innovations. One of the main issues behind this is the skills gap which generates a need for businesses to invest in human capital.

The rise of digitalised business models displaying some or all of the characteristics outlined above has challenged existing concepts of employment and ways of creating value. On one hand, digitalisation has opened up new ways for people to work. For instance, collaborative economy platforms have promoted flexible work and non-standard forms of employment, while technological advances have made remote working easier (EC, 2017b). While on the other hand, digital businesses have found new ways in which to generate value which can be converted into revenue and profit. For instance, the interaction between users and digital businesses (e.g. online platforms) creates a huge amount of data that can be collected, analysed and/or sold by companies. This kind of information can then be used in many ways by businesses, from targeted advertising to customisation (OECD, 2018).

Digital businesses challenge existing concepts, and this has caused tensions with policy frameworks, such as taxation. For instance, the “Gig economy” phenomenon has led to the growth of businesses with many flexible workers and few permanent employees, which presents implications for the taxation of income (Office for Tax Simplification, 2016).

Moreover, digitalisation is exposing a skills gap in the workforce that is creating difficulties for the diffusion and adoption of new technologies and associated business models. According to a survey from the European Commission (2017), 40% of businesses hiring ICT specialists had problems finding candidates with the required skill set. Given that around 37% of the workforce in the EU do not have basic digital skills intervention to close the skills gap will be essential to capturing the benefits of rising levels of digitalisation (EC, 2017a, b).

Box 2.2. Engagement with stakeholders: Adoption of technological innovation

In an interview, a technology expert highlighted that the size is an important factor in determining the ability of a business to adopt technological innovation. Research in Denmark showed that large companies are front runners in embracing new technologies, while SMEs struggle to keep up with innovation, due to the constraints on financial and human resources. The expert also mentioned that small companies, especially in the manufacturing sector, tend to be resistant to change, in contrast to larger companies which can be more eager to take on new technology.

Technological innovation could also help SMEs to expand internationally thanks to new technologies that reduce or remove barriers to doing business (e.g. live streaming, webinars, sharing tools and virtual reality).
As the unit cost of data continues to fall and pace of digitalisation is likely to increase, digitalisation creates the prospect of a long-term increase in the overall rate of innovation, which, it has been claimed, will dwarf the benefits of any one particular innovation (Brynjolfsson, 2011). Despite the need for initial investment, digital technologies also have the potential to lower the time and monetary costs of many core activities in setting up a business (e.g. business registration and recruitment) over the long-term (EC, 2017b). Taken together, rising levels of digitalisation could result in the formation of increasingly more innovative businesses which will exacerbate existing tensions in policy frameworks.

This section discusses how new technologies are changing the nature of employment and the way in which businesses generate value. In particular, we identify a number of emerging technologies that have the potential to create new, or disrupt existing, business models.

We discuss the projected impacts of these technologies in terms of changes to the way in which revenue and value is generated and changes to ways of working. Of course, the distinction between these two areas can be blurred in practice. The means by which labour is accessed is a key component of the value chain of a business. Nevertheless, it is a useful framework with which to present the findings of our literature review.

To complement the literature review in this section a small number of semi-structured interviews were conducted (see appendix 2.4). The results of these interviews are presented in case study boxes.

### 2.2.1 Online platforms

Online platforms have boomed in the last 20 years as Internet technology has made them ubiquitous, connecting consumers and businesses from all over the world (EC, 2016). Platforms “give access to, host, transmit and index content originated by third parties or provide Internet-based services to third parties” (OECD, 2010). They act as middlemen, fostering communication between consumers/users and agents in a marketplace (OECD, 2010).

The OECD has categorised the functions of online platforms as follows (OECD, 2010):

- Provide infrastructure.
- Collect, organise and share information that was previously dispersed.
- Facilitate communication and exchange.
- Aggregate supply and demand.
- Facilitate market processes and transactions.

Brynjolfsson (2011) identifies four ways digitalisation is transforming business innovation: 1) Improved real-time measurement of business activities - vast amounts of data enable analytics and data-driven decision-making. 2) Faster and cheaper business experimentation - digitalisation allows firms to create new product prototypes, expose these to millions of consumers, quickly analyse user interactions, and make rapid decisions based on real-time consumer responses. 3) More widespread and easier sharing of ideas - relational databases, knowledge management systems, intranets and email networks increased the speed at which new findings and insights propagate. 4) The ability to replicate innovations more quickly and more accurately - digitalisation enables the scalability of innovation: when a software is upgraded it can be replicated and delivered with speed and precision at a marginal cost close to zero.
● Be a reliable source of trust for both consumers and agents (in many cases this is only relevant for platforms that facilitate exchanges, not simple content providers).

Online platforms operate in many different areas (e.g. online markets, social media, crowdsourcing and the sharing economy) (Langley and Leyshon, 2016) and offer a number of benefits for consumers (EC, 2016):

● Consumer convenience, simplifying transactions and saving time for users.
● Enhancing users’ decision-making abilities, through rating systems and comparison tools.
● Improved information, showing services and products consumers were unaware of.
● Monetary benefits, through deals, vouchers, group offers.
● Additional sources of income, allowing consumers to become sellers of products or services (e.g. ride sharing).

Although online platforms can take many forms in different sectors, a common feature is that they are often multi-sided, bringing together two or more different groups of participants, with participation are often being free for one group. It is this interaction of users on different sides that has the potential to generate significant value for platform operators and which supports non-neutral pricing (see section 2.2.1.1 for more detail).

The multi-sided nature of platforms can also give rise to indirect network effects whereby participation of a group on one side of the network grows the value of the network for the other side and vice versa (Evans, 2016). Such effects can create a positive loop that can entrench the market position of some platforms (Haucap and Heimeshoff, 2014).

The combination of these effects can lead to the growth of large platforms that hold a vast amount of data which can generate high switching costs for users (e.g. users risk being disadvantaged by moving from one social network to another).

Despite this, online platforms can face dynamic competition, as low market entry costs promote the formation of new platforms. However, recent platform consolidation has created significant challenges to building market share for new entrants.

2.2.1.1 How do online platforms generate value and revenue?

“In its purest form, an online platform simply offers a (virtual) transaction space where suppliers and consumers can meet.” (EC, 2016). The platform does not intervene in the transaction but may require an access fee on one or all sides (EC, 2018c).

In this sense, multi-sided platforms do not price neutrally and often have prices on one side of the platform that are well below the marginal cost while we have prices above the marginal cost on the other side (Rochet and Tirole, 2003, 2006). In many cases the user side has access to the platform for free (or they may even be subsidised to join the platform) in order to reach a sufficient scale of participation, making the platform more attractive to providers (the ones paying the platform’s fees). This can be true for both B2C and B2B online platforms.

Where they are charged user access fees constitute a direct source of revenue for online platforms. However, indirect revenue generation through user participation can often be a more significant source of value for online platforms.
One of the most important features of online platforms is the role of user participation in the value generation process. The end-users of platforms are not only consumers, but active contributors or “prosumers” (EC, 2018d). The personal information provided by users can be used to generate revenue from targeted advertising, as in the case of social networks and search engines. Revenue can also come from user-produced content that is shared with other users, making the platform more valuable such as review websites for restaurants and hotels (OECD, 2017).

A lack of price neutrality and reliance on user participation has two important implications from a fiscal perspective:

- Taxation on business profits generated by the platform operator can be challenging where the operator does not have a physical presence in the same jurisdiction as the activity giving rise to profits (scale without mass).
- Content and data created by users are a fundamental part of the value creation process for platforms, such as in the case of social media. However, it is difficult to estimate the value generated by users for platforms and to determine the location of where the value creation occurred (EC, 2018d).

2.2.1.2 What does this mean for employment?

Online platforms have challenged existing concepts of employment status, opening up flexible working and non-standard forms of employment.

In general, platform workers will often use platform work as a flexible way to supplement their income from other sources and to help them manage varying demand. They will often have to work harder during high-demand periods to compensate for low-demand times (Friedman, 2014, Huws et al. 2017, Office of Tax Simplification, 2016).

**Box 2.3. Engagement with stakeholders: Perspectives on platform work**

In an interview, a technology expert remarked that, while rapidly expanding, platform work is still not fully integrated into everyday life. This could be because businesses are used to working in a particular way or that platform workers are not trusted in providing the same quality as employees of established businesses.

The expert also highlighted the risks that come with platform work. From the perspective of a worker, the nature of platform work can vary substantially between countries. While in Denmark, for instance, platform workers are usually highly educated and can charge higher rates, in other countries (e.g. the USA or China) platform workers are quite low paid. Whereas, from a business perspective, it is difficult for business owners to retain platform workers and keep their loyalty, due to the low prevailing wages.

Findings from the 2018 edition of the European Commission’s COLEEM survey suggest that around 10% of adults across the EU have performed platform work, but that only 2% earn more than half their income from it (European Commission, 2018c).

However, the ability to use platform work as a means of replacing full-time employment will depend on the levels of remuneration offered. Indeed, platform workers’ remuneration can vary significantly depending on the type and location of work. Tasks that are carried out on-location
(delivered in person by the worker) are usually associated with higher wages as there is a limited pool of workers available (Aloisi, 2016; De Groen and Maselli, 2016) and can provide a worker with a stable income, even if modest.

Regardless of the level of remuneration offered, platform workers are exposed to risks from low levels of job security (OECD, 2018b). Although the extent of these risks will be determined by the employment status of platform workers. As many countries do not regulate platform work, employment status is determined by the characteristics of the relationship between platform and platform worker as a result. The difference between “employee” and “self-employed” also has important fiscal implications. While employees have access to many benefits (e.g. minimum wage or statutory sick pay) they frequently pay higher rates of social security. This can act as an incentive for platform workers to retain their self-employed status (Office for Tax Simplification, 2016).

However, when platform workers could choose between regular work and gigs, in a situation of full employment, they went for the former. The rise of the gig economy, indeed, happened in periods of time when workers had less bargaining leverage due to rising unemployment (Friedman, 2014).

Although technological change is the key driving force behind the rise of online platforms and platform work, it is important to recognise that this trend is being reinforced by the policy choices taken by governments on tax and social security.

Differences in the tax and social security treatment of the self-employed can create incentives for individuals to adopt non-standard forms of employment. In general, self-employed workers are able to take advantage of the deductibility of business-related expenditure for tax purposes. Furthermore, as noted above, differences in the social security treatment of the self-employed and workers may incentivise the move to non-standard forms of employment (OECD, 2019a). The rise of online platforms gives those in a position to do so an opportunity to arrange their work to benefit from lower tax burdens.

**Box 2.4. Engagement with digital economy expert: The gig economy and digitalisation**

In interviews, industry stakeholders highlighted that digitalisation will have implications for employment levels. The nature of work in the digital economy will be characterised by less stability and worker protection. One of the risks of digitalisation is inequality, the job market is likely to see an increase in concentration of jobs with a lack of protection and less stability. Governments will need to design a tax system able to offset the negative externalities coming from this new type of economy.

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7The European Commission’s Directorate-General for Employment, Social Affairs and Inclusion recently made the following recommendations to Member States to support workers in non-standard forms of employment (European Commission, 2018a): 1) Closing formal social security coverage gaps for self-employed and non-standard workers; 2) Take measures to allow these workers to build up adequate and effective social security coverage; and, 3) Increase transparency regarding social security systems and rights.
Stakeholders also highlighted the role of regulation. It was mentioned that the gig economy currently is not sufficiently regulated by the government. In addition, one area that requires more regulation is Artificial Intelligence and machine learning with an increased focus on questions surrounding ethics and accountability. There is also currently a lack of judiciary oversight over the application of AI and machine learning.

2.2.2 Cloud computing

Computing is shifting from client/server architectures to cloud computing.\(^8\) Cloud computing “is an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location.” (Marston et al. 2011). Users pay for the service as an operating expense without incurring any significant initial capital expenditure (Marston et al. 2011). This has led 95% of digital businesses to employ cloud computing facilities in 2016 (Joe-Wong, Sen, 2018).

It should be noted that cloud computing centres (or server farms) require a large amount of electricity. Depending on the energy mix of the country in which the server farm is located, this could generate a large carbon footprint. However, it has been shown that, in general, cloud computing represents a greener option compared to conventional hardware and software systems. Furthermore, major cloud companies have pledged to use only renewable energy in their data centres (Radu, 2017).

2.2.2.1 How does cloud computing generate value and revenue?

Cloud computing can generate value for both the provider and the user.

Cloud computing providers generate revenue through sales of service, in what is generally considered a high-volume, low-margin business (OECD, 2017). These services are usually provided on a pay-as-you-go basis, providing maximum flexibility to businesses.

In terms of the user, value is generated through operational cost savings achieved by using cloud computing. Compared to traditional software architecture, cloud computing is proving to be cheaper, faster, more effective and more flexible (Khalidi, 2011). The flexibility of cloud computing is particularly innovative as it allows businesses to scale resources up or down based on their clients’ needs, something that represented a costly issue in older physical systems. Using cloud computing can reduce the cost of hardware maintenance and backups, resulting in important savings for companies. Backups solutions are also extremely important in case of system failures (Tole, 2014).

Although value is generated by cloud computing on both sides, the tax policy implications are different. The value generated for users could increase returns to capital, which, if sufficiently large, could create implications for the capital:labour balance in the tax system. Whereas, as

\(^8\) There are three models of cloud computing (Adrian, 2014, NIST, 2011): 1) Infrastructure as a Service (IaaS): pure infrastructure, offering physical or virtual machine to users in order to develop their own software with reduced costs. 2) Platform as a Service (PaaS): this model adds its own operating system to the infrastructure, facilitating the implementation of software solutions. 3) Software as a Service (SaaS): a pay-per-use service where the user gets access a complete system (both hardware and software). It is the layer most users interact with.
cloud computing providers can operate within a country without the necessity of creating a permanent establishment, it can be difficult for tax authorities to locate the source of profits (Ball, 2012).

### 2.2.2.2 What does this mean for employment?

As with the literature on other technologies, the future implications for employment and ways of working of cloud computing are unclear. However, the consensus from the limited body of evidence is that it could have a positive impact in terms of job creation.

A 2009 study by Etro (2009) found that cloud computing is expected to have a positive influence on employment. Using a dynamic stochastic general equilibrium (DSGE) calibrated model and taking into consideration country specific factors, Etro (2009) estimated that the introduction of cloud computing in Europe could create around 1 million additional jobs in Europe over the short and medium term. Etro’s (2009) projections suggest that almost 66% of those jobs would be concentrated in the six largest Member States (UK, France, Germany, Italy, Spain and Poland).

In a more recent paper, Jindal (2013) found that cloud computer services had created more than 1.5 million jobs worldwide by 2012. Jindal (2013) also illustrated how the growth of cloud computing could result in a more prominent role for IT in the strategy of businesses and an associated rise in demand for enterprise architects (e.g. such as cloud capacity planners and cloud service managers).

While it remains to be seen whether the rise of cloud computing will result in labour displacement or contribute to labour polarisation, it is clear that there will be public expenditure implications for closing skills gaps in the workforce to benefit from job creation.

### 2.2.3 Data analytics

As outlined above, reliance on data was identified by the OECD (2018a) as a key characteristic of a digitalised business model. Reductions in the unit cost of data has resulted in the collection of more data which, in turn, has driven increasingly sophisticated data analytics to inform decision making.

Indeed, data has become a key resource of innovation and businesses that have not invested in data are rapidly losing ground to data-centred competitors. Data is also a critical input to AI, a rapidly expanding field that, some have commented, may become very important in the future (EPSC, 2018).

#### 2.2.3.1 How does data analytics generate value and revenue?

Lambrecht (2014) outlines that value can be generated from the collection and sale of data in four main ways:

- Specific websites sell information about users to direct marketing companies.
- Websites can make a deal with data management platforms to allow them to put cookies on their visitors’ computers and collect information on recent activity and preferences.
- Data can be sold indirectly through bundling of information by a data aggregator, such as comparison websites. These businesses profit from percentage fees on transactions processed through their websites.
● Recent advancement in the ability to combine data from different sources, such as geolocation, online surveys, previous purchases and browsing behaviour, enhances advertising companies’ ability to target their ads on the costumer, reducing “Baseline noise” (Lambrecht 2014).

Data can also be sold directly to businesses for the development of new products based on the insights of customers. For example, data coming from wearables, such as smart watches, can be aggregated and sold to retail clothing manufacturers or services suppliers (e.g. medical services).

Growing trade in data could generate tax implications for the valuation of such assets and value generated from the collection of user data feeds into the wider debate of establishing whether a business has a taxable presence in a particular jurisdiction.

2.2.3.1.1 What does this mean for employment?

The implications of growth in demand for data analytics on ways of working is underappreciated in the literature. However, estimates suggest that there will be a growing demand for data workers in the short- and medium-term. Estimates of the World Economic Forum (2018) suggest that jobs that are heavily reliant on technology or that are enhanced by its use, such as data analysts and scientists, are expected to increase in demand in the period up to 2022. Whereas, in an EU context, 1.3 million positions for new data workers are expected to be created in the EU by 2020, compared to 2015 (EC, 2017b).

It is unclear whether this would result in displacement or whether demand for data workers would be additional. Some have suggested that advancements in data analytics will, to a certain extent, displace knowledge workers (Loebbecke and Picot, 2015).

Although the tax implications are, as yet, unclear, growing demand for data workers suggests a need to address skills gaps which has public expenditure implications.
2.2.4 Distributed ledger technologies

“A distributed ledger is essentially an asset database that can be shared across a network of multiple sites, geographies or institutions” (UK Government, 2016).

Distributed ledger technologies (DLT) are tools that enable bilateral transactions and other exchanges of data. There are several forms of DLT, but Blockchain is among the most prominent (other forms include Etherum, Hyperledger, Fabric and r3’s Corda). There are five main features of blockchains:

- Distributed database: each party of the blockchain has access to the entire database and no single party controls the data.
- Communication occurs on a peer-to-peer transmission
- Transparency: each transaction is visible to all the users in the blockchain. Users can still choose to remain anonymous, if they want.
- Irreversibility of records: each transaction that happen inside the blockchain is permanently recorded and cannot be cancelled or modified as is it is linked to every transaction that happened before (chain).
- Computational logic: transaction can be programmed and set to occur automatically.

The technology can be used for recording financial transactions, legal and public recordkeeping, such as property registration, birth certificates, voting or court records. They also have the potential to create “smart property”, supporting the ability to track buy-sell mechanisms for tangible assets, such as jewellery or cars (Lindman et al., 2017). Indeed, the potential applications of DLTs are so wide ranging that some have commented that they could become the system of record for all forms of transactions and exchanges (Iansiti, Lakhani, 2017).

In addition, DLT has also led to the creation and adoption of cryptocurrencies (e.g. Bitcoin). Coupling distributed transaction systems with a cryptocurrency can facilitate payments but can also be a focus of financial speculation. Recent events have shown that cryptocurrencies can be highly volatile as market forces rather than monetary policy drive their value. However, some governments are exploring the development of government-backed cryptocurrencies, which could address the problems associated with volatility and could encourage greater uptake.

The consensus in the literature is that blockchain technologies are not yet regarded as disruptive because it will take time to insert them into the economic environmental and social infrastructure. Many barriers will have to fall before that can happen. As the ecosystem involved in blockchains is complex, time will be needed before all parties will be able to cooperate at the required level. This will need institutional change (Iansiti and Lakhani, 2017).

Box 2.5. Engagement with technology expert: Distributed ledger technology

9 Cryptocurrencies can have a detrimental impact on the environment. Cryptocurrency mining, the process that verifies transactions and adds them to the distributed ledger, requires large amounts of energy. Krause and Tolaymat (2016) estimated that the four major cryptocurrencies produced 3 to 15 million tonnes of CO2 emissions between January 2016 and June 2018.
In an interview, an expert on DLT highlighted how the technology could have many untapped applications, such as the tokenisation of resources (i.e. the process of developing digital tokens to manage the security of information or the use of resources). However, as the application of DLT is still in its infancy, it is difficult to predict the effect the technology will have on business models and the nature of employment.

The impact of DLT will depend on the level of sophistication and the choices made by policymakers and regulators. While DLT can be seen as a solution to a number of problems, policymakers should understand the limitations of this technology in order to address problems that may arise through its application (e.g. developing strategies to address coding errors that can be unintentionally introduced in routine upgrades and can, in extreme situations, result in competing ledgers).

The expert also highlighted how the recent success and use of cryptocurrencies, such as Bitcoin, depends on policy choices. While cryptocurrencies are perceived somewhat negatively due to high levels of volatility and the potential to facilitate illegal and illicit activities, they could become widely used if governments or supranational institutions were to support them. This would give them authority and legitimacy, while also ensuring appropriate levels of regulatory oversight.

2.2.4.1 How do distributed ledger technologies generate value and revenue?

The value generated by DLTs lies in their ability to achieve operational cost savings by eliminating duplication and inefficiencies in control and coordination. DLTs could remove the need for intermediaries like lawyers, bankers and brokers. With the blockchain system there is no need for a third party to be a guarantor of the transaction, as records of the values and assets exchanged are permanently written in all copies of the ledgers distributed across several databases (Iansiti and Lakhani, 2017). Value creation in this manner could increase returns to capital, posing implications for the balance between capital and labour taxation much in the same way as automation.

Speculation on cryptocurrencies is a further way of generating value from DLTs which could generate tax policy implications. Such activity can be challenging to tax either due to a lack of transparency in cryptocurrency exchanges and/or because of inappropriate valuation approaches for capital gains tax purposes.\(^{10}\)

2.2.4.2 What does this mean for employment?

While the full impact of DLTs on employment still needs further research, the current literature presents mixed findings. On one hand, the implementation of DLTs in retail banking could lead to a 30% loss in banking jobs over the next decade (Woodside, 2017). However, the same paper also suggests that DLTs could potentiality create new jobs as there will be demand for expertise in this area (Woodside, 2017).

\(^{10}\) Investment in cryptocurrencies are exempt from VAT as established by Skatteverket v David Hedqvist Case C-264/14: CJEU
Although the evidence is mixed and underdeveloped, the process of creating and displacing jobs does suggest that there will be implications for the balance of capital and labour taxation, as well as public expenditure implications for any skills gaps associated with DLTs.

2.3 Tax implications

2.3.1 Lower labour income share and increased wage inequality

The empirical and theoretical research discussed above suggests that recent technological progress has likely contributed to reduce the share of income going to labour and may also have wage inequality. This process may continue also in the future. In this section, we consider its tax implications.

We first consider the case for a “robot tax”, i.e. a tax on specific technologies that substitute labour with capital. We then discuss other capital and labour tax measures. Finally, we ask how an increase in the capital income share is likely to affect fiscal sustainability.

2.3.1.1 The case for a robot tax

The concern that new labour replacing technologies will destroy jobs at an increasing pace, has resulted in calls for a “robot tax”. This idea has recently been taken seriously also in the economics literature. In that literature, robot tax usually refers to an additional tax on investments or intermediate goods that are used to replace labour in production, see Guerreiro et al. (2017) and Thuemmel (2018). This tax would be on top of e.g. current corporate income taxes that tax return to all productive capital including robots.

This literature is about the trade-off between efficiency and equity (or redistribution). By affecting the relative prices of different factors of production, a robot tax tends to make production less efficient thereby reducing aggregate output. On the other hand, it may also help to achieve distributional objectives by affecting employment and wages in a way that benefits relatively poor workers. This may be the case at least in a situation where robots substitute for less educated or low skilled workers but complement well-educated workers.

Despite this theoretical argument in favour of a robot tax, there are reasons to be sceptical about it.

First, while technological progress may indeed emphasize the redistributive function of taxation, the government may have better instruments at its disposal to tackle distributional concerns than a tax on specific technologies. The distributional effects of new technologies depend on a wide variety of policies and institutions, including social security, competition policy, and education policies (Korinek and Stiglitz 2018). A tax on specific technologies is not necessarily the best instrument.

Second, a robot tax may have unintended consequences in sectors whose output is traded internationally. A domestic tax on robots would hurt the competitiveness of domestic production in the world markets. In other words, one cannot protect workers against competition from foreign robots (robots used elsewhere) with a domestic tax on robots. Formal analyses have often abstracted from this issue by considering a closed economy.

Third, it might be quite difficult to define in practice the technologies that would be taxed with a technology specific tax. In principle, the idea would be to tax investments or intermediate goods
that substitute for less educated workers thereby depressing their wages. The need to distinguish between different types of technologies would necessarily complicate the tax system. Related to this, there is a risk that we end up taxing also production capital that complements labour and increases the wage level. Moreover, in the task-based model of Acemoglu and Restrepo (2018a), deepening of automation, i.e. increasing the productivity of already automated task, increases the demand for labour. A robot tax might also slow down this process.

2.3.1.2 Labour income taxation
As discussed above, technological progress may increase wage inequality via job polarization and by putting downward pressure on the wages of some low-skilled workers. The theoretical models with labour-replacing technological progress show that trying to mitigate its (potentially) adverse effects via minimum wages may backfire. This is because binding minimum wages risk promoting investments into labour-replacing technologies and slow down the creation of new tasks that would require labour. Of course, there may be other reasons for imposing a minimum wage, such as employers having market power, which are absent from these models.

A safer approach would be to address distributional concerns with taxes and government transfers. Of course, EU countries already redistribute income via tax-financed transfers to lower earners and progressive income taxation. Job polarization may increase public expenditures by increasing tax-financed transfers paid to low earners. On the other hand, because of the progressivity of labour income tax schemes, it may also increase aggregate tax revenues. Thus, the overall impact of job polarization on public finances is unclear.

The crucial issue is likely to be how job polarization affects employment. Because of income tested transfers, individuals with relatively low wages often have relatively weak economic incentives to participate in the labour market. If job polarization increases unemployment, its effect on public finances is likely to be negative. The challenge is how to support those with poor labour market prospects without compromising their work incentives too much. One approach is to provide in-work benefits that are targeted to the working poor (for a review, see Van der Linden, 2016). Another approach is to try to improve workers’ skills with increased public support for education.

2.3.1.3 Capital taxation
A higher capital income share would obviously make capital taxation, by which we taxes on the return to savings, capital gains, dividends, firms’ profits, inheritances and wealth, more important in terms of both aggregate tax revenues and redistribution. By the same token, if the capital income share keeps increasing, it becomes increasingly important to try to limit international tax competition in corporate taxation and the opportunities of wealthy capital owners to engage in tax avoidance.

Perhaps the most radical proposal to address the problems of international corporate taxation is destination-based cash-flow taxation (see Auerbach et al. 2017 for a very clear presentation). It seeks to eliminate, or at least greatly mitigate, corporate tax competition and profit shifting by levying corporate taxes based on where goods are sold, rather than where they are produced (or where the profit is made). See section 4.1.3 for a discussion of possible policy measures to improve international corporate taxation.
Capital taxation should seek to tax part of the income accruing to capital owners without compromising the incentive to save, invest or innovate too much. The general recommendation in the economic literature is to tax returns that are close to the “normal return” – the (almost) riskless return on savings - at a lower rate than returns in excess of the normal return (“excess returns”).\textsuperscript{11} In fact, there are arguments for not taxing the normal rate at all. This principle also applies to the returns earned by the innovators of new technologies. In corporate taxation, cash-flow taxation (immediate expensing of investment) and allowance for corporate equity are both concrete examples of tax schemes that would tax only excess returns.

In theory at least, systems that exempt the normal return allow taxing excess returns at relatively high rates, without necessarily weakening investment incentives. The point is that as long as the expected before-tax return of an investment project exceeds the normal return and the tax rate on excess returns is less than 100\%, investors should be willing to undertake the project. (However, this assumes full loss offset.) This feature should also be helpful in tackling some of the distributional concerns related to technological progress or the profits stemming from innovation.

Increasing wealth inequalities have spurred calls for the adoption or increasing of wealth taxes, i.e. taxes that are based on the value of assets owned rather than the income they generate. A wealth tax violates the idea that the normal return should be taxed at a lower rate than excess returns. It is also often considered to be administratively costly, partly because the value of some assets is hard to estimate reliably (see e.g. chapter 8 in Institute for Fiscal Studies and Mirrlees, 2011). However, the relevance of this concern depends on the extent of wealth inequality. In countries with high wealth inequality, a wealth tax may generate substantial tax revenue even if it has a relatively high exemption level (e.g. several millions of euros), see e.g. Saez and Zucman (2019). In that case, the administrative costs associated with the wealth tax can be reasonably small relative to tax revenue it generates. On the other hand, wealthy individuals may be able to avoid wealth taxes by offshoring their wealth (see section 4.1.3 for evidence).

In contrast to a general wealth tax, a property tax based on land values is usually considered to be a very efficient tax. This is because land is in fixed supply so a tax on it cannot reduce its supply. Immovable property taxes are also immune to capital mobility. Korinek and Stigliz (2017) point out that even if capital could substitute for all labour in production, thereby making wages relative to GDP converge to zero, competition would drive the price of land, and other fixed resources that are part of consumption, up. Thus, taxes on land values are likely to be a secure source of tax revenues also in the face of dramatic technological changes.

Inheritance taxes are similar to wealth taxes in that they do not exempt the normal return. However, they are often seen as administratively less costly than general wealth taxes because the assets need not be valued only yearly. There are also efficiency arguments for inheritance

\textsuperscript{11} This view is clearly reflected in the Mirrlees Review (Institute for Fiscal Studies and Mirrlees 2011). The rate of return that is taxed at a lower rate should include a small risk-premium to compensate for imperfect loss offset in taxation.
taxes, as opposed to wealth taxes. In particular, individuals leave bequests also because it is hard to fully annuitize savings. To the extent that individuals do not care about bequests they leave, taxes on them do not lower their welfare or affect their savings behaviour (see e.g. Piketty and Saez, 2013).

Consumption taxes such as VAT are usually not seen as being part of capital taxation. Yet they of course tax also consumption that is financed by capital income. It can be shown that a constant consumption tax rate is equivalent to a positive tax rate on excess returns to savings. Moreover, an increase in consumption taxes is effectively a tax on existing wealth (see e.g. Correia 2010). The fact that consumption taxes are an important part of the tax mix in the EU protects tax revenues in the face of increasing capital income share.

2.3.1.4 Higher capital income share and fiscal sustainability

As discussed above, there are reasons to believe that the ongoing technological progress works to decrease the labour share of national income and increase the capital share. An important question is how this would affect public finances.

The answer is not obvious. Clearly, lower labour income share would imply less revenues from labour income taxation (at least relative to GDP), which is an important source of tax revenues in all EU countries. On the other hand, higher capital income share would presumably increase firms’ profits, market value, dividends and interest payments to external debt. Those revenues are taxed via corporate taxes, personal income taxes, and consumption taxes. Public finances would also be affected by changes in relative prices.

We are not aware of previous studies that would try to capture these effects in a systematic way. We have therefore analysed the public finance outcomes of a higher capital income share using a numerical overlapping generations model\textsuperscript{12} that features a relatively detailed description of the main tax and transfer schemes and government expenditures of a small open economy welfare state. The model is briefly described in the box below. A more detailed description of the model and the simulation is provided in Appendix 2.1.

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\textbf{Box 2.6. An overlapping generations model of the Finnish economy}

The model is a perfect foresight numerical overlapping-generations model of the type originated by Auerbach and Kotlikoff (1987). It is modified to describe a small open economy and calibrated to the Finnish economy.

The model economy consists of five sectors: households, enterprises, a government, pension funds, and a foreign sector. Each household generation is divided into three educational groups with different lifetime productivity profiles determined by empirical observations of recent wage profiles. Households decide about hours of work, but the employment rate is exogenous. Aggregate production depends on aggregate capital stock and aggregate effective labour via a constant elasticity of substitution (CES) production function.

\textsuperscript{12} In overlapping generations models individuals (or households) live for a finite number of periods and individuals of different age are alive at the same time.
We assume that the main subsectors of the general government, such as the municipal sector, the public and the private sector pension fund, and the national social security institute, have their own budgets, which are balanced either by social security contributions or earned income taxes. The only exception is the central government budget, which is balanced with a lump sum transfer to or from the households.

The model does not include robots or other labour replacing technology. Instead, we generate an increase in the capital income share by lowering the value of the labour share parameter in the production function. We keep all other parameters, including the shares of households with different education level, fixed. Thus, this exercise does not account for job polarization.

We generate an increase in the capital income share by lowering the labour share parameter in the aggregate production function. For a given stock of productive capital and labour, the marginal product of labour declines and so does the average wage level. The marginal product of capital in turn increases, which promotes investments and capital income, even though the interest rate is fixed to the level prevailing in international financial markets.

The development of the capital income share is described in Figure 2.1. The parameter change takes place in the model period corresponding to years 2020-2024 (a model period corresponds to five years), but firms and households anticipate it already in the previous period. There are small anticipation effects that show up as a minor decline in the capital income share in period 2015-2019 due to a jump in labour supply. In the following period, the capital income share increases sharply. Because of population aging, the capital share changes slightly over time also in the baseline simulation with constant technology.

The development of the tax bases is described in Figure 2.2. The lines describe the changes in the shares of the three major tax bases, total wages, private consumption and capital income, relative to the baseline simulation. A higher capital income shows up as lower total wages and higher profits. Household consumption falls with the decline in wage income. The adjustment is gradual because older generations’ consumption is financed partly with accrued wealth.

The tax rates are adjusted endogenously to balance the budgets of the various subsectors of the economy. The total tax rate needed to finance public expenditures is lower in the simulation with a higher capital income share, as depicted in Figure 2.3. One reason for this is that many tax financed services (e.g. old-age care) are very labour intensive. As a result, lower wages tend to reduce public expenditures relative to GDP.¹³

Figure 2.1. Capital income share in private production, baseline vs. experiment.

¹³ The differences between the public expenditures-to-GDP ratio and tax revenues-to-GDP ratio in Figure 2.3 reflect the fact that the pension system faces only an intertemporal budget constraint.
Figure 2.2. Higher capital income share. Differences in the shares of the major tax bases relative to baseline simulation, percentage points.
A more detailed analysis also reveals that following the increase in the capital income share, the contribution rate of the earnings-related pension system first needs to be increased in order to finance accrued pension benefits. (The system is only partly funded.) But since the pensions are earnings-related, the lower accruals gradually diminish the future pension expenditure. This allows the contribution rate to be reduced later.

Figure 2.3 thus suggests that a higher capital share in itself is not a concern for public finances. While it decreases some tax basis, it increases others. At the same, a higher capital income share lowers the cost of public expenditures relative to GDP.

To assess the robustness of these results, we have also conducted simulations with a similar overlapping-generations model that features institutional and economic characteristics of several European countries. The aggregate production function in the model features physical capital and three skill-levels of labour as inputs, with the different types of labour exhibiting differing degrees of substitutability between each other and with physical capital. To generate an increase in the capital share of income and job polarisation, we lowered the share parameter of medium-skilled labour in the production function to the extent that the capital share increases by 1 percentage point in the long run. The social security budget is closed by adjusting social security contribution rates, while the general government budget is closed by adjusting lump-sum taxes on households.

The reduction in the share parameter of medium-skilled labour again changes the production technology. For given levels of capital and labour input, the marginal product of medium-skilled labour declines, while the marginal products of capital and low and high-skilled labour increase. This promotes investment, leading to a build-up of capital stock until the marginal product of capital again equals the interest rate determined in international financial markets. The relative increase in the capital stock is quite large partly because employment is increasing as well. Parallel to the increase in the capital stock, firms increase their demand for labour input, so overall output and GDP increase. However, demand for and the employment rate of medium-
skilled labour decreases relative to that for low and high-skilled labour. In this sense, this exercise also captures job polarisation.

Table 2.1 reports long-run outcomes for a number of European countries. As can be seen from the table, the results are qualitatively similar across the countries, but differ widely in their quantitative extent. The differences are partly due to differences in the tax and social security systems in place. However, the main drivers of the quantitative divergence of results are differences in the underlying initial parameters of the production function, which are calibrated so as to reproduce initial capital and labour income shares as well as other macroeconomic features of the economies in question. What remains as an outcome across all simulations, though, is that the technological change analysed here is likely to lead to a shift in the relative importance of tax bases and revenues but does not seem to pose direct problems for public finances. In fact, both the total tax rate and the lump sum tax that balances the general government budget decrease in the long run.

Table 2.1. Long-run effects for a selection of European countries

<table>
<thead>
<tr>
<th></th>
<th>AT</th>
<th>FR</th>
<th>DK</th>
<th>UK</th>
<th>PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital stock (∆%)</td>
<td>45.52</td>
<td>26.02</td>
<td>15.59</td>
<td>21.15</td>
<td>13.92</td>
</tr>
<tr>
<td>Effective employment, all (∆%)</td>
<td>7.74</td>
<td>4.91</td>
<td>3.69</td>
<td>4.21</td>
<td>2.18</td>
</tr>
<tr>
<td>Low-skilled (∆%)</td>
<td>18.93</td>
<td>8.73</td>
<td>4.81</td>
<td>6.73</td>
<td>4.40</td>
</tr>
<tr>
<td>Medium-skilled (∆%)</td>
<td>2.96</td>
<td>-0.99</td>
<td>0.39</td>
<td>-1.10</td>
<td>0.66</td>
</tr>
<tr>
<td>High-skilled (∆%)</td>
<td>17.12</td>
<td>10.96</td>
<td>7.65</td>
<td>10.05</td>
<td>6.42</td>
</tr>
<tr>
<td>Tax base share, total wages (∆pp)</td>
<td>-1.37</td>
<td>-1.78</td>
<td>-1.86</td>
<td>-1.31</td>
<td>-0.86</td>
</tr>
<tr>
<td>Tax base share, consumption (∆pp)</td>
<td>1.30</td>
<td>1.96</td>
<td>1.86</td>
<td>1.02</td>
<td>0.29</td>
</tr>
<tr>
<td>Tax base share, profits (∆pp)</td>
<td>0.07</td>
<td>-0.18</td>
<td>0.00</td>
<td>0.28</td>
<td>0.57</td>
</tr>
<tr>
<td>Revenue share, profit tax (∆pp)</td>
<td>0.88</td>
<td>1.21</td>
<td>0.22</td>
<td>0.95</td>
<td>0.31</td>
</tr>
<tr>
<td>Revenue share, consumption tax (∆pp)</td>
<td>2.67</td>
<td>2.35</td>
<td>1.68</td>
<td>1.01</td>
<td>0.34</td>
</tr>
<tr>
<td>Revenue share, SSC &amp; tax on wages (∆pp)</td>
<td>-3.15</td>
<td>-3.10</td>
<td>-1.90</td>
<td>-0.92</td>
<td>-0.25</td>
</tr>
<tr>
<td>Social security contribution rate (∆pp)</td>
<td>-3.32</td>
<td>-3.49</td>
<td>-0.79</td>
<td>-0.82</td>
<td>-0.25</td>
</tr>
<tr>
<td>Lump sum taxes / GDP (∆pp)</td>
<td>-7.50</td>
<td>-7.09</td>
<td>-6.27</td>
<td>-5.46</td>
<td>-2.97</td>
</tr>
<tr>
<td>Total taxes / GDP (∆pp)</td>
<td>-3.02</td>
<td>-2.30</td>
<td>-0.62</td>
<td>-0.01</td>
<td>-0.48</td>
</tr>
</tbody>
</table>

Overall, these results suggest that a higher capital income share is unlikely to pose a direct problem for public finances. An important caveat here is that in these models, technological progress does not show up as increased involuntary unemployment. The fiscal effects of a higher capital income share could of course be very negative if the increase in capital income share was associated with higher unemployment. It should also be emphasized that the simulation results described here do not consider the increased demand for redistribution that is likely to be associated with a higher capital income share. Finally, depending on the underlying reasons for the increase in the capital income share, there may also be a need to increase public investment in education, which would again require increasing the total tax rate. Clearly, more research is needed to fully understand the fiscal implications of increasing capital income share.
or job polarization. Ideally, instead of just changing the aggregate production function, one would address this question using a model that somehow endogenizes the technological change itself.

2.3.2 Changing business models

As outlined above, technological innovation is currently creating impacts on ways of working and the way in which businesses generate value (i.e. revenue and profit). It is expected that this trend will continue into the future as existing technological innovations are adopted by businesses and new technologies emerge.

While the magnitude and timing of these future impacts are unclear, they are likely to generate a number of implications for tax policy at both an EU and a Member State level. Aside from the implications of the uptake of AI and increasing levels of automation for the balance between labour and capital taxation (discussed in section 2.3.1), these implications can be grouped into three main areas.

1) Digital businesses that operate with ‘scale without mass’ present challenges for the attribution of profits.

Technological innovation has allowed digital businesses, such as online platforms, to operate in a jurisdiction without necessarily having a physical presence in the same jurisdiction. This characteristic is known as scale without mass. Current permanent establishment (PE) rules place emphasis on the physical presence of a business when establishing taxable presence. However, the ability of digital business to operate with scale without mass can cause difficulties in establishing whether a business has a taxable presence in a particular jurisdiction. Where such difficulties are encountered, the attribution of business profits generated by the business can be challenging for tax administrations.

Recent multilateral initiatives, such as the OECD’s BEPS agenda\(^\text{15}\) and those of the European Commission\(^\text{16}\), as well as unilateral initiatives (e.g. national digital services taxes) have sought to address this issue.

For instance, the OECD, as part of the BEPS agenda, proposed several changes to the criteria for the identification of a PE in their model tax treaty. These included broadening the definition of a dependent agent PE to include agents that play a principal role in the conclusion of contracts that are routinely concluded without material modification by the business and tightening the scope of specific activity exemptions to those that are solely auxiliary or preparatory in relation to the business as a whole. The main effect of these changes for digital businesses would be that central purchasing entities or stock warehouses could constitute a PE.

\(^{15}\) Please see [https://www.oecd.org/tax/beps/](https://www.oecd.org/tax/beps/) for more information on the OECD’s BEPS initiative.

\(^{16}\) Please see [https://ec.europa.eu/taxation_customs/sites/taxation/files/fair_taxation_digital_economy_ia_21032018.pdf](https://ec.europa.eu/taxation_customs/sites/taxation/files/fair_taxation_digital_economy_ia_21032018.pdf) for more information on the European Commissions proposals for rules relating to the corporate taxation of a significant digital presence and a common system of a digital services tax on revenues resulting from the provision of certain digital services.
More recently the OECD and EU have announced their intention to explore the case an income inclusion rule that would impose a minimum rate of tax on multinational enterprises regardless of where they are headquartered\textsuperscript{17}.

However, the continued rise of digital business models will only add to the need for a tax policy solution to the phenomenon of scale without mass.

2) **Business is increasingly data-driven, but growing reliance on and trade in consumer data presents challenges for tax policy.**

Growth in data analytics and the rise of online platforms is likely to change the value of consumer data.

Data-driven businesses, in particular online platforms, typically do not have significant holdings of physical assets, but generate profits based on the economic value of data collected from consumers. Data are collected, analysed and used (within the limits of data protection regulation) by such businesses (for example, to sell targeted advertising). In other words, consumer data have an economic value that can be exploited by platforms. In a digital world “data has become a significant business asset” (OECD, 2016).\textsuperscript{18}

Growth in the reliance on, and trade in, consumer data as a source of economic value can generate a set of related tax implications.

If data is to be treated as an intangible asset for taxation purposes, it will be essential to develop clear guidelines for the valuation of such assets. This will support the taxation of gains arising on the disposal of data, the amortisation of acquisition costs and transfer pricing for cross-border transactions involving data.

More fundamentally, the reliance on user-generated data to generate value, as is the case with many online platforms, can pose questions regarding nexus and profit attribution. This links to the tax challenges of ‘scale without mass’ discussed earlier. It has also been the subject of discussion in the OECD’s BEPS agenda\textsuperscript{19} and is the motivation of proposals, such as the European Commission’s, to charge digital services taxes in relation to the number of users in a particular jurisdiction\textsuperscript{20}.

\textsuperscript{17} Please see https://www.oecd.org/tax/beps/programme-of-work-to-develop-a-consensus-solution-to-the-tax-challenges-arising-from-the-digitalisation-of-the-economy.htm for more information on the OECD’s proposed changes to income inclusion rules to impose a minimum rate of tax on multinational enterprises.


\textsuperscript{19} Please see the OECD’s 2018 report, Tax challenges arising from digitalisation - Interim report 2018 for more information: https://www.oecd-ilibrary.org/docserver/9789264293083-en.pdf?expires=1567705180&id=id&accname=ocid195464&checksum=E25C73CC163DA7F14F8D6C3D600DBCC1

\textsuperscript{20} Please see https://ec.europa.eu/taxation_customs/sites/taxation/files/fair_taxation_digital_economy_ia_21032018.pdf for more information on the European Commissions proposals for rules relating to the corporate taxation of a significant digital presence and a common system of a digital services tax on revenues resulting from the provision of certain digital services.
3) The continued rise of online platforms will present opportunities and challenges for direct and indirect taxation.

Online platforms have challenged existing concepts of employment status, which has generated significant debate as to whether platform workers should be treated as employed or self-employed for tax purposes (Appendix 2.2 contains a brief overview of this debate). Differences in the taxation of income and social security between different forms of employment status may create incentives for non-standard forms of employment.

Implications for tax compliance and administrative costs are generated where a platform worker is deemed to be self-employed. In such instances, these costs could be significantly higher for tax administrations and taxpayers alike and could also present implications for social security revenues in instances where the self-employed pay a lower rate than workers do.

The use of withholding taxes deducted by the platform operator could lessen the compliance and administrative costs where platform workers are deemed to be self-employed. However, the design of withholding taxes would need to take account of rights of self-employed taxpayers to deduct expenses incurred wholly and exclusively for the purposes of business. Features that achieve this could, without careful design, add complexity. As such, some have advocated a fixed deduction against platform income\(^\text{21}\) or the use of a turnover tax as a proxy for a business profits tax where provisions to deduct business expenses do not exist.

Alternatively, where platform workers are deemed to be self-employed, data sharing between the platform operator and national tax administrations could reduce the administrative and compliance costs that might be generated by a withholding tax mechanism. Data provided by the platform operator could support the prepopulation of self-assessed income tax returns. This would allow taxpayers to input data on business expenditure, while reducing the time to comply and the time required for tax administrations to process the tax return.

From a similar perspective, some have commented that platform work can be seen as a good way to reduce the informal economy, as digitalised transactions can be easily stored and transmitted to authorities.

In terms of indirect taxation, the VAT-treatment of transactions taking place on an online platform will be, to a certain extent, linked to the employment relationship between the platform operator and the platform workers.

Where platform workers are deemed to be employed by the platform operator, the platform performs not only the intermediation service, but also the underlying supply. In this case,

\(^{21}\) Thomas (2017) proposes a simplification of the tax regime on platform workers, based on two measures: on one end a “non-employee withholding” on earnings paid by firms, based on a fixed percentage of the worker’s gross receipts (as would happen with an employee); on the other end a “Standard Business Deduction” for platforms workers equal to 60% of the worker’s gross receipts. A similar solution has been proposed by the UK’s Office for Tax Simplification (OTS): a self-employed platform worker would have the possibility to enter a withholding tax arrangement with the firm, based on the PAYE (Pay-as-you-earn) system that is applied to employees. This withholding tax would be based on average or actual earnings on a monthly basis (Office for Tax Simplification, 2016).
transactions between the online platform and its users would be subject to VAT. If employed, it is likely that online platform operators will make a growing contribution to VAT-revenues.

On the other hand, where platform workers are deemed to be self-employed, there would be two potentially VAT-able transactions. Where the online platform generates income from platform workers using the platform, such transactions may be subject to VAT. In addition, transactions between platform workers and the platform’s users would also be subject to VAT (dependent on national VAT registration thresholds).

Furthermore, if the platform worker is self-employed, it is likely that the rise of platforms will result in an increase in the number of smaller VAT-registered business and sole traders. This will be driven by prevailing contractual relationships between the platform and the platform worker but also by preferences for flexible work among the workforce. However, the scale of the impact is less clear and will depend on two interrelated factors: i) The neutrality of the VAT treatment between online and physical transactions, as this will determine that level of VAT incurred on platform transactions; and ii) Whether platform work is a substitute or complement of existing work as this will determine the extent to which potentially taxable activity is created.

Due to the complexity in the application of VAT to online platforms, national tax administrations have been exploring options for simplification. For example, there is a growing interest in the use of online platforms as a vehicle for collecting VAT on the sales they facilitate, in part to counter risks of noncompliance by platform users.

Separate to the VAT implications stemming from the employment status of platform workers, online platforms in the sharing economy can promote barter transactions, which are challenging to tax from a VAT perspective. Transactions where individuals contribute goods or services to a common pool in exchange for the right to benefit from other goods or services included in the pool should be analysed on a case-by-case basis to determine the VAT implications. Appendix 2.3 briefly discusses some of the related legal issues.

2.3.3 Technology, tax administration and compliance

Technology and digitalisation are revolutionising how citizens and the government perform tasks. Previously complex and burdensome tasks have become easier and less time-consuming. An example of this is a move away from traditional paper-based interactions between taxpayers and authorities towards online and electronic interactions (James and Sawyer, 2018). As a result, this is having major implications for the way the private and public sector operate.

The findings of this section are predominantly based on a review of the literature available in the public domain. Due to the nature of the subject matter, this topic is not particularly well-covered in peer reviewed academic literature. As such, we have expanded the focus of this review to include high quality institutional and private sector sources.

22 See Commission Staff Working Document, accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a European agenda for the collaborative economy, COM(2016) 356 final, p. 41 (2 June 2016) where it is written that “where there is an exchange of goods doubts may arise as to the qualification of individuals as taxable persons and as to the existence of a direct link between the supplies and the remuneration in kind. The assessment must be carried out on a case-by-case basis”).
We have also based this section of the report on an interview with officials from the Estonian Tax and Customs Board. Estonia is generally considered as a frontrunner in digitalisation, one of the key purposes of the interview was to understand the country-specific factors that have led to Estonia’s successful transition to a technology enabled tax administration. The interview was also designed to draw out key lessons other countries can learn from Estonia’s experience.

The time horizon for this report is the period to 2050. However, the timing of the impacts discussed in this section is less certain. There are a number of barriers slowing down the implementation of technology in tax administration and compliance. Firstly, the initial transition costs of digitalisation could be high for both the government and taxpayers. Secondly, some taxpayers may not have internet connections of sufficient speed or knowledge on how to use digital software, this can create digital exclusion.

Tax administrations in the EU currently already have a baseline level of digitalisation, and with new technologies being adopted this will increase the range of services which will be digitalised. The extent to which digitalisation is becoming more widespread for tax administrators has been captured by the OECD (2017) which has compiled a dataset on provision of e-services, including, electronic invoicing systems and online applications for taxpayers. The OECD has compiled information from 55 advanced and emerging market economies, including all EU Member States. The data suggests that the majority of EU Member States have digitalised aspects of their tax administration. The extent to which governments have digitalised services is illustrated below in figure 2.4.

**Figure 2.4. Digitalisation of government services in the EU 2015**

Source: OECD
As illustrated in figure 3.4 above, the majority of EU Member States have digitalised most aspects of their services. The only area EU Member States lag behind in is the implementation of electronic invoicing systems with only seven Member States implementing them.

As discussed in section 2.2, technological advances have brought about a reduction in the unit costs of data. This has led to dramatic increases in the use of digital transformation that can be manipulated at high speeds and low marginal costs (OECD, 2018a). It has also led to the rise of digital and data-driven businesses, which has implications for the collection of tax. With digitalisation becoming more widespread across the world, a number of European countries have appeared as frontrunners in utilising technology. In Europe, the UK, Estonia and Portugal are members of the D9, a network of the world’s most advanced digital countries (New Zealand Government, 2018).

2.3.3.1 Tax administration
The purpose of this section of the report is to provide an overview of the projected effects of technological innovation on the way in which national tax administrations in the EU operate.

The primary focus of this section has been on the application of technological innovation to tax administration in the EU. However, to highlight the medium and long-term opportunities and risks, this review has sought out examples from other countries and regions. In particular, examples of technological innovation in the collection of taxes in developing countries can be insightful to the case of EU national tax administrations. This is due to the phenomenon of technological ‘leapfrogging’, which allows rapid movement to the technological frontier due to lower levels of sunk costs in systems and infrastructure.

This section of the review will focus on how technology is likely to change the way in which national tax administrations discharge their core functions. Tax administrations administer taxes, they implement, enforce tax laws, and receive their mandates by law. The core business function of a tax administration is levying and collecting taxes imposed by law. Other core functions include; registration of taxpayers, detection of non and false registration, processing of tax returns and enforced debt collection (IFBD, 2015).

2.3.3.2 Online platforms
The collection of tax has already benefited from technological innovation in the payments industry, an example of this is mobile payments. However, the rise of online platforms presents national tax administrations with both a risk and an opportunity with regards to tax collection.

One way in which online platforms present a challenge to tax administration is that they promote flexible employment, which can be difficult to tax. However, they also present two distinct opportunities to support the collection of tax, firstly, they can be used as tax collection agents through withholding tax mechanisms and secondly, they generate a vast amount of data on potentially taxable transactions.

Some EU Member States have already implemented policies to increase taxes collected from online platforms. In 2017, Belgium introduced withholding tax on online peer to peer sharing platforms, becoming the first European country to build a tailored framework for sharing economy platforms. Under this new law, platforms will be responsible for levying a 20% withholding tax and passing on the collected tax to authorities (CDER, 2017). Under this new law platforms will be responsible for levying withholding tax and passing on the collected tax to
authorities (CDER, 2017). Income under EUR 5,000 will be taxed at 20% and earnings above that will be taxed as ‘professional income’ under progressive tax rates between 25 and 50%.

Online platforms have formalised previously undocumented activities in the informal economy, an example of this is the peer-to-peer (P2P) economy where online platforms intermediate transactions. Online platforms store a large amount of data on a number of variables such as income and consumption. They can increase tax collection if they share data with tax authorities. (Gupta et al., 2017). However, tax authorities have had difficulties in getting platforms to share data, Estonian tax officials have stated while some platforms are complying, there remains a lack of jurisdiction over getting online platforms to share data. One way in which tax authorities can improve tax collection from online platforms is by making sharing data with tax authorities on a regular basis an obligation by law (OECD, 2019b).

An example of online platforms complying is in Estonia, where platform technology is used to connect Uber drivers directly to the tax office (Gupta et al., 2017). The country has also introduced X-Road, a platform that enables the secure exchange of internet-based data between information systems. 98% of tax returns in 2016 came in through electronic filing which was done on the X-Road platform. The platform has also enabled digitised income tax declaration system by linking employment tax records to each citizens’ tax record (Gupta et al., 2017).
Box 2.7. Engagement with tax administrations: Online Platforms

In interview, the Estonian Tax and Customs Board mentioned that they have begun developing solutions to collect data from online platforms such as Uber and Airbnb. For example, the Estonian tax administration has asked several online platforms to share XML files on data on platform workers on a voluntary basis. The tax administration then receives this file and imports the data into tax return automatically. This form of data sharing with online platforms has been simple so far and the tax administration has not reported any data breaches. The Estonian Tax and Customs Board is also working with rental property platforms to build a user interface where a person earning income will automatically share their earnings directly with the tax administration. The Tax and Customs Board have worked collaboratively with platforms and have argued that data sharing arrangements can be perceived as an additional feature of benefit to users (i.e. instead of having to file tax returns the tax administration will automatically receive their data saving them time). By the end of 2018, the Tax and Customs Board had reached out to eight online platforms, of which two had agreed to share data in principal and one had concluded a data sharing agreement.

2.3.3.3 Fraud detection and Distributed Ledger Technology

The development and management of systems to combat fraud are also a core function of national tax administrations. As discussed above, online platforms and data analytics can be used to detect tax fraud. While tax administrations have used data matching and analytics from third party sources for a number of years, advances in technology in recent years and reductions in the unit cost of data have enabled improvements in data analytics.

In the UK, HMRC has started using big data in order to tackle tax evasion. Since many tax avoidance schemes use businesses and trusts based overseas, the UK government has extended HMRC’s legal authority to collect data from merchant service providers and data aggregators based outside of the UK. The data collected is then used to track and monitor high risk groups who are more likely to evade taxes (Hope, 2018). In the US, tax authorities target tax evasion by data mining social media content for evidence that people are living more affluent lifestyles than their tax returns suggest (Hope, 2018).

Alongside data analytics, tax authorities have also begun employing distributed ledger technology as a tool to prevent fraud. Distributed ledger technology is a shared and immutable ledger for recording the history of transactions (Gupta et al., 2017). It can be a useful tool for tax authorities because it provides accurate information that can be shared and allow earlier collection and oversight of transactions related taxes (PwC, 2016). The storage of information on blockchain also makes errors and fraud easier to detect for tax authorities in areas where revenue leakage has been high such as VAT (PwC, 2016).

Distributed ledger technology can make micro transactions more visible for tax authorities and can improve compliance for small businesses. The use of blockchain can be beneficial when used to record VAT transactions, blockchain has important characteristics such as making fraud and errors easier to detect, which makes it especially applicable to transactional taxes such as VAT, withholding and stamp duty taxes (PwC, 2016). Distributed ledger technology significantly reduces the risk of VAT fraud as digital ledgers cannot be altered or tampered with once data
has been entered (PwC, 2016). It can also lead to behavioural change as the risk and the price of non-compliance increases, those who are caught engaging in VAT fraud can be excluded from the blockchain network (PwC, 2016).

The UK’s Department for Work and Pensions is currently engaged in a project to employ distributed ledger technology to improve the payment of welfare benefits (Gupta et al., 2017). The project has been introduced, in part, to reduce the £3.1 billion the UK government overpays in welfare annually (Gupta et al., 2017).

2.3.4 Tax compliance

This section explores the impact of technology on how a taxpayer complies with the obligations of the tax system. To do this we have considered how digitalisation has affected the simplification of tax processes and the use of data and analytics to improve tax compliance.

A number of countries have started to digitalise aspects of their tax administration in order to increase tax compliance. Italy has recently introduced mandatory real-time electronic invoice issuance and reporting, from January 2019, businesses are required to submit all invoices to the Italian Revenue Agency’s online collection platform (Avalara, 2018). The Italian government’s aim is to reduce Italy’s VAT gap. Italy’s VAT gap is the largest in the EU, accounting for 24% of the total EU VAT gap in 2016 (European Commission, 2018b). In the UK, HMRC has recently launched the Making Tax Digital initiative which aims to make tax administration more effective and efficient by transitioning to a digital tax system by 2020 (Thomson Reuters, 2018). In January 2019, Ireland modernised its PAYE by introducing Real-time Reporting (RTR). Employers are now required to report results from their payroll on the Revenue Online Service in real time (Immedis, 2018). The results of the 2017 Digital Gov’ barometer survey indicated that taxation was an area of digital excellence in the UK, Italy and Ireland (Sopra Steria, 2017).

Commentators have noted that a number of emerging technologies have the potential to change the way in which tax is collected. Indeed, tax administrations in developed countries could learn from their counterparts in developing countries when it comes to the application of advanced technology to core functions. While most advanced economies have opted for the incremental approach with regards to digitalisation, there have been cases of developing countries leapfrogging advanced economies with the use of digitalisation. Kenya is an example of a developing country that has gone from lacking universal basic landline infrastructure to using sophisticated mobile and internet technology, to allow citizens to pay taxes and access government services (Gupta et al., 2017). India currently is host to the largest biometric system in the world with more than 1.1 billion citizens registered (Gupta et al., 2017). The biometric system records characteristics such as fingerprints, which allows for a more accurate authentication of a person’s identity and reduces the risk of fraudulent welfare claims.

Many EU tax administrations are taking steps to use technology to change the way core functions are performed. An example of a core function which has undergone digitalisation is tax collection. Tax collection is becoming increasingly digital among EU Member States, while electronic filing and taxpayer services have long been used by EU Member States. A number of

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23 The VAT gap is the difference between expected and actual VAT revenues.
Member States have recently launched programmes to further digitalise aspects of tax collection. An example of this is in Estonia where tax authorities recently implemented a business account service, taxpayers will have their tax automatically calculated and paid when money is deposited (e-Estonia, 2017).

The IMF has highlighted that digitalisation of public services, including tax collection, comes with opportunities and risks (IMF, 2018). The opportunities include, supporting the implementation of current policies, as well as creating new, previously unavailable policy options. The risks include the creation of new opportunities for fraud and the costs of implementation.

One of the benefits of digitalisation is that it leads to significant cost reductions for tax administrators, this is especially the case for developing economies. Gupta et al. (2017) found that digitising government payment processes can lead to savings of up to 1% of GDP for developing economies. While digitalisation brings long term benefits, the short-term costs of transitioning are quite high and the benefits take a while to materialise. As a result, this makes it politically difficult to justify spending on digitalisation (ICAEW, 2019). However, the opportunity cost of not transitioning is also high, with countries at risk of losing out on potential future savings (ICAEW, 2019).

**Box 2.8. Engagement with tax administrations: Design of digital solutions**

In an interview, the Estonian tax administration highlighted that the administrative costs of processing taxes for both the tax administration and taxpayers has decreased because of digitalisation. Digitalisation eliminates the amount of paperwork taxpayers need to do, for example, in Estonia taxpayers now fill in tax forms online and send them directly to the tax office.

While security issues can arise from putting a large amount of data in one place the Estonian tax administration so far has not found any issues, one of the reasons for this is due to the fact that security issues have been prevented at the development stage of new systems. Estonia has general solutions that are applied to multiple systems, so if the core solutions are developed properly, the risk is eliminated across a wide number of systems.

One of the difficulties the Estonian tax administration has had is finding qualified developers who have business specific experience related to taxation. Although project managers are not expected to have knowledge of programming or coding, there is a need for them to understand how the systems have been developed.

2.3.4.1 *Simplifying Tax Processes*

With tax systems becoming more digitised and simplified, taxpayers expect more access and connectivity with tax administrators. One of the benefits of digitising is that taxpayers and authorities require fewer interactions as processes become more simplified which lead to faster response times (PwC, 2017). The use of technology has led to a number of changes in the way taxpayers are registered. In Estonia, citizens are given digital identity cards that allow them to access public, financial and emergency services. The digital identity cards also allow citizens to vote online and file taxes.

Another benefit from digitalisation is that it is enabling improvements in governance and fiscal transparency, allowing taxpayers to easily access data on how the government allocates
spending from taxation. They are also able to access their own data and see where their tax is allocated by the government at an individual level. In the UK, taxpayers can access their data on their mobile phones via the HMRC app which users to access their tax data (GOV.UK, 2018). Studies have found that taxpayers are more willing to voluntarily comply if they perceive tax systems in their country are honest and transparent (PwC, 2017).

Technology has allowed governments to easily access additional information sources and the capability to link them in order to better detect evasion and avoidance of tax (Gupta et al., 2017). An example of this is electronic filing, studies have found that electronic filing has reduced the cost of administration for governments and the cost of compliance for taxpayers. By using third party information, tax authorities can now pre-populate tax forms online while taxpayers are only required to confirm or amend pre-existing forms (Gupta et al., 2017). Pre-populated tax forms have been in use for a number of decades, Denmark was the first country to introduce them in 1988 (OECD, 2006). The use of pre-populated tax returns has increased in recent years and has been enhanced by the use of data from online platforms. In Estonia, the average time to complete a tax return form is five minutes due to pre-filled information provided by the government on the X-Road platform (ICAEW, 2019). One key factor in creating successful pre-population of citizens’ tax returns is through the effective use of technology, as more countries undergo the digitalisation transition, it is expected that the use of pre-populated tax forms will increase (ICAEW, 2019).

2.3.4.2 Data and Analytics

Another way digitalisation is improving tax compliance is through electronic tracking of sales through the use of e-invoicing. Electronic tracking of sales has allowed for a more streamlined administration of indirect taxes, an area that for many countries is a source of revenue leakage and fraud. In Spain, the government has taken steps to reduce VAT fraud and increase the robustness of their VAT systems by increasing taxpayer reporting requirements. The new system has reduced the average time to comply with VAT obligations by 4.5 hours in 2017 to 30.5 hours, down from 34.5 in 2016 (PwC, 2018). In Canada, e-filing is required for all corporations with annual gross revenues of more than C$1 million, in the tax year of 2014-2015, 86% of corporation income tax returns were filed electronically (EY, 2016b).

The use of technology by tax authorities has also enhanced non-compliance detection. Tax authorities have started using analytics to identify taxpayers at higher risk of future non-compliance. This allows tax authorities to monitor those who are more likely to be non-compliant and act if necessary before tax evasion has taken place (EY, 2016a). An example of analytics being used is predictive modelling, where historical information is used to build models that identify behaviours, attributes or patterns that correlate with known patterns of non-compliance (EY, 2016a).

Indeed, the European Commission launched the Transaction Network Analysis (TNA) tool in May 2019 which is a system designed to tackle cross border VAT fraud. The TNA will allow tax authorities in EU Member States to jointly process and exchange VAT transaction data. The tool also is expected to also strengthen cooperation between the EU’s network of anti-tax fraud experts, Europol, and OLAF, the EU’s anti-tax fraud agency. Furthermore, increased data exchange between Member States will facilitate the swift detection and repression of VAT fraud (EC, 2019).
Box 2.9. Engagement with tax administrations: Risk analysis

In an interview, the Estonia tax administration highlighted that risk assessment of tax returns has been automated, which has significantly reduced labour costs. On the business side, they have automated the processes behind VAT risk analysis, with most claims for VAT reimbursements being processed within three days.

However, when the risk assessment model detects high risk cases, the tax returns are sent for manual analysis. In 2013, the Tax and Customs Board introduced a more detailed return - they asked taxpayers to list all outgoing and incoming invoices. Once they have this data they can then match transactions, which allows the Tax and Customs Board to audit a single transaction, which is more efficient and less invasive.

The Estonia tax administration can only go so far when it works alone but can make a more efficient intervention when cooperating with taxpayers.

With the increasing use of technology in recent years, the cost of compliance for taxpayers has been reduced significantly (PwC, 2018). PwC’s annual Paying Taxes report (prepared in conjunction with the World Bank) has found that the global average time for a business to comply with the tax system has fallen by 84 hours since 2004 due in part to the increasing use of real-time reporting systems, pre-populated tax returns and machine learning tax accounting systems (PwC, 2018). The time to comply in the EU/EFTA bloc has fallen by 75 hours between 2004 and 2017 as illustrated in figure 2.5 below.

Figure 2.5: Time to comply with taxes

Paying Taxes is a joint report between the World Bank Group and PwC which provides in-depth analysis into the tax and related compliance burden of a case study company in 190 economies around the world. The latest edition of the report “Paying Taxes 2019” was published in November 2018 and relates to the data of calendar year 2017. A copy of the latest report can be found at www.pwc.com/payingtaxes.
While Spain’s new VAT system has reduced the time to comply by 4.5 hours in 2017, Poland’s new VAT system increased compliance time by 76 hours in 2017. The difference between the two systems is that the Spanish one is more automated and required taxpayers to update their systems, the compliance process and the cost of implementation was higher for Spain. A key lesson that can be drawn from these two diverging experiences is that technology may lead to a more costly process if it is not implemented correctly.

An added benefit of digitalisation is that it can support tax administrations by giving them access to more data, reduce the administrative burden of collecting data and increase tax compliance (CGI, 2016). Tax authorities are better able to utilise and when properly managed, taxpayer registration data, audit information, financial transactional data and appeal records allow revenue authorities not only to determine risk profiles of individual taxpayers, but it also allows them to answer specific tax policy questions (Atos, 2017). An example of this would be tax administrations being able to design more effective and efficient tax systems as a result of having more access to taxpayer data.

2.4 Summary

Recent technological progress has likely contributed to lower labour share of income. It is reasonable to expect this trend to continue. Technological progress has also contributed to job polarization, where due to the automation the share of employment in relatively high- and low-paying occupations increases at the expense of middle-income occupations. However, ongoing technological progress, such as advances in AI, may allow automating also tasks that are currently performed by relatively well-educated workers. Automation has not resulted in mass unemployment. Increasing labour demand in the service sector and the creation of entirely new tasks may fully compensate for the negative effects of labour-displacing technologies on employment also in the future.

Technological innovation is also changing how businesses generate profits and, in turn, how we work. The digitalisation of business is making it easier for businesses to operate in a particular jurisdiction without necessarily having a physical presence and opening up new marketplaces for goods and services through online platforms. Underpinning all of this is the growing importance of data. The digitalisation of business models has increased the demand for and value of data, in particular consumer/user data. Indeed, the collection and sale of data is becoming an important source of revenue and value for some businesses, while others have placed this at the centre of their business model to indirectly generate revenue (e.g. advertising revenue for online platforms). It is plausible to assume that as the marginal cost of data continues to fall and emerging technologies mature, we will see a continuation of this trend at least in the medium-term.

The main implications for tax policies are detailed in the following list:

* Tax revenue and public expenditure
  * Empirical and theoretical research suggests that recent technological progress contributed to lower labour share of income in many developed countries. It is plausible
that this trend will continue across the EU. Without changes in tax structure, capital and consumption taxes will then become increasingly important in the tax mix.

- The direct effect on public finances of a higher capital income share is not necessarily negative. This is partly because lower wage growth could decrease the cost to the government of labour-intensive public services. On the other hand, a higher capital income share might increase fiscal pressures by heightening the need for redistribution.

- Based on the empirical evidence, it seems likely that technological progress has contributed to job polarization where the share of employment in relatively high- and low-paying occupations increases at the expense of middle-income occupations. The resulting increase in the share of low-paying occupations could increase tax-financed transfers to low earners.

- From the point of view public finances, the most crucial aspect related to technological changes is its effect on employment. There is little empirical evidence linking ongoing technological progress to an increase in unemployment at the country-level. Theoretical studies also show that growing demand for labour in the service sector and the creation of new tasks could offset the negative effects of labour-displacing technologies. However, there is likely to be an increasing need for public investments in education to ensure that displaced workers have the skills needed in new tasks.

- New technologies may also affect tax revenue by influencing the way in which businesses operate. The rise of online platforms generates challenges to direct and indirect taxation. One issue is that the traditional legal distinction between self-employment and employment is often unclear in the case of platform workers. Their employment status also varies across EU countries. More generally, increasing reliance on data poses challenges to valuing such assets for tax purposes, as well as feeding into broader challenges associated with profit attribution.

- Following current principles relating to profit attribution (i.e. that profits are taxed where value is created) is complicated by the fact that companies often provide digital services in a country without being physically present.

**Burden sharing and redistribution**

- If ongoing technological advances increase the capital income share income inequality is likely to increase because capital income is more unevenly distributed than labour income. New technologies have also increased wage inequality by serving as a complement to the tasks performed by high-skill workers. However, the long-run effect of technological progress on wage inequality is unclear. It is possible that future advances in technology (e.g. related to AI) will allow automating some relatively complex tasks that are currently performed by high-skilled workers thereby reducing the demand for high-skilled workers relative to other workers.

**Externalities and competitiveness**

- Some investments in new technologies by businesses may not be socially optimal. For instance, firms may overinvest in labour-saving technologies to automate tasks, since they do not consider how automation affects inequality. However, it would be difficult, and possibly counterproductive, to try to steer technological development via taxation.
• Higher capital income shares make it increasingly important to protect the corporate tax base from profit-shifting and to limit international corporate tax competition in order to secure tax revenues. A more uniform corporate taxation across EU Member States, that avoids large differences in effective tax rates on the return to corporate investment, would also foster productivity growth by levelling the playing field across firms.

**Tax administration**

• National tax administrations are becoming increasingly digital and utilise tech-enabled operating models. Despite this, there is more that can be done to unlock the benefits of technological innovation for tax administration. Digitalisation has the potential to lower the administrative costs of taxation, including the costs of compliance for taxpayers.

• It is likely that there will be increased interest in sharing data with tax administrations as the importance of online platforms and other “data aggregators” continues to grow. Sharing data could lower compliance costs for platform workers and their customers, as well as helping to secure tax revenue. Data sharing between businesses and tax administrations can be supported by regulatory or legislative frameworks.

• Technology also provides new means to promote higher levels of tax compliance by collecting and analysing large amounts of tax-related data. Such data can be used to inform the design of tax policy and/or tax compliance programmes. However, the use of “big data” by tax administrations is not without challenges, such as the interaction with data protection principles.
2.5 References


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Appendices

Appendix 2.1: The FOG-model

In this appendix we briefly describe the FOG-model (Finnish Overlapping Generations -model) that we use to analyse how an increase in the capital income share would affect public finances.

The model is a perfect foresight model of the type originated by Auerbach and Kotlikoff (1987) modified to describe a small open economy and calibrated to the Finnish economy. The model
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consists of five sectors: households, enterprises, a government, pension funds, and a foreign sector. The model has unit period of five years.25

Households make economic decisions according to the life cycle hypothesis. They maximize utility from consumption and leisure in different periods and the bequest that they give. The lifetime budget constraint requires the discounted lifetime incomes and discounted received bequest and transfers to be equal to discounted consumption expenditure and the given bequest. The aim of smoothing both lifetime consumption and labour supply provides long-lasting dynamics, when prices change.

The 2018 population projection of Statistics Finland provides the number of households in each age group and each period in the future for the model. The population is aging due to longer lifetimes, low fertility rates, and the transition of baby boomers from working age to retirement. Each household generation is divided into three educational groups with different lifetime productivity profiles determined by empirical observations of recent wage profiles. Households decide about hours of work, but the employment rate is exogenous.

Firms choose the optimal amount of investment and labour to maximize the price of their shares. The market value of the firm is determined as a discounted tax-adjusted sum of future dividends. The problem can be presented as maximizing at the beginning of the period the dividends distributed during the period plus the value of the firm at the end of the period, subject to the amount of initial capital stock, the cash-flow equation of the firm, the constant elasticity of substitution (CES) production function, the accumulation condition of the capital stock, the determination of the firm’s debt, and the investment adjustment costs. Investment adjustment costs induce a smooth adjustment of the capital stock to price changes. The costs also create a difference between the market value of the capital in use and the price of the investment goods sold in the markets (Q-theory). Typically, a change in the future tax-adjusted dividends generates a beginning-of-the-period shock in the market price of the firm. This price change brings the net-of-tax rate of return of possessing the shares back to the initial level. The capital gains are taxed on accrual.

The real wage adjusts to equalize the value of marginal product of labor and labor costs in the production of private goods and services. There is trend growth of labor productivity (1.5% per annum) in production of private goods. The rest of the workers, who provide tax-funded public services produced in private and public sectors, earn the same wage, even though there is no productivity growth in the production of the services.

The three markets, for labor, goods, and capital, are all competitive and prices balance supply and demand period-by-period. The pre-tax rate of return on savings and investments is determined in global capital markets. In the trade of goods, the country has, however, some monopoly power, which makes the terms of trade endogenous. Foreign economies are assumed to grow with the trend growth rate of the domestic labor productivity.

Public expenditures have a strong connection to the age of individuals in Finland. The provision of public services is allocated mainly either to the early part of the life cycle (day care and education) or to the last years (health care and old age care). Similarly, income transfers are

25 This model description is an adjusted version of the one presented in Lassila and Valkonen (2018).
distributed mainly either to young families or to retired individuals. Therefore, changes in the demographic structure are very important for the public expenditures. We assume that all income transfers (except the earning-related pensions) are fully indexed to wages because any other assumption would have dramatic consequences for income distribution in the very long-term analysis. Other than age-related expenditure is assumed to grow at the same rate as the GDP.

Revenues of the public sector originate from two types of sources in the model. Most of the receipts are accumulated by income taxes, consumption taxes, and social security contributions. Another noteworthy revenue source is the yield of the public sector wealth. We assume that the main subsectors of the general government, such as the municipal sector, the public and the private sector pension fund, and the national social security institute, have their own budgets, which are balanced either by social security contributions or earned income taxes. The only exception is the state budget, which is balanced by using a lump sum transfer. Earned income tax brackets are adjusted with the growth of the economy. The pension funds follow their current prefunding plans, and pension contributions are endogenous. Households are modelled to react to the income and substitution effects of taxation, social security contributions, and pension accrual rules.

From the point of view of the tax implications of changing factor shares it is important to note that in the model a large share of the capital income goes to untaxed sectors, such as pension funds and foreign investors.

The model features a standard constant elasticity of substitution production function. We generate a higher capital income share by varying the value of the capital share parameter in that function. Since capital and labour are measured in arbitrary units, this parameter has no independent economic interpretation and is not directly linked with the capital share. It turns out, however, that starting from the baseline calibration, increasing the capital share parameter increases the capital income share. The change in aggregate labour supply is small relative to the decline in wages. This reflects both a relatively low elasticity between consumption and leisure and the fact that households in the model need to keep up working to finance the part of old age consumption that is not covered by public pensions.
Appendix 2.2: Employment status of platform workers

There is still a lot of debate and discussion in Europe on the qualification of online platform service providers as employees of the platform, self-employed persons or hybrids. The employment status of platform workers ultimately depends on the labour regulation adopted by the different Member States.

For example, in France, the Cour de cassation, 28 November 2018, n. 1737 decided that “Take it easy” workers should be treated as employees (even if there are some Courts that decided differently, like Conseil de prud’hommes de Paris, 29 January 2018). Moreover, in Spain, platform workers tend to be qualified as employees (see Jose Enrique c. Roofoods Spain S.L. and El Fpondo de caragoria salarial, case n. 244/2018, 1 June 2018 and Juzgado de lo Social de Madrid, 11 February 2019). Whereas, Italy (App. Torino, 11 January 2019, n. 26, but also, regarding pony express, Cass., 10 July 1991, n. 7608) and the United Kingdom (on Uber drivers, see Employment Tribunals, 28 October 2016, case Aslam, Farrar and Others v Uber) adopt hybrid solutions, qualifying service providers as “workers” (not employees) but applying some employees rights.

Generally, it is possible to observe that the traditional legal distinction between self-employment and employment “is by no means exhaustive of all kinds of relationships occurring in the sharing economy. Indeed, workers in the sharing economy have some characteristics that suggest that they should be classified as employees, while others by which they should be included among independent contractors” (G. Beretta, Taxation of individuals in the sharing economy, in Intertax, 2017, Volume 45, Issue 1, p. 6).

For this reason, considering the uncertainty of this issue and risk of reclassification of workers as subordinated employees, “agreements concerning the use of platform and apps contain “representation and warranties” aimed at mitigating the risks and liabilities possibly arising in this respect” (De Stefano, V. 2016).

Appendix 2.3: Platform economy and the value added tax

Platform economy raises new legal challenges related to the application of value added tax. In order to solve such challenges, it is necessary to understand who the economic actors involved are and what types of transactions are taken. There are no specific rules related to platform economy, so general principles and rules must be examined in order to evaluate the VAT consequences of different platform transactions.

There are three potential economic actors involved: the online economic platform (or collaborative platform), that acts as an intermediary, facilitating the connection between individual suppliers of good or services and the individual “demanders” of such goods or services; the individual service providers, who share assets, resources, time and/or skills; goods or services recipients, who can use as consideration money or, in certain cases, goods or services (giving rise, in this latter case, to barter exchanges). There are also three possible VAT transactions: (i) individuals providing goods or services thorough online economy platforms; (ii) sharing economy platforms providing intermediation services to service providers and (iii) to service recipients. However, given this general scheme, it is worth noting that there is a variety of different business models and each model could have its own peculiarities.

According to article 9, paragraph 1, of the VAT Directive, a taxable person is a person “who independently carries out in any place any economic activity, whatever the purpose or result of
that activity”. Moreover, the activity must be (generally) provided for consideration (Court of Justice, case C-89/81, par. 10, Hong Kong), and on a regular basis.

This means that in most circumstances, sharing economic platforms qualify as VAT taxable persons. Also the suppliers of goods or services are VAT taxable persons assuming: i) they are independent (and not employees of the platform); ii) they act in a business/professional capacity and not in a personal capacity; iii) the annual turnover is above the registration threshold (see G. Beretta, VAT and the sharing economy, in World tax journal, 2018, p. 416).

Under article 2 of the VAT Directive, four transactions are VAT relevant: i) the supply of goods for consideration; ii) the supply of services for consideration; iii) the intra-Community acquisition of goods; and iv) the importation of goods. Based on the interpretation given by the Court of Justice, the transactions, in order to be subject to VAT, there must be a “direct link” between the service or good provided and the consideration received (Court of Justice, case C-154/80, Cooperatieve Aardappelenbewaarplaats, para. 12).

Based on the above, it seems reasonable to conclude that the intermediation service provided by the sharing platform is a service subject to VAT (unless the services are provided free of charge). It is not clear if it is free of charge the service rendered in exchange to personal data. According to Advocate General van Gerven, in case C-33/93, Empire Stores, para. 15, the consideration received by a supplier can consist in “the obtaining of personal information concerning the customer”. If we follow this argument, we should conclude that any time a platform can take personal information concerning users, there is a consideration and the transaction should be subject to VAT.

The transactions between users (if they are taxable persons, as supra defined) are also in principle VAT taxable. Problems arise in respect of the existence of a direct link between the supplies and the remuneration. If the remuneration is in cash, there is no doubt that there is a direct link. If the remuneration is in kind, it could be based on an exchange scheme or on a pool scheme. In the first case, where goods or services are directly exchanged between users, there are two potential VAT transactions. In case of arrangements where participants contribute goods or services to a common pool in exchange for the right to benefit from that pool, it is not possible to find a general rule.

In fact, even if there seem to be no direct link (because there is no legal relationship between the service provider and the consumer), in the Commission Staff Working Document, accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a European agenda for the collaborative economy (COM(2016) 356 final, p. 41 (2 June 2016)) it was written that in this case the “assessment must be carried out on a case-by-case basis”.

Appendix 2.4: Overview of interviews

To complement the literature review presented in this chapter, a small number of semi-structured interviews were conducted. These interviews aimed to provide anecdotal evidence on the way in which businesses and tax administrations intend to adapt to the changes brought by technological innovation. We conducted three semi-structured telephone interviews. The questions for the interviews were designed based on the findings of the literature review and tailored to the interests of the interviewee. The outputs of the interviews have been developed...
into case study boxes designed to compare and contrast the key findings of the literature review.

The interviewees in the first interview were Maksim Baranov and Henri Lindeberg from Tax and Customs Board in Estonia. The interviewees were initially asked about X-road, an initiative promoted by the Estonian Government. They described it as a framework for sharing data with government organisations that makes it possible to use “e-signatures” for confirmation of identity in tax declarations. Although the initiative could present a target for cyber-attacks the interviewees did not have any concerns about its security.

The interviewees discussed how the introduction of digital system benefited the government and taxpayers alike, reducing the costs of compliance and tax collection. They also described how the Tax and Customs Board has collaborated with online platforms to collect taxpayer data to prepopulate tax returns using .xml files imported into their declaration system.

The interviewees remarked that digitalisation has also helped the Tax and Customs Board in automating the first stages of risk analysis. Furthermore, they highlighted the need for human capital when developing technology-enabled systems for tax administrations. In their opinion, it can be difficult and expensive to find developers with the right skillset.

Finally, evaluating future trends, the interviewees stated that the use of AI was still being investigated by the Tax and Customs Board and that they have not found an application for Distributed Ledger Technology.

The interviewee in the second interview was digital economy expert (who prefers to remain anonymous) form a European industry association. The interviewee was initially asked what makes digital businesses different from other types of businesses. In response, the interviewee highlighted that digital businesses place a greater reliance on intangibles, such as data. This has geographical and tax implications as digital companies contribute to the “blurring of the borders” which presents challenges for taxation.

The interview commented that the issue of location in the value creation process is complex to solve as governments cannot require businesses to reshore. However, some governments are trying a “nudging” approach. The interviewee remarked that digitalisation will have impacts on employment as more industries are expected to embrace digital systems. In the interviewee’s opinion, many workers will need to switch jobs and governments will need to regulate the working conditions of platform workers. Moving to automation and AI, the interviewee remarked on the importance of explainability and accountability of automated systems in order to allow administrative and judicial control over them.

The interviewee in the third interview was blockchain expert Marc Sel from PwC Belgium. The interviewee was initially asked how technological innovation has changed the way businesses operate. The interviewee identified two main ways in which digitalisation is transforming businesses: 1) making existing businesses more efficient, and 2) allowing for the creation of new businesses. The interviewee also highlighted that technological innovation has accelerated the pace of business and the speed of transactions, as well as making it easier to operate across borders. In the opinion of the interview subject, these aspects could potentially lead to labour-displacement as technology could make it easier for businesses to use remote management and offshoring.
Moving to the topic of Distributed Ledger Technology (DLT), the interviewee remarked that they are disruptive because they do not need a central authority and that they have many potential applications. DLT could make reconciliation of data easier, which will help avoid intentional or unintentional mistakes. The interview stated that currently it is difficult to predict whether DLTs will result in labour-displacement.

The interviewee in the fourth interview was Karsten Frohlich Hougaard, a technology expert at the Danish Technological Institute. The interviewee was initially asked how technological innovation will change the way businesses operate in the next 5-15 years. The interviewee stated that the impact of technology will be different across industries, with larger companies having a comparative advantage over smaller companies due to better availability of resources to adapt to change. The interviewee also stressed the importance that services will have in the future, with the rise of the Internet of Things and the customisation of the customer’s needs.

Moving to the topic of platforms, the interviewee remarked that platform work is still not fully integrated in everyday life as it was expected to be in early forecasts. This is due to the fact that many businesses, especially small ones, tend to be resistant to change. The interviewee also highlighted how platforms could be a useful tool for SMEs to become more competitive against larger firms.

Finally, the expert observed that the nature of platform work can change substantially depending on location. While in Denmark platform workers are usually highly educated and earn high salaries, in other countries (e.g. the USA or China) platform work can very low paid.
3 Area of Demographics

Increasing life expectancy in conjunction with fertility rates below the replacement rate will lead to the ageing of the population in European Union countries. While European Commission forecasts project the EU-28 population to stagnate and fall slightly from 2040 onwards (Figure 3.1, top panel), the share of the population aged 65 and older is projected to increase continually in the main population scenario from 19% in 2015 to 24% in 2030, reaching 29% in 2070 (European Commission, 2018). Population ageing is a challenge for labour markets and puts pressure on the financing of public expenditure for pensions, health- and long-term care. The old-age dependency ratio, the number of retirement-aged people (65 and older) for every 100 people of working age (15-64), is set to increase from 29 in 2015 to 51 in 2070 in the main scenario (Figure 3.1, bottom panel). At the same time, the demographic composition of European countries will be affected by patterns and trends in migration, with potentially large differences between countries.

This chapter discusses the potential effects of demographic change on the economy by surveying the relevant literature and drawing on model simulations to discuss mechanisms and the potential quantitative impact of demographic change on public finances. Section 3.1 focuses on the drivers of demographic change and quantifies their importance for the development of the demographic profile in EU-28 countries using a simple decomposition exercise. Section 3.2 summarises the potential macroeconomic effects of population ageing for EU-28 economies, while section 3.3 discusses potential effects of migration on aggregate labour supply, wages and the distribution of incomes, as well as on labour productivity.

Section 3.4 discusses the tax implications of demographic change, including an overview of age-related public spending projections, a discussion of long-run effects of population ageing and migration on public finances on both the revenue and expenditure sides, a discussion of the importance of taxation of pensions in the context of population ageing, a discussion of the interactions between increasing life expectancy, pension policy and taxation, an overview of the political implications of population ageing for public finances, and an overview of the potential effects of migration on preferences for redistributive taxation. Finally, section 3.5 summarises the main findings on tax implications.

3.1 Drivers of demographic change

Demographic change in the European Union is driven by three main factors – below-replacement-level fertility and increasing life expectancy lead to population ageing, whereas migration within and into EU-28 countries alters the population profile. This section discusses the relative importance of these driving forces of demographic change for the development of the population and age structure in EU-28 countries. It uses the old-age dependency ratio as a crude measure of population ageing and the pressures it puts on public finances.

The section uses European Commission forecasts on migration, mortality and fertility as published in the Ageing Report 2018 (European Commission, 2018). These projections are based on the “partial convergence” assumption, meaning that fertility and mortality rates are assumed to converge to the “forerunners” (countries who exhibited trends later observed for other countries early) in the very long-term future (beyond the projection horizon in 2080). As such, mortality is forecasted to decrease, and fertility is forecasted to increase, in most countries (see
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below), with currently high mortality (low fertility) countries projected to experience the highest decrease (increase) in mortality (fertility) rates.

(Net) migration rates are particularly volatile, differ significantly across Member States, and depend on political circumstances that cannot be easily incorporated into statistical models. The European Commission’s approach to the migration projection is to extrapolate current migration trends in Member States in the short term, while assuming that net migration flows will converge to zero in the very long term (in 2150). Thus, longer term projections increasingly smooth current net migration trends towards zero (European Commission, 2017).

Population forecasts are inherently inaccurate, as empirical observations on the drivers of fertility, mortality and migration tend to be limited to a particular space and time, and often do not have much predictive power. Longer-term forecasts in particular are unreliable, as unexpected shocks tend to be correlated over time, leading to larger deviations (Keilman, 2019). For this reason, the European Commission offers alternative forecast scenarios based on assumptions of higher or lower fertility. This section only presents “baseline scenario” projections (based on “medium” assumptions on fertility, mortality and migration) for simplicity, but a caveat on the limited reliability on any population forecast applies.

3.1.1 Migration

For the European Union as a whole, net migration inflows have been consistently positive since the mid-1980s, averaging 1.27 million per year between 2000 and 2009. While net migration inflows dropped during the global financial crisis, they picked up again to reach 1.58 million between 2013 and 2015, peaking at 1.8 million following instability in North Africa and the Middle East.

EC forecasts project net migration inflow rates to fall from 0.3 % of the population in 2016 to 0.2 % in 2030, stagnating until the end of the projection horizon in 2070. Luxembourg, Austria, Malta, Cyprus, Italy and Sweden are projected to experience the highest inflows relative to the native population – net migration inflows are projected to (cumulatively) account for 22 % of the population in Austria, 19 % in Italy and 18 % in Sweden over the period 2016–70. In contrast, Bulgaria, Romania, Lithuania and Latvia are projected to experience net migration outflows over the projection horizon (cumulatively amounting to 26 % of the population until 2070 in the case of Lithuania, for instance, European Commission (2018)).
Future trends and taxation

Figure 3.1. Population and old-age dependency ratio in EU-28 countries, baseline and no migration scenario, 2015-2080

While net migration inflows into the EU can attenuate and delay the effects of population ageing, the consensus in the literature is that it cannot fully “solve” the problem (e.g. Coleman (2008), Spielvogel and Meghnagi (2018)). While immigrants are on average younger than the resident population, they age too, and thereby contribute to the growing population of retirees. Where immigrants have higher fertility rates than the resident population, these differences typically vanish over time (Spielvogel and Meghnagi, 2018). Thus, immigration would have to continually increase to maintain the current age structure of the population.

This point can be illustrated by comparing the European Commission population projections in the baseline scenario, which assumes net migration inflows to drop from 1.9 Million in 2015 to just over 700,000 in 2070, to a scenario with zero net migration inflows (see Table 3.1 for the assumptions underlying the scenarios presented in this section). In the baseline scenario, the
size of the working age population drops by 4% between 2015 and 2030, and by about 6% between 2015 and 2070. In the scenario that assumes no net migration inflows into the European Union, the working age population falls by 9% until 2030, and by 12% until 2070. This implies that stabilising the working age population over this time horizon would require a doubling of the projected net migration inflows into the EU. Similarly, immigration clearly slows the rise in the old-age dependency ratio, but does not fully compensate for the other drivers of demographic change. Under the assumption of no net migration inflows, the old-age dependency ratio would rise to 59 by the year 2070, an increase by roughly 103% relative to the level in 2015. The baseline projection puts the old-age dependency ratio at 51 by 2070, an increase by roughly 76% relative to 2015. The projected net migration inflows thus compensate for less than a third of the rise in the old-age dependency ratio caused by low fertility and mortality over the next 50 decades (Figure 3.1, bottom panel, Table 3.1).

### 3.1.2 Fertility

The total fertility rate (TFR) in EU member states declined sharply from over 2.5 during the “baby boom” of the 1960s to 1.5 in 2000, below the natural replacement level of 2.1. Between 2000 and 2010, fertility rates increased across the EU, but this trend reversed in 2010. European Commission projections assume that low-fertility Member States’ fertility rates will converge to the rates of countries which have been forerunners of fertility trends in the past. The average EU-28 TFR is expected to rise from 1.58 in 2015 to 1.81 in 2070, levels observed in Ireland, France, Sweden or the UK today (European Commission, 2018).

The quantitative importance of below-replacement level fertility for population ageing in the EU-28 countries can be illustrated by the following decomposition exercise: assume that the TFR in all EU-28 countries were constant at the natural replacement level of 2.1 children per woman over the entire time period 2015-2070, while life expectancy develops according to EC baseline projections and net migration is zero (series “replacement fertility, projected mortality” in Figure 3.2, see also Table 3.1 for an overview of decomposition scenarios). This allows for separating the contribution of fertility trends to the dynamics of population ageing from that of mortality trends, net of the effects of migration.

Assuming a TFR at the replacement level mechanically keeps the working age population constant beyond 2030, but does not affect the size of the population aged 65 and older within the projection horizon until 2070 – the number of over 64 year-olds increases until about 2050 because of the size of the “baby-boomer” generation and increasing life expectancy. It takes 15 years for new cohorts to age into the working age population, and about a decade longer for the bigger younger cohorts to make a quantitative difference in the age composition of the entire population. Thus, TFRs at the replacement level only decrease the old-age dependency ratio noticeably from 2040 onwards relative to the no-migration scenario. By 2070, the scenario of a consistently high fertility rate puts the old-age dependency ratio at 48, an increase by roughly 66%

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26 The total fertility rate (TFR) is the sum of all age-specific fertility rates in any given year. The age-specific fertility rate is the number of births per 1,000 women of a given age. Thus, the TFR can be thought of as the number of children a woman would have given birth to aged 50, had she given birth at the age-specific fertility rate from ages 14 to 49, and age-specific fertility rates had remained constant over this period (i.e. there are no cohort effects).
% relative to the level in 2015, which is substantially lower than the increase to 59 (roughly 103 %) projected in the no-migration scenario (Figure 3.2). Thus, pro-natalistic policies that persuade women to have 0.52 additional children on average (a substantial increase in the TFR of 33 % compared to 2015) could significantly counteract population ageing caused by mortality trends in the longer run.

Figure 3.2. Old-age dependency ratio in EU-28 countries, 2015 mortality and replacement fertility scenarios*, 2015-2070

*Simulations based on EC population projections (population on the 1st of January, no migration scenario, assumptions on fertility and mortality rates by age, sex, and type of projection). The scenario “No migration” is the EC baseline scenario with zero net migration (projected fertility and mortality according to the baseline scenario). The scenario “2015 mortality, projected fertility” assumes that the age- and sex-specific mortality rates at the national level remain constant from 2015 through 2070, that fertility follows the baseline scenario and that there is zero net migration. The “replacement fertility, projected mortality” scenario assumes that the total fertility rate is 2.1 from 2015 through 2070, that the age- and sex-specific mortality rates at the national level follow the baseline scenario, and that there is zero net migration.


### 3.1.3 Life expectancy

Increasing life expectancy is the main driver of population ageing across European Union countries. Since 1960, life expectancy at birth increased by about 2.2 years on average per decade for both genders. Life expectancy increased in all EU-28 countries, although large differences between Member States remain – in 2015, life expectancy for women at birth was 85.8 years in Spain compared to 78.2 years in Bulgaria, for men it was 80.4 years in Sweden compared to 69.2 years in Lithuania. EC projections assume large increases in life expectancy between 2015 and 2070 (+7.8 years for men and + 6.6 years for women) – these increases are largely driven by countries with currently comparatively low life expectancies. Life expectancy at age 65 is projected to increase by 5.3 and 5.1 years for men and women, respectively, to reach 23.4 years for men and 26.6 years for women.
Analogous to the decomposition exercise in the previous section, the quantitative importance of increasing life expectancy for population ageing can be gauged by holding life expectancy constant at the 2015 level while assuming that fertility develops according to EC baseline projections and net migration is zero (series “2015 mortality, projected fertility” in Figure 3.2)\(^{27}\).

Under constant life expectancy, the old-age dependency ratio starts to decline already from 2030 onwards relative to the no-migration scenario (see Figure 3.2). By 2070, the scenario of constant life expectancy puts the old-age dependency ratio at 45, an increase by roughly 55% relative to the level in 2015, which is again substantially lower than the increase to 59 (roughly 103%) projected in the no-migration scenario, and also lower than the increase to 48 (roughly 66%) in the replacement fertility scenario (Figure 3.2). Thus, in comparison, increasing life expectancy affects ageing earlier, and to a larger extent than low fertility.

### 3.1.4 Quantitative effect of the pensionable age

A number of EU countries have enacted pension reforms in response to population ageing which increase the incentives to postpone effective retirement, and which are expected to have sizeable effects on labour market participation rates of older workers (aged 55-64). In some countries, such as Greece, the Netherlands and Denmark, pension reforms are also expected to lead to participation rates of persons aged 65-74 of 30% and higher. At the same time, labour force participation of young people aged 15-24 is declining, mainly because of rising educational enrolment (European Commission, 2018).

As a simple mechanical simulation exercise related to the above described changes in labour market participation over the life cycle, we consider the effect of extending the upper threshold for the working-age population from 65 to 75 across all EU-28 countries. At the same time, we raise the age at which young people join the working age population from 15 to 20. Thus, we look at the old-age dependency ratio with the working-age population defined as persons aged 20-74 in the baseline scenario (without varying European Commission projections on migration, fertility and mortality). Such an extension of the definition of working life by a net number of five years has an immediate and large mechanical effect on the old-age dependency ratio: in the baseline scenario, this ratio declines from 29 to 13 (-55%) in 2015, and only climbs to 18 in 2030 (compared to 39 with an assumed pensionable age of 65). The old-age dependency ratio stabilises at 29 in 2070, while it reaches 51 if the pensionable age is set at 65 (-44%, not shown).

To what extent this redefinition of the old-age dependency ratio reflects actual changes in the size of the contribution base relative to the spending needs of pay-as-you-go financed social security systems depends, however, on a number of factors. First of all, while the pensionable age is a policy choice, effective retirement ages can differ substantially from the legal retirement age (e.g. OECD (2017)). Moreover, even with higher effective retirement ages, the actual labour market participation of older workers will largely depend on how employment opportunities and health status at higher ages develop in the future.

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\(^{27}\) The decomposition exercise holds age- and sex-specific mortality rates at the national level constant at 2015 values but uses EC baseline projections for fertility rates.
Table 3.1: Scenario assumptions and resulting population projections by scenario

<table>
<thead>
<tr>
<th>Drivers of demographic change</th>
<th>European Commission baseline scenario</th>
<th>No migration scenario</th>
<th>Replacement fertility, projected mortality</th>
<th>2015 mortality, projected fertility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migration</td>
<td>Decline from 0.3% of the EU-28 population in 2016 to 0.2% in 2030, remain at 0.2 until 2070</td>
<td>Zero net migration</td>
<td>Zero net migration</td>
<td>Zero net migration</td>
</tr>
<tr>
<td>Fertility (total fertility rate*)</td>
<td>Rise from 1.58 in 2016 to 1.69 in 2030, and further to 1.81 in 2070</td>
<td>Same as EC baseline</td>
<td>Rise to 2.1 in 2016 and remain constant until 2070</td>
<td>Same as EC baseline</td>
</tr>
<tr>
<td>Mortality (illustrated here using life expectancy at age 65)**</td>
<td>Males: rise from 18.1 years in 2016 to 23.4 years in 2070. Females: rise from 21.5 years in 2016 to 26.6 years in 2070</td>
<td>Same as EC baseline</td>
<td>Same as EC baseline</td>
<td>Remain constant at 2016 values (males: 18.1, females: 21.5) until 2070.</td>
</tr>
</tbody>
</table>

**EU28 total population (in Million persons)**

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>508</td>
<td>508</td>
<td>508</td>
<td>508</td>
</tr>
<tr>
<td>2030</td>
<td>524</td>
<td>502</td>
<td>427</td>
<td>396</td>
</tr>
<tr>
<td>2070</td>
<td>520</td>
<td>427</td>
<td>527</td>
<td>396</td>
</tr>
</tbody>
</table>

**EU28 population 65 years and older (in Million persons)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>96</td>
<td>96</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>2030</td>
<td>125</td>
<td>128</td>
<td>141</td>
<td>121</td>
</tr>
<tr>
<td>2070</td>
<td>150</td>
<td>136</td>
<td>141</td>
<td>104</td>
</tr>
</tbody>
</table>

**Old-age dependency ratio (Number of persons aged 65 and older per every 100 people aged 15-64)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Ratio 2015</th>
<th>Ratio 2030</th>
<th>Ratio 2070</th>
<th>Ratio 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>2030</td>
<td>39</td>
<td>41</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>2070</td>
<td>51</td>
<td>59</td>
<td>48</td>
<td>45</td>
</tr>
</tbody>
</table>

* The total fertility rate (TFR) is the sum of all age-specific fertility rates in any given year. The age-specific fertility rate is the number of births per 1,000 women of a given age. Thus, the TFR can be thought of as the number of children a woman would have given birth to aged 50, had she given birth at the age-specific fertility rate from ages 14 to 49, and age-specific fertility rates had remained constant over this period (i.e. there are no cohort effects). ** In the scenarios we use the age and sex specific mortality rates for each country and year.
Source: (European Commission, 2017), own calculations.
3.2 Effects of population ageing on the economy

Population ageing is expected to have several macroeconomic consequences that affect public finances through a variety of channels (see e.g. Lee (2016) for a recent broad overview). The following subsections discuss the channels that matter most for European countries.

3.2.1 Relative supply of factors of production and rates of return

The age composition of the population affects the relative supply of factors of production in the economy. Both increasing life expectancy and decreasing fertility lead to a reduction in the number of people of working age relative to the total population. Moreover, decreasing fertility also leads to slower labour force growth (see e.g. Sichel et al. (2007)). At the same time, increasing life expectancy raises the fraction of the elderly in the population. While young adults typically have low levels of wealth, older people tend to have accumulated a substantial amount of assets over their working lives to finance part of their consumption in old age (see e.g. Lee et al. (2003)).

An economy with an older population is therefore typically associated with relatively less labour (as the share of people of working age decreases) and relatively more capital (as the share of older people holding more assets increases, and individuals have increased incentives to save for consumption during a longer retirement period). Population ageing is thus expected to lead to increased capital intensity, or “capital deepening” (see e.g. Lee (2016)). This, in turn, affects the production possibilities and the returns to factors of production in an economy, raising the returns to labour (wages) and lowering the returns to capital (interest rates) (see e.g. Kehoe (2018)). The size of these price changes will, among other factors, depend on the elasticity of substitution between physical capital and different types of labour in the production function, with lower elasticities leading to larger price changes. It is worth noting that the expected effect of population ageing on the average wage level is the opposite of the expected effect of labour-saving technologies (see section 2.1) or globalisation (see section 4.1.1).

3.2.2 Open economies and international capital flows

The extent of capital deepening brought about by population ageing will, however, depend on a number of factors. First, in open economies, the long-term development of wages and interest rates will largely be influenced by global demographic trends and international capital flows, as it is the global relative supply of factors of production that will determine rates of return. European countries are open economies and typically have an older population than the rest of the world. Therefore, they can export part of the increase in asset demand arising in the context of population ageing by investing in countries with younger populations and higher rates of return. As a result, population ageing in Europe should lead to an increase in international capital flows. The capital-labour ratio in European countries should rise less, and the decline in interest rates as well as the increase in wages should be less pronounced, than in a closed-economy setting (see e.g. Börsch-Supan et al. (2006) and Attanasio et al. (2007)).

3.2.3 Intergenerational transfer systems and increasing household savings

Moreover, the increase in asset demand caused by an ageing population will strongly depend on the intergenerational transfer system in place. In general, increased longevity should lead to an increase in individuals’ savings for retirement and therefore to an increase in asset demand,
which at least partly translates into an increased demand for capital. However, in countries in which the elderly are largely supported through public or private transfers rather than assets, the increase in asset demand brought about by population ageing should be less severe (see e.g. Lee et al. (2003) and Lee (2016)). In most European countries, public transfers to the elderly in the context of pay-as-you-go pension systems play a large role in supporting consumption in retirement. In the absence of major pension reforms, the increase in capital intensity in European countries should therefore also be less severe than in other parts of the world.

3.2.4 Labour force composition, human capital, and labour productivity

The relative decline in labour as a factor of production brought about by population ageing may be affected by a number of factors. To begin with, increases in labour force participation of women and of older workers, as projected for instance by the European Commission (2018), are expected to lead to an increase in aggregate labour supply. At the same time, declining fertility leads to the ageing of the labour force even if labour supply by age remains the same. This shift towards older ages is reinforced by increased labour force participation of older workers. As labour productivity varies with age (see e.g. Pekkarinen & Uusitalo (2012)), such a change in the age composition should affect average labour productivity and thereby change the effective aggregate labour supply. This change in effective aggregate labour supply due to a shift in the age composition of the work force may also be influenced by the degree of substitutability between workers of different ages (see e.g. Prskawetz et al. (2008)). Finally, population ageing may lead to an increase in human capital investment, thereby offsetting the reduction in the relative quantity of labour input to some degree by an increase in quality. The reason is that capital deepening reduces returns to capital and raises returns to labour and human capital. This should create incentives for individuals to shift investment from physical to human capital, leading to human capital intensification and increasing effective aggregate labour input (see e.g. Krueger and Ludwig (2007) and Ludwig et al. (2012)).

There are also several other channels through which population ageing may affect aggregate productivity and the growth rate. On the one hand, the age composition of the work force may affect both the speed and type of technology adoption, as workers of different ages may differ in both their ability to adopt new technologies and in their complementarity with particular types of technology (see e.g. Acemoglu & Restrepo (2018)). On the other hand, the age composition of the population may affect both the rate and direction of technological progress, as age groups may differ in their contributions to innovation and in their interest regarding the direction of innovation (see e.g. Prettner (2013) and Liang et al. (2018)). These channels are discussed in more detail in Section 6.3.

3.3 Effects of immigration on the economy

The economic and fiscal impact of immigration on receiving countries depends on the skill level, labour supply and labour market performance of migrants. But immigration may also affect the employment and wage level of natives and have spill-over effects on labour productivity.

3.3.1 Labour supply and labour market performance of migrants

Immigrants tend to have lower employment and higher unemployment rates than the native population – on average across EU-28 countries, the employment rate of the working-age
The foreign-born population in 2017 was 63% compared to 66% among the native-born population. The gap in unemployment rates was even higher – 13.1% for foreign-born workers, compared to 8.1% for native-born workers. However, employment rates vary widely across countries of origin: immigrants from EU-28 and EFTA countries as well as from North America have higher employment rates than the native population (71% and 72%, respectively), and immigrants from North Africa and the Middle East have significantly lower employment rates (49%, OECD (2018)).

Employment and wage levels of migrants are closely correlated with the degree of development of their country of origin – skills acquired in well-developed economies are more easily transferable to European Union countries. There is also a selection effect: migrants from less developed countries may be more ready to accept that they will have to undertake significant investments in language and other skills in order to live and work in Europe (Duleep, 2015), implying that they are willing to accept lower employment and wage levels for some time after arrival.

Regarding the qualification of immigrants in EU-28 countries, immigrants tend to be overrepresented among both the low educated (below secondary education) and the tertiary educated. This is partly because of differences in reasons for migration: immigrants who come to join family or for humanitarian reasons are often low-educated, while those who come to study and work are more likely to have (or attain) tertiary qualifications Spielvogel and Meghnagi (2018). But this pattern is uneven across countries: in the UK, 47% of the foreign-born population above the age of 15 have a tertiary qualification, compared to 27% of the native-born population. In contrast, the share of low educated migrants is more than 10 ppts higher than that of the native population in Germany; in Finland, this difference is nearly 20 ppts (Arslan, et al., 2014).

While immigrants are more likely to hold a tertiary qualification than the native population in EU-28 countries on average, they are less able to translate their skills into earnings. Foreign-born workers are more likely to work part-time or on temporary contracts, and they are more likely to be overqualified for their jobs than native-born workers: In 2015, the share of foreign-born workers with a tertiary qualification who were overqualified for their job was higher than among their native counterparts in all EU-28 countries where data were available. The difference was particularly high in Italy (35 ppts), Greece (25 ppts) and Denmark (20 ppts). Their concentration in low-skilled and routine-based occupations also makes immigrants more vulnerable to automatisation-driven job displacement (OECD, 2017).

Overqualification is especially prevalent among new arrivals who often cannot adequately put their human capital to use because they lack language skills or need more time to find an adequate job. While immigrants do “assimilate” to natives in terms of occupational composition and wages over time (Duleep, 2015), there are significant variations in the degree and speed of assimilation between receiving countries, countries of origin, and immigrant cohorts. For the United States, Borjas (2015) shows that migrants who arrived in the 1970s were able to roughly half their earnings disadvantage within the first decade of arrival28, but that later migrant cohorts suffered both a higher initial earnings disadvantage, and made smaller if any gains in

28 Their earnings gap narrowed by about 15 ppts. within the first ten years after arrival.
their first decade in the US. This trend is associated with a slower acquisition of English language skills by recent migrant cohorts, which in turn is correlated with an increase in big national origin groups in the US. This could be connected to the formation of “enclaves”, segmented economies serving and employing specific immigrant communities, which might harm workers by hampering language and transferable skill acquisition (e.g. Xie and Gough (2011)). For Europe, Dustmann and Frattini (2011) show that recently arrived migrants are at the biggest disadvantage in Southern European countries such as Italy and Spain in terms of barriers to enter certain occupations, while their chances to access various occupations are more similar to those of natives in France and the UK29. Migrants from other EU-countries perform better in terms of most dimensions of labour market integration (such as unemployment risk, position in the wage distribution, and closeness of fit between qualifications and occupation) than non-EU migrants in all countries and assimilate much faster in those dimensions, too.

3.3.2 Wages and income distribution

Immigration can affect an economy’s income distribution through a composition effect (if the skill distribution of immigrants differs from the native population, they mechanically affect the earnings distribution), or through a direct effect on the wages of the native population. The composition effect depends on the skill level of migrant populations and their labour market performance. As discussed in Section 3.3.1, immigrants are more likely to have either low (below upper-secondary) or high (tertiary) education than native workers but are overrepresented in low-skilled (and low-wage) jobs. As a consequence, immigrants tend to concentrate on the low end of the income distribution, especially in the first years after their arrival (Dustmann et al. (2013)). However, on the macro level, the effects of immigration on the education level of the labour force, and thus on the aggregate earnings distribution across the EU is likely to remain modest, in line with the limited effect of migration on EU-countries’ populations as a whole (see Section 3.1.1, Spielvogel and Meghnagi (2018)).

The question of how immigration affects natives’ wage levels is more complex. Economic theory suggests that immigration will increase overall GDP if receiving countries have a higher ratio of capital to labour (and therefore a higher marginal productivity per worker) than sending countries, while at the same time decreasing the wages of the resident population as wages are equalised across sending and receiving countries. Thus, in a simple model of homogenous labour and fixed capital, migration leads to substantial output gains accruing to immigrants (through higher wages) and capitalists (through increasing returns to capital), while native workers suffer an income loss (through a lower new equilibrium wage, e.g. Borjas (2015)).

However, this simple model ignores the adaptability of firms and labour markets, as well as complementarity of native and immigrant labour – firms can react to an immigration-driven increase of labour supply by expanding and adapting their operations, mitigating negative wage effects. In a meta-study of 27 empirical studies on the elasticity of native workers’ wages to immigration (Peri, 2014), only four studies find a significantly negative effect of immigration, while 18 find no or very small effects, and four significantly positive effects on the wages of natives. Negative effects, where they exist, are concentrated on low-educated workers if

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29 The measure of occupational disadvantage applied by Dustman and Frattini (2011) corrects for differences in educational composition between immigrant and native populations.
immigrants are overall less educated than native workers, and on earlier immigrants, suggesting that recent immigrants are a closer substitute for resident immigrants than for native workers (for a recent study for Austria, see Titelbach et al. (2019)).

Two possible mechanisms may enable labour markets to accommodate increasing labour supply while maintaining wage levels: first, firms may adopt labour-saving technologies more slowly if labour is more abundant, increasing labour demand. Lewis (2011) shows that those metropolitan areas in the US that experienced a higher influx of low-skilled immigrants adopted less machinery than metropolitan areas with less immigration, implying that firms substituted labour for labour-saving capital investments, keeping wages equal. Second, native workers may adapt to an inflow of foreign workers by specialising in higher-skill and/or communication-intensive occupations. Using administrative data from Denmark for the period 1995 to 2008, Foged and Peri (2016) show that refugee inflows pushed young low educated workers into less manual-intensive occupations, resulting in positive effects on native unskilled wages. This shift happened gradually over a period of nine years and the effects where still significant 15 years later, suggesting a permanent shift.

Effects on wages, however, depend on the flexibility of labour markets, and thus on labour market institutions: while wage effects are generally small, immigration has been shown to have some employment effects on native workers in rigid labour markets (where adjustment is expected at the employment– instead of the wage margin (Peri, 2014)). This effect may be exacerbated if immigrants are concentrated in the low-skill segment of the labour market.

3.3.3 Diversity and labour productivity

A culturally diverse labour force can increase productivity through complementarities in skills and experience between workers of different cultural and linguistic backgrounds. Diversity of perspectives in teams can also improve problem solving (Hong and Page, 2004). However, linguistic and cultural barriers can also generate frictions and diminish group cohesion and group effort (see e.g Sparber (2009)). Individuals also tend to have less trust in those who are racially or ethnically different to them (e.g. Alesina and La Ferrara (2002)), which can potentially undermine productivity by harming relationships between colleagues, firms, and firms and customers.

While there is a wealth of experimental and survey-based studies suggesting less collaboration and trust in racially mixed teams and communities, direct empirical evidence on the effect of racial (or ethnic) diversity on firm-level productivity is relatively scarce. Exceptions include Parrott et al. (2014), who, using Danish matched employer-employee data, find that ethnic diversity at the firm level is negatively associated with firm productivity. Exploiting differences in racial diversity across US States, Sparber (2009) finds that industries that depend on creative problem solving and customer service do benefit from a diverse local labour force, while those who rely heavily on teamwork do better in States with a more homogenous workforce – this more nuanced finding is in line with survey- and experimental evidence suggesting that diversity does stimulate creativity and improve problem solving, but hinders collaboration in teams. Highly developed countries and clearly structured organisations seem to be better at realising the positive effects of diversity – well developed, diversified production processes may be necessary to realise skill complementarities, while institutions and organisations which provide clear rules and competencies might curb the associated conflict (Alesina and La Ferrara, 2005).
Some researchers argue that large scale migration might also more directly depress productivity in receiving countries as migrants bring their social models, culture and organisations with them. As badly performing political and economic institutions are one of the most important reasons for conflict and poor economic conditions (Acemoglu and Robinson, 2012), it is unlikely that their import will leave the production processes and economic institutions in receiving countries unchanged (Borjas, 2015).

3.3.4 Immigration and innovation

Knowledge formation and technological change are important factors determining total factor productivity and economic growth. Immigration might affect the speed of innovation through two channels: firstly, immigrants directly contribute to research and innovation in their host countries. Because of positive selection into immigration (educated and talented individuals from less developed countries are more driven to emigrate to countries with a better environment for research and entrepreneurship, and developed countries offer specialised programs to incentivise skilled migration), immigrants may be more innovative than natives – e.g. about one quarter of innovators in the United States are immigrants (Kerr, 2013). Secondly, diversity in teams might spur innovation (see also Section 3.3.3). Thus, the effect on economic growth via innovation is a further channel through which high-skilled migration can affect tax revenues (in addition to the taxation of mobile high-income individuals, see section 4.1.1.2).

As technology progresses and further research becomes increasingly complex, researchers and innovators are faced with increasing educational requirements. They can alleviate this “burden of knowledge” problem by extending their education, narrowing their expertise, and most importantly intensifying collaboration and teamwork, which has been shown to be more relevant in “deeper” (that is, more developed) areas of research. Thus, research collaboration and teamwork are expected to further gain in importance in the future, and diversity in knowledge is beneficial to the productivity of collaborations (Jones, 2009).

However, as discussed in section 3.3.3, there is a trade-off between increased innovative capacity caused by (culturally and ethnically) diverse teams and the associated communication costs. Thus, the effect of diversity on the innovative capacity of the entire economy (that is, above and beyond the contributions of individual migrant researchers) is ex-ante ambiguous, similar to its effect on labour productivity discussed in section 3.3.3, and therefore an empirical question.

Much of the empirical literature on immigration and innovation uses US-data, and therefore does not fully translate to the European context since source countries and skill levels differ substantially (Kerr, 2013). For Europe, the empirical evidence is mixed and points to no or quite small positive effects of workforce diversity in terms of country of origin on the innovative capacity at the firm level.

For example, Bosetti et al. (2015) relate an indicator for industry-specific innovation (data on patents) and for general-knowledge creation (number of citations) to the share of foreigners in highly skilled occupations. This share varies from over 30% of workers in countries such as Hungary, Poland or the UK to around 10% in countries such as Austria, Germany or Greece. They find that skilled immigration has a positive effect on both industrially applicable innovation and the generation of general knowledge: a one percent increase in the number of foreign born
workers as a share of skilled workers leads to an increase in the number of patents by 0.08 %, and in the number of citations by 0.15 %. Using data on European regions, Ozgen et al. (2011) also find a positive effect of high-skilled immigration on innovation as measured by patent applications, which increased with the internal diversity (with respect to country of origin) of the local migrant population. In contrast, Ozgen et al. (2017), using a panel of Dutch matched employer-employee data, find that any positive effects of diversity on innovation disappears once firm fixed effects are included in the model.

While the evidence on the effect of diversity on innovation at the firm level points to an at best small positive effect, there is more robust evidence for positive effects on the regional level, suggesting that workforce diversity affects innovation across firms and workers, and not on the firm- or even team level. However, the literature suggests that only high-skilled immigration leads to positive spill-over effects on innovation at the local level, and that diversity in the country of origin of immigrants is key for this effect to occur. That is, a high share of immigrants in the work-force by itself is unlikely to increase innovation in the local economy (see Ozgen et al. (2014) for a discussion of this literature).

### 3.4 Tax implications

This section discusses how population ageing may affect public spending, how both population ageing and migration may change the relative importance of major tax bases and of revenues by source, how migration may mitigate the pressure that population ageing creates on public finances, how population ageing interacts with the taxation of pensions, and how demographic change may affect political decision making.

#### 3.4.1 Public spending needs

Since welfare state entitlements such as public pensions, health care and long-term largely depend on age and (past) labour force participation, an increase in the share of older people will pose challenges for the viability of public finances. In particular, the expenditures on health care, long-term care and public pensions will rise significantly in most European countries. Across the EU on average, the EC forecasts total age-related expenditure (including pensions, health care and long-term care) to rise from 25 % of GDP in 2016 to 26.7 % of GDP in 2070. The biggest driver of this increase is spending on long-term care as a result of lower mortality at older ages (expected increase: 1.2 ppts of GDP), followed by health care (+ 0.9 ppts of GDP) and pension spending (+ 0.8 ppts of GDP until 2040, then return to 2016 level, European Commission (2018)).

The extent of pressure on public finances depends on the speed of ageing, the social security system in place, external factors such as advancements in medicine, the development of wages as major cost component in the public sector\(^3\), as well as the development of the contribution base for financing the system – broadly speaking, the labour share of aggregate income. Against the backdrop of population ageing and increasing public spending pressures, several European

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\(^3\) Note that, in this context, an increase in wages due to increased labour productivity in other sectors could also lead to a productivity-unrelated increase in wages in the public sector, as the latter is competing for labour (Baumol effect), thereby increasing public spending even more.
countries have started to implement reforms of their pension-, health- and long-term care systems.

Across the EU-28 countries on average, total age-related spending peaks in 2040, and levels out thereafter (not shown) – this pattern is driven by pension expenditures increasing until 2040, when current (and recent) pension reforms begin to show an effect. In contrast, health- and long-term care expenditures are projected to rise throughout the projection horizon.

There is considerable variety in expected spending pressures across EU-28 countries, caused by differences in the (projected) extent and speed of ageing and the extent and timing of reforms, with some countries experiencing a fall and others a rise in age-related expenditure.

For example, age-related public expenditure is expected to decline in France after 2040, driven by a much flatter ageing profile than across the EU on average (the old-age dependency ratio in France decreases after 2040, due above-average past fertility). In contrast, Italy and Spain are expected to experience declines in age-related expenditure because of pension reforms, although population ageing is more pronounced than across the EU on average (Figure 3.3, top panel).

Similarly, Poland and Portugal, despite ageing faster than the EU average, are projected to experience only moderate increases in public expenditure as a consequence of pension reforms – in both countries, the public pension benefit ratio (the ratio of average pensions and average wages) will decline by over 20 ppts. until 2070 (European Commission, 2018). In contrast, Denmark’s moderate projected spending increase is mainly caused by relatively slow ageing, especially in the middle of the planning horizon.

Finally, some countries (e.g. Germany) will see a significant rise of total age-related expenditure, despite pension reforms, as a result of population ageing. In the Netherlands, increases in public spending are mainly driven by increases in long-term care costs, and in the UK, pension expenditure is expected to increase, partly driven by reforms to improve pension adequacy (e.g. Carone et al. (2017)).
Figure 3.3. Projected total age-related expenditure forecast, 2016-2070

Decline of total age-related expenditure

Moderate rise of total age-related expenditure

Significant rise of total age-related expenditure

Source: European Commission (2018)
3.4.2 Long-run effects of population ageing and migration on public finances

In this section, we present and discuss simulation results on the public finance implications of demographic change for four European countries, based on the model and calculations of Berger et al. (2016). The framework of analysis consists of a dynamic general equilibrium model with overlapping generations that is particularly designed to represent the tax and social security systems as well as the characteristics of demographic change due to population ageing and immigration of the particular countries in detail. Households’ decisions regarding consumption, saving, job search and labour supply, as well as firms’ decisions regarding investments and employment of workers are determined endogenously. Moreover, the general equilibrium nature of the model allows for taking feedback effects of reforms and changes in the economic and demographic environments that arise, for instance, via price and wage effects into account.

The countries considered in this comparative analysis are Austria, Germany, Poland and the UK. The choice of these countries was made along three criteria: The speed of population ageing, the projected volume of immigration, and the type of public pension system in place (Beveridgean or Bismarckian). The goal was to find representative EU countries that differ in the combination of features along these three dimensions. Differences in the speed of population ageing and in the projected volume of immigration are of obvious interest when analysing differences in the effects of demographic change between countries. The type of public pension system in place is of interest in this context because public pensions are an important part of public revenues and expenditures in EU countries, but their basic design may have different implications for the development of public finances under demographic change.

Along the above-mentioned dimensions, the four selected countries have the following characteristics: The UK has a Beveridgean pension system, which focuses on minimum income rather than on earnings-related pensions, is ageing relatively slowly and has relatively small projected immigration flows. Germany is also ageing relatively slowly and has relatively small projected immigration flows but differs from the UK in that it has a Bismarckian pension system which focuses on earnings-related pensions. Austria, like Germany, is also ageing relatively slowly and has a Bismarckian pension system, but, in contrast to the other three countries, has relatively large projected immigration flows. Poland, like Germany, has relatively small projected immigration flows and a Bismarckian pension system, but, in contrast to the other three countries, is ageing relatively fast. Table 3.2 summarises the classification of the four selected countries along these dimensions.

Table 3.2. Selection of countries for simulations

<table>
<thead>
<tr>
<th>Aging speed</th>
<th>Projected net immigration flows</th>
<th>Large</th>
<th>Not large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not fast</td>
<td>Bismarckian: Austria</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bismarckian: Poland</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beveridgean: UK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

31 See the online appendix to Berger et al. (2016) for a detailed discussion of the selection of countries.
For each of the countries, simulations in the baseline scenario assume total fertility and mortality rates as well as net immigration rates as projected by Eurostat (2011). In contrast, the no-migration scenario assumes that net migration is set to zero from 2015 onwards. Projections for age-dependent health and long-term care expenditures are taken from the Ageing Working Group 2012 (European Commission, 2012). Projections for aggregate pension expenditures are endogenous in the model but take already enacted pension reform plans for Germany and Poland into account. In the baseline scenario, the increase in social security expenditures due to demographic change is financed via lump-sum taxes on households. In the no-migration scenario, changes in lump-sum taxes are kept fixed at the baseline scenario values, and the public revenue loss due to the lack of immigration is financed by an increase in labour income taxes.

Tables 3.3 to 3.6 report long-run effects of demographic change on several variables of interest for each of the countries in both the baseline and the no-migration scenario. We first discuss results of the baseline scenario for Austria in detail. We then compare them with results for Austria under the no-migration scenario. Finally, we discuss differences in the results for Germany, Poland, and the UK.

Among the countries considered here, Austria features relatively slow population ageing, relatively large projected immigration flows and a Bismarckian pension system. The first point to note in Table 3.3 is that the old-age dependency ratio in Austria increases by roughly 25 percentage points between 2010 and 2070, confirming that the population is nevertheless projected to age significantly over the coming decades, even in the presence of relatively large immigration.

Figure 3.4 presents changes in key macroeconomic variables per capita (for the population aged 15 and above) in percent. The ageing of the population leads to a significant drop in labour supply per capita, as measured, for instance, in annual hours worked per capita. Part of this drop is mechanically due to the increasing number of retirees relative to the number of people of working age in the course of population ageing. However, also the total number of people of working age decreases, so that the overall potential for aggregate labour supply drops. In response, firms decrease their investments to lower the capital stock to keep the marginal product of capital equal to the interest rate determined on international financial markets. The decrease in production inputs – both labour and capital – leads to a reduction of output (GDP) per capita, which in turn lowers opportunities for consumption. Consumption drops significantly on impact as households start to save more to maintain living standards over a prolonged period of retirement. Due to these savings for retirement, consumption per capita drops less than output in the long run. Finally, changes in the age composition of the labour force also lead to a decrease in average labour productivity, and thus, to a decrease in wage rates. This, together

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32 The projected increase in public pension expenditures is larger than the one presented by the Ageing Working Group 2012 (European Commission, 2012). This is due to differences in projection methodologies - our model projections are endogenous and take changes in factor prices and financing instruments in general equilibrium into account.

33 Note that, if distortionary taxation were used also in the baseline scenarios, the negative impact on public finances from population ageing under migration would be larger than the ones presented here.
with the decrease in aggregate labour supply, lead to a drop of total labour earnings in the economy.

Figure 3.5 depicts changes in the relative importance of the four major tax bases, wage income, pension income, private consumption, and firm profits, in percentage points. Wages as a tax base lose importance while the importance of pensions as a tax base rises significantly, in line with the shift from working age to retired individuals in the population. The importance of the profit tax base decreases as a result of the large decline in capital per capita and the corresponding decrease in aggregate firm profits. The importance of the consumption tax base increases, reflecting the relatively lower decrease in consumption per capita discussed above.

Figure 3.6 depicts changes in revenues from the four major tax bases as percentage points of GDP. In line with Figure 3.5, social security (SSC) and personal income tax (PIT) revenues from wages decline, while those from pension incomes increase. Similarly, value-added tax (VAT) revenue from private consumption increases, while corporate income tax (CIT) revenue decreases. As reported in Table 3.3, total revenues increase by close to 2 percentage points of GDP in the long run. However, total public expenditures increase by nearly 16 percentage points of GDP, mainly due to increased spending needs on public pensions and health care for the elderly. This increase in public spending needs requires a large increase in lump sum taxes on households (over 12 percentage points of GDP) to balance the government budget.

Table 3.3 also allows for a comparison of differences in long-run effects between the baseline and the no-migration scenario for Austria. The numbers show that, without immigration, population ageing in Austria would be significantly more pronounced, leading to an increase in the old-age dependency ratio of roughly 14 additional percentage points in the year 2070. The corresponding increase in social security expenditures relative to GDP would be more than double. At the same time, the decrease in labour supply, capital, GDP and consumption per capita would also be significantly stronger.

Changes in the relative importance of major tax bases and sources of revenue would be more pronounced, too, in particular in terms of the relative increase in pensions and decrease in profits as tax bases. In order to finance the additional increase in public expenditure needs due to population ageing, the tax rate on labour income would have to be raised by 17.21 percentage points relative to the baseline scenario, a substantial increase. Households respond to this large increase in labour income taxes by further decreasing their labour supply, which, in turn, amplifies the decrease in labour as production input due to population ageing. Aggregate wage income as a tax base therefore falls substantially. However, the large increase in the labour income tax rate dominates the fall in the tax base, so that social security and personal income tax revenues from wages increase substantially. To summarize, the comparison of results between the baseline and the no-migration scenarios in Table 3.3 suggests that the projected volumes of immigration could indeed significantly mitigate the fiscal effects of population ageing in Austria over the next decades.
Figure 3.4. Changes in key macroeconomic variables per capita, percent (Austria, baseline scenario)

Figure 3.5. Change in relative shares of major tax bases, percentage points (Austria, baseline scenario)

Figure 3.6. Change in major revenues (in percent of GDP), percentage points (Austria, baseline scenario)
Table 3.3. Long-run effects for Austria, baseline versus no-migration scenario

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2070 Baseline</th>
<th>2070 No migration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old-age dependency ratio</td>
<td>26.27</td>
<td>50.86</td>
<td>64.46</td>
</tr>
<tr>
<td>Total social security expenditures (Δpp)</td>
<td>8.92</td>
<td>17.64</td>
<td></td>
</tr>
<tr>
<td>Hours / capita (Δ%)</td>
<td>-18.73</td>
<td>-28.97</td>
<td></td>
</tr>
<tr>
<td>Capital / capita (Δ%)</td>
<td>-22.76</td>
<td>-28.01</td>
<td></td>
</tr>
<tr>
<td>GDP / capita (Δ%)</td>
<td>-21.64</td>
<td>-27.07</td>
<td></td>
</tr>
<tr>
<td>Consumption / capita (Δ%)</td>
<td>-20.56</td>
<td>-25.49</td>
<td></td>
</tr>
<tr>
<td>Tax base share, wages (Δpp)</td>
<td>-3.39</td>
<td>-4.03</td>
<td></td>
</tr>
<tr>
<td>Tax base share, pensions (Δpp)</td>
<td>2.90</td>
<td>6.85</td>
<td></td>
</tr>
<tr>
<td>Tax base share, private consumption (Δpp)</td>
<td>2.16</td>
<td>2.64</td>
<td></td>
</tr>
<tr>
<td>Tax base share, profits (Δpp)</td>
<td>-1.67</td>
<td>-5.46</td>
<td></td>
</tr>
<tr>
<td>Total expenditures / GDP (Δpp)</td>
<td>15.67</td>
<td>27.60</td>
<td></td>
</tr>
<tr>
<td>Total revenues / GDP (Δpp)</td>
<td>1.92</td>
<td>12.27</td>
<td></td>
</tr>
<tr>
<td>SSC plus PIT / GDP, wages (Δpp)</td>
<td>-0.22</td>
<td>6.93</td>
<td></td>
</tr>
<tr>
<td>SSC plus PIT / GDP, pensions (Δpp)</td>
<td>1.04</td>
<td>6.35</td>
<td></td>
</tr>
<tr>
<td>VAT / GDP (Δpp)</td>
<td>0.87</td>
<td>1.33</td>
<td></td>
</tr>
<tr>
<td>CIT / GDP (Δpp)</td>
<td>-0.11</td>
<td>-0.27</td>
<td></td>
</tr>
<tr>
<td>Lump sum taxes / GDP (Δpp)</td>
<td>12.39</td>
<td>13.30</td>
<td></td>
</tr>
<tr>
<td>Labour income tax rate (Δpp)</td>
<td>/</td>
<td>17.21</td>
<td></td>
</tr>
</tbody>
</table>

Legend: Δ% – change in percent; Δpp – change in percentage points.
Source: IHS calculations, based on Berger et al. (2016).

**Germany**, among the countries analysed here, is characterised by relatively slow population ageing, relatively small projected immigration flows and a Bismarckian pension system. Table 3.4 reports long-run effects of demographic change for Germany under the baseline and the no-migration scenario. Outcomes under the baseline scenario with projected immigration flows are qualitatively and quantitatively like those for Austria, which is not surprising given the similarities in both the institutional setting and the speed of ageing in the two countries. While the relative importance of wages and profits as tax bases and sources of revenue declines, that of pension income and private consumption increases.

When comparing the baseline with the no-migration scenario in Table 3.4, the differences in effects for Germany are also qualitatively like those for Austria, but quantitatively much smaller. This is because projected immigration flows for Germany are significantly lower than for Austria. Setting migration flows to zero would therefore have quantitatively smaller impacts on demographic, and therefore also economic, developments. Without immigration, the old-age dependency ratio would be only around 7 additional percentage points higher in the long run, and social security expenditures relative to GDP would only be around 1.5 times as high as under
the baseline. In order to finance the additional public spending needs due to population ageing, the tax rate on labour income would have to be increased by only 8.95 percentage points. In conclusion, immigration could significantly mitigate the fiscal effects of population ageing in Germany, too, but due to the lower projected immigration flows, the benefits would also be lower than for Austria.

Table 3.4. Long-run effects for Germany, baseline versus no-migration scenario

<table>
<thead>
<tr>
<th></th>
<th>2010 Baseline</th>
<th>2070 No Migration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old-age dependency ratio</td>
<td>31.35</td>
<td>59.67</td>
</tr>
<tr>
<td>Total social security expenditures (Δpp)</td>
<td>10.41</td>
<td>15.05</td>
</tr>
<tr>
<td>Hours / capita (Δ%)</td>
<td>-18.40</td>
<td>-24.66</td>
</tr>
<tr>
<td>Capital / capita (Δ%)</td>
<td>-19.90</td>
<td>-25.01</td>
</tr>
<tr>
<td>GDP / capita (Δ%)</td>
<td>-18.72</td>
<td>-23.71</td>
</tr>
<tr>
<td>Consumption / capita (Δ%)</td>
<td>-17.48</td>
<td>-21.72</td>
</tr>
<tr>
<td>Tax base share, wages (Δpp)</td>
<td>-3.13</td>
<td>-3.54</td>
</tr>
<tr>
<td>Tax base share, pensions (Δpp)</td>
<td>3.47</td>
<td>5.41</td>
</tr>
<tr>
<td>Tax base share, private consumption (Δpp)</td>
<td>3.60</td>
<td>3.96</td>
</tr>
<tr>
<td>Tax base share, profits (Δpp)</td>
<td>-3.94</td>
<td>-5.83</td>
</tr>
<tr>
<td>Total expenditures / GDP (Δpp)</td>
<td>16.96</td>
<td>23.84</td>
</tr>
<tr>
<td>Total revenues / GDP (Δpp)</td>
<td>2.06</td>
<td>8.79</td>
</tr>
<tr>
<td>SSC plus PIT/GDP, wages (Δpp)</td>
<td>-0.07</td>
<td>4.32</td>
</tr>
<tr>
<td>SSC plus PIT / GDP, pensions (Δpp)</td>
<td>0.61</td>
<td>2.60</td>
</tr>
<tr>
<td>VAT / GDP (Δpp)</td>
<td>1.16</td>
<td>1.29</td>
</tr>
<tr>
<td>CIT / GDP (Δpp)</td>
<td>-0.26</td>
<td>-0.23</td>
</tr>
<tr>
<td>Lump sum taxes / GDP (Δpp)</td>
<td>14.90</td>
<td>15.69</td>
</tr>
<tr>
<td>Labour income tax rate (Δpp)</td>
<td>/</td>
<td>8.95</td>
</tr>
</tbody>
</table>

Legend: Δ% – change in percent; Δpp – change in percentage points.
Source: IHS calculations, based on Berger et al. (2016).

Within the selection of countries considered here, **Poland** features relatively fast population ageing, relatively small projected immigration flows and a Bismarckian pension system. Table 3.5 presents long-run effects of demographic change for Poland under the baseline and the no-migration scenario. The first point to note is that Poland is indeed projected to age much faster than Austria and Germany, leading to an increase in the old-age dependency ratio by roughly 41 percentage points until 2070 in the baseline scenario. However, due to reforms of the public pension system, pension expenditures are projected to decline over this time horizon, so that total social security expenditures increase only by two percentage points. The effects on per capita variables of interest in the baseline scenario are qualitatively and quantitatively similar to those for Austria and Germany, except for the decrease in consumption per capita, which is considerably lower. This stems from the fact that gross wage rates for all skill levels of workers
increase, thereby mitigating the fall in consumption opportunities brought about by the decline in output. As in the cases of Austria and Germany, the relative importance of wages and profits as tax bases and sources of revenue declines, while that of private consumption increases. However, the relative importance of pension income decreases in line with the reforms reducing pension expenditures.

Table 3.5. Long-run effects for Poland, baseline versus no-migration scenario

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2070 Baseline</th>
<th>2070 No migration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old-age dependency ratio</td>
<td>22.21</td>
<td>63.58</td>
<td>64.51</td>
</tr>
<tr>
<td>Total social security expenditures (Δpp)</td>
<td>1.99</td>
<td>2.79</td>
<td></td>
</tr>
<tr>
<td>Hours / capita (Δ%)</td>
<td>-25.24</td>
<td>-26.83</td>
<td></td>
</tr>
<tr>
<td>Capital / capita (Δ%)</td>
<td>-18.15</td>
<td>-21.27</td>
<td></td>
</tr>
<tr>
<td>GDP / capita (Δ%)</td>
<td>-17.73</td>
<td>-20.05</td>
<td></td>
</tr>
<tr>
<td>Consumption / capita (Δ%)</td>
<td>-10.61</td>
<td>-12.19</td>
<td></td>
</tr>
<tr>
<td>Tax base share, wages (Δpp)</td>
<td>-2.24</td>
<td>-2.46</td>
<td></td>
</tr>
<tr>
<td>Tax base share, pensions (Δpp)</td>
<td>-1.10</td>
<td>-0.88</td>
<td></td>
</tr>
<tr>
<td>Tax base share, private consumption (Δpp)</td>
<td>5.02</td>
<td>5.08</td>
<td></td>
</tr>
<tr>
<td>Tax base share, profits (Δpp)</td>
<td>-1.67</td>
<td>-1.74</td>
<td></td>
</tr>
<tr>
<td>Total expenditures / GDP (Δpp)</td>
<td>7.98</td>
<td>9.48</td>
<td></td>
</tr>
<tr>
<td>Total revenues / GDP (Δpp)</td>
<td>1.27</td>
<td>2.60</td>
<td></td>
</tr>
<tr>
<td>SSC plus PIT / GDP, wages (Δpp)</td>
<td>-0.07</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>SSC plus PIT / GDP, pensions (Δpp)</td>
<td>-0.16</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>VAT / GDP (Δpp)</td>
<td>1.48</td>
<td>1.59</td>
<td></td>
</tr>
<tr>
<td>CIT / GDP (Δpp)</td>
<td>-0.15</td>
<td>-0.18</td>
<td></td>
</tr>
<tr>
<td>Lump sum taxes / GDP (Δpp)</td>
<td>5.91</td>
<td>6.02</td>
<td></td>
</tr>
<tr>
<td>Labour income tax rate (Δpp)</td>
<td>/</td>
<td>2.14</td>
<td></td>
</tr>
</tbody>
</table>

Legend: Δ% – change in percent; Δpp – change in percentage points.
Source: IHS calculations, based on Berger et al. (2016).

Comparing the baseline and the no-migration scenario in Table 3.5 reveals that, in the case of Poland, the long-run effects are very similar. This is due to both the very low projected level of immigration and the fast ageing speed, the latter of which strongly dominates the mitigation impact that migration could have on the fiscal effects of population ageing. Indeed, the old-age dependency ratio would only be around one percentage point higher without than with migration. The additional public spending needs due to population ageing would be less than a percentage point of GDP and would require an increase in the labour income tax rate of only roughly two percentage points.
The UK, finally, among the selected countries, is characterised by relatively slow population ageing, relatively small projected immigration flows and a Beveridgean pension system. Table 3.6 reports long-run effects of demographic change for the UK under the baseline and the no-migration scenario. The first row of the table shows that the UK is projected to age significantly more slowly than the other three countries, with the old-age dependency ratio increasing by only roughly 15 percentage points until 2070 in the baseline scenario. Interestingly, even though the institutional setting of the pension system is different from those in the other three countries, the change in pension expenditures, and in total social security expenditures, relative to GDP brought about by population ageing are comparable to those for Austria and Germany (as measured relative to the change in the old-age dependency ratio). The effects on per capita variables of interest are qualitatively similar to those for Austria, but quantitatively smaller corresponding to the lower increase in the old-age dependency ratio. The same holds true for changes in the relative importance of the four major tax bases and sources of revenues.

When comparing the baseline with the no-migration scenario in Table 3.6, the differences in effects for the UK are also qualitatively similar to those for Austria, but quantitatively in the same order of magnitude as those for Germany. Again, this is because projected immigration flows for the UK are significantly lower than for Austria - the old-age dependency ratio would
only be around 9 percentage points higher without than with migration, a difference similar to that for Germany. The differences in effects on the relative importance of the major tax bases and sources of revenues, as well as the increase in the labour tax rate necessary to finance the additional public spending needs due to population ageing, are also quantitatively very close to those for Germany. To summarize, immigration could mitigate the fiscal effects of population ageing in the UK to a similar extent as in Germany. The institutional differences of the pension system between the two countries do not play a quantitative role for these results.

3.4.3 Population ageing and taxation of pensions

The taxation of pensions becomes particularly important for the development of public finances in the face of population ageing. It interacts with tax revenues, incentives to work and redistribution.

Typically, pensions are pay-as-you-go financed, taxation of pensions follows EET (exempt-exempt-taxed) regime and taxation of wages and pensions is progressive. In that case the government loses net tax revenues when pension expenditures increase, as they do when the pension schemes mature, and populations are ageing. This is because the deductions of employees’ pension contributions made in wage income taxation are larger than the tax revenues from pensions. Also, the corporate income tax rate is often higher than the tax rate on pensions, which means that the government loses tax revenues also when the pensions are financed with employers’ contributions.

Moreover, for a given pension right accrued, the deduction is made decades before the corresponding tax revenues from the pension are collected. The tax revenue loss due to the delay depends on the difference between the riskless interest rate (the cost of the delay) and the growth rate of the accrued pension right (the benefit of the delay). In a pay-as-you-go pension system the pension right is typically indexed to wages and/or prices and the government loses money the more the larger is pension expenditure and the longer is the delay.

In fully funded defined contribution systems, the growth rate of the pension right depends on the yield of the invested contributions, which is likely to be higher than the riskless interest rate. Therefore, government benefits from the delay. The postponement of taxation can improve fiscal sustainability in ageing countries markedly if the pension funds are large, as for example in the Netherlands and Denmark.

The main tax regime alternative, TEE (taxed-exempt-exempt), provides frontloading of tax revenues and removes the uncertainty from government revenues. It is also better in line with migration, since it avoids the disagreement over the right of taxing pensions for a person who lives as retiree in a different country from the one where her pension contributions have been deducted in taxation. Therefore, it has been suggested to change from EET to TEE taxation and source taxation of pensions (Genser and Holzmann, 2018).

A transition from EET to TEE has been studied by Lassila and Valkonen (2018) using a numerical OLG model calibrated to the Finnish economy and tax and transfer system. The tax reform succeeds to improve public finances, but at the expense of lower wages, employment and consumption. The impacts of the reform are the larger the higher are the age ratio and the pension contribution rate.
In conclusion, population ageing weakens public finances also via taxation of pensions in countries which follow a pay-as-you-go financing principle in their pension schemes. If the schemes are fully funded, pensions are higher, which increases revenues from taxing pensions. However, the government may still lose tax revenues if the tax scale of wages and pensions is strongly progressive.

Table 3.7 gives an overview of the current tax treatment regimes of statutory pensions in place in the different EU countries. The EET tax regime is by far the most common. Only Lithuania follows the TEE principle where deduction of contributions from the income tax base is not allowed and pensions are not taxed. Slovakia and Bulgaria allow a deduction even though pensions are not taxed. For the other countries, the small t means that a reduced tax rate is applied (Genser and Holzmann, 2018).

Table 3.7. Tax treatment of statutory pensions in EU countries

<table>
<thead>
<tr>
<th>Tax regime</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>EET</td>
<td>Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Greece, Italy, Latvia, Luxembourg, Poland, Portugal, Romania, Slovenia, Spain and Sweden</td>
</tr>
<tr>
<td>TEE</td>
<td>Lithuania</td>
</tr>
<tr>
<td>EEE</td>
<td>Slovakia, Bulgaria</td>
</tr>
<tr>
<td>tET</td>
<td>France, Ireland, Malta, Netherlands, United Kingdom</td>
</tr>
<tr>
<td>tEt</td>
<td>Germany</td>
</tr>
<tr>
<td>tEE</td>
<td>Hungary</td>
</tr>
</tbody>
</table>

### 3.4.4 Increasing life expectancy, pension policy and taxation

The key issue for the development of pension schemes is how they deal with increasing life expectancy. Recent pension reforms in several countries have introduced life-expectancy adjustments both in pensions and retirement ages. With a Finnish type of social security, this policy need not generate adverse distributional effects, as shown in Määttänen (2014) using a stochastic life-cycle model. A retirement rule that increases retirement age by eight months, when life expectancy of the cohort increases by one year, together with improving health may even generate enough tax revenues to finance the increasing costs of population ageing (Lassila & Valkonen, 2018).

As discussed previously in this Chapter, longer lifetimes promote higher private lifecycle savings to finance the part of the old age consumption that is not financed by first and second pillar pensions. It also increases retirement age in flexible pension schemes, where the employee can choose when to retire.

Observations from two countries, Finland and Sweden, suggest that adjusting old age pensions to life expectancy in a flexible pension scheme does not create large enough incentives to increase retirement age. The outcome is lower pensions. The additional step needed is to link the lowest retirement age to life expectancy.
Lassila and Valkonen (2018) study the effects of such a pension policy change on fiscal sustainability. In the new pension scheme, one additional year increases retirement age by eight months.

Figure 3.7 shows the sustainability gap (S2) created using a numerical OLG model for 500 realizations of a stochastic population projection. The blue dots relate to a baseline policy, where the retirement age is fixed. The pattern of the dots reveals a strong positive correlation between life expectancy and the sustainability gap. The red dots indicate how the labour supply reaction of employees to longer lifetimes would change the sustainability gap in a flexible pension scheme, where additional working years are rewarded in an actuarially fair way. Finally, the green dots represent sustainability gap patterns in a policy that links both the old age pensions and the lowest eligibility age to life expectancy. It shows that this policy would remove the need to increase taxes because of longer lifetimes. Of course, this conclusion is conditional on many assumptions, especially the ones related to links between health and longer lifetimes. It illustrates, however, the strengths of a well-designed retirement age policy.

In conclusion, linking the retirement age to life expectancy protects the finances of the pension system from variation in lifetimes. Moreover, it brings additional tax revenues that can be used to finance the increasing health and long-term care costs as lifetimes increase.

For comparison, in the 2018 Ageing Report of the European Commission one of the variants of public expenditure projections also assumes a link between retirement ages and life expectancy. It is implemented so that retirement ages are shifted year-over-year in line with the change in life expectancy. For countries that already have some kind of a link (Denmark, Greece, Italy, Cyprus, the Netherlands, Slovakia and Finland) this variant is not calculated (European Commission, 2018).

Introducing this link influences public finances through several channels. Employment rates at old age increase, which leads to higher contribution revenues. The number of retirement years decreases, but monthly pensions are higher.

The simulations produce large differences in the pension expenditure changes between the countries, depending e.g. on the replacement rates of pensions, future longevity and other existing adjustment mechanisms. The largest decline in pension expenditure is in Austria, 2.4 as pps of GDP. The average decline in the EU is 0.8 pps of GDP. The influence of the policy measure on the total costs of ageing, as measured in+ percent of GDP, is somewhat larger.
3.4.5 Political implications of population ageing and public finances

Ageing of the population changes the composition of voters’ preferences regarding the size and design of the welfare state, and thus the preferences on what public resources are spent on and from which revenue sources those expenditures are financed. In particular, it changes the preferences within the voting age population regarding the amount and the specifics of intergenerational redistribution within the welfare state. Intuitively, elderly voters would typically like to raise transfers within the public pension and health systems, from which they are the main beneficiaries, at the cost of higher payroll taxes, implying redistribution from younger to older generations. In contrast, working-age voters would typically like to lower these transfers and downscale pay-as-you-go social security systems, which become less profitable as the old-age dependency ratio rises. Instead, they would typically like to redirect public spending towards education of their children or to lower payroll taxes, implying redistribution from older to younger generations. De Mello et al (2017) present empirical evidence for the above described age differences in political preferences regarding the allocation of government expenditure from an analysis of 34 countries in Europe and Central Asia. In this vein, most contributions to the political economy literature of population ageing identify counteracting effects of ageing on preferences of the electorate about the size of the welfare state (see e.g. Razin et al. (2002), Galasso and Profeta (2007). Theoretically, the overall effect is therefore ambiguous. Empirical assessments of this overall effect reach different conclusions. Razin et al. (2002), using data for the US and several EU countries, find a negative correlation between the dependency ratio and the size of the welfare state. In contrast, Disney (2007) analyses a sample of 21 OECD countries

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34 Here, the size of the welfare state is measured by the level of labour tax rates and by the generosity of social transfers.
Future trends and taxation

(including 14 EU Member States) and finds positive correlations between the dependency ratio and the size of the welfare state\textsuperscript{35}.

Population ageing also affects the composition of voters’ willingness to support different types of social security reforms, in particular regarding reforms of public pay-as-you-go pension systems (see Galasso and Profeta (2002) for an overview). Standard reform options for pay-as-you-go pension systems are either to raise contribution rates or to reduce per-capita pension benefits, where the latter can be in the form of a direct benefit cut or in the form of postponed retirement. Again, these reform options are associated with different intergenerational redistribution, although the degree and direction is not always clear cut: While an increase in contribution rates would unambiguously redistribute from younger to older generations, the redistribution between different age cohorts implied by a cut in benefits or an increase in the retirement age depends on the specifics of the reform. Regarding political preferences, already retired individuals would clearly support a raise in contribution rates for working-age individuals or an increase in the retirement age. For people of working age, the trade-offs between these reform options are less clear-cut. For them, population ageing reduces the rate of return from the pension system under all policy options. However, increasing contribution rates on labour income are likely to have the most distortionary impact and therefore lead to the highest individual and aggregate economic costs. Several theoretical and simulation studies find that, under population ageing, an increase in the retirement age is favoured by the majority of the electorate and therefore the politically most feasible reform option (see e.g. Bütler (2000), Galasso (2008) and Bittschi and Wigger (2019)).

3.4.6 Diversity and preferences for redistributive taxation

There is a large body of evidence suggesting that individuals are less inclined to support progressive taxation and other redistributive policies if they benefit individuals that are different from them along racial, ethnic, linguistic and religious lines (Alesina and Giuliano, 2011). For example, welfare programmes are less generous in U.S. States with a higher share of African Americans, and homogeneity across racial lines is positively correlated with social spending in cross-country studies (Alesina, Glaeser and Sacerdote, 2001). Indeed, the generosity of European welfare states compared to the US has been shown to be related to the fact that in the 20th century, the U.S. was more racially diverse than Europe (Alesina and Glaeser, 2004). In a recent large-scale representative survey in five European countries\textsuperscript{36}, Alesina et al. (2018) show that support for redistribution is also dependent on the (perceived) composition of the migrant population: respondents’ support of redistributive policies decreases with the (perceived) share of Middle Eastern, North African or Muslim immigrants. Thus, increasing migration – especially from countries that are racially and/or religiously different from European Union countries – could lead to a loss of support for redistributive taxation, especially if migrants are overrepresented in the bottom tale of the income distribution, and thus seen to disproportionately benefit from redistributive taxation.

\textsuperscript{35} Here, the size of the welfare state is measured by the average direct tax burden as percent of GDP, by the average social security contribution rate, and by the average replacement rate from the social security programme.

\textsuperscript{36} France, Germany, Italy, Sweden, and the U.K.
High immigration rates can lead to a push towards conservative (and generally less immigration-friendly) political parties among native voters (Mayda, Peri, and Steingress, 2016). In the short run, this can jeopardise the funding for policies aimed at improving the labour market integration of migrants, such as upskilling programmes, at the time they are most needed. In the long run, this effect might erode public support for redistributive taxation in general.

3.5 Summary
Demographic change in the European Union is driven by three main factors – below-replacement-level fertility and increasing life expectancy lead to population ageing, whereas migration inflows into the EU alters the age profile and partly mitigates the ageing of the population. EC forecasts of fertility, mortality and immigration trends project the old-age dependency ratio, a crude measure of public-spending pressure caused by population ageing, to increase from an average of 29 in 2015 to an average of 51 in 2070.

The main implications for tax policies are detailed in the following list:

**Tax revenues and public expenditures**

- Simulation analyses suggest that population ageing will lead to a change in the relative importance of major tax bases and in the relative importance of revenues by source. On the one hand, it should decrease the importance of revenues from social security contributions and taxes on labour income as well as from corporate income taxes. On the other hand, it should increase the importance of revenues from social security contributions and taxes on pension income and from taxes on private consumption. At the same time, the increase in public spending needs due to population ageing should require significant increases in tax rates.
- Population ageing tends to weaken public finances also via taxation of pensions in countries which follow a pay-as-you-go financing principle in their pension schemes. This is because the deductions of employees’ pension contributions made in wage income taxation are usually larger than the tax revenues from pensions.
- Linking the retirement age to life expectancy protects the pension system finances from variation in lifetimes. Moreover, it brings additional tax revenues that can be used to finance the increasing health and long-term care costs.
- An increase in the share of older people will pose challenges for the viability of public finances. Across the EU on average, the EC forecasts total age-related expenditure (including pensions, health care and long-term care) to rise from 25 % of GDP in 2016 to 26.7 % of GDP in 2070.
- The political feasibility of reforms to the tax and social security systems in the face of fiscal challenges due to demographic change will depend, among other things, on the age composition of the population, as groups of different ages are likely to differ in their preferences for redistribution as well as for contributions levied on different tax bases.

**Burden sharing and redistribution**

- Population ageing reduces labour supply, making labour scarce relative to physical capital. At the same time, increased longevity raises incentives for households to save for consumption over a prolonged retirement period, increasing aggregate savings. The change in relative supplies of labour and capital is expected to raise wages and decrease
interest rates, which is likely to reduce income inequality and the need for redistribution. For open economies such as the EU-28 countries, the long-term development of wages and interest rates will, however, largely be determined by global demographic trends and international capital flows.

- There is little evidence that migrants depress the wage rates of natives. Where negative effects exist, they are concentrated on low-educated workers and earlier immigrants.
- Changes in the age structure of the population also change the composition of voters’ preferences regarding the size and design of the welfare state and, in particular, with respect to the amount and specifics of intergenerational redistribution within it. These changes of preferences regarding intergenerational redistribution are particularly relevant when it comes to the political implementation of reforms in order to ensure the financial viability of the social security system.

Externalities and competitiveness

- An increase in wages relative to interest rates should induce individuals to shift investment from physical to human capital. Such an increase in human capital investment should at least partially offset the reduction in the relative quantity of labour by an increase in quality.
- The effect of immigration on EU-28 economies depends crucially on immigrants’ labour supply and labour market performance. Across the EU on average, immigrants have lower employment rates than natives, especially immigrants from the Middle East and North Africa. While foreign-born workers are more likely to have a tertiary education than natives, they often struggle to translate their skills into earnings and are more likely to be overqualified for their jobs. Again, non-EU migrants are the group most at-risk. The extent to which immigration can mitigate the economic and fiscal impacts of population ageing therefore depends on the degree to which they acquire and effectively translate their skills into earnings on the labour market. High-skilled immigrants earning wages commensurate with their qualifications can significantly mitigate the economic and fiscal effects of population ageing.
- Immigration increases the cultural and linguistic diversity of the workforce, which can lead to increases in productivity and innovation through skill complementarities, and improve problem solving in teams by providing a wider range of perspectives and experiences. But diversity in teams can also create costly communication barriers, conflict and an erosion of trust. Empirically, the effect of workforce diversity in country of origin on productivity and innovation seems to be nil or slightly positive, with high-skilled immigrants from geographically dispersed countries of origin most likely to increase the innovative capacity of the economy.

Tax administration

- No evident implications.

3.6 References


4 Area of Globalisation

Economists see globalisation as the process of economic integration of markets in goods, services and capital through international trade (e.g. Rodrik, 1998, 2011; Rodrik and Subramanian 2009). In this light, the two major drivers behind this phenomenon have been the enormously reduced costs of transportation and communication brought about by technological progress and innovation in the private sector, and reduced policy barriers to trade and investment - i.e. lower tariffs and removal of artificial non-tariff barriers - on the part of the public sector (e.g. Stiglitz, 2002). Financial markets are more highly integrated than goods markets, at least when it comes to portfolio capital since transaction costs and capital controls are by now almost negligible for industrialised countries and have remarkably reduced even for developing countries (Frankel, 2006). In addition, a comprehensive definition of globalisation would include also the movement of people (labour) and knowledge (technology) across international borders. There are also broader cultural, political, and environmental dimensions of globalisation (e.g. IMF, 2008), which will however play a more marginal role in our analysis. Thus, we use the term globalisation to refer to the process of integration of goods, services, and financial markets, and to the increased mobility of people and technology.

This chapter is organised in two sections. First, we focus on the literature, which looks at the impact of globalisation on the economy. Second, we focus on political aspects and consider the literature discussing the rise in populism and how the latter could limit or reverse the globalisation process or modify its influence on the economy. Within each section, we discuss the more relevant tax implications of globalisation for the economy and the society, with a specific focus on EU.

4.1 Globalisation and the economy

Globalisation is certainly a crucial area of change that has characterised the world economic development for the last 40 years. According to both economic theory and the results of empirical studies, globalisation has had a positive aggregate impact on the economy. It has fostered economic growth, as numerous studies show both considering the separate components of globalisation – such as openness to international trade (e.g. Dollar, 1992), actual trade flows (e.g. Frankel and Romer, 1996; Greenaway et al., 1999) or foreign direct investments (FDI, e.g. Borensztein et al., 1998; Dollar and Kraay, 2002) – and comprehensive indexes of globalisation (e.g. Dreher, 2006b). In addition, there is evidence that globalisation has on average reduced global inequality and poverty (e.g. Dollar and Kraay, 2002, 2004; Hasell et al., 2019)\(^\text{37}\). The literature has also provided specific evidence on the positive effect on growth of economic integration within the EU. Henrekson et al. (1997), Crespo Cuaresma et al. (2008) and, more recently, Dreyer and Schmid (2017) and Campos et al. (2019) find that EU membership stimulated growth because of scale effects and reduced inflation and exchange rate volatilities across Member States.

However, while higher growth has boosted the tax base compared to a situation in which mobility of goods, people and capital were absent, globalisation has also posed challenges for tax systems. In this section we focus on those economic effects of globalisation that have a more

\(^{37}\) The impact of globalisation on global inequality is discussed also in section 4.2.1.1.
direct bearing on tax policy in the EU, highlighting the challenges tax systems face. In this light, we first analyse how globalisation has modified the composition of tax bases and has affected their sensitivity to tax differentials between countries. Second, we study the impact of globalisation on within country inequality and demand for redistribution through the tax system. Third, we consider the impact of globalisation on the possibilities of international tax planning aimed at transferring income from multinationals and wealthy individuals to tax havens. Finally, we explore the consequences that globalisation might have on the possibility of using fiscal policies to stabilise the economic cycle.

4.1.1 Changes in income shares and tax base elasticity

4.1.1.1 Changes in income shares
The last five decades have been characterised by drastic changes in the functional income distribution (see also section 2.1.1). Figure 4.1 shows the mean, the median, the 25th and 75th percentiles of the adjusted wage share aggregated for the EU 15 countries. The long-term trend is noteworthy: between 1975 -when the median wage share peaked at 71% of GDP-, and 2019 there was a decline of 9.20 percentage-points. Both theoretical and empirical studies suggest that globalisation has played a key role in determining the decline in the labour share of income through international trade and the increasing importance of the financial sector. There are two main channels through which globalisation may affect them. The first one is the impact of trade and capital mobility on factor prices. The second one is the financialisation of the economy. We will consider them in turn.

Figure 4.1. Adjusted wage share, 1970–2020, mean, median and interquartile range over EU 15 countries.

Source: AMECO
Note: The wage share is defined as the share of wage income in GDP at factor costs. The adjusted wage share includes the imputed income of self-employed workers.
The impact of international trade on factor shares features prominently in political debates as well as in economic analysis. There are two main approaches in the literature. The classical international trade models suggest that the labour share should grow in labour-intensive countries and shrink in capital-intensive countries (Stolper and Samuelson, 1941). Thus, greater international trade is expected to lead to factor price equalisation and to factor share equalisation. However, these theoretical claims are based on strong assumptions that do not hold in practice, making their predictions, including factor price and factor share equalisation only a theoretical possibility.

In contrast to the classical theory, the Political Economy approach to international trade suggests that globalisation may reduce the labour share, both in developed and developing countries, by affecting the bargaining position of labour and capital (Rodrik 1998; Onaran 2011). Due to a greater access to global financial markets, firms face a greater set of investment options: they can invest in financial assets as well as in real assets, and they can invest at home as well as abroad. Thus, domestic firms are less dependent on domestic investment and hiring. Consequently, companies experience an increase in bargaining power relative to labour and may therefore obtain a larger share of income (see e.g. Diwan 2001, Stockhammer, 2013; ILO, 2012).

Empirical studies suggest that the increase in trade did not lead to an equalisation of the relative price of labour across countries (Krugman 2008) but rather produced the same negative impact on wage shares worldwide. More precisely, the increased trade openness fostered by globalisation is one of several factors that have acted to reduce the share of income accruing to labour both in advanced economies and developing countries and among net exporters and net importers (see e.g. Rodrik, 1998; Jayadev, 2007; IMF, 2007; Jaumotte and Tytell, 2007; Böckerman and Maliranta, 2012; Elsby et al. 2013).

There is also evidence that capital mobility negatively affects the labour share. Harrison (2005) finds that capital controls are associated with an increase in labour share and that foreign investment flows are associated with a fall in labour share. Tomaskovic-Devey and Lin (2011) and Kristal (2010) come to the same conclusion highlighting that globalisation affects the labour share.

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38 The classic Heckscher-Ohlin trade model (Heckscher and Ohlin, 1933) states that a country’s comparative advantage is determined, among other things, by its factor endowment. The model predicts that countries will specialize in producing the good that uses their abundant factor intensively. Thus, since capital and skilled labour are relatively abundant in advanced economies, the latter are expected to specialise in producing and exporting capital-intensive goods. Instead, labour abundant (usually developing) countries will specialise in the production and export of labour-intensive goods (Guscina, 2006). Consequently, according to these models, income inequality and income concentration towards top incomes is expected to increase within high-income countries and is expected to decrease within low-income countries. We discuss more in detail the impact of globalisation on inequality in section 4.1.2.

39 Several studies have identified some inconsistencies in the assumptions of the standard trade models (see e.g. Dorn et al., 2018 for a review of this literature). In particular, the assumption of full employment is at odds with the popular perception that unemployment is created by the export of jobs abroad (Stockhammer, 2013); the assumption of perfect competition has also become increasingly discordant with empirical evidence (Harrison, 2005), which points more in the direction of increasing returns and imperfect competition (Krugman, 2008). Last, the assumption of identical technology across borders does not hold in practice. These studies tend to reverse the HO-model predictions on how globalisation influence factor shares and income inequality.
share by weakening labour bargaining power. In particular, Guscina (2006) shows that European employment protection policies, a proxy for labour bargaining power, have become less effective following globalisation, thus generating a decline in the bargaining power of labour and in the labour share of national income.

Another important driver of the observed decline in labour share is financialisation, i.e. the accelerated growth of the financial sector experienced by the world economy in the last three decades (see e.g. Epstein, 2005). This process is linked to globalisation through the increased integration of international financial markets (Hein and Mundt, 2012). Since income shares differ across sectors, financialisation may have contributed to the decline of the labour share by changing the sector composition of the economy (see Hein, 2015; Hein et al., 2018). For example, if the importance of the public sector and the non-financial business sector in the economy decrease in favour of a raise in the share of the financial business sector, we typically observe a fall in the labour income share due to the lower labour income share of the financial sector (as shown by Dünhaupt, 2012 for Germany and the US). The financial openness may also operate by increasing exit options for capital with respect to labour, thus reinforcing the already mentioned bargaining power channel (see e.g. Kohler et al., 2019).

In conclusion, the literature points out that globalisation in the form of increased international trade, capital mobility and FDI inflows has had a negative effect on the labour share in both developed and developing countries and among net exporters and net importers. Also the financialisation fostered by globalisation may have played a role, e.g. by reinforcing the bargaining power channel (Kohler et al., 2019). However, the existing studies fail to provide robust evidence of a causal link between this phenomenon and the evolution of the labour income share and further research is needed to reach a consensus on this issue.

4.1.1.2 Tax base elasticity

Besides changing the labour share, globalisation has significantly changed the elasticity of tax bases by increasing the mobility of both capital and labour (Rodrik, 1998). As a result, the enhanced mobility of capital, people and wealth has reduced the government ability to set tax rates at an optimal level. In particular, the greater mobility of capital and high skilled workers has constrained the ability of the public sector to raise revenue and to do so equitably, with negative effects income inequality (we discuss this issue more in detail under section 4.1.2). In the long run, taxes tend to be borne by the most immobile factors (i.e. workers instead of capital, and in particular, low skilled workers). The lower revenues also reduce the ability to redistribute income towards those mostly harmed by globalisation (i.e. low skilled workers, see

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40 Hein (2015) reviews the empirical literature on the determinants of functional income shares against the background of the Kaleckian theory of distribution (Kalecki 1954, Part I; Hein 2014, Chapter 5), in order to identify the theoretical channels through which financialisation may have contributed to the rising gross profit share, and hence to the falling labour income share.

41 The variables used in the literature to proxy financialisation include, but are not limited to: capital controls and capital mobility (Rodrik, 1998; Harrison, 2005); foreign direct investment inflows (FDI, Onaran, 2009); FDI stocks (IMF, 2007); dummy variables that isolate exchange rate crises (ILO, 2011); rentier income of non-financial business as a measure of shareholder value orientation (Stockhammer, 2004); financial globalisation, measured as the sum of foreign assets and liabilities as a share of GDP; and financial reform variables such as credit controls, interest rate controls, entry barriers, privatisation, international capital flows, security markets, and financial reform indices (ILO and ILLS, 2011; ILO, 2013).
also section 4.1.2). In what follows, we discuss these arguments in more detail, backing them with the relevant literature.

It is broadly accepted that globalisation increased capital mobility. In particular, FDI has become increasingly important globally, and notably in Europe, since the second half of the 20th century, and especially since 1990. Indeed, Europe received approximately 43% of global FDI inflow between 1990 and 2009 with an overall positive trend, albeit with large oscillations (Silva and Lagoa, 2018). However, the global crisis of 2008–2009 was accompanied by large disruptions in international trade and capital flows and more generally, there are signs that the pace of such process around the world has slowed down (see e.g., “Globalisation has faltered” in The Economist, 24/01/2019). In fact, despite a rebound in the aftermath of the crisis, FDI flows are still far from the rapid growth experienced between the mid-1990s and 2008 (see e.g. Kobrin, 2017; Ghironi and Levchenko, 2018). In particular, according to OECD data, FDI inflows to European countries have tumbled from 4.73% of GDP in 2007 to 1.95% in 2017. It is difficult to forecast whether this is a cyclical or a structural process and the literature is investigating this phenomenon within the broader backlash from globalisation (see e.g. Kobrin, 2017 and section 4.2).

Undoubtedly, taxes matter for location decisions and FDI, although there is still a lack of consensus on the estimated magnitude of this impact. Extensive literature reviews on the topic and meta-analyses suggest that FDI is quite sensitive to changes in corporate taxes. More precisely, an increase of one percentage point in the tax rate brings about a decrease in FDI between 1.68% and 3.3% (see de Mooij and Ederveen, 2003, 2005, 2006; Feld et al., 2011). The sensitiveness of FDI to the tax burden is often regarded as one of the main drivers of the global decline in corporate income tax rates. By cutting their tax rates, countries can attract more machines, plants, and equipment, which make workers more productive and boosts their wage (Keen and Konrad, 2013).

Concerning the driving forces behind the decline of corporate tax rates in Europe, the evidence (see Overesch and Rincke, 2011) confirms the theoretical predictions (e.g. Devereux et al., 2008) on the role of competition over statutory tax rates in determining national tax policies. In particular, empirical simulations suggest that in the absence of tax competition, the mean statutory tax rate of Western European countries in 2006 would have been about 12.5 percentage points above its actual level (Overesch and Rincke, 2011). Nevertheless, the decrease in corporate tax rates has been more than offset by an increase in the corporate tax bases over the last two decades. More precisely, between 1995 and 2015, the ratio between the corporate tax collected and GDP in the EU28 has increased by 0.222 percentage points, from 2.252% to 2.473%. Indeed, while on the one hand, the decrease in tax rates has contributed to a negative evolution of this ratio by about -0.8 percentage points, on the other, the increase in the corporate tax bases has positively affected the ratio by about +0.9 percentage points. Finally, the increase in the size of the corporate sector in the economy has positively contributed to sustain corporate tax collection by about 0.2% of GDP. However, this phenomenon seems to be

42 Feld et al. (2011) use as starting point the meta-analyses of de Mooij and Ederveen (2003, 2005, 2006) and add some new study and model characteristics to their original data set. These features explain the difference in the estimated magnitude of the impact of tax rates on FDI across these different studies
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decelerating since, over the last decade, base broadening has not been able to match further
cuts in tax rates (Nicodeme et al., 2018). Further evidence sheds light on the different types of
capital mobility-based competition in Europe. The intensity of strategic tax competition is three
times stronger for financial assets than for less mobile capital – as e.g. industrial buildings
(Candau and Le Cacheux, 2018).

Such a race to the bottom can also be documented for labour income tax rates on high-income
earners, but not on the median earner. Indeed, the sensitivity of labour tax bases to
international after-tax earning differentials depends on several factors, including age, level of
education, the regional area (urban vs. rural), and the skill level (Acemoglu, 2002; Liebig et al.,
2007; Bhagwati and Hanson 2009). Studies estimating the elasticity of taxable labour income
conclude that income responses to taxation are larger at higher income levels (see Saez et al.,
2012 for a survey). Besides the tax implications, the higher mobility of high-skilled labour has far
reaching implications: evidence shows that high-skilled immigration is an essential component of
innovation and entrepreneurship (see e.g. Kerr 2013). Thus, high-skilled immigration into rich
countries and competition for talent and professional skills are of major concern in a globalised
world and a growing number of academic studies provides insights into their economic
consequences (e.g., Freeman 2006; Clemens 2011; Docquier and Machado, 2016).

Recent literature estimating the elasticity of mobility of top-earner taxpayers to statutory tax
differentials has focused on specific groups of workers. For instance, Kleven et al. (2013)
consider football players and provide evidence that football players might be substantially more
mobile than other high-skilled workers, because they earn most of their lifetime income over a
short period and their profession involves little country-specific capital. Kleven et al. (2014) and
Kreiner et al. (2016) look at top-income earners in Denmark: exploiting a preferential foreigner
tax scheme, which allows new immigrants with high earnings to be taxed at a preferential flat
rate for a duration of three years, they provide evidence of very high elasticities. The scheme has
doubled the number of highly paid foreigners in Denmark relative to slightly less paid—and
therefore ineligible—foreigners. Akcigit et al. (2016) and Moretti and Wilson (2015) focus on
scientists and inventors. Evidence for both North America and Europe shows that the elasticity
to the net-of-tax rate of the number of domestic superstar inventors is on average 33 times
smaller than that of foreign superstar inventors, which is around 1. This distance is even more
significant for what concerns the sub-sample of European countries, being the elasticity of
foreign superstar investors (1.24) 62 times bigger than that of their domestic counterpart
(Akcigit et al., 2016).

In summary, the estimated response of top-income workers to differences in tax levels
presented in this literature is substantial and quantitatively similar across studies. More
precisely, the estimated elasticities are between 1 and 2, meaning that (top) labour income
responds more than proportionately to a change in tax rates (see Esteller-Moré et al., 2017 for a
more extensive survey).

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43 High skilled workers bring valuable knowledge which is key to stimulate productivity levels and growth
(Peri, 2012; Peri et al., 2013), do not compete with nationals for the welfare state and other public
services (Chojnicki, 2011), integrate faster in the labour market (Miller and Neo, 1997; Amuedo-Dorantes
and De la Rica, 2007) and assimilate better into society (Dustmann, 1996; de Palo et al., 2006)
44 By means of a cross-country analysis, these authors estimate an elasticity of 1.22.
The (increased) elasticity of tax bases reduces government discretion to set tax rates at an optimal level, with the effect of tax revenue reductions (see e.g. Brennan and Buchanan, 1980; Zodrow and Mieszczosky, 1986; Wilson, 1986; Persson and Tabellini 1994; Devereux et al., 2008 and Keen and Konrad, 2013 for an extensive survey of this theoretical literature). The distribution of the labour tax burden across different skill levels is also affected by differential mobility. Egger et al. (2019) provide evidence on the effects of globalisation on the distribution of worker-specific labour taxes for the period 1980-2007. Prior to 1994, greater openness meant that higher income earners were taxed progressively more, but not so afterwards. In particular, there has been a globalisation-induced rise in the labour income tax burden of the middle class after the mid-1990s, while the top 1 percent of workers and employees faced a reduction in their tax burden. These contrasting effects are explained by the higher mobility of high-income earners relative to low- and middle-income earners in the later years of the sample. Interestingly, this phenomenon is more prevalent among developed countries (i.e., the OECD) than among less developed ones. Furthermore, by putting a downward pressure on statutory and effective tax rates for mobile bases (capital and skilled labour), globalisation limits the ability of governments to redistribute income and wealth (e.g., Sinn 2003). There is thus a call for more coordination among governments across countries. This could entail both tax base and tax rates harmonisation and the adoption of minimum effective tax rates in order to reduce the negative impact of tax competition on revenues. However, concerted actions may be difficult to implement and involve other negative effects (Keen and Konrad, 2013) such as the loss of discretion in setting tax rates and defining tax bases.

4.1.2 Inequality

There is a growing concern in advanced economies over the impact of globalisation on the ability to sustain relatively high and evenly shared living standards. Globalisation is widely believed to have had a generally positive impact on global economic growth and to have reduced global income inequality and poverty. Indeed, empirical evidence supports this view (e.g. Dollar and Kraay, 2002, 2004; Hasell et al., 2019)45. However, it is well-known that the gains in terms of efficiency and wealth creation brought about by globalisation are unequally distributed within countries (see e.g. Ravallion 2018; Bourguignon, 2016; Milanovic 2016) and the effect of globalisation on employment and the distribution of incomes has generated an intense policy debate in recent years. Looking at the evolution of global inequality, an effective and popular representation of the effect of globalisation is the “elephant chart” proposed by Lakner and Milanovic (2013), a graph showing how different parts in the world’s income distribution benefited from globalisation between 1988 and 2008. According to this representation, globalisation had some clear “winners”: people in East Asia (especially China) and South Asia (especially India), and some parts of sub-Saharan Africa who have escaped extreme poverty in recent decades; and the very rich, concentrated in rich countries in Europe or North America. By contrast, the relative “losers” are the lower-middle classes in advanced economies (corresponding to the 85-95 percentile in the world income distribution), who experienced income growth close to zero.

45 We will further discuss this under section 4.2.1.1 of this chapter.
Trends in income inequality across advanced economies have been quite different over the past decades (see e.g. Atkinson and Bourguignon, 2015). In particular, according to the World Inequality Database (WID), income inequality – measured as quintile share ratio (S80/S20) – increased substantially in the European Union during the initial period of globalisation (late 80s – early-mid 90s) but remained quite stable since then. However, one can observe a certain heterogeneity across Member states. Despite some fluctuations over the period 1980 – 2018, some European countries (e.g. Germany, Italy, Portugal) present an increasing trend in income inequality. In some other Member states, instead, inequality remained fairly stable during this period (e.g. in Belgium, Denmark, Spain and Finland). From a theoretical point of view, the impact of globalisation on inequality may operate through several channels: trade, capital mobility and migration.

As already discussed under section 4.1.1, the standard trade models tend not to be reliable in predicting the impact of globalisation on both factor shares and income inequality. However, trade may affect income inequality through a different channel. Indeed, income inequality may rise due to firms’ heterogeneity within sectors and countries. Exporting firms are more productive than non-exporting firms and are expected to pay higher wages to hire higher-skilled labour, increasing the skill premium and thus income inequality (see Yeaple, 2005; Munch and Skaksen, 2008; Verhoogen, 2008; Egger and Kreickemeier, 2009, 2013; Frías et al., 2012; Sampson 2014; Helpman et al., 2017).

By fostering economic growth, capital mobility is a further channel that may influence income inequality. Kuznets (1955) postulated that income inequality increases in the early stages of economic development and then tends to decline once a certain threshold level of development is reached. In contrast to these predictions, Feenstra and Hanson (1997) argue that increased capital flows augment income inequality independently of the country’s level of development. Indeed, FDI raises the relative demand for high skilled labour both in developed and developing economies. Thus, by increasing the skill premium, higher economic globalisation levels should relate to increasing income inequality in both contexts (Bergh and Nilsson 2010).

International migration may also affect income inequality, with asymmetric effects between origin and destination countries. Standard models of immigration suggest, for example, that factors for which immigration is a good substitute will lose relatively to complementary factors. If immigration increases the labour supply of unskilled workers, the wage gap between high-skilled and low-skilled labour and income inequality are expected to increase (see Borjas et al. 1997).

Apart from the economic dimensions of globalisation, also political integration is likely to influence income inequality. This issue seems to be relevant for the European Union, since political integration may influence income inequality by setting minimum standards and therefore enhance equality both within and between countries (Dreher 2006a). In this light, according to the Bruegel dataset "Global and regional Gini coefficients" (from Darvas, 2019), income inequality in the EU28 countries increased significantly between late '80s and early '90s due to the collapse of post-communist countries, declined in the period 1994-2008, remaining broadly stable thereafter up to 2015, and started to decline again in latest years. The main reason behind the decline of income inequality during the period 1995-2008 was income convergence fostered by political integration (see also “European income inequality begins to
fall once again” in the Bruegel blog, 30/04/2018). Changing social norms, which results from more interaction and integration around the world, may also change the social acceptance of income inequality and therefore affect the behaviour of people, for example the wage bargaining of unions (Atkinson 1997).

In summary, theoretical models identify several channels through which economic and political integration may affect income inequality. These alternative approaches lead to different and sometimes contradicting predictions. In this light, the impact of globalisation on income inequality seems to be an empirical matter.

The link between globalisation and income inequality has been examined in many empirical studies.\footnote{Early studies include: Wood 1995; Cragg and Eppelbaum 1996; Borjas et al. 1997; Edwards 1997, Feenstra and Hanson 1996, 1997, 1999; Barham and Boucher 1998; Leamer 1998. More recent contributions revised this literature (see Goldberg and Pavcnik 2007, Dreher and Gaston 2008, Roine et al. 2009, Bergh and Nilsson 2010, Figini and Görg 2011, Jaumotte et al. 2013, Dabla-Norris et al. 2015, Gozgor and Ranjan 2017, Dorn and Schinke 2018, Dorn et al. 2018).} The results differ depending on the measures of globalisation and income inequality used and the sample of countries examined. However, most studies report a positive relationship between globalisation and within-countries income inequality (see Bergh and Nilsson 2010; Jaumotte et al. 2013; Dabla-Norris et al. 2015; Gozgor and Ranjan 2017). Nevertheless, examining the causal effect of globalisation on income inequality is a challenging task. Indeed, reverse causality may occur since changes in income inequality are likely to influence policies which, in turn, affect globalisation. Furthermore, some unobserved omitted variables may still cause biased estimates by influencing both globalisation and income inequality. Some recent studies have used different strategies to tackle these issues and provide evidence that only specific features of globalisation cause income inequality.

In particular, Dorn et al. (2018) study the impact of globalisation on income inequality by considering a large set of countries (including European and non-European developed countries, emerging economies and developing countries) over the period 1970-2014. They show that there is a positive relationship between an aggregate measure of globalisation (the KOF index proposed by Dreher, 2006a) and income inequality. By examining specific characteristics of globalisation, the authors show that rising export openness, foreign direct investments and social globalisation – measured as the spread of ideas, information, images and people – are the main determinants of the positive relationship. The results, however, vary depending on the sample of countries. The study confirms that the effect of globalisation on income inequality is driven by China and transition countries from Eastern Europe. Indeed, the results for the most advanced economies do not show a significant impact of globalisation on income inequality. The authors conclude that institutions providing income insurance and education, which characterise most advanced economies but are less mature in transition economies, may have moderated the effects of globalisation on income inequality.

As to the impact of FDI on income inequality, evidence shows that FDI affect income inequality in Central and Eastern European economies currently in the European Union, but the impact depends on the characteristics of the host economy. For lower levels of human capital and economic development, FDI tends to increase income inequality; on the contrary, if the spread of education and GDP per capita increase, this distributional effect of FDI diminishes. Finally, FDI...
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can even contribute to a reduction of income inequality starting from higher levels of human
capital and economic development (see Mihaylova, 2015). The impact of FDI on income
inequality has also been analysed for other European countries47, finding support for the
Kuznets’ hypothesis, according to which income inequality is likely to increase with development
before a turning point. Since most of the countries in the sample have already passed the
corresponding turning point, growth with equity can be expected in the current stage of
development (Lee, 2006).

To conclude, while the empirical evidence is generally mixed, some recent papers employing
more robust estimation strategies highlight that globalisation affects income inequality through
specific channels such as export openness, FDI and social globalisation. While promoting on
average a reduction in income inequality and fostering a catching up process across countries,
globalisation has nonetheless increased income inequality in less developed countries (and even
within a cluster of developed countries), whilst it has no significant impact or has even
decreased income inequality for more developed countries.

In addition to the evidence on overall income inequality at the country level and globalisation,
there is interest as to whether, at least in the short/medium term, globalisation has worsened
the conditions for specific groups of the population. The rapid growth of globalisation-driven
offshoring increased the skill premium both within firms (see e.g. Carluccio et al., 2015 for
France; Hummels et al., 2014 for Denmark) and at the industry level (see e.g., Feenstra and
Hanson 1997, 1999). In addition, and conditional on skill type, wage losses from offshoring are
more pronounced for the workers who perform routine tasks (see e.g. Ebenstein et al., 2014 for
the US; Hummels et al., 2014 again for Denmark). Consequently, there has been a call to address
the economic conditions of the losers through more effective redistribution, which is harder to
implement if higher taxation leads to a flight of mobile factors of production (skilled labour and
capital) or increases distortion in the labour supply decision of high earning factors such as
skilled labour, reducing output and per capita income.

4.1.3 Profit and income shifting by corporations and wealthy individuals

Globalisation has increased not only the mobility of physical capital – with the effects illustrated
in the previous sub-sections – but also the ability of corporations to shift profits to low-tax
countries in order to avoid tax payments.

The literature on BEPS is flourishing. Some recent studies use global macro data attempting to
estimate the total amount of profits shifted globally by multinationals (e.g. Beer et al. 2019, Lane
and Milesi-Ferretti, 2018, UNCTAD 2015, Crivelli, de Mooij and Keen 2016, Clausing 2016,
Gravelle 2009, Zucman 2014, Guvenen et al. 2018, see also IMF, 2019). According to the most
relevant contributions to this literature, around 40% of multinational profits is shifted to tax
havens each year (Tørsløv et al., 2018).

47 Specifically, these are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, The
Netherlands, Portugal, Spain, Sweden, and the United Kingdom analysed over the period 1951–1992 (see
Lee, 2006).
Further contributions estimate the size and macroeconomic effects of base erosion and profit shifting using a computable general equilibrium model designed for corporate taxation and multinationals. (see e.g. Álvarez-Martínez et al., 2016, 2018). These studies estimate that the impact of BEPS on corporate tax losses ascends to about €36 billion annually or 7.7% of total corporate tax revenues for the EU. These estimates are consistent with gaps in bilateral multinationals’ activities reported by creditor and debtor countries reported by official statistics for the EU. From the policy point of view, these studies estimate that eliminating profit shifting given tax rates and tax bases would increase the cost of capital and thus would slightly reduce investment and GDP. It would however be possible to attenuate these negative effects by conveniently modifying tax rates or tax bases or even by reducing other taxes. This, in turn, could increase welfare.

A large body of work estimates profit shifting using a microeconometric approach, employing corporate financial and balance-sheet micro-data (see e.g. Dharmapala and Riedel 2013, Lohse and Riedel 2013, OECD 2015, Johansson et al. 2017, Wier 2018). A consensus estimate of the semi-elasticity of pre-tax profit amount to about 0.8, in absolute terms (Heckemeyer and Overesch, 2017). According to these results, reported profits decrease by about 0.8% if the international tax differential increases by one percentage point. As to the channels, a multinational group member located in a higher tax EU jurisdiction may employ three types of aggressive tax planning (ATP) structures to pass their tax bases to another group member located in a lower tax EU country (see IHS et al., 2017). These are: ATP via interest payments, ATP via royalty payments and ATP via strategic transfer pricing. The stylised calculations suggest that transfer pricing and licensing, rather than inter-company debt, are the dominant profit-shifting channels (Heckemeyer and Overesch, 2017).

As to the EU, IHS et al. (2017) provide economic evidence of the relevance of ATP structures for all EU Member States and the potential impact on their tax base (erosion or increase). The study develops a series of economic indicators of ATP both at macro- and firm-level and for each indicator identifies outliers. Using macro-data the study notes, for example, that Cyprus, Malta, and Luxembourg raise more corporate revenues relative to GDP than other countries, suggesting the use of these countries by multinational groups for tax avoidance purposes. Ireland is also notable because it is the Member State with the highest net royalty payments as a percentage of GDP, which is consistent with facilitating aggressive tax avoidance using royalty payments. Moreover, the report observes that “high tax countries”, such as Germany and France, tend to have higher import prices than lower tax countries. However, none of the indicators can be taken in isolation as direct evidence of aggressive tax planning. By considering all indicators the study provides a broad picture of which Member States appear to be exposed to ATP structures, and how it impacts on their tax base (erosion or increase). The literature has also recently analysed how profit shifting varies across industries finding a large variance (Barrios and d’Andria, 2016). This result suggests that the empirical analyses of profit shifting should probably pay more attention to specific sectors of activities.

48 Their analysis is based on a comprehensive meta-analysis covering 27 studies on corporate profit-shifting behaviour employing both micro and macro approaches.
In summary, the empirical literature on this topic provides evidence that globalisation has increased the mobility of pre-tax profits and their sensitivity to tax rates and suggests that transfer pricing and licensing, rather than inter-company debt, is the dominant profit-shifting channel.

Until a few years ago, the structure of the international tax regime reflected the economic and political framework of last century and it was not fit to deal either with BEPS or, in general, with the challenges coming from the digital economy. The international tax law rules were designed to be applicable to business models with physical presence and were not fit to effectively address tax arbitrages and international double non taxation (COM, 2018).

Moreover, countries used to adopt unilateral individual measures in order to address BEPS and digital economy. There was no real coordination among countries. The only form of substantial coordination was given by double tax treaties, but the same treaties were exploited by multinationals to reach double non taxation. There has been some convergence among the tax systems which it was not the result of coordination, but rather the result of legal transplants (i.e. the borrowing of legal models from other jurisdictions – see Avi-Yonah et al. 2011). For example, Italy and France addressed unilaterally the issue of tax havens by disallowing the deduction of business expenses, if the seller was located in a tax haven.

In the last decade, we observe two different phenomena. On the one side the higher capital mobility led most countries to lower their tax burden both by reducing their statutory tax rates, as discussed in section 4.1.1.2, and by abolishing unilateral anti-avoidance measures (for example, Italy abolished the above-mentioned specific and peculiar anti-avoidance rule in 2016, and adopted a general anti-avoidance rule, similar to the one adopted by other EU countries). This race to the bottom brought the OECD corporate tax rate average to drop from 32,5% in 2000 to 23,9% in 2018. Moreover, in order to repatriate foreign earnings, most countries started moving towards territoriality, providing exemption for incoming dividends. On the other side, the OECD and the EU realised that unilateral measures with no coordination increased the BEPS problem because multinationals were able to exploit the tax differences between different tax jurisdictions through tax arbitrages. This problem was exacerbated for multinationals involved in digital economy (OECD, 2015a).

For these reasons, both the OECD and the EU started addressing the above-mentioned problems. At the EU level, the Council Directive (EU 2016/1164) was adopted on Anti-Tax Avoidance. It contains five legally binding anti-abuse measures, which all Member States should apply from January 2019 (but for the exit tax rule that must be implemented by December 31st, 2019) in order to counteract common forms of aggressive tax planning. These are:

1) Controlled foreign company (CFC) rule to deter profit shifting to a low/no tax country;
2) Exit taxation to prevent companies from avoiding tax when re-locating assets;
3) Interest limitation to discourage artificial debt arrangements designed to minimise taxes;
4) General anti-abuse rule (GAAR) aimed at counteracting aggressive tax planning features in tax systems in order to tackle abusive tax practices that have not yet been dealt with through specifically targeted provisions;
5) Rules on hybrid mismatch arrangements: where corporate taxpayers take advantage of disparities between national tax systems in order to reduce their overall tax liability.

As for digital economy, in March 2018, the European Commission adopted two legislative proposals: one, as a long term solution, aims at changing tax rules in a way to tax profits of digital companies where businesses have digital interactions with users; the second, as a short term interim solution, aims at taxing digital services (see European Council, 2018).

The anti-avoidance Directives and related reports were adopted as a follow-up of the project against Base Erosion and Profit Shifting (BEPS) by the G20 and the Organisation for Economic Cooperation and Development (OECD).

The BEPS Action Plan was developed by the OECD Committee on Fiscal Affairs and endorsed by the G20 Leaders in September 2013. It identified 15 actions to address base erosion and profit shifting (BEPS) in a comprehensive manner. The Final BEPS Package was produced in November 2015 and contains the tools countries need to use to ensure that profits are taxed where economic activities generating the profits are performed and where value is created. One of the goals of the entire project is to reduce tax disputes, increasing the level of legal certainty. Certain measures are structured as minimum standards, meaning that countries have agreed that the standard must be implemented. Implementation of the Final BEPS Package has required the adoption of measures such as changes to model tax conventions (as well as to the bilateral tax treaties based on those model conventions). Moreover, stricter reporting and transparency requirements, like country-by-country reporting, are set as minimum standard.

Following Action plan n. 1 of the BEPS project, related to digital economy, the OECD has published in 2018 an interim report titled “Tax challenges arising from digitalization”, with the plan to publish the final report in 2020. This report describes interim measures that single countries are planning to implement to tax digital economy.

On May 31\textsuperscript{st} 2019, the OECD announced that the international community had agreed on a roadmap for resolving the tax challenges arising from the digitalisation of the economy, and committed to continue working toward a consensus-based long-term solution by the end of 2020 (OECD, 2019).

This 2019 report describes the main features of certain new digitalised business models and discusses the value creation in the digitalised age and the related new international tax issues. The final goal of the report is to build consensus on this complex issue among OECD countries, reviewing the “nexus” and “profit allocation” rules, in order to better allocate taxing rights among jurisdictions (pillar 1) and implementing a new global anti-base erosion proposal (pillar 2) (see OECD, 2019).

\textsuperscript{49} Directive EU 2016/1164 has applied since 8 August 2016 and had to become law in the EU countries by 31 December 2018. The amending Directive (EU 2017/952) has applied since 27 June 2017 and has to become law in the EU countries by 31 December 2019 (or by 31 December 2021 in the case of hybrid mismatches).
Under the first pillar, three proposals have been formulated: the “user participation” proposal, the “marketing intangibles” proposal and the “significant economic presence” proposal. The common features of the proposals are a higher level of allocation of taxing rights to the customer jurisdiction, the existence of a nexus between a country and a business even in the absence of a physical presence, the issuance of simplified conventions and the use of total profits of businesses. Under the second pillar, new approaches in fighting double non taxation are explored (like, for example, inclusion rule, switch over rule, undertaxed payment rule, subject to tax clause).

In summary, during the last decade and under the initiatives of both OECD and EU, the structure of the international tax regime has evolved in an attempt to deal with the challenges coming from BEPS and the rise of digital economy in a multilateral way. It is not clear what the possible evolutions of the OECD and EU projects could be and, more generally, what the future steps will be. Based on what we have observed so far, there are three possible outcomes for the future.

The first one is that countries will not take any other step forward. EU member States will implement the ATAD Directives but will not reach consensus on digital economy and on the taxation of multinationals in general. Tax competition will go on and individual measures will continue to be adopted in a non-coordinated scenario. More jurisdictions will adopt uncoordinated unilateral tax measures. As noted by the OECD (OECD, 2019, at 7), the downside of this scenario is the fact that the “proliferation of uncoordinated and unilateral actions would not only undermine the relevance and sustainability of the international framework for the taxation of cross-border business activities, but will also more broadly adversely impact global investment and growth”.

The second scenario is to have an intermediate level of tax coordination in the future. BEPS will be addressed with unilateral multiple measures (i.e. unilateral coordinated measures, which are similar domestic measures adopted by different countries at the same time), but countries will not find consensus-based solutions on how MLN’S profits should be determined and on how taxing rights should be allocated among them. Multilateral measures (i.e. new international tax agreements, like new forms of exchange of information and a higher level of tax collaboration) would also be adopted but would be limited to procedural aspects of taxation (like exchange of information, tax enforcement and so on). This scenario also includes what the OECD (2019) is proposing in pillar 2: countries are free to determine their own tax system but are coordinated in avoiding all forms of double non taxation. For example, under the “subject to tax rule” (see page 30 of OECD 2019), the source country could deny treaty benefits to the resident of another country, if the residence country does not tax the cross-border income.

Finally, the third outcome, in the long-term perspective, is based on more fundamental reform options. Common based solutions are not adopted only to counteract BEPS and double non taxation, but also to determine the amount of profits of MNS, to allocate those profits among different countries and to design new nexus rules. One example is the the formulary apportionment, which is a method used to allocate income and expenses between related enterprises using a formula consisting of some factors such as sales, property, or payroll. This is a form of unitary taxation for multinationals (the OECD has expressly considered formulary apportionment as a possible solution for the taxation of digital economy: see OECD, 2019, page 14, pillar 1). Another example that was not considered by the OECD (2019) is the destination-
based cash flow tax, which is basically a consumption tax applied to all domestic consumption. Any goods or services that are produced domestically, but consumed elsewhere, are not taxed (a similar tax was proposed in the United States by the Republican Party, 2016).

These multilateral solutions would be based on full cooperation among the States. Cooperation would not be limited to formal tax rules (like exchange of information and tax procedure) but would also regard substantive tax law. This third approach would produce a re-allocation of taxing rights and a redistribution of tax bases and revenue among countries. Both destination-based income taxation and formulary apportionment (to the extent that sales are included as a factor in the formula) would tend to shift revenue from countries with trade surplus toward countries with trade deficits (Devereux and Loretz 2008, Fuest et al. 2007, Hebous et al. 2019). Furthermore, cooperation requires States to give up part of their sovereignty in taxation, finding the right trade-off between sovereignty over taxation and international cooperation.

In this regard, it is noteworthy that, in October 2016, the EU Commission proposed to relaunch the common consolidated corporate tax base, a single set of tax rules to calculate companies’ taxable profits in the EU, that would be divided among EU member States based on a formula. This measure would improve the single market for business, would combat tax evasion and BEPS in general and would support growth, jobs and investments in the EU.

Within the EU, the adoption of coordinated solutions has been difficult due to the unanimity principle to the majority principle in direct tax law decisions. On January 2019, the Commission launched a debate on a gradual transition to more efficient and democratic decision-making in EU tax policy. The Communication suggests a roadmap for a progressive and targeted transition to qualified majority voting under the ordinary legislative procedure in certain areas of shared EU taxation policy, as is already the case with most other EU policy areas.

Unitary taxation and the prospected high level of coordination at least at the EU level would have much more chances to take place if this transition happened.

Globalisation and the absence of cooperation among countries also increase the mobility of wealthy individuals for tax purposes as well as capital flight.

Tax competition makes certain jurisdictions more attractive than others. For example, UK, Italy and Portugal have adopted attractive tax measures temporarily lowering the tax burden on wealthy and retired individuals who move the tax residency in their countries (see e.g. articles 24-bis and 24-ter of the Italian revenue code), raising some equity concern.

Moreover, recent technological innovations have made it simpler for wealthy individuals to move funds to undeclared bank accounts in tax havens. To estimate the global amount of offshore wealth, the literature employs indirect methods. For instance, Zucman (2013a, 2013b) rely on the anomalies in global investment statistics caused by offshore fortunes. This author estimates that 8% of the global financial wealth of households is held in tax havens, which corresponds to about $7.6 trillion at the end of 2013. A similar estimate is obtained by Pellegrini et al. (2016) while other estimates are generally larger. Based on interviews with wealth managers, the Boston Consulting Group (2014) has an $8.9 trillion figure for 2013. Henry's (2012) estimate is as high as $32 trillion.

Furthermore, available evidence from Switzerland and Luxembourg, as well as systematic anomalies in the international investment data of countries, show that offshore personal wealth
is growing fast and that the bulk of it seems to be evading taxes (Zucman 2014). Alstadsæter et al. (2018) provide the first direct evidence on how hidden wealth is distributed and show that offshore tax evasion is highly concentrated among the rich. By employing a novel dataset of leaked customer lists from offshore financial institutions matched to administrative wealth records in Scandinavia, these authors show that the 0.01% richest households evade about 25% of their taxes. By contrast, tax evasion detected in stratified random tax audits is less than 5% throughout the distribution. Top wealth shares increase substantially when accounting for unreported assets, highlighting the importance of factoring in tax evasion to properly measure inequality.

The challenge for fiscal policy in this framework is to counteract this individual tax base erosion (i.e. base erosion on personal income tax) and tax evasion by improving international tax enforcement and coordination. In this regard, many tax systems enacted specific domestic rules to fight tax havens, tax evasion and money laundering, like general anti-avoidance rules, CFC rules also applicable to individual shareholders, or mandatory disclosure rules. At the international level, the main instrument to fight tax evasion is the exchange of information, also adopted at the EU level with Council Directive (EU 2011/16), amended by Council Directives (EU 2014/107, EU 2015/2376 and EU 2016/881). Moreover, the EU has successfully signed agreements on the automatic exchange of information (AEOI) in tax matters with many countries (like the ones signed with Andorra, Monaco, San Marino, Switzerland and Liechtenstein).

### 4.1.4 Fiscal Multipliers

A recent strand of the literature argues that globalisation may have an impact on fiscal multipliers. The global integration of capital markets has increased the external financing of public debt and, as Broner et al. (2018) suggests, there is a natural and largely unexplored connection between fiscal multipliers and the foreign holdings of public debt. The rationale they propose is intuitive. Fiscal expansions can raise domestic economic activity but can also have crowding-out effects on the domestic private sector. In particular, the resources used by the domestic private sector to acquire public debt can detract funds from consumption and investment. As a result, the crowding-out effect of fiscal expansions is likely to be stronger when they are financed by selling public debt to domestic (as opposed to foreign) residents. As a corollary, the effects of fiscal expansions on economic activity are likely to be stronger when they are financed with foreign resources. This result holds both for the United States during the post-war period and for a panel of OECD economies (including EU countries) over the last few decades. In both cases, the estimated multiplier is larger than one in periods and countries with a high foreign share of public debt holdings (such as in the US and Ireland today), and is smaller than one in periods and countries with a low foreign share (such as in the U.S. in the 1950s and 1960s and Japan today).

Priftis and Zimic (2017) also explore this idea by employing a sample of 59 countries (including several EU member states). Their results suggest that government-spending multipliers are larger when government purchases are financed by issuing debt to foreign investors (non-
residents), compared to the case when government purchases are financed by issuing debt to home investors (residents). These results have important policy implications for the effects of fiscal consolidations in several European countries. Since foreign debt-financed spending shocks have higher multipliers this suggests that in countries such as Greece, where most of the debt is externally held, government expenditure cuts can cause deeper than anticipated recessions. This is opposite to the case of Italy, where most of the government debt is domestically held.

4.1.5 Globalisation, protectionism and digitalisation in the WorldScan model

In this subsection, we complement the previous discussion with new simulation-based results. We consider how further globalisation, increased protectionism, and digitalisation would affect GDP, capital income share, and the wages of low- and high-skilled workers. The point of considering digitalisation in this section is to be able to compare the effects of different trade policies with the effects of a specific ongoing technological progress.

The results are based on a computable general equilibrium (CGE) model called WorldScan. It uses a global input-output table that connects economies through bilateral trade data. The model allows to assess the macroeconomic impacts of country- and sector-specific trade policies, but also of specific technology shocks. The model structure and the underlying database are part of the widely used GTAP-class CGE models.\textsuperscript{50} The model and its calibration are described in some detail in Appendix 4.1.

The model distinguishes low-skilled and high-skilled labour.\textsuperscript{51} This is relevant for the evolvement of the labour market and economic growth, but also for specialisation patterns. Regions endowed with high-skilled labour specialise in the production of high-skilled labour-intensive goods, and regions endowed low-skilled labour specialise in low-skilled labour-intensive goods.

We first construct a business-as-usual (BAU) simulation that runs until 2040. The BAU simulation is based on region-specific GDP growth per capita projections from the OECD, demographic projections from the United Nations (UN, 2015) (for non-EU countries) and EuroStat population projections (for EU countries), as well as labour participation and unemployment projections from the ILO, EuroStat and WorldBank.\textsuperscript{52}

We compare the BAU simulation to the following three simulations.

1) Protectionism: Increase all bilateral import tariffs on all goods with 10 percentage points on trade between USA and India/China/rest OECD\textsuperscript{54}

2) Globalisation: Remove all import tariff barriers by 2030

\textsuperscript{50} The main characteristics of the GTAP model can be found at: www.gtap.org.

\textsuperscript{51} The GTAP-9 version identifies five different labour types, but these can be aggregated to the common two labour types used in most CGE models.

\textsuperscript{52} From the Economically Active Population Estimates and Projections (EAPEP).

\textsuperscript{53} The endowment of high- vs. low-skilled labour is taken from GTAP-9. This database identifies five different skills with respect to labour but are aggregated to the common two labour types used in most CGE models. The composition of skills is assumed to remain constant for the years beyond 2011.

\textsuperscript{54} Rest OECD comprises all OECD minus USA, i.e.EU28 countries, Japan, Australia, Canada, New Zealand, Switzerland, Rest of EFTA, Mexico, Korea, and Turkey.
3) Digitalisation: increases of productivity up to 2030 in sectors depending on their ICT-intensity.

The other exogenous parameters are taken from the BAU simulation. For example, the protectionism simulation only imposes higher tariffs. The digitalisation simulation assumes extra productivity based on OECD estimates as applied in Bekker et al. (2018). Productivity is increased depending on the ICT intensity in a specific sector.\footnote{Digitalisation is not included in the BAU simulation. The impact from digitalisation on the BAU simulation is estimated by the procedure following Bekker et al. (2018), which uses OECD data.}

Table 4.1 presents the main results. The indicators in the table are the average annual growth rate of GDP in different regions, wages of low and high-skilled workers and the capital income share between 2018-2040 in the BAU simulation, and the percentage difference in the levels of GDP, wages and the capital income share in 2040 between the BAU and the three alternative simulations.

Table 4.1 GDP, wages and capital income share in WorldScan simulations.

<table>
<thead>
<tr>
<th></th>
<th>BAU, average annual growth 2018-2040, %</th>
<th>Outcome in 2040 relative to BAU, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>protectionism</td>
</tr>
<tr>
<td>GDP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU28</td>
<td>1.5</td>
<td>-2.1</td>
</tr>
<tr>
<td>China</td>
<td>5.0</td>
<td>-4.3</td>
</tr>
<tr>
<td>Rest-of-the-world*</td>
<td>3.5</td>
<td>-0.2</td>
</tr>
<tr>
<td>World</td>
<td>2.4</td>
<td>-2.8</td>
</tr>
<tr>
<td>EU28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wage low</td>
<td>1.2</td>
<td>-1.1</td>
</tr>
<tr>
<td>Wage high</td>
<td>1.8</td>
<td>-1.6</td>
</tr>
<tr>
<td>Capital income share</td>
<td>-0.1</td>
<td>0.0</td>
</tr>
</tbody>
</table>

* Rest-of-the-world consists countries other than the OECD countries, China, ASEAN countries, India, and Latin American countries.

The BAU simulation can be characterized by a global average annual GDP growth of 2.4% per year between 2018 and 2040. EU28 is growing at a moderate average GDP growth rate of 1.5%. The Chinese economy grows 5% and the rest-of-the-world by 3.5% per year.

In the BAU simulation, the growth of the EU28 is negatively affected by population ageing but spurred by increased specialisation in high-skilled service sectors. This specialisation translates into higher growth of high-skilled wages, which increases the gap between high- and low-skilled wages. The average annual growth rate of low-skilled (real) wages is 1.2% while the average growth rate of high-skilled wages is higher, i.e. 1.8%. In long-term scenarios, income growth increases the consumption of luxurious goods. But, the production of luxurious goods is high-
skill intensive, thus making high-skilled workers scarcer relative to low-skilled workers. The capital income share remains virtually constant because of two reasons. Firstly, in
the simulations presented here, the production functions remain more-or-less fixed over time, so in
the absence of sectoral shifts in production the capital input share remains more-or-less fixed.
Secondly, the capital share of input to production is also unlikely to change from a sectoral shift
(composition-effect), as the capital input share does not vary that much across the sectors.

In the protectionism simulation, world GDP in 2040 is 2.8% lower than in the BAU simulation.
China loses more because a large part of its trade is with the USA. The GDP loss in the rest-of
the-world is limited as they are only indirectly affected by the trade war (tariffs between US and
other countries). Nevertheless, rest-of-the-world (mainly poor countries) loses as the trade war
affects richer economies. This is partly because the poor countries lack the market power to
benefit from reduced trade between countries involved in the tariff war. We can also see that
protectionism lowers high-skilled wages more than low-skilled wages in EU28, thereby reducing
the wage gap relative to the BAU simulation. This result stems from increased specialization in
primary production in the EU28, which employs low-skilled workers. However, the effect is very
small. In 2040, low-skilled wages are down by 1.1% and high-skilled wages by 1.6%, relative to
the BAU simulation. The capital income share remains constant, because it is already high in the
BAU and remains so in this scenario.

The globalisation simulation features higher global economic growth because of reduced trade
barriers (as existing tariffs are removed). Increased trade and specialisation yield a switch of
inputs across sectors in all economies that leads to an overall productivity gain. However,
different regions are affected very differently. The world economy increases by 0.9% relative to
the BAU simulation. EU28 and other countries in the rich North increasingly specialise in high
value-added sectors, while exerting market power at the expense of sectors in poorer regions. In
2040, GDP in the EU28 is 1.1% higher than in the BAU. China will be expected to gain 3.6% in
GDP due to heavy specialisation in specific sectors. Relative to the BAU simulation, the rest-of
world loses 3.1% in terms of GDP in 2040. In the EU 28, wages increase in line with GDP. There is
virtually no effect on the wage gap between high- and low-skilled workers or the capital share.

In the digitalisation simulation, both the world economy and the Chinese economy in 2040
increase by 1.9% relative to the BAU simulation. EU28 economy increases almost as much, i.e.
1.8%, while the GDP of the rest-of-the-world increases by 0.6%. Digitalisation increases the wage
gap slightly in the EU28. The reason is that productivity gains from digitalisation are higher in
those sectors that heavily relying on high-skilled workers (often also high-value added sectors).

To summarize, the results based on the WorldScan model suggest that the gap between high
skilled and low-skilled wages will increase in the EU until 2040, mainly due to increased
specialization in high-skilled services, whereas the capital income share remains almost
constant. Increased protectionism in the form of higher trade tariffs between USA and other
countries would affect also the EU economy negatively, while the elimination of the tariffs as
well as digitalisation would increase it. However, the wage gap and the capital income share
would be almost unaffected by higher tariffs or the elimination of the current tariffs. They are
also not much affected by digitalisation. When interpreting these results, it should be kept in
mind that the model of course does not capture all the mechanism discussed in the previous
sections.
4.2 Globalisation and politics

The last few years have been marked by a series of events that are commonly interpreted as a challenge to and a rejection of the existing political and economic order, and are usually referred to with the term 'populism'. Although this is a much abused term (especially in the public debate), whose definition is disputed among social scientists, we will follow common usage and refer to populism to describe the political forces and positions that have recently emerged in Europe and the United States, questioning the pre-existing political-economic order.

As a political phenomenon, contemporary populism has many facets and is not easily ascribable to a homogeneous ideological orientation. Indeed, the generic label “populism” includes a set of very different political forces and movements, which may diverge in their proposal and affiliation to the left or the right of the political spectrum. Rather than an ideology, populism can be defined as “anti-elitist discourse that purports to represent some morally charged idea of the ‘people’ as a whole while condemning existing institutions for betraying or failing to properly represent the people.” (Hopkin and Blyth, 2019). The common denominator of populist forces is the fact of proclaiming themselves defenders of the "people" against the elites (Eatwell and Goodwin, 2018).

Broadly speaking, the ordinarily accepted interpretation is that the emergence of populist forces is the result of some particularly critical trends in the process of globalisation in recent decades. According to this interpretation, populism is a response fuelled mainly by the resentment of those components of Western societies who perceive that they have borne the costs of the processes underway, or who believe they have not participated adequately in the benefits generated by economic growth. In this regard, the financial crisis of 2008 and the Great Recession that followed have played the role of triggering factor, further worsening the sense of insecurity and aggravating the conditions of the "losers".

The surge of populism is often seen as a threat not only to the current political and economic setup, but also to prosperity and democracy (see e.g. Eichengreen, 2018). A more nuanced position on populism is the one held by Rodrik (2018a), who distinguishes between political and economic populism. Populist governments often reject the idea that the power of the executive should be limited in its exercise. This attitude is clearly dangerous in politics, as it could undermine the separation of powers, the independence of the judiciary and free media, and democracy could degenerate into some form of autocracy. Similarly, in economics, populists reject constraints on the conduct of economic policy, such as autonomous regulatory agencies, independent central banks, and other external constraints (such as global trade rules) which narrow their policy options. However, in Rodrik’s view, there are times when “relaxing the constraints on economic policy and returning policy autonomy to elected governments may well

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56 Although there are some similarities, we will not consider here the historical antecedents of the contemporary populist phenomenon, such as the populism of the nineteenth century in the U.S. and that occurred in the 1940s and 1950s in Latin America (e.g. Peron’s Argentina). Again, with reference to Latin America, the term populism has also been used to indicate the economic policy orientation of governments such as the experience of Allende’s Unidad Popular in Chile or Alan Garcia’s Peru (Dornbusch and Edwards, 1990; 1991).
be desirable”. Populists’ opposition to external constraints is very often driven by the belief that restraints have not been imposed for the benefit of society as a whole. In Rodrik’s view, such beliefs are justified in some case.

In this section, we will survey the main conclusions reached on how economic globalisation backlashed on politics by feeding populist forces. To this end, we will rely on a comprehensive notion of populism as a political opposition to the current order based on the rhetoric of the people against the elite. Although other concurrent causes, such as economic insecurity determined by technological change or, possibly, cultural factors not directly related to economic changes, can be identified for the success of populist forces in advanced economies, and in Europe in particular, we will concentrate our attention primarily on the link between globalisation and populism.

Our questions will be: to what extent can globalisation, and more precisely its effects on economic insecurity of certain segments of the population, be seen as a cause of the populist wave? How did globalization interact with other factors, if any, to generate such political upheavals? This will help us understand what effect such upheavals might determine on policies, in particular fiscal and taxation policies, at a national and international level.

4.2.1 Globalisation as a cause of populism

As claimed by Eichengreen (2018, p. x), “[p]opulism is activated by the combination of economic insecurity, threats to national identity, and an unresponsive political system”. This short description expresses in a nutshell the three main explanatory factors on which the analyses conducted by economists and other political and social scientists have focused their attention. All of them can be related to globalisation:

1) Economic insecurity. Changes brought about by globalisation (as well as technological change) result in an asymmetric distribution of costs and benefits among classes and production factors; those who are left behind develop resentment and rejection of the current political and economic order. In this regard, the Great recession represented a triggering factor for the burst of discontent and political backlash (“Populist revolts rarely arise in good economic times”, Eichengreen, 2018, p. x).

2) Unresponsiveness of the political system. The political system and its (in)ability to respond adequately to the demand coming from the electorate is another crucial cause of the rise of populist parties. Although this inability may be due to national specificities (political institutions, the specific party system), here too we can identify a link with globalisation, as the action of government or legislation is often constrained by international economic and political integration. In fact, the international mobility of capital, and factors in general, combined with the presence of international treaties or other commitments, can make it difficult to adopt appropriate policies at national level to counter the demand for economic security.

The point is best explained by recalling Rodrik’s famous trilemma, which says that democracy, national sovereignty and global economic integration are mutually incompatible, i.e. it is possible to combine any two of the three, but never all three simultaneously and in full (Rodrik, 2011). As a consequence, increasing global economic integration requires that nation states are made responsive only to the needs of the international economy, at the expense of other domestic objectives. Thus, the outcome of globalisation brought to its extreme is a misalignment
between sovereignty and national democracy: politics is constrained by globalisation, as if it had put on a “Golden Straitjacket” which narrows the political and economic choices of those in power (Friedman, 1999).

3) **A threat to the (national or local) cultural or ethnic identity.** This is mainly due to the effects of migration flows, but also determined by a tendency towards homogenisation, which erodes (or is considered to erode) traditions and cultural specificities; these factors are once again related to globalisation, as long as the latter encourages or forces large scale mobility of individuals and spreads common models of consumption.

In the following sections, based on the scheme above, we present several contributions, which have examined the various causal relations between economic (and non-economic) factors and populism.

**4.2.1.1 Economic insecurity: the “losers” of globalisation**

With regard to the relation between globalisation and economic insecurity, it is a well-known result in international economics that globalisation will tend to have an asymmetric impact, creating winners and losers. The basic intuition in this regard has been explained in a clear way by Stolper and Samuelson (1941): in a model of two factors of production with full intersectoral mobility, the opening of trade is predicted to adversely affect the owners of the factor which is more intensely used in the importable good. The standard implication is that openness to trade makes low skilled workers in advanced economies worse off. Since the “losers” from globalisation are more likely to be placed at the bottom of the income distribution, globalisation will generally translate into increased inequality. Note, however, that some of the effects of the asymmetric distribution of gains and losses may not be captured by the change in the overall level of within-country inequality (this is especially true when competition affects skills that are not at the lower end of the distribution). According to Rodrik (2018b) “Redistribution is the flip side of gains from trade”. Since we have extensively discussed in section 4.1.2 of this chapter the relationship between globalisation and inequality, here we only develop the link with the voting behaviour.

Economic insecurity can influence voting behaviour. A number of empirical studies test the effect of globalisation on political behaviour and attitudes. Autor et al (2016) consider the effect of exposure to trade in different congressional districts in the US elections between 2000 and 2016, and find that larger increases in import penetration is correlated with a higher probability that moderate candidates are removed from office and replaced by more radical ones in congressional elections, and a higher probability of a shift towards the Republican candidate in presidential elections. This is interpreted as supporting the view that adverse economic conditions due to increased globalisation increase support for nativist and extreme politicians.

In a similar fashion, Colantone and Stanig (2018) analyse the impact of trade openness, as measured by growing exposure to Chinese imports, and political attitudes in Europe. Namely, they consider the electoral outcomes in 15 Western European countries in the period 1988-2007. By relating voting behaviour with a measure of ideology orientation, they identify a causal
impact of import shocks on support to nationalist and isolationist parties, and in general on support for radical parties, along with a general shift of the electorate to the right. The influence of economic insecurity on political behaviour brings us to discuss about how the political system reacted to the Great Recession, whose effects called for a political response. The fact that this political response has not been (or has not been considered) adequate is at the root of recent political events. This is particularly evident when we look specifically at the European context.

4.2.1.2 Unresponsiveness of the political system

Although, in principle, the gains from trade deriving from market openness can be shared in order to compensate the losers of globalisation, the required redistributive policies can face many obstacles in practice, so that we can speak of a “failure of compensation” (Frieden, 2018). In fact, another effect of globalisation is the erosion of the possibility of a political correction of its outcomes. That the possibility of taxing is constrained by how mobile a tax base is, is a well-known and long-standing tenet of public finance and public choice (Brennan and Buchanan, 1980). The fact that capital is more mobile than labour, even when the freedom of movement of both factors is formally recognised, implies that with market integration the burden of financing public expenditure will be increasingly borne by labour, while there will be an incentive to reduce taxation on capital (see on this our discussion in section 4.1.1.2). The general view in this regard is that globalisation, by making competitiveness more relevant, increases the cost of taxation (esp. on labour), thus requiring a reduction in the generosity of the welfare states (Alesina and Perotti, 1997; Mishra, 1999). Sinn (1997) arrives to the similar conclusion that system competition induced by mobility of factors or people will result in inefficient provision of public goods, insurance or regulation by the government.

Globalisation also affects the balance of political power. By weakening the influence of workers' organisations, trade openness and capital mobility tend to limit the political influence of workers (Rodrik, 2018a; 2018b), thus making it more difficult to implement redistributive policies.

Indeed, the second crucial factor explaining the surge of populism is the unresponsiveness of the political system, its inability to provide an effective answer to the perception of growing insecurity and unequal access to the benefits of globalisation. This has been particularly clear in the aftermath of the Great Recession. The prolonged period of low growth that followed it has led to giving greater salience to the distribution of gains and losses that had taken place in the preceding decades. The Great Recession exposed and brought to the general attention some of the weaknesses and contradictions of the globalisation process.

As we said, the integration of markets (especially financial markets) made it difficult to rely on the traditional instruments to reduce the adverse effect of a recession. This lack of response

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57 Rather than populism, Colantone and Stanig (2018) talk about “economic nationalism”. This is defined in Colantone and Stanig (2019) as a mix of (1) isolationism; (2) economic conservatism; and (3) a nationalist narrative, centered on the goal of ‘taking back control’.

58 Other studies, however, have emphasised that the link between the degree of openness and the size of welfare state is more complex; along with the higher cost of redistribution, there may be a higher benefit from social protection in more open economies, so that the optimal degree of social protection may in fact increase when the economy is more open (Rodrik, 1998; Arachi and D’Antoni, 2004).
determined a loss of credibility of the ruling political forces, and dissatisfaction at the institutional setup that impeded the adoption of more aggressive policies aimed at alleviating the consequences of the crisis. From this point of view, the European Union and the Eurozone represent a context in which these aspects seem to have played a particularly important role; in the case of the EU, the effects of the integration of goods, services and factor markets have been accompanied by explicit constraints on monetary and fiscal policy, thus reducing the scope for policy action at the national level.

The logic of Rodrik's trilemma can be applied in this case too. In the European Union, the Golden Straitjacket took the explicit form of a surrender of national monetary policy and an adoption of constraints on fiscal policies, through treaties and shared fiscal rules. As these constraints are the explicit target of populist parties across Europe, it is important to analyse what role they may have played in shaping the attitude of voters.

The role played by constraints on policy is confirmed by a number of empirical studies. Using regional data across Europe, Algan et al. (2017) find that an important factor linking insecurity (as measured by rising unemployment) and support for non-mainstream parties is a drop in confidence in national and European political institutions. Notably, they find no comparable decrease of trust in other institutions, such as the police or the UN; this points to the fact that the national and European political establishment are held responsible for the adverse economic outcome. On the other hand, support for national democracy suffers from the alleged lack of democratic legitimacy of the political programme of internal austerity and devaluation that the countries of the Eurozone periphery have been induced to adopt. Based on Eurobarometer data for the period 2002-2014, Armingeon et al. (2015) find that internal devaluation programmes imposed to these countries are unambiguously associated with a significant increase in the share of “detached” individuals, i.e. individuals who simultaneously evaluates the democratic political system both at a national and European level in a negative light.

This aspect is analysed by Guiso et al (2019), who point to institutional constraints limiting the action of governments, especially in the periphery of the Eurozone, as a cause of the increasing support for populist parties. The paper analyses the effect of the “policy strait-jacket” to which Eurozone countries are subject (represented by the loss of discretion in devaluing the currency, constraints on domestic fiscal policy, and lack of discretion in setting monetary policy) on frustration of citizens with European institutions (measured as mistrust in such institutions) and traditional parties associated with them. Data show that frustration is more acute in countries where the constraints on domestic policies from participating in the single currency are stronger, particularly in the years following the financial crisis. In the peripheral Eurozone countries, especially when comparison is made with other Western European countries outside the Eurozone, trust in the European Parliament, the European Commission as well as the ECB has dropped more markedly, and so has the perception of benefits from membership in the EU.

It is not clear, however, whether these shifts in opinions that took place in the aftermath of the crisis are permanent or, instead, they are being reversed by the more recent economic recovery across Europe, as suggested by persistently increasing overall support for the EU in surveys after the lows reached in 2012-2014 (see e.g. Spring 2019 Standard Eurobarometer) and by the outcome of the recent European parliamentary elections, where mainstream parties maintained their consensus.
4.2.1.3 The threat to the (national or local) identity

Most of the studies analysed above tend to confirm the idea that the explanation of populism can be found in economic causes and, more specifically, in economic insecurity and dissatisfaction at the distribution of gains and losses from globalisation, and in discontent with the political reaction by existing parties. We have left aside the third factor mentioned in section 4.2.1, namely the perception of a threat to the cultural or ethnic identity. The relevance of this factor is shown by the emphasis given by populist political forces, in particular those on the right of the political spectrum, to the problem of immigration and the protection of national identity. As long as such “cultural” explanation prove relevant, economic policies, and tax policies in particular, may be a less important determinant of current political tendencies; this has clear implications also for the kind of policies that can be devised to respond to the political demand of voters who turned to populist parties, as immigration or integration policies may be more important than tax policy in regaining the support of these voters.

Some studies have analysed the importance of cultural factors as the origin of the populist push, as an alternative to the one based on more strictly economic variables.

Norris and Inglehart (2019; see also Inglehart and Norris, 2017) argue that support to populistic authoritarian parties in the US and in many European countries is driven by a backlash against cultural change, rather than by economic outcomes per se. According to this view, economic variables play only a subsidiary role: while existential security would lead to support for post-materialist values and greater tolerance, insecurity would have the opposite effect of stimulating authoritarian attitudes and in-group solidarity, with rejection of outsiders and xenophobia. 59

In a much-debated contribution, Mutz (2018) argues that, economic hardship does not play a major role in the election of President Trump, the main variable being anxiety among high-status Americans about their personal role in the social hierarchy and America's dominance role. The “left behind” thesis (i.e., the theory that the incumbent parties have been punished by voters experiencing economic hardship) is rejected by the result of an analysis based on a sample of American voters between 2012 to 2016, while support is found for the alternative explanation that the 2016 presidential election outcome reflected increasing “anxiety among high-status groups”: white Americans felt under siege and threatened because of growing domestic racial diversity and globalisation. However, this conclusion has been subsequently criticised by Morgan (2018), who argues that the data of the panel are consistent with the claim that economic interests are at least as important as the threat to status.

In the European context, Gildron and Hall (2018) find a sort of middle ground between the cultural and economic explanation, by looking at how the two dimensions interact in explaining support for populism. In their framework, the driving force is (subjective) status anxiety, to which both economic and cultural developments contribute. Indeed, populism has a strong attraction for those who feel left behind by economic and cultural developments. Data from a comparative survey of European democracies show that those who feel more socially marginal (less attached to the regulatory order, less socially committed or lacking a sense of social

59 The idea that recent political upheavals can be interpreted primarily as a reaction to the growing heterogeneity of our societies and the resulting threat to identity and social cohesion is strongly supported, among others, by Goodhart (2017).
respect) are more likely to disengage from traditional politics and support radical parties of the left or the right. Such support therefore reflects issues of social integration.

The discussion on the relative importance of economic and cultural factors is still open. A reasonable conclusion is that both factors have played a role, with economic insecurity reinforcing the perception of being threatened by immigrants not only from an economic but also from the point of view of cultural identity.

4.2.2 The consequences of populism for economic policy

We have discussed how globalisation is at the root of the recent political upheavals, generally referred to as populism. We have identified different ways in which globalisation and populism can be linked, namely: (1) globalisation has asymmetric effects across the population and creates economic insecurity in some “loser” groups; (2) by constraining the action of national government, reducing their ability to redistribute and determine fiscal policy according to domestic voters’ preferences, it can determine frustration at national and international institutions and distrust for mainstream political forces; (3) as long as it encourages mobility of individuals and migration, it can feed the perception of a threat to cultural identity.

The advancement of populist forces can determine two types of effects on policies. First, it can push mainstream parties to implement policies that limit consensus for anti-system and populist parties by breaking, or by trying to break, one or more of the links between globalisation and populism. In particular, progressive taxation, wealth and inheritance taxation could be used to address the issue of economic insecurity and inequality. However, such policies can be difficult to put in place, first of all as a consequence of the “external constraint” represented by economic integration itself, as discussed in Section 4.1.1.2.

Second, where populist forces gain access to government, they may be able to implement their agenda, and translate their opposition to globalisation into actual policies.

As a matter of fact, the same policies may come about even where populist forces are not strong enough to be in the government, if mainstream governing parties take on part of the populist agenda and introduce reforms to reduce the risk of losing power.

As we said above, populism is characterised by a request to “take back control” of the country, freeing the action of the government from constraints that are perceived to limit its ability to address the people’s concerns and demand. This intolerance of constraints has both an internal and an external dimension.

From the internal point of view, the action of populist governments is characterised by the search for "unorthodox" policies, which may be in violation of the accepted rules of a prudent public finance management. For fiscal policy, this can translate into an attempt to violate internal fiscal rules (rules that may be backed by treaties, as in the case of the rules of the European Union and the Eurozone), with the goal to carry out expansive policies or policies that are perceived to limit its ability to address the people’s concerns and demand.

Bordignon et al. (2018) try to investigate the relative importance of these two channels in Lombardy (Italy), and find that economic factors are important, especially in the form of labour market competition.

It is important to emphasize that the link between immigration and support for populism can imply both an economic (via crowding out of social services and competition in the labour market) and a cultural/ideological effect.
oriented towards the segments of the population most represented in the electorate of the populist parties.

The “external” dimension of populist action is likely to be a partial retreat from globalisation, or at least a stop in the process of increased integration, with a greater focus on national interest. Inasmuch as the link between economic insecurity and international trade – or offshoring or capital mobility – is made explicit and identified as relevant, we can expect attempts to impose barriers of some kinds to the mobility of goods, service and factors of production, determining a return to protectionist policies. In addition, if populism takes a xenophobic flavour, there may be a call for an end or a significant reduction to the influx of foreign workers who, it is assumed, compete with local workers and impose downward pressure on wages.

Admittedly, protectionist policies, in the form of tariffs or other kinds of preferential tax treatments affecting the trade balance, and distortions to trade had been detected even before the recent political turn associated with populism (Everett and Fritz, 2015). Indeed, after the financial crisis, the response of many countries was the introduction of new protectionist measures (Henn and McDonald, 2014). Recent evidence suggests that protectionism is on the rise (Kee, Neagu and Nicita 2013; for a more recent analysis including non-tariff protection, see Niu et al 2018), and that we are facing a "global trade slowdown" (Hoekman 2015; Constantinescu et al., 2018). The CPB World Trade Monitor shows that world trade growth has, indeed, been slowing down in the past years (see https://www.cpb.nl/en/worldtrademonitor).

We can expect that, as a consequence of the fact that populist parties take control, the level of cooperation among states may be reduced and replaced by a more competitive attitude, driven by a more explicit pursue of national interest (although this aspect should not be overstated, as the change in this regard may be more rhetorical than real). As long as this is the case, international coordination may be made more difficult in the future, with adverse effects e.g. in terms of fiscal competition among countries or less cooperation in terms of exchange of information between national tax administrations. For example, Fuest and Sultan (2018) argue that if the UK will leave the EU, it will no longer be subject to EU state aid regulations and the EU code of conduct for business taxation that prevents setting lower tax rates to specific companies or sectors to attract investment and tax bases. They show that if the UK would resort to tax discrimination after Brexit, the incentives for tax harmonisation among the countries remaining in the Union would decline, even in an ideal setting where the gains from harmonisation could be shared through compensating transfers.

However, we cannot rule out the possibility of an increased cohesion among “remaining” countries in case one Member State defects by breaking cooperation; it appears that the experience of the negotiation for Brexit is having such a unifying effect on the other Member states.

At this stage, we can only try some tentative prediction on the possible areas in which fiscal competition can materialise, in case a more general pursuit of the national interest dominates:

- **Corporate taxation.** This is one of the fields where competition has shown up, as firms, and in particular multinational corporations, are very responsive to differential tax treatments. A less cooperative attitude could encourage some countries to adopt unilateral corporate tax reforms, aimed at fostering exports and penalising competition
from foreign companies. As discussed in section 4.1.3, the proliferation of uncoordinated unilateral measures could undermine the sustainability of the international framework for the taxation of cross border business by increasing the opportunities for aggressive tax planning aiming at either eroding the tax base (by exploiting the mismatches between tax systems) or shifting profits in low tax countries. Uncoordinated unilateral measures may also increase the dispersion of effective tax rates within and across countries, thus producing a misallocation of resources, which may hinder TFP growth as recently suggested by the IMF (IMF 2017).

- **Commodity taxation.** In the European context, less coordination could be reflected in a revival of tax competition for commodity taxation. This would be allowed by the recent VAT Action Plan, which gave up the idea of origin taxation, allowing countries more freedom in setting tax rates in a destination taxation framework (for a survey of possible spillovers under different regimes, see Lockwood 2001).

- **Capital taxation.** Another example is the possibility for countries to introduce restrictions on the mobility of capital, aimed at implementing forms of "financial repression" (Reinhardt and Sbrancia 2015); countries may consider the possibility to introduce tax provisions aimed at encouraging residents to invest in domestic assets, although this could be difficult under EU legislation. For example, by resorting to the imputation system a country may introduce or reinforce a "home bias" in the allocation of savings by granting a tax credit to shareholders under the personal income tax for the amount of corporation taxes paid on distributed profits of domestic companies (Mishra and Ratti, 2013).

- **Personal income taxation.** Competition can also involve the introduction of incentives to attract certain kinds of taxpayers. Examples in this regard are tax reliefs on the personal income tax paid by pensioners moving their residence to particular areas or regions (Portugal and, more recently, Italy, have introduced this kind of provision) and the preferential treatment of top earner immigrants introduced for example in Denmark (see section 4.1.1.1) and Italy (see section 4.1.3).

The interpretation that populists would respond to the security demands of the groups most disadvantaged by the effects of globalisation means that also tax policies must contribute to this objective. It is not easy to predict how this orientation can be translated into practice, since the demand for tax support is necessarily filtered by the ideological orientation of the various populist forces. It is possible that a "left-wing" populism could propose forms of taxation of wealth, in order to compensate for the tendency to wealth concentration of the last decades, but it is unlikely that such a tax will be promoted by "right-wing" forces.

Some trends can be detected in countries that have recently experienced a strong rise in populist forces and movements (i.e. France and Italy). On the one hand, there is the attempt to compensate via the tax system the occupational groups who have most suffered from the rise in economic insecurity due to globalisation and austerity policies. Given that these groups are usually middle-class employees and self-employed, the aim was achieved by implementing specific tax breaks rather than by increasing the progressivity of the tax schedule. In Italy, for
example, a tax break for employees earning an income between 8,000 and 26,600 euro was introduced in 2014, while in 2019 the government implemented a special tax regime (with a reduced tax burden) for the self-employed. On the other hand, populist movements have opposed the implementation of corrective taxation, in particular with reference to climate change, when the burden was mainly borne by losers of globalisation, as in the case of the eco-tax on fuel in France.

Finally, related on the one hand to the renewed emphasis on national interest, on the other to the emergence of new economic powers, the world geopolitical landscape is likely to change in the coming years. One can see the signs of a possible new bipolar order (Murray and Brown 2012), in which the US hegemony is opposed mainly by China (although this opposition might be easily overstated, see Tai 2015). The scenario is also uncertain regarding the position of other countries or groups of countries, starting with Europe, Russia and other regional powers. A new polarized world order could involve significant economic effects, influencing the extension of trade agreements and the cogency of the rules at global level, and it could determine a redefinition of the partners at a commercial level and of the international division of labour (Frieden 2018).

4.3 Summary

Globalisation has had several effects on the economy that are relevant for tax policy. First of all, globalisation has contributed to the decline in the labour share of income and increased the responsiveness of mobile tax bases (capital and high skilled workers) to tax rates. Globalisation has also generated new opportunities for profit shifting for corporations and for tax evasion of wealthy individuals. Lower revenues reduce the ability to finance institutions that provide income insurance or education, both of which have the potential to moderate the impact of globalisation on income inequality.

From the political angle, globalisation has contributed to the emergence of populist political forces. The rise of these forces is linked to globalisation through a variety of channels: the increase in economic insecurity, the unresponsiveness of the political system and the perception of a threat to local or national identity and culture. The emergence of populist forces, combined with the attempt by mainstream political forces to counteract it, could lead to a change in attitudes on tax policy. A stronger orientation towards the national interest could lead to a lower level of cooperation between countries and to a weakening of the drive to enter into multilateral agreements. The same forces may also limit the use of environmental taxes.

The main implications for tax policies are detailed in the following list:

Tax revenues and public expenditures

- Globalisation has significantly affected the tax bases by contributing to the decline in the labour share of income and by increasing the responsiveness to the tax rates.
- The greater mobility of capital and high skilled workers has constrained the ability of the public sector to raise revenue and to do so equitably.
- Globalisation has created new opportunities for tax base erosion and profit shifting (BEPS) by corporations and for tax evasion by wealthy individuals. Uncoordinated
unilateral measures did not succeed in curbing BEPS as multinationals exploit tax differences between different jurisdictions through tax arbitrages.

- Globalisation may have an impact on fiscal multipliers: they are likely to be larger when government purchases are financed by issuing debt to foreign investors. Government expenditure cuts can cause deeper than anticipated recessions in countries where most of the debt is externally held (e.g. Greece).
- In reaction to globalisation, in many countries of Europe and in the US, "populist" political forces have emerged that challenge the existing political and economic order. They may defy fiscal rules (such as the EU rules on budget balance) either by cutting taxes or by increasing public expenditure.

Burden sharing and redistribution

- In the long run, taxes are borne by the most immobile factors (i.e. workers instead of capital, and in particular low skilled workers). Lower revenues also reduce the ability to redistribute income towards those mostly affected by globalisation.
- Theory identifies alternative channels through which globalisation may affect inequality, leading to different and sometimes contradicting predictions. Empirical evidence is also mixed, but some recent papers highlight that globalisation increased inequality in less developed countries. Institutions providing income insurance and education have moderated the effects of globalisation on income inequality in more developed countries.
- Fundamental reforms in the allocation of international taxing rights to coordinate tax policy, like formula apportionment or a destination-based cash flow tax, may produce a significant international redistribution of tax bases.
- The emergence of populist political forces, or the attempts at countering their success, may bring to the introduction of tax expenditures and special tax regimes in favour of specific occupational groups; this would constitute a threat to the overall consistency of the tax system, with possible adverse effects on horizontal equity.

Externalities and competitiveness

- It is possible that the orientation of emerging populist political forces towards the national interest, along with the attempt of traditional parties to counter their success, will lead to a lower level of cooperation between countries, and to a weakening of the drive to enter into multilateral agreements. The effect could be the strengthening of tax competition and an increase in the complexity of international taxation, which could create new opportunities for BEPS by multinationals and tax evasion by wealthy individuals.
- The emergence of populist political forces may limit the use of environmental taxes.

Tax administration

- To the extent that the emergence of populist political forces leads to a lower level of cooperation among states, further measures to facilitate and increase the exchange of information between national tax administrations may be stalled.
4.4 References


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Appendix 4.1: WordScan model and its calibration

The key features of the WordScan model are: i. the model that describes economic activity and behaviour; ii. a set of parameters that drive responses of agents to any given perturbation to the initial equilibrium (e.g. trade elasticities); and iii. the underlying database that accounts for initial equilibrium of the global economy (i.e. the GTAP database). By employing a balanced and internally consistent global database, in tandem with an economic model that describes economic activity for a variety of sectors and agents in the global economy, any change in exogenous variables --for example, a tariff increase-- can be assessed to understand the effects on the endogenous variables in the model. For example, trade policies are assessed by imposing changes in tariffs, additional to a business-as-usual (BAU) scenario or simulation. This counterfactual is compared with the BAU to obtain the potential economic effects of the policy.

The WorldScan model uses the GTAP 9 database (base-year 2011) and distinguishes 29 goods and services sectors, and 30 countries and regions. The model departs from the standard GTAP model by incorporating a monopolistic competition setting and endogenous labour supply mechanisms. In addition, it is a recursive dynamic model that provides year-to-year estimations between 2011 and 2040. We also analyse the effects using assumptions of perfect competition and exogenous labour supply (for more info, see Appendix A).

WorldScan can distinguish as many goods and services markets as are accounted for in its database and describes both a labour market and a capital market. By assumption each producing sector produces one type of good. All goods are produced using labour, capital and intermediate inputs, albeit in different proportions. The relative demand for each of these inputs depends on the characteristics of the sectoral production function. In general, we assume that labour and capital substitute rather well. Although intermediate inputs generally are also good substitutes, there are hardly any substitution possibilities between intermediate inputs on the one hand, and capital and labour on the other hand.

As for capital, international markets for goods and services are linked to each other as well. The demand is not only expressed at the home market, but also at foreign markets. We assume each region to supply a different variety of a good. In principle, customers demand all the varieties. The demand for each of the varieties depends on its relative price, the substitution possibilities between the varieties, transportation costs, trade barriers and preferences for the variety. If the price of a variety goes up, demand will decrease in favour of other varieties. Total demand originates from production at home and abroad.

WorldScan does not model the government in all details. The government collects taxes on labour, other inputs, imports, production, and consumption, while spending on (export) subsidies and consumption.

To construct the BAU simulation, we combine the GTAP9 data with the following: GDP growth per capita projections are region-specific (taken from OECD), which are in the BAU simulation endogenously matched by sector and region specific TFP growth. In other simulations than the BAU, TFP growth is fixed at the estimated values of the BAU simulation. Labour supply ($L_{Sup} \! = \! P_{0t} \times P_{Rt} \times (1 \! - \! \mu_t) \!$) where $P_{0t}$ is total population in year $t$ with Medium Variant projections from United
Nations (UN, 2015) (for non-EU countries) and EuroStat population projections for EU countries. Labour participation rates (PR) are taken from ILO projections.\textsuperscript{61} Long-term unemployment rates ($\mu$) come from EuroStat and World Bank projections. Trade balances are projected to gradually decrease over time. As an initial benchmark we use the updated 2011 net foreign assets data from Lane and Milesi-Ferretti (2001).

Supply and demand are in balance at some equilibrium set of prices and quantities; where workers are satisfied with their wages and employment, consumers are satisfied with their basket of goods, producers are satisfied with their input and output quantities and savings are fully expended on investments. Adjustment to a new equilibrium, governed by behavioural equations and parameters, are driven by price linkage equations that determine economic activity in each product and factor market.

For any perturbation to the initial equilibrium, all endogenous variables (i.e. prices and quantities) adjust simultaneously until the economy reaches a new equilibrium. Constraints on the adjustment to a new equilibrium include a suit of accounting relationships that dictate that in aggregate, the supply of goods equals the demand for goods, total exports equals total imports, all (available) workers and capital stock is employed, and global savings equals global investment; unless adjustments to these assumptions are modified for a particular application.

\textsuperscript{61} From the Economically Active Population Estimates and Projections (EAPEP).
5 Area of environmental externalities

Despite an overall 22% reduction of EU greenhouse gas (GHG) emissions compared to 1990 levels, concentrations of some of the atmospheric GHGs continue rising at record rates, and climate damage is intensifying across the planet. In 2017, the CO₂ concentration in the atmosphere reached a record level, 0.5% higher than a year earlier and 41% higher than in 1990 according to the latest report by the World Meteorological Agency (WMO, 2018). In response to these on-going rapid climate and other environmental developments, the World Economic Forum (WEF, 2019) has identified five critical categories of risks: extreme weather events; accelerating biodiversity loss; pollution of air, soil and water; failures of climate change mitigation and adaptation.

Climate change and other environmental externalities are some of the most significant areas of structural changes, potentially affecting the basic functions of taxation listed in section 5.1. At the same time, the division between climate change and other environmental externalities is not always clear as often individual drivers triggering climate changes, also impact other environmental externalities, such as water pollution. Effectively, while proceeding with their forecasts and scenarios, various climate-oriented institutions, as well as the European Commission (EC) bodies, typically address all the climate- and environment-related drivers together. For example, the EC compiled a common list of “indicators of climate change and environmental degradation”. Nonetheless, for the purpose of this chapter, we identify temperature and precipitation pattern changes resulting from GHG emissions as predominantly related to climate change. Subsequently we identify ecosystem services including biodiversity loss, air and water pollution, as well as waste increase as related to other environmental externalities. This division has been selected and imposed in order to sharpen some interactions between respective drivers, tax functions and tax implications (see Figure 5.1. below). Moreover, it reflects the already mentioned five critical categories of risks identified by the WEF by decomposing them into prime factors.

This chapter identifies and describes links between concrete drivers affecting climate and environment-related changes and their impacts on the basic functions of tax systems. Figure 5.1 illustrates these links. It should be noted that different drivers often affect the same functions of taxation. For instance, policies promoting the use of renewable energy sources (RES) may reduce both the emission of GHGs and mitigate other environmental externalities, like air pollution.


For the purpose of this chapter, the Organisation for Economic Co-operation and Development (OECD) terminology regarding environmental externalities has been used. In this respect, externalities “refer to the economic concept of uncompensated environmental effects of production and consumption that affect consumer utility and enterprise cost outside the market mechanism. As a consequence of negative externalities, private costs of production tend to be lower than its “social” cost. It is the aim of the ‘polluter/user-pays’ principle to prompt households and enterprises to internalise externalities in their plans and budgets.”

Section 5.1 first discusses the implications of changes in temperature and precipitation, as well as biodiversity, air and water pollution, and waste, and provide the most common projections for their development. As many of these environmental issues are not EU-specific but global challenges, the EU and worldwide projections and targets (i.e. United Nations Sustainable Development Goals – UN SDGs/2030 Agenda) will be clearly separated where possible. Section 5.2 considers actions related to internalisation of externalities via taxation and other policies. It also includes a discussion of how distributional issues may influence the design of environmental taxation. Section 5.3 focuses on certain mediating factors, that are ultimately influenced by the drivers identified in section 5.1 and describes how these factors may relate to taxation. Mediating factors are understood as variables that link the independent and the dependent variables, and whose existence typically explains the relationship between the other two variables (i.e. biodiversity loss continues if tangible taxation and other policies are not in place; energy prices grow if the infrastructure capacities are not modernised). As the exact energy mix for 2030 and 2050 remains unknown given quick and stable developments in green technologies, a focus is put on energy use and prices on which the mix eventually depends. Section 5.4 considers the implications on tax revenues and public expenditures. The last section again summarises the tax implications.

While this chapter is almost entirely based on existing literature, we also refer to the results of own simulations derived with the use of the Input-Output model and to the remarks from interviews with high-level practitioners. The interviews focused on understanding the practical implications of climate change and environmental policies. The appendix provides technical consideration regarding the model and a brief overview of the interviews.

Figure 5.1. Tax implications of climate change and environmental externalities

Source: own elaboration
5.1 Major sub-areas of change

5.1.1 Climate change related developments resulting from GHG increases

The trends in emissions of all GHGs identified in the Kyoto protocol as the most crucial (i.e. carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆) and natrium trifluoride (NF₃)) set the background for the climate-related scenario building and predictions for the future given their influence and interlinkage with other drivers.⁶⁵ This international agreement, which is linked to the United Nations Framework Convention on Climate Change (UNFCCC) and entered into force in 2005, not only indicated the main GHGs, but also imposed more restrictions and responsibilities on developed countries, in line with the principle of “common but differentiated responsibilities”.⁶⁶

Despite the Kyoto agreement, according to the EEA estimates the total concentration of all GHGs reached a value of 449 parts per million (ppm) in CO₂ equivalents in 2016 — an increase of more than 4 ppm compared to the level in 2015, and 33 ppm more than 10 years ago.⁶⁷ According to the Integrated Carbon Observation System (ICOS, 2019), these increased concentrations, which are predominantly caused by human activities (fossil fuel combustion, deforestation, etc.), lead to higher temperature, more regular occurrence of weather extremes, and also destruction of biodiversity.

While the EEA projections showing that existing policies and measures are expected to result in a reduction in emissions of 30% by 2030 (compared with 1990 levels)⁶⁸, one needs to keep in mind that these estimated declines still are far below the 40% target of emissions reduction by 2030, as presented in Figure 5.2 below.

Figure 5.2. Greenhouse gas emission trends, projections and targets in the EU

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⁶⁵ “The driving forces behind GHG (e.g. increased energy use, etc.) are not discussed here, nor are the impacts of climate change on human activities”, which is aligned with the EU-wide approach: [https://ec.europa.eu/eurostat/statistics-explained/index.php/Greenhouse_gas_emission_statistics#Trends_in_greenhouse_gas_emissions](https://ec.europa.eu/eurostat/statistics-explained/index.php/Greenhouse_gas_emission_statistics#Trends_in_greenhouse_gas_emissions)

⁶⁶ For more information see: [https://unfccc.int/kyoto_protocol](https://unfccc.int/kyoto_protocol)


It can thus be outlined that in spite of the overall progress related to decrease in GHGs emissions, atmospheric GHGs concentrations are still increasing rapidly. A number of projections can be made. As an example:

1. Recent trends in emission reductions suggest that achieving climate-related goals will be rather challenging. Current pledges and some emissions on pace to rise (in the EU, particularly due to rising emissions from transport)\(^{69}\), put the world on pace for around 3 degrees Celsius of warming by 2100. During COP24 it has been estimated that in order to reach the so-called “Paris goals”, countries need to quickly (within next 12 years) transit towards clean energy.

2. On the other hand, if the trends from 2008-2016 (the time horizon with detailed emissions data in Eurostat) in emission intensity were to continue, despite economic growth, the aggregate CO\(_2\) emissions in the EU would fall by 30% by 2040 (wrt 2016).

3. There are sectors, in which emission intensity of CO\(_2\) have been stagnant or even increasing since 2008, thus adaptive forecast point to increase in emissions (e.g. agriculture).

4. Along similar lines, for the third time in a row, in 2017 emissions in sectors covered by the Effort Sharing increased, mostly due to higher oil consumption in the road transportation sector.\(^{70}\) Heavy-duty vehicle emissions and real driving emissions are very likely to decrease given recently applied strict legislative measures aimed at helping to reverse the current upwards trend in these particular emissions.


\(^{70}\) Ibidem
5. Waste emissions have been decreasing steadily, particularly as a result of reduction in emissions from solid waste disposal.\textsuperscript{71} They are expected to decrease further.

6. Emission of N\textsubscript{2}O and PFC are expected to increase due to expected growth in agriculture (a large share of N\textsubscript{2}O emissions are attributed to the agriculture sector; a smaller one to transport, business, waste and LULUCF sectors; minor share is resulting from the industrial processes and the residential sectors), and from halocarbon production and the electronics industry.\textsuperscript{72}

Table 5.1 below presents forecasted change in emissions in 2040.

Table 5.1. Forecasted change in emissions 2040 vs. 2016.

<table>
<thead>
<tr>
<th></th>
<th>CO\textsubscript{2}</th>
<th>N\textsubscript{2}O</th>
<th>PFCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products of agriculture, forestry and fishing</td>
<td>42%</td>
<td>48%</td>
<td>74%</td>
</tr>
<tr>
<td>Mining, quarrying and manufacturing</td>
<td>-2%</td>
<td>-4%</td>
<td>4%</td>
</tr>
<tr>
<td>Utilities</td>
<td>-58%</td>
<td>-37%</td>
<td>34%</td>
</tr>
<tr>
<td>Constructions and construction works</td>
<td>14%</td>
<td>14%</td>
<td>20%</td>
</tr>
<tr>
<td>Trade</td>
<td>-20%</td>
<td>-18%</td>
<td>37%</td>
</tr>
<tr>
<td>Transport and postal</td>
<td>13%</td>
<td>10%</td>
<td>48%</td>
</tr>
<tr>
<td>Accommodation and food services</td>
<td>-48%</td>
<td>-48%</td>
<td>56%</td>
</tr>
<tr>
<td>Information and communication services</td>
<td>5%</td>
<td>6%</td>
<td>38%</td>
</tr>
<tr>
<td>Financial and insurance services</td>
<td>51%</td>
<td>63%</td>
<td>44%</td>
</tr>
<tr>
<td>Real estate services</td>
<td>-33%</td>
<td>-33%</td>
<td>40%</td>
</tr>
<tr>
<td>Professional, scientific and technical services</td>
<td>-34%</td>
<td>-36%</td>
<td>36%</td>
</tr>
<tr>
<td>Other services</td>
<td>-45%</td>
<td>-33%</td>
<td>47%</td>
</tr>
<tr>
<td>Households</td>
<td>-58%</td>
<td>-58%</td>
<td>40%</td>
</tr>
<tr>
<td>Total</td>
<td>-30%</td>
<td>31%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Source: own elaboration

Although the set of different implications is large and spans from desertification to sea levels rise, we focus below on changes in temperature and precipitation patterns, as they are likely to have particularly important effects on taxation.

5.1.1.1 Changes in temperature patterns

The 2015 and 2018 Conference of the Parties (COP) meetings of the UNFCCC gave new impetus to come up with an internationally binding deal leading to a limitation of the temperature increase to 1.5 degrees Celsius above pre-industrial levels. However, there is a high degree of consensus in the international community of researchers that the chances of the temperature increase staying below 1.5°C are very small, perhaps just around 1%. (Tyszczuk and Smith, 2018). As one of the experts interviewed suggested, it may still be technologically possible to stay below the 1.5°C temperature increase, but this would require a broader consensus among the global and EU-wide players — a rather unlikely scenario for the time being. This is particularly important for the EU, where values in almost all projections on the temperature rise exceed even the initial target of 2 degrees Celsius set by the UN bodies. Indeed, according to the EEA,

\textsuperscript{71} Ibidem

\textsuperscript{72} See Appendix 5.3 for assumptions made in the I-O analysis.
the last decade has been the warmest one for Europe. Between 2008 and 2017, the average temperature increase in Europe varied between 1.6 and 1.7 degrees Celsius compared to the pre-industrial level.\textsuperscript{73}

The Third Assessment Report of the Intergovernmental Panel of Climate Change (IPCC) concluded that there were many gaps related to the global assessment of temperature extremes and the indicators used even across the EU were far from unified. To answer this ambiguity-related problem, the Expert Team on Climate Change Detection and Indices (ETCCDI) launched a series of technical expert meetings in data sparse areas of the globe to fill in these gaps and unify the ways in which temperature extremes can be assessed (Peterson and Manton, 2008). As a result of the multiple regional seminars organised by the ETCCDI, a vast list of 27 indicators linking data on daily temperature and precipitation patterns have been agreed so that more extreme ends can also be taken into account (Zhang et al., 2011).

Despite various methods and modelling techniques, some predictions are widely popular among the experts. For example, from the King and Karoly study (2017), we find out that the temperature increase in Europe will be higher than in other continents and it is believed to substantially exceed 2 degrees Celsius, unless some new technologies combating global warming are in place in the near future. Their report is in accordance with the EEA estimates where “climate models project further increases in global average temperature over the 21st century (for the period 2081–2100 relative to 1986–2005) of between 0.3°C and 1.7 °C for the lowest emissions scenario (RCP2.6) and between 2.6°C and 4.8°C for the highest emissions scenario (RCP8.5)”\textsuperscript{74} Regardless of the source of predictions, the strongest warming is projected in the north-eastern Europe and Scandinavia in winter and southern Europe in summer.

Figure 5.3. EU temperature projections for 2050

\textsuperscript{73} For more information see: https://www.eea.europa.eu/data-and-maps/indicators/global-and-european-temperature-8/assessment

\textsuperscript{74} For more information see: https://www.eea.europa.eu/data-and-maps/indicators/global-and-european-temperature-8/assessment
5.1.1.2 Changes in precipitation patterns

While heavy precipitation is growing in some regions across the EU, in the Mediterranean Basin the periods without rain are becoming longer each year (EEA, 2017a) as presented in Figure 5.4. below. Heavy rainfall led to floods in 50 of the 53 countries of the World Health Organisation (WHO) European Region in the last 10 years (Menne and Murray, 2013). Droughts combined with high temperatures leading to unexpected fire events in the southern parts of the continent are equally destructive (e.g. Greece and Portugal in 2018). Eventually wildfires in the summer can be linked with higher precipitation during winter as the trees’ humidity makes it difficult to handle fires with regular fire practice (Hamadeh et al., 2017).

All in all, on a daily basis, extreme rainfalls are more and more common in Europe, even in regions with decreases in mean rainfall such as the Mediterranean coast. Moreover, there is evidence that since the 1960s, heavy precipitation throughout the year is common for the northern and north-eastern Europe. Continuous rains will almost certainly become more frequent and stronger in most parts of Europe, particularly in Scandinavia and eastern Europe in winter. Evidence from high-resolution climate models suggests that “the intensity of sub-daily extreme rainfall is likely to increase in the future”. Maraun (2013) adds that precipitation “averaged to larger scales”, will emergence quicker – most likely within the next decade.

Correspondingly, in the Mediterranean region lower precipitation will lead to longer and sudden droughts (Fischlin et al., 2007) and in other countries, higher precipitation will be an equivalent of regular floods, impacting the quality of water, air, and soil and forcing people to migrate. As a result of recent changes in precipitation in Europe, 33 thus far exotic infectious diseases are considered climate-sensitive and are expected to start occurring in the Mediterranean Basin (Wolf et al., 2013). For example, the threat of dengue in Europe, has been heavily discussed in recent years with recently reported dengue cases in Croatia, France and Portugal (WHO Regional Office for Europe, 2014) posing a real threat for European societies.

Figure 5.4. Projected change in annual and summer precipitation in the EEA countries

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75 See: [https://climate4impact.eu/](https://climate4impact.eu/)
Climate change is not the only environmental trend degrading our planet. Examples of other human actions leading to a more polluted and ecologically degraded world are multiple. The theory of public goods and the concept of “natural capital” have gained a strong societal and political interest in recent decades. This results from a greater understanding that provision of ecosystem services as well as absorption of emissions and waste is crucial for sustainable economic growth and overall well-being of the country citizens. Out of core types of capital that countries need in order to develop (financial, natural, produced, human, and social), natural capital can be thus considered indispensable as it provides elementary necessities for our existence, such as food, water and fresh air. Essentially, living without natural resources would not be possible. Despite the importance of ecosystem services, they are still not fully accounted in national wealth accounting systems.

At the same time, misuse and mismanagement of natural capital often takes place at various levels of decision-making processes because its importance is not reflected in the prices that individuals or organizations face. Due to this underestimation, the EEA warns that most European ecosystem services will not be in position to provide a sufficient quality of basic services in the upcoming decades.

Table 5.2. illustrates the 2015 EEA estimates in this respect. They suggest that in many areas, ecosystem services have been degrading over time. The complexity of natural systems and the irreversibility of many environmental changes mean that replacing natural capital with other products, solutions or processes is often impossible.

Below, a selection of four pressing issues related to ecosystem services is presented. The examples have been chosen based on their potential importance for taxation. As in the case of

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climate change-related drivers, the list is not exhaustive and serves mainly as a point of reference.

Table 5.2. Ecosystem services in the EU

<table>
<thead>
<tr>
<th>Services</th>
<th>Ecosystems</th>
<th>Agro ecosystems</th>
<th>Forests</th>
<th>Grasslands</th>
<th>Heath and scrubs</th>
<th>Wetlands</th>
<th>Lakes and rivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provisioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crops/timber</td>
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<td>↑</td>
<td>↑</td>
<td>↓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock</td>
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</tr>
<tr>
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<tr>
<td>Capture fisheries</td>
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<tr>
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<tr>
<td>Pollination</td>
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<tr>
<td>Climate regulation</td>
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<tr>
<td>Pest regulation</td>
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<tr>
<td>Erosion regulation</td>
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<tr>
<td>Water regulation</td>
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<tr>
<td>Water purification</td>
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<tr>
<td>Hazard regulation</td>
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<tr>
<td>Cultural</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Recreation</td>
<td>↑</td>
<td>=</td>
<td>↓</td>
<td>↑</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aesthetic</td>
<td>↑</td>
<td>=</td>
<td>=</td>
<td>=</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Status for period 1990–present**

- Degraded
- Mixed
- Enhanced
- Unknown
- Not applicable

**Trend between periods**

- Positive change between the periods 1950–1990 and 1990 to present
- Negative change between the periods 1950–1990 and 1990 to present
- No change between the two periods


### 5.1.2.1 Biodiversity loss

Even though the European continent is biodiversitically rich, the deployment of species and ecosystems varies significantly. While the least richness is typical for the northern areas, the most biodiversitically interesting spots can be found in the Mediterranean Basin and on the margins of Europe. According to the EEA, almost every European Member State (MS) has some endemic species (species found nowhere else) with around 5000 plants being endemic to individual countries across the continent. At the same time, a significant number of endangered species can be found in more than one country. Since many of the domesticated plants were discovered in countries other than those where they are cultivated these days, the

genetic material that is needed to sustain the habitat in case of its possible extinction is oftentimes found in other countries or even continents. This implies the necessity of developing cooperation schemes at the international level.

Biodiversity plays a key role in the functioning of biological ecosystems and the provision of the above-mentioned ecosystem services which are essential for human life and well-being. Nevertheless, biodiversity's fundamental importance for countries citizens is often ignored despite global agreements responding to the looming threats of its loss (i.e. the Aichi Biodiversity Targets and SDGs). Biodiversity continues to be threatened, also in the EU, resulting in general degradation of ecosystem services. Biodiversity levels are declining largely due to intensive agriculture and forestry practices used to increase the provision of food and biomass-based fuels. Recent data (EEA80) shows that 60% of species assessments and 77% of habitat assessments are endangered. Regular habitat loss, over-exploitation of resources, air pollution as well as global warming are to blame. Moreover, according to the OECD (2018b), despite regulatory endeavours within the Aichi Convention on Biological Diversity enabling implementation of “positive incentives for the conservation and sustainable use of biodiversity”, including biodiversity-relevant taxes and fees, data on actions undertaken is only now becoming available.

5.1.2.2 Air pollution

Air pollution has complex and problematic impacts on public health. The statistical estimates presented by the EEA (2017b) suggest that air pollution (excluding CO₂ emissions) was responsible for approximately 428 000 premature deaths in 2014. Air pollutants can be emitted either from anthropogenic or natural sources. They can also be emitted either directly (primary pollutants) or formed as a result of chemical interaction between precursor substances in the atmosphere (secondary pollutants). Additionally, there is a consensus that road transport emissions are more harmful than others, as they happen closer to the ground and often in densely populated areas.

The EU Air Quality Directive requires all the countries to implement air quality management legislation and tools which will be warning responsible authorities whenever air quality standards are exceeded. These political commitments detailed in country strategies aim to reduce concentrations of air pollutants to below the legislative limit and target values specified in the Directive in the shortest possible time. Other worldwide-agreed air quality policies continue to bring many improvements. Reduced amounts have progressed the overall air quality in many EU MS, and, for a number of pollutants, exceedances of European standards are rare. However, negative impacts on human health and productivity as well as environment are still serious. A significant percentage of European population, particularly in Poland and Bulgaria, where smog is particularly serious in autumn, winter, and early spring, is still exposed to air pollution that exceeds European standards and, especially, the WHO Air Quality Guidelines (AQGs).

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80 For more information see: https://www.eea.europa.eu/soer-2015/europe/biodiversity
5.1.2.3 Water pollution

Changing water quantity and quality will have significant adverse effects and will require new and innovative ways of managing limited water sources. In general, the quality of water (for various purposes) across the EU improved during the last two decades, with an increasing share of population having access to all water facilities. However, the pollution from sources such as cosmetics, municipal and industrial waste, agriculture products, as well as marine debris increases, poses a threat to people, animals (i.e. drinking water) and plants (agriculture).

This is especially problematic in regions where water resources are already limited. According to the EEA, ca. 30% of the European land (particularly in Greece, Portugal and Spain) is currently threatened by some sort of water stress conditions. Additionally, more significant water pollution and stress is expected due to tourism, agriculture and increasing temperatures ultimately leading to more frequent water shortages.

5.1.2.4 Waste

Recycling as well as turning waste into a resource are key concepts for achieving an EU-wide circular economy. The EC underlines that recently set “objectives and targets set in European legislation have been key drivers to improve waste management, stimulate innovation in recycling, limit the use of landfilling, and create incentives to change consumer behaviour. If we re-manufacture, reuse and recycle, and if one industry’s waste becomes another’s raw material, we can move to a more circular economy where waste is eliminated and resources are used in an efficient and sustainable way.” Despite the fact that well-managed recycling activities as well as municipal waste management have a positive impact on everyday lives of EU citizens, no single country across the continent can be considered fully “circular economy-friendly” as of yet.

The amount of waste in the EU has been steadily growing in recent years despite increasing citizen’s awareness and the Commission’s initiative to reduce waste. In 2017, the amount of waste produced across the whole EU stood at 249,238 tonnes (or 487kg per person), compared to 242,195 tonnes (or 479kg per person) in 2013, according to the EC statistics.

The long-term assessments of reducing the waste generated in the EU are uncertain despite a shift to a circular economy legislation in place. At the same time, the EC underlines that landfilling of waste is in contrary to the circular economy concept and generally leads to increased air, water and soil pollution. Therefore, efforts in safeguarding circular economy are planned to be linked with a budget share of the next Multiannual Financial Framework (MFF). As an example, the EC proposes introduction of a new own resources for MS consisting of national contribution on the basis of the amount of non-recycled plastic packaging waste. At the more local level, the EC highlights the need of a stable waste reduction – municipal waste preparing for re-use/recycling target of: “55% to be achieved by 2025, 60% by 2030 and 65% by 2035. The
revised Packaging and Packaging Waste Directive introduces a new plastic packaging recycling target of 55% to be reached by 2030. Moreover, by 2022 a special type of collection of hazardous waste from domestic use needs to be provided, followed by bio waste in 2023 and by collection of textiles in 2025 posing another serious obligations for municipalities which will need to secure enough funds to manage such a complex operation. Although the growth of waste is slower than GDP growth, prompt actions linking waste taxes into a holistic waste management strategies and recycling guidelines might be necessary at the EU MS level to minimise the waste and maximise the recycling rates and push the circular economy forward.

5.2 Climate change mitigation policies

5.2.1 Tax policies

Among other things, the problem of environmental externalities stems from the fact that households and companies are not sufficiently concerned about the environmental impacts and that costs are not incorporated by the polluter (Pigou, 1920). Thus, if externalities are not sufficiently integrated into the price systems, they lead to a “market failure”. Therefore, the use of pollutants is too large and external costs are shifted to the society. Environmental taxes that internalise negative externalities can be used to resolve these types of problems. Due to their goal of meeting efficient market outcomes, these taxes are classified as Pigovian-type. According to Eurostat, an environmental tax is a tax whose tax base is a physical unit (or a proxy of a physical unit) of something that has a proven, specific negative impact on the environment, and which is identified by ESA as a tax, i.e. compulsory, unrequited payments levied by general government or, in a few cases, by the EU institutions.

Environmental taxes can play a key role in internalising environmental externalities. When compared to regulatory instruments, one advantage of taxes is the possibility to reduce the externalities up to the point where the marginal cost of pollution abatement is equal to the additional costs of tax. Moreover, as in the case of other market-based instruments, polluters have the flexibility to choose the method of abatement (Kosonen and Nicodeme, 2009).

In the case of climate change, the Pigovian approach calls for a tax on all CO₂ and other GHG emissions, at least in sectors where other policies do not restrict emissions. Taxation may also be needed to internalize the externalities related to how land use affects soil and forest carbon stocks. In the EU, however, a large part of production is covered by the EU emissions trading systems (ETS). ETS imposes a price on emissions that is equal to the price of buying or selling a permit for emitting a given amount of CO₂. Taxes on GHG emissions, or carbon taxes for short, are thus needed in the sectors outside the ETS. Major industries outside the ETS include transport, agriculture, and housing.

The value of the negative externality associated with CO₂ and other GHG emissions is difficult to estimate as it covers a wide range of various costs described in section 5.4.2. Moreover, the costs are borne long after the GHGs are emitted to the atmosphere. The difficulty of evaluating the social costs of carbon are signalled by the dispersion of estimates in the empirical research.


87 For more information see: [https://ec.europa.eu/eurostat/web/environment/environmental-taxes](https://ec.europa.eu/eurostat/web/environment/environmental-taxes)
According to Tol (2010), the mean estimate of marginal cost of carbon in 232 relevant studies was USD 105 per metric per tonne of CO₂, whereas the mode was USD 13. While some research points to social costs of carbon at more than USD 1000 per tonne of CO₂, one of the most influential analyses, by Nordhaus (2017), offers a much more modest figure of USD 31 per ton of CO₂ (in 2010 USD for 2015). Since there is a lot of uncertainty around the value of externalities, the scale of the need for internalisation is also uncertain. The wide dispersion of estimates results from multiplicity of assumptions that need to be made regarding e.g. future emissions, patterns of warming, sensitivity of human health and productivity, and many others.

While the proper level of carbon taxation is uncertain, its optimal structure is in principle clear. Since climate change involves a global externality, meaning that the externality associated with emitting GHGs does not depend on where the emissions take place, the price that different emitters face should be the same. Uniform pricing minimises the aggregate cost of abatement of emissions by equalising marginal abatement costs. In the EU, this argument calls for uniform carbon taxation outside the ETS. Moreover, carbon prices outside the ETS should in principle also be in line with carbon prices inside the ETS. However, the carbon price in the ETS is still relatively low (around EUR 25 per ton of CO₂ in June 2019).

Currently, we are very far from uniform carbon pricing. OECD (2018a) has estimated the price of carbon emissions from energy use by summing up specific taxes on fossil fuels, carbon taxes and prices of tradable emission permits in OECD countries. The results show that prices vary hugely – from around zero to several hundreds of EUR per tonne of CO₂ - both between industries and countries. The variation is very large also within EU countries.

It should be noted that the theoretical case for uniform carbon pricing assumes that there are no externalities other than the one related to climate change. For instance, road traffic may create other negative externalities, such as local air pollution and congestion. Such additional externalities justify higher fuel taxes.

Environmental taxes may also be used to internalise other environmental externalities discussed above. However, designing related tax policies may be more complicated than in the case of a carbon tax. One reason for this is that these externalities are more local in nature and the costs associated with similar activities may be distinct in different areas. This also means that the optimal tax rates on the same activities may vary between countries and its respective regions and cities. Moreover, some of the most relevant activities, e.g. agriculture and land use in the case biodiversity loss, are already heavily affected by regulation-based policies as well as various subsidies.

Nevertheless, environmental taxes could have a much bigger role in mitigating other environmental externalities as well. Some of the externalities related to biodiversity could be tackled through land taxation that imposes a higher tax rate on converted land than to natural land. Lafuente et al. (2018) argue that land taxes would be particularly helpful in internalising biodiversity-related externalities under unpredictability of ecological dynamics. Water pollution taxes (or effluent fees) in turn are frequently proposed by as a cost-effective way to achieve goals related to water quality (Boyd, 2003).

Waste taxes in turn could be used to reduce waste and promote the circular economy. The circular economy ideates a transition from a linear “take-make-dispose” system to a model
where each product’s material is a resource for something new, therefore the notion of waste disappears. This could imply entirely new taxation schemes where “less renewable” goods are taxed more heavily.

As depicted by Table 5.3., the list of taxes which are already introduced across the EU, and that could be used to internalise externalities, is broad. These taxes could be grouped as energy (including fuel for transport), transport (excluding fuel for transport), pollution and resource taxes (see Eurostat, 2013).
Table 5.3. Examples of environmental taxes and fees already introduced across the EU

<table>
<thead>
<tr>
<th>Air pollution fees and taxes: Czech Republic, Hungary, Slovakia, Sweden</th>
<th>Waste, resources &amp; circular economy</th>
<th>Water quality &amp; marine litter</th>
<th>Water stress &amp; availability</th>
<th>Biodiversity &amp; land use</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Landfill taxes and gate fees: Austria, Greece, UK</td>
<td>• Wastewater fee: Poland</td>
<td>• Water abstraction charges: Bulgaria, France</td>
<td>• Forestry-related fees/charges: Austria, Croatia, Slovenia, Spain</td>
<td></td>
</tr>
<tr>
<td>• Incineration taxes: Sweden and UK</td>
<td>• Pesticide/fertilizer/phosphorus taxes/charges: Denmark, Italy, Sweden</td>
<td>• Water pricing: Cyprus, Malta, Portugal, Netherlands</td>
<td>• Biodiversity offsetting: Germany</td>
<td></td>
</tr>
<tr>
<td>• Pay-as-you-throw schemes: Benelux</td>
<td>• Packaging charges/taxes/deposit refund: Belgium, Finland, Latvia, Romania</td>
<td>• Packaging charges/taxes/deposit refund: Belgium, Finland, Latvia, Romania</td>
<td>• Result-based agri-environment measures: Germany</td>
<td></td>
</tr>
<tr>
<td>• Packaging/charges/taxes/deposit refund: Belgium, Finland, Latvia, Romania</td>
<td>• Aggregates levy: UK</td>
<td>• Plastic bag levy: Ireland</td>
<td>• Peatland tax reform: Finland</td>
<td></td>
</tr>
<tr>
<td>• Plastic bag levy: Ireland</td>
<td>• Environmental/natural resources charges: Belgium, Estonia, Lithuania</td>
<td>• Environmental/natural resources charges: Belgium, Estonia, Lithuania</td>
<td>• Hunting and fishing-related fees/taxes: Estonia, Ireland</td>
<td></td>
</tr>
<tr>
<td>• Environment/natural resources charges: Belgium, Estonia, Lithuania</td>
<td>• Aggregates levy: UK</td>
<td>• Aggregates levy: UK</td>
<td>• Ecological fiscal transfers: Portugal</td>
<td></td>
</tr>
<tr>
<td>• Taxes on batteries: Belgium, Italy and Hungary</td>
<td>• Taxes on fertilizers: Austria, Finland and Sweden</td>
<td>• Taxes on fertilizers: Austria, Finland and Sweden</td>
<td>• Taxes on fertilizers: Austria, Finland and Sweden</td>
<td></td>
</tr>
</tbody>
</table>
Higher environmental taxation allows for changing the overall tax structure. As classified by Ekins and Speck (2011), the Environmental Tax Reform (ETR) is a term describing a partial shift from taxing income taxes, social security taxes and fees as well as capital (e.g. corporation taxes) to taxing those areas negatively impacting the environment such as resource depletion and pollution. ETR aims shifting tax burden to industries producing negative externalities. Effectively, if implemented cautiously, ETR is believed to increase human well-being in two ways: improving the environmental protection and generating economic activity and equality, mainly thanks to new, green employment possibilities. It should be noted, however, in order to mitigate climate change, GHG emissions should decline relatively fast. As a result, the tax base for carbon taxes should be decreasing.

5.2.2 Non-tax policies

Collective actions undertaken by relevant stakeholders might be reflected in increasing importance of non-tax public policy instruments tailored to mitigate the risks resulting from rising concentrations of atmospheric GHGs at the national level. Broadly defined SDGs or Paris Agreement conclusions (the UN level) set the ground for the overall EU policy commitments and targets which then require specific actions from single MS. It can thus be concluded that despite differences in substance of climate agreements and other environment-related international commitments, these agreements oftentimes focus on similar problems and needs and therefore should not be treated separately.

Figure 5.5. Example of a simplified climate-related policy-making scheme (based on Polish energy policy by 2040 case study)
Overall, the potential public policy responses could be grouped (OECD, 2015a) as follows:

1. Subsidies and fiscal incentives, ETS;
2. Regulatory standards;
3. Improving competitiveness of low-emission alternatives;
4. Strong incentive to innovate.

### 5.2.2.1 Subsidies and fiscal incentives, ETS

Subsidies for fossil fuels (for concrete purposes or for concrete groups) currently take up a significant share of national budgets. The global value of fossil fuel subsidies dropped from USD 500 billion to USD 325 billion between 2014 and 2015, in part due to subsidy reform (IEA, 2016). In the EU, the value of fossil fuel subsidies reached EUR 55 billion in 2017 and saw a slight increase in the period 2008-2016 due to growing consumption of transport services and agricultural products. Clearly, one way towards more efficient carbon pricing is to reduce these subsidies.

The average yearly value of subsidies to renewables and other subsidies in pursuit of climate goal (in that energy efficiency, feed-in tariffs\(^8\) (FiT) for electricity generation from

\(^8\) For the purpose of this research feed-in tariffs (FiTs) are understood as “generation-based, price-driven incentives. The price that a utility or supplier or grid operator is legally obligated to pay for a unit of
microgeneration technologies), in the EU has tripled over the period 2008-2016, and amounted on average to over EUR 75 billion in 2017 constant prices. In 2016, 33% of these interventions in the EU took a form of tax expenditure, whereas the other had a form of transfers or were directly financed from R&D budgets (DG ENER, 2018).

As mentioned above, in the area of climate change, the ETS plays an important role in the EU. Compared to carbon taxes, cap and trade systems (like the ETS) have many similarities. They are both intended to correct for market failures, both put a price on carbon, and both generate revenue for governments. An important difference between the two is in certainty about outcomes. Last year, the global value of cap and trade systems amounted to EUR 144 billion.\(^89\) As the largest such system in the world, EU Emission Trading System (EU ETS), has generated about 15.8 EUR billion revenue to EU MS from the auctioning of allowances over the period 2013-2016.\(^90\) The scheme works by setting a cap (determining the potential number of permits on the market) on emissions and for the emitters who need to request permits for the CO\(_2\) they emit. In case of lack of permit, emitter is obliged either to buy additional permits from other actors, or simply stop emissions. This means that a cost is imposed on emissions, equal to the price of buying or selling a permit. The main difference between EU ETS and carbon tax is that in the latter the cost is the outcome of the emissions, without any caps. The ETS scheme works by setting a cap (determining the potential number of permits on the market) on emissions and for the emitters who need to request permits for the CO\(_2\) they are responsible for. In case of lack of permit, emitter is obliged either to buy additional permits from other actors, or simply stop emitting. This means that a cost is imposed on emissions, equal to the price of buying or selling a permit. Unlike in the ETS, under a carbon tax it is the price that determines the level of emissions, not the cap.

While in academic discourse carbon taxes and EU ETS are typically presented as alternatives which are not necessarily complementary, across the EU, both instruments are oftentimes implemented to address emissions stemming from different sources (Haites, 2018). What is more, apart from ETS and carbon tax, EU MS have a range of other policies affecting its pollutants. The forms and phases of EU ETS have changed dramatically based on the needs, institutional experience as well as projections. Carbon taxes have thus far evolved based on purely individual experiences. However, perhaps, as it was with the EU ETS, these will evolve with time, ultimately becoming the coherent and market-driven “EU carbon border taxes”.

As for the ETS, at the beginning of the current trading period, manufacturing industry received 80% of its allowances for free. Previously, within the 2008-2016 period, free emission allowances


\(^90\) For more information see: https://ec.europa.eu/clima/policies/ets_en
in EU ETS fell from EUR 41 bn to EUR 4 bn (DG ENER, 2018). The proportion of free allowances will decrease gradually each year to 30% in 2020. The increasing role of the EU ETS is marked by the prices of EU Allowances (EUAs) on secondary markets. In April 2019, price in EUR/tCO$_2$ has reached EUR 25, approximately five times more than 24 months earlier.\textsuperscript{91} EU carbon prices are expected to further increase (see section 5.4.3). According to Carbon Tracker, the price will double by 2021 and could quadruple to EUR 55 a tonne by 2030.\textsuperscript{92} According to the EU reference scenario\textsuperscript{93}, ETS price will be increasing to reach EUR 78 per tonne in 2040 and EUR 100 in 2050. However, even after such a significant increase, carbon prices will be lower than the mean estimate of externalities caused by CO$_2$ emissions in the literature, which is USD 105 per metric per tonne of CO$_2$ (see section 5.2 for more detailed discussion). Assuming that the carbon price will increase in accordance with the EU reference scenario, total value of the ETS auctioned in 2040 would reach approximately EUR 50 billion.\textsuperscript{94} As depicted by Figure 5.6., most significant increase of over 10 times is forecasted for manufacturing of basic metals and air transport. This is due to rapidly growing output of these sectors, increasing price of allowances and anticipated modest decline in emissions per EUR 1 output. ETS revenue in manufacturing of chemical products is expected to increase much slower that in the other major sectors covered by ETS (by roughly 200%).

Figure 5.6. Forecasted change in ETS revenue for major sectors covered (2040 vs. 2016)

\begin{center}
\includegraphics[width=\textwidth]{figure56.png}
\end{center}

Source: own elaboration

\textsuperscript{91} For more information see: https://www.eex.com
\textsuperscript{92} For more information see: https://www.carbontracker.org/eu-carbon-prices-could-double-by-2021-and-quadruple-by-2030/
\textsuperscript{94} See Appendix 5.2 for details of the forecast.
5.2.2.2 Regulatory standards

The issue of policy alignment plays a crucial role. Core climate-oriented responses are fundamental, and yet not sufficient to effectively tackle climate change, if our regulatory standards and regulatory elements are to be geared towards fossil fuels. The issues related to regulatory inadequacy, among others, may include: lack of recognition of the need to adapt legislation to challenges related to climate change; the fact that oftentimes regulatory framework only applies to new infrastructure and does not apply to existing sites; lack of harmonisation and fragmentation of approach within and between jurisdictions, and regions; inability to review regulations or standards with sufficient frequency, or the fact that enforcement mechanisms are weak or too costly to pursue, among others.

At the same time, there is no doubt that regulatory framework across the world (COP resolutions and decisions) and specifically across the EU, is significantly growing. The publication of a legislative package on sustainable finance in May 2018 by the EC, aimed at asset managers, investment funds, investing institutions (including insurance companies and pension funds) and intermediaries, has been followed by publication of similar regulations defining how environmental, social and governance (ESG) considerations must be taken in account in financial transactions.95

Rules on sustainable finance are complemented by other sectoral arrangements. Regulations targeting some specific issues within the industry, i.e. the “MAC Directive”96 or “F-gas Regulation”97 have been recently supported by Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011.98 This regulation, which will enter into force on 1 January 2020, when the current rules setting CO2 emission standards for cars and vans will be repealed, is of particular importance as from 2025 onwards, it will force car manufacturers to meet the new targets for new cars and vans registered in a given calendar year (with stricter targets applying from 2030), eventually enforcing all producers to manufacture only low-emission vehicles.

5.2.2.3 Improving competitiveness of low-emission alternatives

The EC underlines the importance of digitalisation of these new facilities and infrastructural sites to make them more user-friendly. The OECD (2015b) believes that digitalisation will result in shifts in skills and the labour force as the technologies for low-carbon transition imply the creation of new business models and complex support frameworks for innovations to be accepted and used. In order to improve the competitiveness of the EU labour force in this new set-up, enhanced education and trainings related to digitalisation need to be widely available. One of the main conclusions of the EEA (2018) report implies that without sufficient awareness-

95 For more information see: https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance_en
98 For more information see: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0631
raising campaigns, truly open public debate, as well as targeted educational actions, people might not be eager to accept climate-friendly innovations.

Dechezleprêtre et al. (2014) provide evidence that clean technologies grow and scale quicker than those based on fossil fuels and thus are more attractive for end-users. As a result, R&D actions towards ensuring sustainability of energy mix based on RES (e.g. smart grids, large-scale energy storage) and other solutions considered climate-friendly (i.e. electric and hydrogen cars when energy mix stems purely from RES) should acquire more substantial amounts of public financial support than old-generation ones. In this scenario, improving competitiveness of low-emission alternatives equals improving their reach. This is in line with Dechezleprêtre et al. (2016), who argue that, apart from technological developments, a large-scale commercialisation of alternative technologies such as solar panels, initially pushed by the states, could significantly lower prices in the future.

5.2.2.4 Stronger incentives to innovate

Averchenkova et al. (2016) underline issues related to low levels of investments towards research and development across the EU. The pan-European cooperation, despite large sums forwarded to innovative European actions, i.e. in the form of H2020 programmes, only partially solves this issue. The ambitious plan of reaching a target of MS spending 3% of their GDPs in innovation by 2020 and doubling the sources for the research on clean energy, sets the ground for an Energy Union.

This is in accordance with empirical evidence on the impact public policies typically have on adaptation of innovative climate-friendly solutions, particularly in the predominantly regulated electricity market. See for instance Kemp (1998), who studied the correlation between charges and biological treatment of wastewater and Popp (2006), who pursued research on solutions targeting NOX pollution control at power plants.

As R&D endeavours are usually boosted by potential profits and inventors tackle the issue of changing regulations by coming up with new alternative technologies, the change in relative prices due to climate change regulation should spurs so-called ‘induced innovation’ (Acemoglu, 2002; Acemoglu et al., 2012). These predictions have already found support in various studies (Popp, 2010; and Ambec et al., 2013). Aghion et al. (2016) investigated innovations within car industry. Their findings suggest that companies were more eager to commence with new solutions and products (hydrogen and electric vehicles) than stay with the old technologies and overall status quo when fuels were more expensive. They discovered that prices increased by approx. 10% can lead to respectively ca. 10% more patents related to low-carbon technologies and up to 7% decrease in patents related to fossil fuels.

Overall, there is quite a lot of empirical evidence to conclude that strong incentives positively impact the process of inventing and further upscale of those innovative products and solutions created. Appropriate regulations and incentives to innovate can thus help the EU to phase out polluting technologies and push the innovative green development forward.

5.3 Major mediating factors

Some additional factors other than specific policies from the previous section might trigger the decisions regarding implementation of particular environmental taxation trends, and effectively major sub-areas of change per se. Prices, consumption trends and energy usage undoubtedly
shape taxation policies as much, as direct political choices. As has already been mentioned in the introductory part, these major mediating factors are understood as variables that link the independent and the dependent variables, and whose existence typically explains the relationship between the other two variables (i.e. biodiversity loss continues if tangible taxation and other policies are not in place; energy prices grow if the infrastructure capacities are not modernised). Nevertheless, other by-products (i.e. technological developments) and aspects such as resources scarcity and human behaviours determine their importance to an equally significant extent as in case of targeted policy actions. This helps in separating the two — internalisation of externalities via taxation and other policies from major mediating factors. For example, while some policies mentioned above, especially regulations and ETS, can be considered mediating factors in the area of climate change and environmental externalities, they depend predominantly on public authorities’ choices and actions, and therefore were covered in the preceding section.

Below, a selection of three mediation factors with potential important tax implications, namely energy prices, energy consumption, and ecological process, are briefly discussed.

5.3.1 Fossil fuel prices and the uptake of renewables

The power industry is undergoing a paradigm shift; shutting inefficient plants and replacing them with modern technologies – or shifting toward other power sources altogether. The cost competitiveness of natural gas and renewables (particularly wind and solar), combined with supportive policies, have captured commercial interest across the globe (OPEC, 2018). At the same time, as emphasised in “A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy” (EU LTS), the issue of lock-in of fossil fuel technologies should not be neglected as power plants currently built will almost certainly be in use in 2050. Concerted actions promoting their transformation into low-emission generators should be executed. In fact, it is estimated that new business, financial models, and instruments that are better suited to investor needs can reduce the cost of renewable energy by up to 20% (Climate Policy Initiative - CPI, 2014).

Increased shale gas production could indirectly depress alternative fuel transport penetrating by lowering oil prices. EV as a share of total new vehicles has increased significantly in the EU28 in recent years, rising from 0.006% to 1.5% between 2010 and 2017. For more information see: https://www.eea.europa.eu/data-and-maps/indicators/proportion-of-vehicle-fleet-meeting-4/assessment-2.

However, an early warning of the potential exposure of green technologies to fossil fuel prices was seen in 2016, when the share of EV sales in the EU28 briefly declined in the wake of the 2014-15 oil price glut, in which the price of Brent Crude collapsed by around two-thirds between mid-2014 and late 2015. For more information see: https://markets.businessinsider.com/commodities/oil-price/eur?type=brent. A decline in oil prices could lead to a slower transition towards renewables - a “sailing-ship” effect (Cherif et al. 2017). However, oil prices will fall if their demand for consumption falls. At the same time, elasticity of consumption to the price of oil products is relatively low (e.g. in transport). The most recent (for 2018) “Energy prices and costs in Europe” report suggests that oil prices are on the rise again.

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100 For more information see: https://markets.businessinsider.com/commodities/oil-price/eur?type=brent.
As one of the interviewees points out, other fuels (e.g. natural gas) will be following the price of crude oil, but their role will be minimal after 2050 as new technologies will overtake the market, e.g. synthesis gas and artificially created hydrogen, positively affecting the prices for all end-users. Following the reveal and commercialisation of perspective alternative engines in the 3rd decade of the current century, the crude oil will lose its leading role. This would however be greatly dependent, on the global trends and policies undertaken. Another interviewee agrees that oil prices will be higher, but “not much”. In his opinion, agricultural and biofuel products will be more popular and therefore will also be more expensive.

As concluded in the last “Energy prices and costs in Europe” report, since the price of fossil fuels is typically driven globally or agreed regionally outside Europe in OPEC or Middle Eastern countries, the EU can do little to control their rates. As for the electricity prices, these are set according to the marginal price of the fuels used for generation, often a fossil fuel traded on a global market. As such, the price of electricity in Europe can be driven globally, albeit to a lesser degree as the contribution of local or regional renewable energy sources increases. Such a price exposure has some serious consequences for the EU’s overall economic performance and various actions have been undertaken to minimise these negative implications. The creation of the Energy Union, taxation of fossil fuels-based energy, as well as serious investments in green technologies are in place to control the prices so that quicker transition to decarbonised economy worldwide is ensured.

5.3.2 Energy consumption

5.3.2.1 Energy use in buildings

While the total energy demand is not expected to change substantially according to EEA, significant seasonal shifts and effects on the energy mix are expected regionally. For instance, a rare example of a beneficial aspect of climate change, although partially counterbalanced by the increase of cooling needs by individuals and households, is the decrease in heating demand in Northern and Central European countries.

As global climate negotiations have progressed, in 2016, the EC presented a set of legislative proposals (“Clean Energy for All Europeans”). The package provides the legislative framework to stimulate investments promoting RES and energy efficiency solutions, while taking into account the affordability of energy. Additionally, the Energy Performance in Buildings Directive (EPBD) promotes nearly zero-energy buildings (NZEBS), mandatory for all new buildings from 31 December 2020. In June 2018, the EU announced its intention to improve and set more stringent GHG emission targets for the period up to 2030, reinforcing its commitment to the Paris Agreement.

According to Eurostat, 26% of the final energy consumption in the 28 EU MS in 2016 corresponded to residential consumption, thereby making up a non-negligible share of about 5% of total consumption expenditures in the EU. Buildings, residential and non-residential services in the EU account for approximately 40% of energy consumption and 36% of CO₂ emissions. About 35% of the EU’s buildings are over 50 years old and almost 75% of the building stock is

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energy inefficient, while only 0.4-1.2% (depending on the country) of the building stock is renovated each year.\textsuperscript{102}

It is estimated that around 97% of the European building stock will need to be upgraded to meet the 2050 goals. It is also assessed that this would require renovation rate increase from current approx. 1% to 3%. Therefore, to achieve the 2030 (relevant for approximately 1/3 of the building stock) goals set by the EU, an investment of nearly EUR 100 billion a year is needed.\textsuperscript{103} Given that the implementation of the Energy Efficiency Directive is behind the schedule, this might be difficult to achieve (EC, 2015).

5.3.2.2 Energy usage by commercial entities
Industry has been decreasing its energy consumption (approximately by 60 Mtoe from 2000 to 2015). This is predominantly an outcome of further energy savings (70 Mtoe) and to a lesser extent due to a structural effect (10 Mtoe) stemming from less energy intensive branches increasing their contribution to aggregate value added.\textsuperscript{104} Offshoring of EU production to Asia also reduces the total energy consumption of EU MS. Starting from 2007, electricity, steadily declines (similarly to overall consumption).\textsuperscript{105} Nevertheless, a lot needs to be done to meet the targets set at the European level. The figure below presents the distance to 2020 and 2030 targets for primary energy consumption.

Figure 5.7. Distance to 2020 and 2030 targets for primary energy consumption, EU28

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure5.7.png}
\caption{Distance to 2020 and 2030 targets for primary energy consumption, EU28}
\end{figure}

\textsuperscript{102} EU Energy Efficiency, Buildings: https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings
\textsuperscript{103} EC, Financing energy efficiency, available at: https://ec.europa.eu/energy/en/topics/energy-efficiency/financing-energy-efficiency
\textsuperscript{104} For more information see: http://www.odyssee-mure.eu/publications/efficiency-by-sector/industry/industry-eu.pdf
\textsuperscript{105} For more information see: http://www.odyssee-mure.eu/publications/efficiency-by-sector/industry/
\textsuperscript{106} For more information see: https://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_saving_statistics
The IEA also underlines that in order to meet the ambitious climate targets, global direct industrial emissions would need to peak before 2025 and then decline rapidly, despite the expectation that industrial sector value-added will grow by 2.9% annually until 2030. Concerted actions should be executed to achieve these objectives. Efficient World Scenario (EWS) of the IEA “identifies the potential for industry to produce nearly twice as much value per unit of energy use in 2040, compared to current levels. Overall manufacturing energy intensity could improve by 44% between now and 2040 with 70% of the energy savings potential in less energy-intensive manufacturing sectors”.

In order to enable the green industrial transition, the EU created various long-term strategies. Initiatives and funds targeting industry include targeted initiatives such as “the InvestEU” platform which budget for the next MFF (2021-2027) is believed to sum up to approximately ¼ of the final figure. Moreover, the revised EU ETS Directive 2003/87/EC launched two specific funds to help the European industry in this green transition: the new Innovation Fund (with a budget of EUR 450 million), as well as the Modernisation Fund targeting green energy transition of 10 lower-income MS have been created. As the funds are not fully operational yet, it is difficult to assess their potential mediating power. This is also largely due to reduction of taxes and levies allocated to the sector under the ETS state aid guidelines.

One of the experts interviewed concludes that in the European’s industry sector, energy efficiency will be easier to be managed and controlled as the private companies are controlling their operational expenditures. At the same time, government spending on R&D will boost private sector’s confidence and application rates of new solutions on industrial energy efficiency.

### 5.3.2.3 Energy usage in transport

The expected uptake of electric vehicles is a significant factor in mitigating GHS emissions although there is still a lot of uncertainty about it. This is reflected in the significant variance among forecasts for uptake rates over the next few decades. In OPEC’s 2016 World Oil Outlook the global market share by 2040 was forecasted to be 22%. Bloomberg New Energy Finance predicts an even higher uptake of 25% by 2040, while BNP Paribas predicts this 25% uptake will be reached a decade earlier than forecasted by Bloomberg. In 2017, the IMF predicted a 44% uptake by 2050, while Carbon Tracker and the Grantham Institute predict uptake will have already reached 55% ten years before that (Cherif et al., 2017). For the EU specifically, the EEA (2016) predicts an 80% electric vehicle share by 2050, while Kasten et al. (2016) see this level reached only under a high-uptake scenario, with a medium-uptake scenario seeing electric vehicles make up just 50% of the total car fleet by 2050.

At the same time, one of our interviewees underlined that pure electric vehicles will become much more popular as they become more energy efficient than other technologies. In their opinion, a mix of new technologies will eventually become popular (e.g. electric vehicles with

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107 For more information see: [https://www.iea.org/tcep/industry/](https://www.iea.org/tcep/industry/)
108 For more information see: [https://www.iea.org/topics/energyefficiency/industry/](https://www.iea.org/topics/energyefficiency/industry/)
109 For more information see: [https://europa.eu/investeu/home_en](https://europa.eu/investeu/home_en)
110 For more information see: [https://ec.europa.eu/clima/sites/clima/files/docs/pages/vision_2_industrial_en.pdf](https://ec.europa.eu/clima/sites/clima/files/docs/pages/vision_2_industrial_en.pdf)
additional renewable technology), as well as vehicles powered by the overhead electric power lines, but that the logistics and infrastructure are needed first. Another interviewee complements this scenario, adding that by around 2025, the storage of hydrogen will become economically justified and technically efficient enough to reach the break-even point. Therefore, fossil fuel-based technologies will lose their market position by 2040-2050. The interviewee believes that the transition will take place particularly quickly during the 2030s. Tax and regulatory policies promoting hydrogen technologies could further support the growth of hydrogen, particularly for larger vehicles and large-scale energy storage. Nevertheless, lower income consumers will still be using fossil fuel-based automotive vehicles for some time after.

These are several variables, which in turn generate significant uncertainty about future energy consumption and fossil fuel emissions given that transport already accounts for a quarter of Europe’s GHG emissions. If Europe’s electric vehicle stock reaches 80% by 2050 as predicted by the EEA, this would result in an increased electricity demand of 150 GW, 41 GW of which would come from fossil fuels based on current trends. In certain EU MS with a high proportion of fossil fuel power plants (e.g. Poland and the Czech Republic), the increased demand for electricity resulting from a high uptake of electric vehicles could even lead to a net increase in CO₂ emissions (EEA, 2016). The 2050 LTS indicates that low carbon electricity will reach around 60% in 2030 and 80% only in 2050. This still raises questions about the approach governments are taking to internalise environmental externalities and stimulate behavioural change through fiscal mechanisms, and whether greater emphasis should be placed on actors further upstream such as utility companies.

Electric vehicle uptake is also dependent on improvements in price competitiveness. For sale of battery electric vehicles, Bloomberg New Energy Finance predicts price competitiveness will not be reached until 2022, while Cambridge Econometrics predicts a later date of 2025 (OPEC 2018). For some models, however, price competitiveness may have already been reached. In 2015, the average EV achieved the equivalent of 67 miles per gallon (mpg) compared to 25 mpg on average for motor vehicles, and they are much cheaper to maintain (Cherif et al., 2017). The uptake of electric vehicles could increase sharply once the threshold for price competitiveness has been reached.

5.4 Implications

5.4.1 Environmental tax revenue

In 2017, the overall value of environmental tax revenue amounted to EUR 368.8 billion, or 2.4% of EU28 GDP. Despite the intensifying debate on environmental problems, the number fell from 2.58% of GDP in 2000. Currently, the most prevalent form of environmental taxation is energy taxes which account for more 76.8% (2017) of all environmental tax revenue. These taxes include mostly excise on petrol and diesel. Transport taxes amount to 19.8%, pollution and resources contribute to only 3.2% of overall environmental tax revenue.

Figure 5.8. Environmental taxes revenue in the EU (% of GDP)

112 Calculations by Cherif et al., using averages for the retail prices of electricity and gasoline, and the fuel efficiency of electric and motor vehicles.
The shares of environmental taxes in GDP vary quite significantly in the EU, with the largest proportion in Greece (3.97%) and the lowest in Luxembourg (1.71%).

Figure 5.9. Environmental taxes revenue in the EU MS (% of GDP)

Source: Eurostat

5.4.2 Extra costs

As discussed above, there is a significant uncertainty around the estimates of the climate and environmental externalities since they comprise of various long- and short-term impacts. Moreover, as described in the preceding section, tax systems are affected by climate change and
other environmental externalities via mediating factors. The overall effect on the economy is expected to be more than significant. Based on estimating the effects of temperature increases on economic growth using a multi-country panel data and allowing for non-linearities, Burke et al. (2015) find that economic growth in both developed and developing countries will be harmed by global warming leading to global income losses of 23% by 2100 due to insufficient mitigation actions. For historical evidence of the impact of temperature changes on economic growth, see also Dell et al. (2012). An important component of these impacts will take the form of damages and their direct and indirect costs, which will likely be co-shared by the public through intervention programmes.

Increases in temperature can negatively impact various areas of every day’s lives, spanning from workers’ labour productivity (Bloom et al., 2016), health condition (e.g. Bosello et al., 2006), or the quality of natural resources (e.g. Gollop and Swinand, 2001). The nexus between worsening public health and climate change has already been documented and for the first time officially enshrined in the Paris Agreement. Particularly, policies aimed at air quality improvement and deployment of green public transport technologies have been mentioned as those leading substantial health co-benefits. In fact, only some specific sectors, such as tourism in parts of Europe currently not considered attractive destinations due to low temperatures, could benefit from higher temperatures.

On the other hand, according to Ciscar (2009), river floods are the most severe natural disaster in Europe and result in large economic losses through direct damage to infrastructure, property, and agricultural land. In the future, due to climate change, the magnitude and frequency of extreme precipitation events will likely lead to more intense and more frequent river floods. The increase in direct yearly damage from river floods in the 2080s is expected to range between EUR 7.7 billion and EUR 15 billion. Similarly, Rojas et al. (2013) project that the effects of climate change only will cause damages of around EUR 10 billion a year by the 2020 and around EUR 15.5 billion a year by the 2080.

Another important event linked to climate change and affecting public finance is sea-level rise. The mid-point projections point to 37cm of rise by the 2080 yearly. This cost of damage would result in a loss of EUR 1.7 billion in 2050s and EUR 11.4 billion in 2080s compared to no sea-level rise scenario. The Netherlands, France, Germany and the UK are expected to be the most affected (Brown et al., 2011).

5.4.3 Changing prices and its impacts

The risk of declining revenue due to lower oil and gas consumption stems from fact that the effective rate\textsuperscript{113} on fossil fuel is relatively high. Among developed countries, corporate income tax (CIT) is the most commonly used form of taxing oil and gas producers. Though in some jurisdictions (e.g. Greenland), there are no separate tax laws governing the oil and gas sector, CIT is usually applied in combination with one or a combination of royalties (Croatia, Germany, Greece, Italy, Netherlands), special taxes on oil and gas production or revenues (Denmark, Ireland, Netherlands, Poland, Romania, UK), rents (Croatia, Greece, Ireland, Netherlands, Netherlands, Poland, Romania, UK), sales taxes on capital purchases, capital taxes, transfer taxes, stamp duties, profit-based resource levies, and royalties as a share of the pre-tax rate of return on investments (Bazel and Mintz, 2019).

\textsuperscript{113} Understood as METRR, summary measure that accounts for corporate income taxes, sales taxes on capital purchases, capital taxes, transfer taxes, stamp duties, profit-based resource levies, and royalties as a share of the pre-tax rate of return on investments (Bazel and Mintz, 2019)
Romania), and capital gains taxes (Cyprus, Poland). Bonus payments, particularly those open to competitive bid, provide additional, lump sum, revenues to governments, though the relative value of these payments varies significantly between countries. VAT and excise duties, as described in the preceding section, are also widely used forms of raising revenues indirectly from oil and gas production. Production sharing contracts are used in two EU countries: Croatia, and Cyprus (EY, 2018).

Overall, taxes on products of the Coke and refined petroleum products (CPA 19) amounted to EUR 176.4 billion in the EU in 2016.\(^\text{114}\) This accounted for 11% of total revenue from taxes (less subsidies) on products in the EU, which was much higher than the share of products in both final and total use in the EU (1.3% and 1.2% respectively). As a result, the effective rate on products on Coke and refined petroleum products was the highest among 65 CPA groups and amounted to ca. 36% with respect to total use and 60% with respect to final use (see Figure 5.10.). Assuming business-as-usual scenario for 2016-2040 period and constant effective rates, we forecast that tax revenue from Coke and refined petroleum products will increase to EUR 192.7 billion (in EUR 2018).\(^\text{115}\) However, as a share of overall taxes on products, it will decline by two percentage points up to 9% (see Figure 5.11.).

Figure 5.10. Effective rates taxes (less subsidies) on products (% of final and total use, 2016)\(^{116}\)

![Figure 5.10. Effective rates taxes (less subsidies) on products (% of final and total use, 2016)](image)

**Source:** own elaboration based on Eurostat

Figure 5.11. Revenue - taxes (less subsidies) on products (EUR billion)

![Figure 5.11. Revenue - taxes (less subsidies) on products (EUR billion)](image)

\(^{114}\) Source: Eurostat. Taxes on product include primarily VAT, excise and customs duties, and other levies that become payable as a result of the production, sale, transfer, leasing or delivery of those goods or services, or as a result of their use for own consumption or own capital formation (OECD).

\(^{115}\) Estimated using Input-Output analysis described in Appendix 5.3.

\(^{116}\) See Appendix 5.2 for sectoral breakdown.
Source: own elaboration based on Eurostat

Production and consumption of energy does not only generate tax revenue. Government share of petroleum revenue is around 65-85%, and 40-60% for mining (IMF, 2012). Governments own the majority of upstream coal assets (primarily in Poland, Greece, and Germany), approximately 40% of coal-fired power plants, and a smaller share of oil, natural gas, and gas-fired power plants (Nelson et al., 2014).

Some 80% of world petroleum reserves are controlled by State Owned Enterprises (SOEs) and 15 of the 20 largest companies are SOEs (IMF, 2012). Governments own 50-70% of global oil, gas and coal resources, and collect taxes and other revenues on privately owned resources. Compared to taking no action on climate change at all, achieving the IEA’s low carbon goals is estimated to cost producers some USD 25 trillion in value, of which some 80% would be borne by governments according to CPI (2014).

5.4.4 Changing patterns of energy use

According to the EBRD, stranding of natural gas power plants before 2030 will be of relatively low importance. Though long-term reliance on natural gas could lead to loss of asset value due to rising cost competitiveness of renewable energy and the convergence of regional gas markets into a single international market with the accompanying disruption to gas prices. Rise of LNG could impact the economic value of assets to governments both through depressing oil prices due to LNG’s substitutability and through the growth in LNG capacity decreasing the price of gas itself (CPI, 2016).

There is some evidence of asset stranding in EU coal-fired power generation resulting in write downs, closure and forced mothballing (Caldecott et al., 2017). Similar evidence in EU gas-fired power generation, where plants were decommissioned and mothballed can be named (Caldecott and McDaniels, 2014).

As explained in the introductory remarks, the future energy mix remains unknown, thus attention is paid to technological developments, changing patterns of consumption and energy prices – factors that will predominantly impact its shape in the coming decades and for which projections are more common.
As long as there is no incremental investment in existing plants or building of new coal plants, the effect on EU MS will be limited. The total value at risk is under USD 3 billion - less than 2% of EU power plant investments in 2011 alone. Good electricity market design could preserve the value of the remaining coal plants by paying them to provide flexible generation to balance out renewable energy. If governments focus on coal, they could reduce emissions while minimising asset stranding. Reducing coal consumption can make up 80% of the emissions savings needed to meet the IEA’s low carbon goals, while representing only 12% of the total asset value at risk of stranding according to the CPI (2014).

As alluded to above, the exposure of public budgets to asset stranding in the coming decades will to a large extent depend on the level of state involvement in the ownership of resources, manufactured assets and equipment, and licenses and rights to specific revenue streams (Nelson et al., 2014). Production sharing contracts (PSC), though not commonly used in the EU, leave governments particularly exposed to declining prices due to the revenue certainty typically provided to private investors through fixed returns. The higher share of production that is allocated to private investors under low prices to recover producers’ costs leaves a smaller share of revenue to be divided between producers and governments. There is evidence to suggest that, under a typical PSC, the host government usually bears more than 80% of the risk (in terms of lost value) if prices fall (CPI, 2014).

There is also some evidence of potential windfalls to government budgets resulting from the transition away from fossil fuels. In particular, a decline in fossil fuel consumption and the subsequent decline in the cost of fuel subsidies could free up significant revenues for EU governments. The CPI estimates that, using only price-based policy tools such as raising fuel duties and ending fossil fuel subsidies and relying on existing technologies, reducing oil demand in line with the IEA’s 450 ppm target would produce a net benefit of USD 1.5 trillion to EU28 economies. Reducing energy demand through investment in technological innovation and increased energy efficiency would have a greater economic benefit to the EU28 than raising taxes, but this boon would come in the form of lower costs to consumers rather than through increased tax revenue. The cost of funding this innovation would also place additional pressures on government budgets (Nelson et al., 2014).

A move away from operation and maintenance contracts towards more concessions and partial/total privatisation will reduce public accounts exposure (EBRD, 2015). The CPI suggests governments consider taking steps such as using production sharing contracts to limit upfront capital commitments, adapting tax regimes to frontload revenues through mechanisms such as fixed fees for licences or faster infrastructure cost recovery, and hedging exposure to commodity prices through investment in low-carbon energies (CPI, 2016).

5.4.5 Distributional concerns

Minimising adverse effects of environmental taxes often has undesirable distributional consequences. Since many environmental taxes are levied on goods deemed of basic necessity (i.e. low price elasticity of demand), they may cause disproportionately negative effect on low- and even middle-income households. This mostly concerns energy taxation as transport taxes have the most significant impact on middle-income families, whereas pollution taxes are considered to be neutral in this respect (EEA, 2011).
The distributional effects of current environmental taxes vary across Europe. Among five EU MS analysed by Leipprand et al. (2007), environmental taxes in aggregate proved to be clearly strongly regressive in the UK and the Czech Republic. In three other MS, namely Germany, Spain and Sweden, environmental taxes had the most significant impact on middle income tax groups, mostly due to the significance of motor fuel taxes. Overall, top earners were the least affected group.

In order to reduce the negative distributional impact, tax policies aiming to internalise externalities are often designed by choosing the base so that taxes affect mostly richer households. Moreover, they could include usual measures introduced in other forms of taxation like progressive tax bands, exemptions, and tax allowances. The summary of measures reducing negative distributional impact is presented in Table 5.4.

Table 5.4. Policies to mitigate negative distributional effects of environmental taxes

<table>
<thead>
<tr>
<th>Option</th>
<th>Example/Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax exemptions and reductions (directly and indirectly supporting low-income groups)</td>
<td>Reduced electricity tax rates for night storage heating (Germany)</td>
</tr>
<tr>
<td></td>
<td>Energy tax reductions for public transport (Germany)</td>
</tr>
<tr>
<td></td>
<td>Income tax deduction for installation works (only labour costs); measures eligible for the deduction are related to renewable energy devices and the replacement of conventional heating sources (Sweden)(^\text{118})</td>
</tr>
<tr>
<td></td>
<td>Income tax credit (Crédit d’Impôt) for investments in renewable energy plants (France)(^\text{119})</td>
</tr>
<tr>
<td></td>
<td>Income tax relief for persons who initiated an energy upgrading of their building (Greece)(^\text{120})</td>
</tr>
<tr>
<td></td>
<td>Reduced waste water tax/or other water charges for the poor (Belgium, Netherlands)(^\text{121})</td>
</tr>
</tbody>
</table>


\(^{121}\) For more information see: [https://books.google.pl/books?id=9KP6 zbNNPEC&pg=PA35&lpg=PA35&dq=Progressive+water+tax&source=bl&ots=w0uPWwxGzV&sig=ACfU3U2 giz5IUEs3mMa2dn2naoyAqWnh9Q&hl=de&sa=X&ved=2ahUKEwjxjxVzErdTiAhVksYskHe_9CDEQ6AEwE3oECAkQAQ#v=onepage&q=Progressive%20water%20tax&f=false](https://books.google.pl/books?id=9KP6 zbNNPEC&pg=PA35&lpg=PA35&dq=Progressive+water+tax&source=bl&ots=w0uPWwxGzV&sig=ACfU3U2 giz5IUEs3mMa2dn2naoyAqWnh9Q&hl=de&sa=X&ved=2ahUKEwjxjxVzErdTiAhVksYskHe_9CDEQ6AEwE3oECAkQAQ#v=onepage&q=Progressive%20water%20tax&f=false) p. 35
<table>
<thead>
<tr>
<th>Progressive taxation (according to energy consumed)</th>
<th>Progressive water/wastewater charges (Portugal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing-block tariffs (Spain)(^{122})</td>
<td></td>
</tr>
<tr>
<td>Progressive water tariffs (Belgium, Greece, Italy)(^{123})</td>
<td></td>
</tr>
<tr>
<td>Progressive electricity tariff (Italy)(^{124})</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tax-free basic amounts of consumption</th>
<th>Electricity tax (Netherlands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection of a tax base that affects richer households more</td>
<td>Taxes or charges applied on air traffic (Leipprand et al., 2007)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Selected specific support measures for vulnerable households, in that transfer payments and allowances</th>
<th>Means-tested benefit for heating costs (Germany) (EEA, 2011))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Energy audits for low income households (Austria, Germany)(^{125})</td>
</tr>
<tr>
<td></td>
<td>Social energy tariffs: reduced prices to vulnerable households (UK, France)(^{126})</td>
</tr>
<tr>
<td></td>
<td>Low-income households can benefit from support fee included in social security mechanisms (Wohngeld/Grundsicherung) (Germany)(^{127})</td>
</tr>
<tr>
<td></td>
<td>Heating allowance for low income households (Austria)(^{128})</td>
</tr>
</tbody>
</table>

\(^{122}\) For more information see: [https://eau3e.hypotheses.org/files/2011/11/ATHENS_Spain_paper.pdf](https://eau3e.hypotheses.org/files/2011/11/ATHENS_Spain_paper.pdf)

\(^{123}\) For more information see: [https://books.google.pl/books?id=9KP6-zbNNPEC&pg=PA35&lpg=PA35&dq=Progressive+water+tax&source=bl&ots=w0uPWxGzV&sig=ACfU3U2gizSIUes3mMa2dn2naoyAqWnh9Q&hl=de&sa=X&ved=2ahUKEwjxjYzErDIATiAIVKsYKHe_9CDEQ6AEwE3oECAkQAQ#v=onepage&q=Progressive%20water%20tax&f=false p. 35](https://books.google.pl/books?id=9KP6-zbNNPEC&pg=PA35&lpg=PA35&dq=Progressive+water+tax&source=bl&ots=w0uPWxGzV&sig=ACfU3U2gizSIUes3mMa2dn2naoyAqWnh9Q&hl=de&sa=X&ved=2ahUKEwjxjYzErDIATiAIVKsYKHe_9CDEQ6AEwE3oECAkQAQ#v=onepage&q=Progressive%20water%20tax&f=false p. 35)


\(^{128}\) For more information see: [https://www.energypoverty.eu/policies-measures?sort_by=search_api_aggregation_1&field_date_year=&field_date_year_1=&search_api_views_fulltext=&field_highlighted=All](https://www.energypoverty.eu/policies-measures?sort_by=search_api_aggregation_1&field_date_year=&field_date_year_1=&search_api_views_fulltext=&field_highlighted=All)
Use of income taxes and transfers to compensate negative distributional effects

All EU MS

Source: Environmental tax reform: implications for income redistribution and own elaboration

There is often a trade-off between efficiency and distributional effects. For instance, to the extent that individuals or firms face different tax rates on CO₂ emissions, the aggregate cost of mitigating climate change is not minimised. In some cases, it may be better to tackle distributional concerns using e.g. direct transfers or e.g. changes in income tax progressivity. For this reason, increase in energy tax rates and development of emission trade schemes, which are widely considered to be an efficient instrument for internalising externalities, shall be accompanied effective instruments for income redistribution, in that transfer systems.¹²⁹

5.4.6 International competitiveness

In accordance with the WEF definition on which the annual Global Competitiveness Report (GCR) the international competitiveness of countries, often referred to as national competitiveness in wide sense, could be understood as policies, institutions, strategies and processes – that determine the level of sustainable productivity of an economy (WEF, 2018). In the narrow sense, it could be associated with international trade. According to the OECD, international competitiveness refers to a country’s ability to sell goods in global markets (OECD, 2005), and thus could directly be associated with productions costs.

Regardless of the definition used, there are numerous linkages between international competitiveness and environmental policies. As an example, international competitiveness is determined by both events (i.e. Jensen and Ruback, 1983), as well as broad range of short-term and long-term factors that determine the productivity and quality of goods which firms produce. According to a study pursued by professor Klaus Schwab for the WEF (2018), while the most competitive countries are usually responsible for the largest share of GHG emissions, they are at the same time the most “efficient emitters” as their carbon footprint per unit of GDP is the lowest. What is more, environmental policies, specifically internalisation of externalities via taxation (see section 5.2.1), aim at changing relative costs. As a result, additional costs on firms or limitations imposed by the government impact prices of products and services both consumed domestically and exported what may erode companies’ competitiveness (UNCTAD, 2002). Last but not least, the “Porter hypothesis” assumes that strict environmental regulations can positively impact energy efficiency savings and stir up innovations that help in boosting companies’ competitiveness (Porter, 1995).

At the same time, despite existence of a broad empirical evidence on the impact of trade on environment, the literature on the impact of environmental regulations on trade flows is rather rare and oftentimes presenting mixed results. For example, De Santis (2011) proves the hypothesis that environmental regulations have not constituted a trade barrier for the EU members. However, she does not cover all 28 MS, but only preselected 14. There are also specific case studies identifying instruments mitigating “the potential adverse effects of EU climate policies on competitiveness of European industries and leakage risks” (Turcea and Kalfagianni, 2015, p. 8). The paper, focused on steel sector, concludes that technological

¹²⁹ According to OECD (2012), transfers accounted for ca. 75% of income redistribution in the OECD.
innovations incentivised by climate policies may substantially reduce losses in international competitiveness caused by increase burden on companies. In this spirit, the European Commission is presently considering implementation of several potentially far-reaching climate policies with carbon border tax being one of them.\(^{130}\) A measure which would need to be aligned with World Trade Organization (WTO) rules, just like the ETS, could gradually expand its sectoral coverage to become a fully-fledged market instrument with time. According to this proposition, the main purpose of adjusting for carbon costs at the border would be to prevent the relocation of carbon-intensive production to non-EU countries, or, in other words – the carbon leakage. The revenues would be spent on R&D and innovation funds.

### 5.5 Summary

Concentrations of atmospheric GHGs continue rising and climate damage is intensifying across the planet. There is a broad consensus among researchers on the dominating role of negative effects of climate change in the long run. These include adverse health effects, decreased labour productivity and material damages caused by extreme weather conditions and sea-level rise. These effects are likely to reduce tax revenues by shrinking tax bases and increase public expenditure needs. However, the quantitative estimates regarding the costs of climate change are highly uncertain with the mean estimate of marginal cost of USD 105 and mode of USD 13 per metric tonne of CO\(_2\). There is also a general decline – also in the EU – in biodiversity richness, decrease in quality of air and water, as well as growing amount of waste with potentially serious consequences for the ecosystem services on which humans depend. This trend is related to e.g. changes in land use but also climate change.

The main implications for tax policies are further in the following list:

**Tax revenues and public expenditures**

- Mitigating climate change and the degradation of ecosystem services via tax policies could substantially increase tax revenues from environmental taxes, at least in the short run. An important element of environmental tax reform would be carbon taxes, or taxes on GHG emissions, outside the ETS. In the long run, increase in revenue from environmental taxes will be necessary as anticipated growth in ETS revenue run will not fully compensate decline in carbon tax revenue. There is also a need for reducing or eliminating various subsidies and tax deductions for fossil fuel users. However, given climate policy goals, the tax base for carbon taxes, including current fuel taxes, should diminish quite rapidly over the next two decades or so.

**Burden sharing and redistribution**

- Some environmental taxes, such as taxes on energy and transport, are likely to cause a disproportionately large negative effect on low- and middle-income households. The use of environmental taxes may therefore need to be accompanied by measures mitigating their negative distributional consequences. However, there is often a trade-off between efficiency and equity: attempting to address distributional concerns with differentiated

tax rates risks undermining the ability of the tax system to address the environmental concerns. Changes in other taxes or transfers may be preferable to non-uniform environmental taxes.

- A clear narrative and a good communication strategy, that for instance emphasises the connection between the introduction of environmental taxes and reduction in other taxes, should help in securing political support for environmental taxes.

**Externalities and competitiveness**

- The main purpose of environmental taxes is to induce individuals and organisations to internalise negative externalities. In the case of climate change, the externalities mainly relate to GHG emissions due to the use of fossil fuels as well as changes in land-use that affect soil and forest carbon stocks. Other examples of environmental taxes to mitigate to degradation of ecosystem services include land taxes that increase the price of converting natural land to other uses.
- In the EU, carbon taxes are needed at least outside the ETS. There is a large range of estimates of the correct tax rate or carbon price per unit of (CO₂ equivalent) emissions. This range reflects uncertainty about the marginal damage of GHG emissions.
- Standard efficiency arguments call for uniform carbon pricing (through taxes or e.g. cap and trade mechanisms such as ETS) across countries and industries. This is because the effects of CO₂ emissions are independent of where they are generated. The current situation is very far from uniform carbon pricing, both within and between EU Member States. Optimal carbon pricing would thus require international coordination. However, that the case for uniform carbon pricing assumes that there are no other externalities than the ones related to climate change. For instance, road traffic creates other negative externalities, such as local air pollution and congestion, as well. Such additional externalities may justify higher taxes on fuel that is used in road traffic, even though fuel taxation is a very imperfect way of internalising them.
- Other environmental externalities, such as air or water pollution, are often more local in nature, and the associated costs are distinct in different areas. Therefore, the related environmental taxes should presumably vary as well.
- Well-designed environmental taxes provide incentives for firms to develop new, greener technologies without a priori restricting technological choices. This lowers the cost of addressing environmental challenges and improves the international competitiveness. Under regulation-based approaches these incentives disappear once firms have complied with the regulated standard.

**Tax administration**

- Internalising the global externality of climate change, which may take the form of carbon border adjustments, requires collective action and thus coordination between EU MS, and worldwide.
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Appendix 5.1: Overview of interviews

For this chapter, 5 semi-structured interviews were conducted with Jaroslav Klusák, Ph.D., energy manager, Sustainable Development and Strategic Planning Unit, Litoměřice; Maciej Bukowski, PhD, president of WiseEuropa and assistant professor at the University of Warsaw; Paul Ekins, professor of Resources and Environment Policy, Bartlett School Env, Energy & Resources, Faculty of the Built Environment; Martin Jänicke, professor and founding director, Environmental Policy Research Centre (FFU); Jon Stenning, associate director, Cambridge Econometrics.

The experts were interviewed between April and May 2019, and they all answered similar questions either via phone, or electronically.

The interviews were structured into three separate categories:
Questions concerning the evolution in the future and relevance of core drivers of change, where ideas on the pollution and temperature patterns; energy resources (e.g. when we may expect certain resources to be depleted, sites and likelihood of finding new resources); as well as energy prices and energy use in different sectors have been discussed. All the experts agreed that the environmental problems, such as concentrations of CO₂ will be increasing. Although Europe is very committed to challenge ambitious targets agreed at the UN level, the rest of the world stays behind, therefore at least in the short-term, climate change externalities such as increase of the overall temperatures, will continue to occur;

Questions concerning tax instruments that are debated currently and could be implemented or widespread in the future, where experts interviewed presented their opinions about specific tax instruments, typically those which are currently in use, where some empirical evidence can be found. Experts shared their ideas about: pollution taxes including tradable emissions permits, tax reliefs for renewables; lower tax on electric vehicles; tax reliefs for green production; climate change levies; landfill taxes; aggregates levies; prosumers exemptions, and quantity caps for green and renewable industries;

Direct and indirect impacts of introducing specific tax instruments, where specific instruments from section 5.2 were elaborated further, based on their importance for the taxation systems overall. In general, the experts agreed that a complex green tax reform with reduced social security payments makes sense, however some broad communication and networking activities are needed to inform the society about all potential costs and benefits.
## Appendix 5.2: Sectoral breakdown

<table>
<thead>
<tr>
<th>CPA code</th>
<th>CPA name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPA_A01</td>
<td>Products of agriculture, hunting and related services</td>
</tr>
<tr>
<td>CPA_A02</td>
<td>Products of forestry, logging and related services</td>
</tr>
<tr>
<td>CPA_A03</td>
<td>Fish and other fishing products; aquaculture products; support services to fishing</td>
</tr>
<tr>
<td>CPA_B</td>
<td>Mining and quarrying</td>
</tr>
<tr>
<td>CPA_C10-C12</td>
<td>Food products, beverages and tobacco products</td>
</tr>
<tr>
<td>CPA_C13-C15</td>
<td>Textiles, wearing apparel and leather products</td>
</tr>
<tr>
<td>CPA_C16</td>
<td>Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials</td>
</tr>
<tr>
<td>CPA_C17</td>
<td>Paper and paper products</td>
</tr>
<tr>
<td>CPA_C18</td>
<td>Printing and recording services</td>
</tr>
<tr>
<td>CPA_C19</td>
<td>Coke and refined petroleum products</td>
</tr>
<tr>
<td>CPA_C20</td>
<td>Chemicals and chemical products</td>
</tr>
<tr>
<td>CPA_C21</td>
<td>Basic pharmaceutical products and pharmaceutical preparations</td>
</tr>
<tr>
<td>CPA_C22</td>
<td>Rubber and plastics products</td>
</tr>
<tr>
<td>CPA_C23</td>
<td>Other non-metallic mineral products</td>
</tr>
<tr>
<td>CPA_C24</td>
<td>Basic metals</td>
</tr>
<tr>
<td>CPA_C25</td>
<td>Fabricated metal products, except machinery and equipment</td>
</tr>
<tr>
<td>CPA_C26</td>
<td>Computer, electronic and optical products</td>
</tr>
<tr>
<td>CPA_C27</td>
<td>Electrical equipment</td>
</tr>
<tr>
<td>CPA_C28</td>
<td>Machinery and equipment n.e.c.</td>
</tr>
<tr>
<td>CPA_C29</td>
<td>Motor vehicles, trailers and semi-trailers</td>
</tr>
<tr>
<td>CPA_C30</td>
<td>Other transport equipment</td>
</tr>
<tr>
<td>CPA_C31-C32</td>
<td>Furniture; other manufactured goods</td>
</tr>
<tr>
<td>CPA_C33</td>
<td>Repair and installation services of machinery and equipment</td>
</tr>
<tr>
<td>CPA_D35</td>
<td>Electricity, gas, steam and air-conditioning</td>
</tr>
<tr>
<td>CPA_E36</td>
<td>Natural water; water treatment and supply services</td>
</tr>
<tr>
<td>CPA_E37-E39</td>
<td>Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services</td>
</tr>
<tr>
<td>CPA_F</td>
<td>Constructions and construction works</td>
</tr>
<tr>
<td>CPA_G45</td>
<td>Wholesale and retail trade and repair services of motor vehicles and motorcycles</td>
</tr>
<tr>
<td>CPA_G46</td>
<td>Wholesale trade services, except of motor vehicles and motorcycles</td>
</tr>
<tr>
<td>CPA_G47</td>
<td>Retail trade services, except of motor vehicles and motorcycles</td>
</tr>
<tr>
<td>CPA_H49</td>
<td>Land transport services and transport services via pipelines</td>
</tr>
<tr>
<td>CPA_H50</td>
<td>Water transport services</td>
</tr>
<tr>
<td>CPA_H51</td>
<td>Air transport services</td>
</tr>
<tr>
<td>CPA_H52</td>
<td>Warehousing and support services for transportation</td>
</tr>
<tr>
<td>CPA_H53</td>
<td>Postal and courier services</td>
</tr>
<tr>
<td>CPA_I</td>
<td>Accommodation and food services</td>
</tr>
<tr>
<td>CPA_J58</td>
<td>Publishing services</td>
</tr>
<tr>
<td>CPA_J59-J60</td>
<td>Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services</td>
</tr>
<tr>
<td>CPA_J61</td>
<td>Telecommunications services</td>
</tr>
<tr>
<td>CPA_J62-J63</td>
<td>Computer programming, consultancy and related services; information services</td>
</tr>
<tr>
<td>CPA_K64</td>
<td>Financial services, except insurance and pension funding</td>
</tr>
</tbody>
</table>
Appendix 5.3: Input-output analysis

In order to analyse interdependencies between sectors, forecast tax and ETS revenue, as well as pollution externalities, similarly to Muller (2016), we conduct input-output analysis. The I-O model was constructed for the EU as a whole by aggregating supply and use table (naio_10) for all EU MS. The baseline model was extended by adding flows of pollution from sectors using three main types of emissions: CO₂, N₂O and PFCs (source EUROSTAT) and ETS revenue for relevant sectors covered.

The structure of the model could be described by the matrices:

\[ U = \begin{bmatrix}
  u_{1,1} & \cdots & u_{1,n} & f u_1 & t u_1 & n t_1 \\
  \vdots & \ddots & \vdots & \vdots & \vdots & \vdots \\
  u_{n,1} & \cdots & u_{n,n} & f u_n & t u_n & n t_n 
\end{bmatrix} \]

\[ S = \begin{bmatrix}
  s_{1,1} & \cdots & s_{1,n} \\
  \vdots & \ddots & \vdots \\
  s_{n,1} & \cdots & s_{n,n} \\
  f s_1 & \cdots & f s_n \\
  t s_1 & \cdots & t s_n \\
  e_1 & \cdots & e_n 
\end{bmatrix} \]

where:
To enable the analysis of future implications of the ongoing trends, the model was constructed for two time periods, namely for 2016 and 2040. In order to forecast the structure of the EU economy in 2040, we use sectoral growth rates in line with the baseline simulation described in section 4.1.5. Moreover, we assume that the sectoral inputs structure as well as effective tax rates will remain similar to those in 2040.

In addition, certain assumptions regarding emissions need to be made. To estimate and attribute emissions to sectors in 2040 we define a measure of emission intensity which is defined as the amount of emissions per monetary unit of gross output of each industry. To account for technological advancement, we assume that for each industry average yearly drop in emission intensity between 2016 and 2040 will be the same as average drop between 2008 and 2016. We made minor corrections in certain industries based on industrial reports. The rate of emission intensity decline between 2000 and 2008 was slightly higher but the data is only partially available.

The Input-Output analysis is also used to estimate potential revenue from the ETS. We assumed that list of ETS applicable industries and share of free allowances will be the same in 2040 as in 2030 (end of Stage III). The value of ETS allowances auctioned by each industry in 2040 is equal to estimated emissions amount multiplied by price. We assume full switch to auctions as allocation mechanism for allowances. Household emissions are added to ETS system as proposed for Stage IV. In the end, the value of ETS allowances auctioned by each industry in 2040 is equal to estimated emissions amount multiplied by price.
6 Interactions

The previous chapters already referred to various interactions between different areas of change. As an example, the discussion of the digitalised business models in section 2 (focusing on technology) referred to issues related international corporate taxation, which is also discussed in the context of globalisation in section 4. However, it is useful to discuss separately some of the most important interactions between different areas of change.

The following Table 6.1 illustrates the possible combinations. The interactions are always bidirectional. An extensive description of all the links is out of the scope of this study. Instead, we focus on the that are coloured with grey in the table. Section 6.1 discusses what is known about the link between climate change – and certain other environmental issues – and migration. Section 6.2 focuses on the interactions between globalization and technology. Finally, section 6.3 considers the interactions between demographic changes and technology.

Table 6.1. Interactions

<table>
<thead>
<tr>
<th></th>
<th>Environment</th>
<th>Technology</th>
<th>Demographics</th>
<th>Globalisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>Technology to Environment</td>
<td></td>
<td>Technology to demographics</td>
<td>Technology to globalisation</td>
</tr>
<tr>
<td>Demographics</td>
<td>Demographics to environment</td>
<td>Demographics to technology</td>
<td>X</td>
<td>Demographics to globalisation</td>
</tr>
<tr>
<td>Globalisation</td>
<td>Globalisation to environment</td>
<td>Globalisation to technology</td>
<td>Globalisation to demographics</td>
<td>X</td>
</tr>
</tbody>
</table>

6.1 Climate change, other environmental externalities and migration

6.1.1 Causal link between environmental hazards and migration

Construction of a causal link between climate change and migration is not easy. The decision to migrate (or not) depends on many drivers – with climate change as only one amongst others. It influences migration, but more in an indirect way, through its impact on and interplay with other migration drivers.

Many of the early works on the topic have drawn a picture of climate-induced mass migration to Europe (Foresight 2011, Myers and Kent 1995, Myers 2002, Friends of the Earth 2007, Aid 2007, Stern 2007). Such accounts have been criticized by Wood (2001), Goldstone (2002) and White (2011) for “securitizing” climate-induced migration and playing so easily to voters who are worried about climate change and immigration. Goldstone (2002) criticized this security-approach as inappropriate to address the problem of climate-induced migration.
Moreover, recent publications on climate change and migration are questioning the possibility and usefulness to calculate numbers at all and raising considerable doubts on the methodology of the above-mentioned publications (see Castles, 2002). Black et al. (2011) argued that the estimation of Myers was based rather on “common sense” than on evidence and it is impossible to draw a direct causal connection between climate/environmental change and migration.

In the later publication Black et al. (2012) underline that it is almost impossible to unravel the different “effects of environmental change on migration from other potentially constitutive factors such as economic, social, political, and demographic changes.” The authors argue that people moving due to environmental change are “likely to move towards and not away from environmental risk and hazard by moving from rural areas to rapidly growing urban areas.” Secondly, migration caused by environmental change could become less likely due to erosion of the households’ income.

Different studies have already shown that climate change affects the poorest people the most (see Bardsley and Hugo 2010). Therefore, they are the most vulnerable to climate-induced hazards and often cannot afford to migrate. In drawing attention to those who are “trapped” rather than to those who might migrate, the article provides a new contribution in shaping future policy considerations.

The extensive work of the Foresight project (2011) follows a similar approach. The authors of the study argue that migration will continue due to economic, social and political drivers, but environmental change will intensify the impacts of existing drivers. The report derives an interesting conclusion from this thesis: it might be, “as equally likely to make migration less possible as more probable.”

What becomes clear from the literature review on drivers of migration is the following: it seems to be an impossible undertaking to separate climate-induced migration from other factors. Furthermore, Black et al. (2012) deconstruct a common assumption: the negative impacts of climate change on the livelihood of affected people does not inevitably lead to migration. On the contrary, they might even “trap” people.

A look at other calculations illustrates the fuzziness in estimations on climate-induced migration. The International Organization for Migration (IOM) for instance notes that “forecasts vary from 25 million to 1 billion environmental migrants by 2050, moving either within their countries or across borders, on a permanent or temporary basis, with 200 million being the most widely cited estimate. This figure equals the current estimate of international migrants worldwide.” The World Bank’s Groundwell Report (Rigaud et al. 2018) estimates between 31 until 143 million internal migrants for the next 30 years.

Overall, when it comes to numbers, there is no consensus within the research community. At one end of the scale are those who estimate millions of climate refugees willing to enter the EU. Opposed to them are researchers and expert refusing to name any numbers at all.

### 6.1.2 Migration as an adaptation strategy

Bardsley and Hugo (2010) argue that migration is in fact a successful adaptation response to the impacts of climate change. To them, the question is not if climate change will lead to migration, but in which way: migration could be influenced by climate change in a linear manner that is
voluntary. In this scenario people tend to migrate before their socio-ecological system has reached a critical level. Or climate change could cause a non-linear, involuntary migration when critical tipping points or thresholds are reached.

Scheffran et al. (2012) discuss the benefits of climate-induced migration. Drawing from case studies in Senegal, Mali and Mauritania, the authors conclude that migration as adaptation strategy can increase the livelihood, the social capital and resilience of the migrant’s origin communities through migrant networks and trigger innovations through the transfer of knowledge or remittances.

The above-mentioned studies shed light on a threat-victim discourse that dominates the actual debate on climate-induced migration.

Closely connected to the discussion about drivers of migration is the question of the right terminology and definitions. This is not a discussion about grappling for words; rather, it is a discussion about legal implications following a certain definition. Castles (2002) refuses the term “environmental refugee” as applied by Myers as misleading (see also Black 2001). In his opinion, this term evokes an impression of mono-causality, which barely exists. He also rejects the use of the term “refugee” because of its “precise meaning in international law”. A protection gap for climate-induced refugees or migrants teared up by a lack of definition has also been subject of a recent Briefing of the European Parliament (Apap 2019).

So far, no universally accepted definition has been found for migrants or refugees driven by climate change. As outlined above, this has to do with the difficulty of linking migration to environmental change. There is no comprehensive international migration policy in force protecting people who have to migrate or flee due to climate and environmental change.

Different authors have shown that one of the main barriers in developing a joint strategy addressing the impacts of climate-induced migration on EU-level is that the two areas of environment and migration policies coexist - while a connection and coordination between both fields is needed. The lack of incentive to do so could result from the assumption, that the EU is not affected by climate-induced migration as other parts of the world, namely Africa or Asia.

6.1.3 The impacts of climate-induced migration

Most studies suggest that climate-induced migration is usually internal and stays in particular within the borders of poorer countries, flowing from rural to urban areas (Black et al. 2012). One of the most up-to date and extensive works on the issue of internal climate-induced migration is the World Bank’s Groundswell Report. Given the fact that internal migration is already happening at a large scale – conservative estimations speak of 740 - 763 million internal migrants in 2013, which are three times more people than those who crossed boarders (Rigaud et al. 2018) – the report focuses on internal instead of international migration, examining Sub-Saharan Africa, South Asia, and Latin America. The report develops three future scenarios for the next 30 years. In the “pessimistic version” the world could face 143 million internal climate migrants by 2050; in the “more inclusive development” scenario, between 65 and 105 million people could leave their home community. Finally, the report estimates 31 million to 72 million internal migrants in the “more climate-friendly” scenario. It is impossible to assess precise numbers for the EU only though.
The Groundswell Report finds several negative and positive outcomes resulting from climate-induced migration. Climate-related hazards destroy the household’s livelihoods, force people to flee and thus hamper their adjustment to the new situation. Displaced persons are confronted with problems resulting from their emotional state – what is related to the unexpectedness to leave their home - as well from the unfamiliarity of the new area. Besides these obstacles, migration also can have positive impacts on the migrants live: those who are in the position to choose their destination “often improve their economic situation after migrating.” Those who migrate from low- to high-income countries, profit from a 15-fold income increase. Furthermore, those who stay behind, can profit from remittances, diversifying their income and making them less dependent on local governments.

Another discussed topic in the literature closely linked to impacts of migration is whether a connection between climate change, migration and violent conflict exists. In early works on the issue the result seemed obvious: climate change would shorten resources, force people to move due to natural hazards and thus cause major conflicts between migrants or refugees and communities in the receiving countries (Brzoska 2015). In an overview of the development and current state of the climate-change-migration-conflict nexus, Brzoska sums up that any link between them is questionable, and empirical support thin.

In short, the connection between climate change and migration is complex. Different, often contradictory concepts coexist; there is disagreement on the numbers, right definitions and even impacts. For instance, while some researchers estimate millions of climate refugees willing to enter the EU, others refusing to name any numbers at all. What complicates the debate even more is the difficulty to separate climate-related factors from other drivers of migration. That makes not only a clear definition of a “climate migrant” or “climate refugee” nearly impossible. As another result, a protection gap under international law remains for those fleeing from hazards and impacts of climate change.

6.2 Interactions between globalisation and technology

6.2.1 Labour share, globalization and technology

On theoretical grounds, technological progress may amplify the negative effect on the labour share brought about by the reduction of barriers to cross-border trade and capital flows by making production more capital intensive in advanced economies. The literature has highlighted two main channels through which the interaction between technology and globalisation drives the increase in capital intensity: offshoring and the reduction of the relative price of investment goods.

Globalisation made it easier for firms to boost their profits by offshoring production in emerging market economies where labour cost is lower. Since offshored tasks are relatively labour intensive, the production in advanced economies becomes more capital intensive (see Dao et al., 2017). The shift from labour to capital was also fostered by the concurrence of the decline of the relative price of investment due to globalisation and the efficiency gains in capital producing sectors brought about by breakthroughs and advances in ICT (Karabarbounis and Neiman 2014).
6.2.2 Artificial intelligence, digitalisation and market concentration

The analyses presented in section 4 emphasised that globalisation has interacted with technology in influencing factor shares through offshoring, among other channels. The surge of AI, automation and digitalisation, suggests that this process will be more intense in future decades. The development of new technologies, the rise of artificial intelligence (AI) and the digital economy era are key drivers behind socio-economic change in many branches of activity.

AI is surpassing human performance in a growing number of domains. Nevertheless, there is limited evidence of its economic effects, probably due to lags in complementary innovations and business procedure reorganisation (see e.g. Brynjolfsson et al., 2017, 2018). Some evidence on the link between AI and globalisation is however available. By using data from a digital platform (eBay), Brynjolfsson et al. (2018) study a key application of AI: machine translation. The paper shows that by introducing a machine translation system eBay has significantly increased international trade on its platform, increasing exports by 17.5%. Additional studies are needed to deepen the understanding of these issues and reach more robust conclusions, but the existing empirical evidence points out that the effects of increased trade on the economy and the tax system, discussed in the specific chapter on globalisation, might be amplified by the interaction with AI in the near future.

The digitalisation of the economy intended as the process of leveraging digitalisation to improve business processes is pervasive and raises broader issues. Digitalisation has made it easier to work remotely and participation in the global workforce will depend less on people residence and more on the speed and quality of their internet connection. Recent evidence suggests that digitalisation may drive productivity and employment growth, also favouring the inclusion of ‘disadvantaged’ groups in the labour market (Evangelista et al. 2014). This more interconnected world will bring new opportunities but also new challenges (EC 2017). New work patterns, such as casual work, work-on-demand, ICT-based mobile work, where workers can do their job from any place at any time and where connectedness through internet and electronic platforms, are on the rise.

These new forms of (net)working, facilitated by globalisation and digitalisation of the labour market, pose new challenges to worker mobility law in the European Union and the cross-border application of labour law (e.g. Nerinckx 2012, Houwerzijl 2015, Degryse 2016). In particular, this issue has opened the possibility to concentrate service provision in specific countries. This sudden transformation gives rise to issues related to the location of taxes. Moreover, the sustainability of social security and collectively agreed social funds could deteriorate as a result of a large-scale adoption of ICT-based mobile work. In the same light, and as already discussed in sections 2 and 4, digitalisation raises questions on where taxes should be paid and in what amount, in a world where new business models allow enterprises to be effectively heavily involved in the economic life of different jurisdictions without any significant physical presence (OECD 2019).

6.3 Interactions between demographic changes and technology

6.3.1 How demographic trends influence technological progress?

There are several ways how population ageing affects production. The low fertility reduces the amount of working-age population and investment rate and generates capital deepening in
private production, as discussed in section 3.2. Secondly, an increasing share of labour force is allocated to personal health and long-term care services due to lower mortality rates in old age, which lowers average productivity growth.

Another potential reason for lower productivity growth is the ageing of the labour force. On one hand, the age composition of the work force may affect both the speed and type of technology adoption, as age groups of workers may differ both in their ability to adopt new technologies and in their complementarity with particular types of technology (see Acemoglu and Restrepo 2018). On the other hand, the age composition of the population may affect both the rate and direction of technological progress, as age groups may differ in their contributions to innovation and in their interest of innovation direction (see Prettner 2013 and Liang et al. 2018).

Several empirical studies examine the relationship between demographic change and productivity. The results are not unanimous. Feyrer (2007) examines the relationship between workforce demographics and aggregate productivity in a cross-country sample and finds that demographic change is highly correlated with changes in total factor productivity. The relationship he finds is U-shaped with negative effects of increases in the fraction of workers below age 40 and above age 50. On the other hand, Börsch-Supan and Weiss (2016) did not discover any decline in productivity, at least before age 60, when they used individual data on workers in an assembly line of a large factory.

Maestas et al. (2016) estimate the impact of population ageing on output per capita across states in the U.S. They find that an increase in the population aged 60 and above significantly reduces output per hour worked and argue that the driving force behind this is a decrease in the marginal product of labour. However, Acemoglu and Restrepo (2017) find no negative relationship between population ageing and GDP per capita in a cross-country estimation. In Acemoglu and Restrepo (2018), they present cross-country estimates showing that an increasingly ageing work force leads to faster adoption of robots and other automation technologies.

6.3.2 How technological progress influences demographic trends?

The direct link from production technology to demographic trends goes from the advancements in health care technology to lower morbidity and longer lifetimes. However, the most influential link is indirect: the productivity growth generated largely by technological change has contributed strongly to higher incomes and thereby indirectly to higher life-expectancy. On the other hand, the increase in incomes and lower child mortality have promoted lower fertility. The technological progress in health care is expected to lower morbidity and mortality rates especially in retirement years also in the future, which deepens population ageing. A counterbalancing factor is that the relatively high living standards in Member States attract immigrants from outside of the EU area. The wealthiest EU countries benefit also from internal EU immigration.

The technological developments are likely to continue promoting economic growth and thereby alleviate the expected decline in the growth rate of tax revenues, which helps to finance the increasing public expenditures of the ageing societies. However, the overall positive effects on public budgets generated by productivity growth and higher wages in private production may turn out to be smaller than expected. This is because public sector wages are linked to private
sector wages, but productivity in the production of public services may lag behind. Therefore, the public sector labour costs can increase without corresponding increase in productivity. Higher wages increase public expenditure also because of wage-indexed income transfers. These counteracting mechanisms are the more important the larger is the public sector of the country. From the point of view of public finances, a major challenge will be how to improve the productivity in the provision of public services. Even a minor increase in the productivity growth would improve markedly the long-term outlook of public finances.

6.4 Summary

- The impact of climate change on migration is unclear.
- Digitalisation allows enterprises to do business in different jurisdictions without any significant physical presence. As a result, it makes it more difficult to assess where taxes should be paid thereby aggravating problems in international corporate taxation. Similar issues may also arise e.g. in relation to social security and the increase in ICT-based mobile work.
- Ongoing technological progress, e.g. advances in AI, is likely to increase international trade and offshoring of tasks by lowering language barriers.
- The evidence on the effect of population aging on labour productivity is mixed. There is some evidence, however, that ageing population leads to faster adoption of labour-saving technologies. From the point of view public finances, a key issue is to what extent this can be expected to happen also in the provision of public services.

6.5 References


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OECD (2019), Addressing the Tax Challenges of the Digitalisation of the Economy – Policy Note


White, Gregory (2011), Climate Change and Migration: Security and Borders in a Warming World, Oxford University Press.

7 Futures tables and scenarios

In this section, we summarize key uncertainties related to the future trends in the four areas of change discussed in the previous sections and illustrate their possible relations. To this end, we first present area specific “futures tables” displaying possible realisations for a small number of dimensions of uncertainty that we believe to be the most relevant ones for taxation. We then illustrate plausible relations between different dimensions of uncertainty and their tax implications with four scenarios. The scenarios essentially combine specific realisations for the dimensions of uncertainty presented in the futures tables. They also include a brief narrative explaining why some of the trends might realise together.

The time frame we consider is about 20 years\textsuperscript{131} and our focus is on EU countries alone. We consider only development possibilities that seem plausible within the scenario period. In our view, developments that could totally disrupt our societies, such as a widespread use of AI technologies and developments in the field of robotisation spilling over from industrial applications to the service sector and displacing workers in virtually all tasks are very unlikely during the next 20 years.

We have chosen the dimensions of uncertainty in the futures tables based on two guidelines. The first guideline is to consider only developments that can be potentially very relevant for taxation. The second one is to focus on development possibilities which are associated with a large degree of uncertainty over the scenario period. For instance, while there is a lot of uncertainty about climate change and its effects in the second half of the century\textsuperscript{132}, there is much less uncertainty about it during the scenario period. Moreover, there is a high degree of consensus in the scientific community on the need to tighten climate policies very soon. In contrast, there is considerable uncertainty about the labour market implications of new technologies such as AI already during the next two decades. We therefore take climate change and the need to reduce GHG emissions as given, but highlight the uncertainty related to how technological progress affects certain labour market outcomes.

The scenarios are chosen so that they highlight possible relations and interactions between different dimensions of uncertainty described in the futures tables. For instance, one of the scenarios takes as the starting point the possibility that the recent change in the political landscape towards nationalism and protectionism strengthens globally. It seems plausible that such a shift in the political landscape would weaken international policy coordination in several policy areas that are relevant for taxation either directly (e.g. international corporate taxation) or indirectly (e.g. trade policies).

We also present a baseline scenario that is largely based on assuming that various current trends continue. The baseline scenario provides a comparison point for the other scenarios; they follow the baseline scenario in some dimensions of uncertainty while differing from it in others. When

\textsuperscript{131} We consider a longer time frame in the case of some demographic changes. This is because changes in e.g. fertility rates have long-lasting and predictable effects on future demographics.

\textsuperscript{132} One example is the uncertainty about tipping points which would initiate irreversible destructive processes in nature.
describing the baseline scenario, we also refer to some trends that are not included in the futures tables. These are trends that we believe to be very relevant for taxation but not subject to large uncertainty over the scenario period. As mentioned above, an example of such a trend is climate change and the increasing need to reduce GHG emissions. Another example is population ageing in the EU.

It should be emphasized that the futures tables and scenarios reflect subjective and somewhat speculative assessments based on our own reading of the related research literature. Other researchers might have chosen to highlight different dimensions of uncertainty, even if they had followed the same guidelines. It should also be emphasized that we are unable to assess the likelihood of the different possible realisations in the futures tables. Related to this, we cannot say that the realisations of uncertainty that we associate with the baseline scenario are the most likely ones. Finally, one could of course construct many other scenarios in addition to those presented here. We hope that the futures tables are helpful for a reader that would like to construct other scenarios.

This section relies on the research literature that is discussed and referred to in sections 2-6. For the sake of brevity, we do not repeat references to that literature here.

### 7.1 Futures tables

This section presents our area specific futures tables. In order to make it easier for the reader to map the futures tables and the scenarios that will be presented in section 7.2, we also indicate in the tables the combinations of the realisations of uncertainty used in the different scenarios.

#### 7.1.1 Technology

Table 7.1. Futures table for the area of technology.

<table>
<thead>
<tr>
<th>Key dimensions of uncertainty</th>
<th>Possible realisations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low-skill vs. high-skill automation</strong></td>
<td><strong>Automation replaces mainly low-skill workers</strong></td>
</tr>
<tr>
<td><strong>Geographic drivers of platform economy</strong></td>
<td><strong>Competition led by platforms headquartered outside Europe</strong></td>
</tr>
<tr>
<td><strong>Prevailing employment status of platform workers in the EU</strong></td>
<td><strong>Status quo prevail</strong></td>
</tr>
</tbody>
</table>

Bolded realisations refer to assumptions used in the baseline scenario (scenario 1). References to scenarios indicate where and how scenarios 2, 3, and 4 deviate from the baseline scenario. The scenarios are described in section x.x below.

The first dimension of uncertainty in the futures table for technology concerns the substitution relations between automation and different types of labour in production. So far, automation has mainly replaced relatively low-educated workers in low- and medium-wage occupations. The
Table refers to this as “low-skill automation”, and it is also part of our baseline scenario. If this trend continues, wage inequality is likely to increase, which in turn would make the redistributive function of taxation more important. At the same, there would be a need for increasing public investments in education to support employment. Thus, the tax revenue requirement would also increase.

However, technological progress, e.g. advances in artificial intelligence, may in the future also result in “high-skill automation” that increasingly replaces relatively high-educated workers, for instance in accounting or financial services. Such a trend may reduce wage inequality by decreasing the demand for high-skilled workers. However, there is likely always a relatively high demand for high-skilled workers who can develop new technologies or introduce them in production.

The second dimension of uncertainty relates to the location of future growth in the platform economy. Like other digital businesses, online platforms are characterised as having ‘scale without mass’. They can operate across borders without necessarily having a physical presence in each jurisdiction, which creates challenges for the taxation of business profits. Much of the growth in the platform economy to date has been led by businesses based outside Europe. It is likely that the tax challenges associated with ‘scale without mass’ will persist for Member States should future growth be led by platforms headquartered outside Europe. The magnitude of these challenges for certain Member States could be reduced should European platforms gain a larger share of the market in the future. In such a scenario, European platforms would have ‘scale with mass’ ensuring that EU tax authorities capture greater share of global platform revenues under existing rules. However, there would still be challenges for taxation within Europe, as platforms based in a particular Member State could still operate across Europe without having a physical presence in each Member State.

The last dimension of uncertainty in the table relates to the employment forms of platform work. Much of the debate in Europe has centred on whether platform workers are deemed to be employed or self-employed. Recently, several Member States have adopted hybrid classifications for platform workers, encompassing aspects of self-employment while retaining certain protections (e.g. minimum wage). However, there is a question as to whether a hybrid employment status for platform workers will change the underlying tax treatment of platform workers. A hybrid employment status could simply increase employment protections afforded to platform workers without affecting the tax treatment of the work done via platforms and their profits: workers would continue to classify platform income as if protections were not afforded (i.e., in most cases, as self-employed taxable income). Such an approach could have implications for social security policy and administration if the protections generated a need for greater levels of public expenditure.

7.1.2 Globalisation

Table 7.2. Futures tables for the area of globalisation.

<table>
<thead>
<tr>
<th>Key dimensions of uncertainty</th>
<th>Possible realisations</th>
</tr>
</thead>
</table>

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The first dimension of uncertainty in the futures table for globalisation relates to the general political landscape, which can have tax implications through various channels that are related to globalisation. One possibility is that we will see waves of nationalistic populism with protectionist tendencies and more liberal political forces that are supportive of international coordination taking turns. The support of populist and nationalistic parties may also diminish more permanently if people eventually become disappointed with current populist policies. The change in the political landscape towards populism, nationalism and protectionism may also strengthen further as a backlash to real and imagined employment and redistributive effects of globalisation and migration.

The second dimension of uncertainty in the table is the scope for international trade. The main source of uncertainty relates to the future of multilateral trade agreements, which directly impact on the extent of international trade. First, it may happen that barriers to international trade will not diminish systematically from their current levels, and some further barriers will be increased temporarily. As an alternative, further agreements will be signed to reduce the existing barriers, thus increasing the potential for international trade. Further expansion of multilateral trade agreements would increase world trade and specialisation through international value chains. It would also sustain economic growth and tax revenues, but possibly at the cost of increasing income inequality within EU. However, this development is not

<table>
<thead>
<tr>
<th>Political landscape</th>
<th>Waves of nationalistic populism and more liberal political forces supportive of international coordination take turns.</th>
<th>Disappointment to outcomes of populist policies.</th>
<th>Increasing support for nationalistic populism and further political polarisation. (scenario 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope for international trade</td>
<td>Periods of lower and higher trade barriers take turns.</td>
<td>Increase in multilateral trade thanks to permanent reduction in trade barriers.</td>
<td>Permanently increased trade barriers. (scenario 3)</td>
</tr>
<tr>
<td>International tax legal framework</td>
<td>No further tax coordination (but for the adoption of EU Directives) and proliferation of uncoordinated and unilateral actions. (scenario 3)</td>
<td>Intermediate level of tax coordination mainly involving exchange of information and the adoption of similar measures in different countries in order to counteract double non taxation.</td>
<td>High level of tax coordination related not only to double non taxation but also to common rules for the quantification and allocation of profits and common new nexus rules.</td>
</tr>
</tbody>
</table>

Bolded realisations refer to assumptions used in the baseline scenario (scenario 1). References to scenarios indicate where and how scenarios 2, 3, and 4 deviate from the baseline scenario. The scenarios are described in section 7.2 below.
necessarily the most likely, as tensions over trade policy have increased in many ways. If these tensions materialise, we may end up in a world with increased barriers to trade.

The third dimension of uncertainty relates to the international coordination of corporate taxation. In recent years, international tax coordination has focused on reducing tax avoidance of multinational corporations especially through the BEPS-project and EU anti-avoidance Directives. However, the principles of international corporate taxation have remained unchanged. The question is whether there will be agreement on more fundamental changes in the international tax regime. In this regard, with an intermediate level of tax coordination, agreements could be reached on the adoption of similar measures in different countries in order to generally counteract double non taxation (for example, the adoption of measures like the subject to tax clause, suggested in pillar 2 of OECD, 2019). With high level of cooperation, agreements could be reached also based on substantive rules (i.e. common rules for the quantification and allocation of profits and common new nexus rules, such as the common consolidated corporate tax base or, generally, the formulary apportionment method suggested in pillar 1 of OECD, 2019). In the absence of coordination, unilateral measures may further undermine the consistency of the international corporate tax system.

The first dimension of uncertainty, namely the political landscape, is likely to be correlated with the other two dimensions: Increasing support for populist and nationalistic parties is likely to make new multilateral agreements on trade or taxation less likely, and vice versa.

### 7.1.3 Demographics

Table 7.3. Futures table for the area of demographics.

<table>
<thead>
<tr>
<th>Key dimensions of uncertainty</th>
<th>Possible realisations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fertility rates</strong></td>
<td></td>
</tr>
<tr>
<td>Average total fertility rate in the EU declines from the current level of 1.6. (scenarios 3 and 4)</td>
<td>Gradual increase in average TFR to 1.8, as in Eurostat 2019 baseline projection.</td>
</tr>
<tr>
<td>Strong increase in average TFR to replacement rate of 2.1.</td>
<td></td>
</tr>
<tr>
<td><strong>Mortality rates</strong></td>
<td></td>
</tr>
<tr>
<td>Age-specific mortality rates decrease less strongly than in the Eurostat baseline projection. (scenario 3)</td>
<td>Age-specific mortality rates decrease in line with the Eurostat baseline projection.</td>
</tr>
<tr>
<td>Age-specific mortality rates decrease more strongly than in the Eurostat baseline projection. (scenario 2)</td>
<td></td>
</tr>
<tr>
<td><strong>Health and long-term care needs in old age</strong></td>
<td></td>
</tr>
<tr>
<td>Compression of morbidity and disabilities. (scenario 2)</td>
<td>Expansion of morbidity and disabilities. (scenario 3)</td>
</tr>
</tbody>
</table>
Immigration from outside the EU|

Immigration from outside the EU declines in line with the Eurostat baseline projection.

Occupational immigration from outside the EU increases significantly. (scenario 4)

Environmental immigration increases significantly. (scenario 3)

Bolded realisations refer to assumptions used in the baseline scenario (scenario 1). References to scenarios indicate where and how scenarios 2, 3, and 4 deviate from the baseline scenario. The scenarios are described in section 7.2 below.

The first dimension of uncertainty in the futures table for demographics relates to the development of fertility rates in the EU. Recent developments in EU countries show some convergence towards the current average level of 1.6 children born alive per woman. However, country-specific fertility rates have varied substantial over recent decades, and the factors behind the recent changes and the large differences between EU countries are largely unknown. This means that future fertility rates should be regarded as highly uncertain. If the long-term trend of declining fertility rates continues, the average fertility rate in the EU by 2040 could, for instance, be around 1.3, which corresponds to the current level in the large Mediterranean member states. On the other hand, the average fertility rate might increase to the level of 1.8, as projected by Eurostat, or even above the level of 2.0 realized in France just ten years ago.

It is useful to divide the economic effects of a lower number of children to three parts. During the first 20 years parents can use more time and money for other purposes than raising children, and public finances would benefit from lower day care and education costs. During their working years, the smaller birth cohorts supply less labour and generate less tax revenues. Demand for occupational immigration and innovations that boost labour productivity increase. After their working lives, smaller cohorts of retirees require less public expenditure on pensions, health care and long-term care. Overall, public finances weaken permanently after the initial improvement, because lower fertility increases old-age dependency ratio. The problem is likely to be more severe in countries with large pay-as-you-go-financed pension schemes. With higher than expected fertility rates the economic outcomes are reversed.

The second dimension of uncertainty concerns mortality rates. With the exceptions of war times, pandemics and other crises, they have fallen continuously in the developed countries. Initially, the absolute decline was strongest for children, but thereafter moved to older age groups and has been strongest for the oldest-old persons until the Great Recession. Population projections have, for a long time, typically assumed that the rate of decline will attenuate at some point, which has led to a systematic underestimation of future longevity.

The Great Recession seemed to curb the improvements in life expectancy in the EU, and the former trends have not revived even after the economies recovered. This is the background for the negative view presented in the second column of table 7.3. The Eurostat projection suggests, however, that life expectancy at birth converges in the EU and will continue to increase on average by more than a year in a decade. It is also not difficult to imagine that with healthier lifestyles and medical innovations the mortality improvements accelerate back to the trend that prevailed during the first decade of the millennium. Changes in life expectancy affect taxation especially via the financing of public pension and health care systems. For instance, higher life
expectancy requires higher pension contribution rates or other additional funding unless legal retirement ages increase, or monthly pension payments are reduced, sufficiently. In some countries, the pension system includes automatic adjustment rules that link the retirement age or the benefit level to longevity.

Future public health and long-term care costs also depend crucially on how morbidity and ability to function of individuals develop when life expectancy increases. There is genuine uncertainty about this aspect as well, which is captured in the third row in the futures table for demographics. Compression of morbidity takes place if the onset of chronic illness can be postponed and if this postponement is greater than the increase in life expectancy, that is, the additional years of life are spent in good health. In this scenario, the public health care expenditures per individual may even decline in the future. Expansion of morbidity occurs if the increase in life expectancy is accompanied by an increase in the number of people with chronic disease and disability so that at least some of the additional years of life are spent in bad health. In the extreme case, age-specific morbidity and disability rates remain roughly constant. Such a scenario would heavily increase the need for public expenditures on health and long-term care, especially if combined with unexpectedly long lifetimes in the future. The Sustainability Report of the European Commission assumes that half of the future gains in life expectancy are spent in good health and ability to function. This projection implies less pressure for fiscal sustainability than the case where age-specific morbidity and disability rates remain constant, but more pressure than under the compression-of-morbidity assumption.

The fourth dimension of uncertainty relates to immigration from outside the EU. Population ageing and the relatively low current and projected fertility rates in the EU are expected to strengthen the demand for occupational immigration. At the same time, migration flows within the EU are likely to continue towards countries with the highest wage levels. As far as the additional immigration is the result of increased demand for labour in the EU, the employment rates of migrants may be relatively high and public finances benefit from larger income tax revenues. Another possibility is that migration from outside of the EU countries is largely driven by environmental catastrophes, political unrest and military interventions. In this case, the employment outlook of immigrants may not be that good and increased public spending needs on social and other assistance programs for immigrants may dominate additional tax revenues at least in the short-run. However, the impact of climate change on international migration is highly uncertain.
7.1.4 Climate change and environmental externalities

Table 7.4. Futures table for the area of climate change and environmental externalities.

<table>
<thead>
<tr>
<th>Key dimensions of uncertainty</th>
<th>Possible realisations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual attitudes</strong></td>
<td>Consumers become generally much more environmentally conscious.</td>
</tr>
<tr>
<td><strong>Green energy</strong></td>
<td>Breakthrough innovations in clean energy technologies start to reduce GHG emissions also in countries with lax climate policies. (Scenario 2)</td>
</tr>
<tr>
<td><strong>International policy coordination</strong></td>
<td>Fast progress: countries representing most of the global emissions tighten their climate policy substantially by 2025 or so.</td>
</tr>
</tbody>
</table>

Bolded realisations refer to assumptions used in the baseline scenario (scenario 1). References to scenarios indicate where and how scenarios 2, 3, and 4 deviate from the baseline scenario. The scenarios are described in section 7.2 below.

The first dimension of uncertainty in the futures table for climate change and environmental externalities concerns individual attitudes. At present, the sense of responsibility with regard to individual environmental behaviour is low, and hardly any noticeable consequences have yet been anchored in law and society. However, there are signs of consumers becoming more willing to reduce environmentally harmful consumption and favour environmentally friendly products, even in the absence of price changes.

While such a change in attitudes may reduce the need to use environmental taxation to internalise externalities, it would also make it politically more acceptable. On the other hand, consumption habits for e.g. travelling and carbon intensive food may be difficult to change, at least in the required timeline. In any case, convincing people about “adequate” environmental behaviour is likely to be strongly influenced by political debates.

The second dimension of uncertainty in this table relates to the nature of technological progress. In general, technological progress creates more income and consumption which, with current carbon intensity, increase GHG concentrations. But innovations may also provide new ways to lower the carbon intensity of production or reduce other environmental externalities. Technological progress has already reduced the cost of clean energy substantially and this trend
will very likely continue. However, there is inherent uncertainty regarding the extent to which technological progress will help resolve environmental problems. An important aspect of uncertainty relates to the use of green technologies in countries with relatively lax climate policies. To the extent that new technologies reduce the use of fossil fuels, they may lower the price of fossil fuels, thereby reducing the incentives to invest in green technologies in countries with lax climate policies. This outlook means that many of the developing countries with high population growth may commit themselves for a long time to carbon intensive energy production by investing in the current technologies which use fossil fuels.

The third dimension of uncertainty relates to international agreements. Environmental policy has global, area-wide, country-specific, regional and local dimensions. For GHG concentrations and climate change, the global dimension is the most relevant. Therefore, abatement agreements that cover at least the largest and most carbon intensive economies are extremely important. Current trends are not encouraging, since the Paris Agreement is not fully binding, and its targets are not ambitious enough. In the table, we distinguish between three possible realisations. In the first one (fast progress), countries representing most of the global emissions agree to tighten their climate policies substantially by 2025 or so. In the second one, at least some major economies agree to tighten their climate policies only after 2025. In the third realisation, there is little progress in international policy coordination and many countries, including some EU Member States, follow lax climate policies.

### 7.2 Scenarios

We first describe the baseline scenario. It builds on the baseline realisations of uncertainty described in the futures tables as well as some other major trends that we consider to be less uncertain. After that, we describe three alternative scenarios focusing on how they differ from the baseline scenario. For each scenario, we first provide its basic logic by explaining why certain possible realisations in the futures tables are likely to be correlated. We then briefly describe trends or developments related to the four areas of change considered in sections 2-5, trying to take into account also the most important interactions between different areas. Finally, we discuss the main tax implications.

#### 7.2.1 Scenario 1: Baseline

**Basic logic**

Our baseline scenario is mainly based on extrapolating current trends. We assume, for instance, that over the scenario period the capital share of output keeps increasing at least a little and labour market polarisation continues. However, in some cases it seems more reasonable to assume that the current trends will be reversed because policies will be changed. We assume that global GHG emissions will be brought down because many countries will adopt tighter climate policies within the scenario period.

**Technology**

Automation continues to replace mainly workers in relatively routine tasks over the entire scenario period. This process works to increase the capital share of output and wage inequality in the EU. However, the increase in the capital share and wage inequality is mitigated by the emergence of new tasks and the increasing aggregate demand due to economic growth.
Population ageing has also a small negative effect on the capital income share. We assume that the net effect is a moderate increase in the capital income share over the scenario period.

The digitalisation of business models continues making it easier for businesses to operate in a particular jurisdiction without necessarily having a physical presence. At the same time, the share of goods and services that are traded through online platforms increases. The platform economy is dominated by large non-European platforms which have significant market power. The digitalisation of business models increases the demand for and value of user data.

### 7.2.1.3 Globalisation

Waves of nationalistic populism and liberal internationalism take turns both in the EU countries and some other major developed countries. Barriers to international trade will not diminish systematically from their current levels, and some barriers will be increased temporarily. On the other hand, digitalisation magnifies many of the tax challenges created by international trade and capital mobility by making it increasingly easy for businesses to be heavily involved in the economic life of different jurisdictions without significant physical presence.

There is some progress in the international coordination of corporate taxation. However, it mainly involves exchange of information and the adoption of similar measures to counteract double non taxation, rather than new, common rules for the allocation of profits such as the common consolidated corporate tax base.

### 7.2.1.4 Demographics

Below-replacement-level fertility and increasing life expectancy lead to population ageing, even though migration inflows into the EU mitigate the ageing of the population. EC forecasts of fertility, mortality and immigration trends project the old-age dependency ratio to increase from an average of 29 in 2015 to an average of 51 in 2070. Roughly half of the future gains in life expectancy are spent in good health. Eurostat projections behind our baseline demographic assumptions do not factor in the possible (and highly uncertain) effect of climate change on migration patterns.

### 7.2.1.5 Climate change and environmental externalities

The average global temperature, which is largely determined by past GHG emissions, keeps increasing over the entire time frame considered, i.e. up to 2040 and Paris Agreement goals are not achieved. The intensification of climate change starts to hurt especially the economies of the southern member states. The main driving forces are higher intensity, length and frequency of extreme weather events, higher average temperatures that impact citizens health condition and weaken production levels in agriculture, construction and manufacturing, and rise of the sea level.

Climate change also aggravates biodiversity loss which continues over the timeframe considered. Many of the coastal regions and poorest countries outside the EU experience much larger damages than EU member states. The negative effects of climate change start to dominate the political debate in many countries and increase the pressure for tighter climate policy. Stronger policy interventions and progress in green technologies will start lowering global emissions during the next decade.
Consumers become more environmentally conscious which increases the incentive to develop green technologies. However, while technologies to e.g. produce and store clean energy improve, technological advances do not suffice to limit the increase in the average global temperature to less than 2 degrees without much tighter climate policies than those currently in place. Large-scale removal of CO2 from the atmosphere remains infeasible until the end of the scenario period. The progress in international coordination of climate policy is also slow relative to what be needed.

7.2.1.6 Main tax implications

Digitalisation reduces corporate tax income in some member states because current principles relating to profit attribution - i.e. that profits are taxed where value is created - are complicated by the fact that companies can often provide digital services in a country without being physically present there. The challenges generated by the rise of online platforms also keep increasing. One issue is that it is often unclear whether platform workers should be treated as employed or self-employed for tax and social security purposes. The rise of platforms also increases barter transactions which escape VAT.

Some of these challenges relate to the lack of international corporate tax coordination and capital mobility. For instance, taxation of work mediated by platforms becomes more important, but often requires at least international exchange of information between the platforms and tax authorities. On the other hand, technology also provides new means to promote higher levels of tax compliance by collecting and analysing large amounts of tax-related data and by lowering compliance costs.

At the same time, population ageing puts pressure on public finances in many EU countries. In addition, there is also an increasing need for public investments in education to ensure that workers that are displaced due to ongoing automation have the skills needed in new tasks.

Higher and more uniform carbon taxes are needed at least outside the ETS in order to reduce GHG emissions. They would also bring more tax revenue in the medium-term. However, distributional concerns limit the use of tax instruments to reduce emissions. Partly due to advances in green technology, the tax base for many carbon-related taxes, including current fuel taxes, start diminishing well before the end of the scenario period.

The increasing capital income share, together with further job polarisation, make the distributive function of taxation more important. However, the pressure from populist political forces prompt some governments to prefer the introduction of tax expenditures and special tax regimes in favour of e.g. specific occupational groups, rather than a comprehensive reform of the tax system to strengthen its redistributive ability. These policies reduce the overall consistency of the tax system, with adverse effects on horizontal equity.

7.2.2 Scenario 2: “High-tech road”

7.2.2.1 Basic logic

Technological development speeds up and the rate of automation increases in nearly all industries relative to the baseline scenario. As a result, also total factor productivity and economic growth increase more than in the baseline scenario. Technological progress also drives down the cost of clean technologies. These developments are strengthened by economic
policies supporting research and development. Technological progress lowers the cost of climate change mitigation. New innovations in health care reduce mortality. Increased automation weakens the role of labour cost differences and strengthens the role of capital costs for decisions on production location.

### 7.2.2.2 Technology
Many of the tasks currently performed by workers with basic or secondary level education performing routine tasks are automated. In contrast to the baseline scenario, advances in artificial intelligence also allow automating many tasks currently performed by highly educated workers, e.g. in accounting, financial and medical services. On the other hand, the demand for high-educated workers who can apply and develop new technologies increases substantially.

The income effects of the higher growth rate and new technologies increase the demand for labour. This, together with an enlarged gig economy, supports the employment of low-skilled workers.

### 7.2.2.3 Globalisation
Rapid automation weakens the role of labour cost differences and increases the role of capital costs when decisions about the location of production are made. This effect supports the competitiveness of countries with relatively high wage costs and may reduce offshoring. On the other hand, rapid advances in AI may increase international trade and offshoring of tasks (again relative to the baseline scenario) by lowering language barriers. The overall effect on offshoring is unclear.

### 7.2.2.4 Demographics
New innovations in health care and long-term care improve productivity and decrease morbidity and old age mortality in EU countries relative to baseline scenario. The improved control of environmental problems reduces mortality and may also promote fertility. New medical treatment possibilities and higher living standards increase the demand for public health care services. The net effect of these trends on fiscal sustainability is unclear.

In the longer term, the improved return on higher education promotes demand for human capital investments, which together with increased supply of higher education increases the share of well-educated.

### 7.2.2.5 Climate change and environmental externalities
Over the scenario period, the average global temperature keeps increasing because of previous GHG emissions and because global emissions decrease only gradually. The loss of biodiversity will also continue at least for some time.

Policies aimed at constraining environmental problems add public and private resources to R&D that aims to mitigate climate change. Due to technological progress, production and storage of clean energy becomes gradually so cheap that the carbon intensive production of energy loses competitiveness also in countries that follow lax climate policies. Even the production processes in cement industry and manufacturing of basic metals become carbon neutral by the end of the scenario period. Technological developments also increase the circular economy.
7.2.2.6 Main tax implications

Higher economic growth induced by technological progress increases tax revenues relative to the baseline scenario. At the same time, countries have increased incentives to compete for highly productive R&D intensive firms by lowering their effective corporate tax rate. International agreements on corporate taxation would be increasingly valuable but are not easy to reach because of the larger conflicts of interest between different countries.

The amount of tax revenues raised from labour income depends on the ability of the governments to maintain progressive tax schedules in the face of increased international competition for highly educated workers.

The development of public expenditures depends on the size of the welfare state, the evolution of labour productivity in the public services, and the evolution of medical treatment costs. It is likely that labour productivity in the public services increases more slowly than elsewhere in the economy. This limits the positive effect of productivity growth on public finances. There is also need for new and at least partly tax-funded training opportunities to ensure that all worker groups have access to new technologies.

The rapid development of green technologies reduces the tax revenue from carbon related taxes, including current fuel taxes, and also government revenues from the ETS.
7.2.3 Scenario 3: “Co-operation fails”

7.2.3.1 Basic logic
The change in the political landscape towards nationalism and protectionism strengthens more than expected as a backlash to real and imagined employment and redistributive effects of creative destruction, globalisation and migration. A general emphasis on national interests and misinformation about global warming reduce the acceptance of climate policies. Political pressures to refrain from new international agreements in the fields of environmental protection, taxation and foreign trade increase. Some of the current agreements are renegotiated to have a lower ambition level or the contracts are simply not respected. The increased use of economic power in international relations harms especially small open economies but also weakens global economic growth.

The current trends in technological progress continue. Towards the end of the scenario period, the demand for technologies, such as cooling, that help adapting to climate change increases strongly besides urgent efforts to develop effective technologies to mitigate climate change. Fertility declines because individuals are increasingly concerned about the effects of climate change on the wellbeing of future generations.

7.2.3.2 Technology
The current trends in technological progress continue. The trends benefit large multinational companies, promote automation and increase the capital share of value added. No agreement is reached on sharing information between countries on the transactions taking place in platforms.

Incentives to develop technologies that are energy-saving or produce clean energy are limited in the short term, since the price of energy and CO2 emissions remains low and regulation is not tightened in the EU. In the long term, the demand for technologies, such as cooling, that help adapting to climate change increases strongly.

7.2.3.3 Globalisation
Replacement of rule-based multilateral trade institutions with bilateral trade agreements and higher customs and other barriers of trade limit world trade and reduce the gains from specialisation. Protectionist trade policy increases production close to markets. Globalisation proceeds, however, in areas that are not restricted by policy, such as cross-border ownership of companies and the digital economy.

No agreement is reached on common corporate income tax bases, new allocation of taxing rights, or minimum rates. Tax competition continues and large digital companies maintain low effective CIT rates.

7.2.3.4 Demographics
During the next ten years there are no surprises in demographic developments in the EU. Fertility follows the baseline population projection of Eurostat suggesting convergence to higher average numbers of children, but still far from the replacement level.

The demographic picture starts to change when approaching the end of the scenario period. Intensification of climate change (relative to the baseline scenario) weakens health and increases mortality especially among the older population in the EU (also compared to the
baseline scenario). Fertility falls because individuals are increasingly concerned about the effects of climate change on the wellbeing of future generations.

Population growth, worse living conditions as well as occasional conflicts in Africa and the Middle East generate pressures for migration into the EU. The dominant nationalist policy in the EU tries to limit the inflow of migrants, but the borders cannot be closed tightly. No agreement on the fair allocation of refugees between Member States is reached. The illegal status of many of the migrants and the inadequate assimilation policy keeps the employment rates of the migrants low.

7.2.3.5 Climate change and environmental externalities
The final goal of the Paris agreement of restricting the global temperature rise in this century to 1.5 degrees Celsius (compared to preindustrial time) is not reached mainly because the major polluting countries outside EU do not start reducing the emissions early and strongly enough. In the EU, the plan to lower the number of ETS allowances fails and CO2 taxation of the non-ETS sector is on average too lenient. Stronger actions will not be taken before a global average temperature increase of 2-3 degrees Celsius, at which point the negative effects of climate change start to dominate the political debate. Climate change and unchanged land use policies aggravates biodiversity loss. The efficiency in the use of natural resources does not improve and the recycling efforts are limited until the prices of non-renewable natural resources increase markedly.

During the next ten years, this development does not influence much the average global temperature and average global GDP growth. Low mitigation spending may even speed up economic growth in the EU compared to more sustainable scenarios. The somewhat higher CO2 concentrations in the atmosphere may also increase crops in the EU and the increasing need for cooling in the southern EU is to some extent compensated by lower warming costs in the northern EU.

In the longer term, the accumulation of GHG concentrations and the consequent global warming starts to affect especially the economies of the southern Member States adversely. The main driving forces are higher intensity, length and frequency of extreme weather events, higher average temperatures that weaken citizens health and production conditions in agriculture, construction and manufacturing, as well as rise of the sea level. Losses in biodiversity diminish crops further and increase the prices of food. Many of the coastal regions and poorest countries outside the EU experience much larger damages. The higher the initial temperature, the more negative are the consequences of additional warming.

7.2.3.6 Main tax implications
In the next decade, the rate of economic growth is close to that in the baseline scenario, since the relatively low prices of energy and low effective corporate income tax rates boost growth, compensating the losses generated by reduced world trade. Tax competition limits the increase in revenues from corporate income taxation. Increased reliance on consumption taxes and other relatively immobile tax bases is likely. The price of ETS allowances increases more slowly than currently expected. The postponement of public expenditures related to preparation for climate change improves public finances slightly during the 2020s.
Failed co-operation implies that countries strive to improve their competitiveness by lowering tax rates on mobile tax bases including R&D resources. As far as location, investment and employment decisions are influenced by differences in tax and transfers policies between countries, economic efficiency and productivity growth suffers. Another efficiency loss is caused by the initial inability of the tax systems to diminish environmental externalities. Price of GHG and other polluting emissions does not reflect the harm caused and differs between countries, sectors and companies.

Long-term economic growth declines markedly because of the damages caused by climate change and increased trade barriers. The permanent loss in GDP and high adaptation costs generate severe difficulties to public finances in EU countries at the same time as the need to help developing countries that suffer the most from climate change and other environmental problems increases. The ability to adapt to climate change varies between households depending on their wealth and income, which adds political pressures for redistribution.

The slow progress in international coordination of climate policies, together with tighter climate policies in the EU, increases the pressure to implement some sort of EU “carbon tariffs”. The rationale for such tariffs would be to limit carbon leakage and address concerns regarding the international cost competitiveness of European producers.

If the welfare state promises are kept, large increases in tax rates are needed in the long run both because of smaller tax bases and higher public expenditures. Because of tax competition, countries may be forced to lower tax rates on corporate and capital income. Countries also compete with lower earned income tax rates for experts and wealthy retirees. These trends increase the pressure to increase consumption and property taxes. Gig work continues to increase, partly because it can sometimes be used to avoid labour income taxation. Disagreements on common CIT and VAT rules increase also the administrative and compliance costs of taxation.
7.2.4 Scenario 4: “Low fertility”

7.2.4.1 Basic logic
Fertility rate trends have been declining – with some exceptions, such as the baby boom after WWII – for several centuries in Europe. Eurostat projects that the EU fertility rates revive and converge gradually towards 1.8 by 2100 (Eurostat 2019), but there is large uncertainty related to this projection. Fertility rates may also decline significantly from their current levels. Total fertility rates currently vary between 1.3 and 1.9 children in EU countries and demographic research has not found factors that would clearly explain the recent variation both over time and between countries. In many of the EU countries with lowest fertility, the number of children has increased in recent years, but not in all of them.

The scenario assumes that the decline in fertility will continue from the current EU average of 1.6 towards the Spanish and Italian level of 1.3 by 2040 or so. Since a decline in fertility has a very long-lasting and predictable effect on future demographics, we consider here a somewhat longer time span (up to 2060 or so) than in the previous scenarios.

The decline in fertility is partly due to negative news about climate change and uncertain employment prospects. A low fertility rate first releases resources from childcare at home, day care and education and thereby adds especially female employment in other professions. But after 20 years, smaller birth cohorts cut back the labour force for decades. Lower fertility accelerates the increase in the dependency ratio and intensifies the pressures to expand employment-based immigration. Population ageing also affects technological progress by increasing the demand for labour-saving technologies.

7.2.4.2 Technology
A low fertility rate first releases resources from childcare at home, day care and education, and thereby adds especially female employment in other professions. A lower number of children also releases other resources than labour as less money is allocated to meet the needs of children. The resources that are saved can be used to increase other kinds of consumption or leisure. They can also be used to increased investments in education, which increase productivity and compensate for the diminished number of workers available in the future.

However, after about 20 years, lower fertility starts reducing labour force for decades. A diminishing labour force increases the incentives to develop and use labour-saving technologies. The demand for new labour-saving technologies is especially high in old age care, which is currently very labour intensive. It seems clear, however, that there also many concerns about the use of new labour-saving technologies (e.g. some sort of care robots) in old age care. One concern is that they may make older people feel more isolated. These concerns are likely to limit the use of labour-saving technologies in old-age care.

7.2.4.3 Globalisation
There are no clear connections between low fertility and globalisation, apart from its potential impact immigration (discussed below).

7.2.4.4 Climate change and environmental externalities
Population growth is a catalyst for climate change and biodiversity loss. Therefore, lower global fertility would be good for the environment. However, a decline in fertility in the EU only does
not have a major impact on climate change, even though the consumption of fossil fuels per capita is high in Europe. Moreover, children consume markedly less than adults, which means that it takes time until the lower number of children fully affects consumption. Therefore, the final environmental effects of low fertility would emerge only slowly and are in any case less important than environmental policy and technological innovations.

### 7.2.4.5 Demographics
There is little reason to assume that changes in fertility would be correlated with changes in mortality in the EU, where infant mortality is already very low. This scenario thus assumes that longevity increases as in the current Eurostat baseline projection. Immigration, in contrast, is likely to be affected by changes in fertility. Lower fertility is likely to increase employment-based immigration (from outside the EU) because of the increased need for labour due to stronger than expected population ageing. Again, this is something that is likely to happen only after the first 20 years or so. Higher immigration would mitigate the increase in the old-age dependency ratio.

### 7.2.4.6 Tax implications
In the long term, economies adjust to smaller populations. Problems emerge, however, during the adjustment process, especially if the decline is fast. The skills and the location of the older labour force may not match labour demand. Companies must scale down activities, especially if replacing labour by capital is not economically feasible. Fixed capital, such as infrastructures, may become underused. The growth rate of GDP as well GDP per capita are likely to fall even though labour productivity increases.

During the first 20 years, lower fertility reduces public expenditures related to health care, day care and education and therefore improves public finances. In the longer term, however, lower fertility creates pressure to increase tax rates. There are two main reasons for this. First, lower fertility increases the old-age dependency ratio. Second, it also lowers the growth of the aggregate wage bill, thereby making the financing of pay-as-you-go social security schemes more costly. Lower fertility also increases the burden of existing public net debt by increasing its value in per capita terms.

Development and application of new labour-saving technologies mitigate the adverse impact of lower fertility on public finances to the extent that they reduce the need for labour in old-age care and other publicly financed services.

In the absence of countervailing measures, the tax structures may become less progressive because pension contribution rates are often proportional to labour income. The need to adjust either pension contributions or benefits also weakens intergenerational equity. Public finances in the few member states where the financing of the pension system is largely based on funding are better protected against a decrease in fertility than others.

### 7.3 References

8 Synthesis

We have considered four main areas of change - technology, demographics, globalisation and environmental externalities – and discussed how different drivers of change in these areas can be expected to impact the main functions of taxation and tax administration. We have also highlighted uncertainties related to future developments as well as possible interactions between different drivers of changes from the point of view taxation.

To summarise the findings, we first briefly describe what we consider as the main (potential) challenges for tax policy created by the (uncertain) future developments discussed in detail in the previous chapters. We group these challenges based on the main functions of taxation that they are most closely related to. We then discuss some relatively broad policy responses that should be helpful across different plausible scenarios.

8.1 Main challenges for tax policy

8.1.1 Raising tax revenue

Perhaps the most serious concern raised in the public debate related to technology is that new labour-saving technologies will result in mass unemployment. That would decrease tax revenues and increase various social expenditures such as unemployment transfers. Fortunately, at least so far, new technologies and automation has not had a clear negative impact on employment at the economy-wide level. One reason is that automation also increases aggregate income which in turn increases the demand for labour. Firms have also created entirely new tasks for workers. Theoretical research suggests that these mechanisms may fully compensate for the negative effects of labour-displacing technologies on employment also in the future. However, there is likely to be an increasing need for public investments in education to ensure that displaced workers have the skills needed in new tasks.

An important technology-driven trend is digitalisation. One aspect of it is that it allows many businesses to operate in a particular country without necessarily having a taxable presence there. Digitalisation has also increased the importance of (e.g. user) data and other intangible assets (e.g. patents) for firms’ profits. As highlighted through the OECD’s BEPS agenda, under the current international nexus and profit allocation rules these developments create challenges for the taxation of multinational corporations.

Digitalisation has also led to the rise of online platforms which has driven the creation of non-standard forms of employment raising questions about the employment status of online workers and their social security contributions. The rise of platforms may also promote barter transactions which are always challenging to tax from a VAT perspective.
There is little doubt that Europe’s population is ageing over the next few decades. The increase in the share of older people will pose challenges for the viability of public finances and is likely to require increases in tax rates to maintain current social welfare systems. At the same time, population ageing lowers the importance of labour income and increases that of pension income as tax bases. The tax implications of population ageing are especially important in member states that rely entirely on pay-as-you-go financing for their public pension systems. It should be kept in mind, however, that demographic projections are highly uncertain over a longer time frame (several decades) that is relevant when considering the sustainability of public finances.

As we explain below, there is a strong case for increasing carbon taxes as part of climate policy and revenue from cap and trade systems. Higher carbon taxes should increase tax revenue at least in the short run. However, given climate policy goals, the tax base for carbon taxes, including current fuel taxes, should diminish already in the medium-term. Hence, carbon taxes cannot be relied on to solve fiscal sustainability issues related to e.g. population ageing.

Climate policy and the climate change itself are also likely to increase the need for tax revenue. On the one hand, tightening of climate policy should involve more subsidies and other type of incentives towards the development of green technologies. On the other hand, part of the costs of adapting to climate change will inevitably be borne by the public sector.

### 8.1.2 Mitigating inequalities

A pervasive trend in the labour market has been job polarisation, i.e. decline in the share of middle-income occupations. The capital share of income has also been increasing in many developed countries over the last few decades (although there are various measurement issues involved). These trends have been associated with both technological change (labour-saving technologies that have allowed automating many relatively routine tasks especially in manufacturing) and globalisation (e.g. offshoring). Job polarisation increases wage inequality unless it is associated with sufficiently large increases for wages for low-skill work. A higher capital income share is also likely to increase income inequality because capital income tends to be much more unevenly distributed than labour income. Both these trends are thus likely to make the redistributive function of taxation more important.

Globalisation has created new opportunities for tax base erosion and profit shifting (BEPS) by corporations and for tax evasion by wealthy individuals, thereby making it more difficult to reduce economic inequality via taxation. Uncoordinated unilateral measures did not succeed in curbing BEPS as multinationals exploit tax differences between different jurisdictions through tax arbitrages. BEPS should be better addressed through coordination, which could be achieved either via unilateral implementation of the same measures in different countries at the same time, or via multilateral solutions. During the last decade and under the initiatives of both OECD and EU, the structure of the international tax regime has evolved indeed in a multilateral way in an attempt to deal with the challenges coming from BEPS and the rise of digital economy. However, it is not clear what the future steps in this regard will be.

Climate change may increase welfare inequality partly because low income households have fewer options to adapt to it than others and because the burden of carbon taxes is likely to fall disproportionately on low- and middle-income households (see below). Both climate change and population ageing raise difficult questions related to intergenerational equity. In the case of
population ageing, these questions relate closely to the pay-as-you-go financing of pensions and old-age care and to choices related to the reforms that ensure the financial sustainability of the welfare state (such as raising contribution rates of the young versus lowering the benefits of the old).

8.1.3 Correcting market failures

The main purpose of environmental taxes is to induce individuals to internalise negative externalities. There is urgent need for policies to mitigate climate change, including higher environmental taxes. Well-designed environmental taxes provide incentives for firms to develop new, greener technologies without a priori restricting technological choices. In the case of climate change, the externalities mainly relate to GHG emissions due to the use of fossil fuels and changes in land-use that affect soil and forest carbon stocks. In the EU, higher, and more uniform, carbon taxes are needed at least outside the EU emissions trading system. There is also an increasing need to stop biodiversity loss and a general degradation of ecosystem services. The measures could include land taxes that increase the price of converting natural land to other uses.

Because of their impact on the price of some goods that can be considered as necessities, such as heating and private transport, carbon taxes are likely to be regressive, which reduces their political acceptability. Another challenge related to the task of mitigating climate change is that the externalities involved are global; cutting GHG emissions in the EU alone would not have a major impact on climate change. There is also a concern that unilateral policy measures undermine the global competitiveness of European firms. At the same time, the chances of achieving such enhanced international cooperation could be weakened by recent political trends related to populism.

8.2 Addressing the challenges

As indicated above, many of the future trends that may be relevant for taxation are uncertain. Rather than asking how to react to a specific trend, it makes sense to first consider how to make public finances more resilient in the face of uncertainties. This could be done by trying to better align actual tax systems to general guidelines of good taxation that are not sensitive to these future trends. The following commonly accepted guidelines are especially helpful in this context:

1. Seek to avoid distortions by minimizing the effect of taxation on people’s choices, except for cases, such as environmental externalities, where changing behaviour can clearly increase welfare.

2. Not every tax needs to be progressive. It is the redistributive impact of the system as a whole which matters.

One application of the first guideline is the taxation of land. High land values are due to attractive location (e.g. in a city centre), which is fixed and therefore not affected by taxation of capital mobility. This feature makes property taxes on land values very efficient. Moreover, even

133 See for instance, Chapter 2 in the highly regarded Mirrlees review (Institute for Fiscal Studies and Mirrlees 2011).
if future productivity growth would benefit mainly capital owners, it should drive up the price of land in attractive areas. Increasing property taxes on land values, at least in member states where they are currently relatively low, would thus make the overall tax system both less distortionary and more resilient toward some of the future trends discussed above, namely international capital mobility and increasing capital income share.

A similar application of the first guideline is the idea to tax returns that are close to the “normal return” – the (almost) riskless return on savings – at a lower rate than very high returns, or “excess returns”. In theory, systems that exempt the normal return allow taxing excess returns at relatively high rates, without necessarily weakening investment incentives; as long as the expected before-tax return of an investment project exceeds the normal return and the tax rate on excess returns is less than 100%, investors should be willing to undertake the project. This feature could also be helpful in tackling some of the distributional concerns related to higher capital income share as well as international capital mobility.

Both guidelines are relevant when designing environmental taxation. In order to minimize the aggregate cost of reducing GHG emissions (per unit of emissions), the (effective) carbon price should usually be the same across sectors. On the other hand, as mentioned above, such a policy can impose a disproportionately large burden on low-income households. Rather than imposing differential tax rates on GHG emissions in different sectors to mitigate the distributional impact, governments should consider compensating low-income households with other measures, such as lowering the income tax rate for low earners and increasing transfers to low-income households. Of course, in order to secure political support for efficient environmental taxation, it is also important to communicate the connection between higher environmental taxes and the compensating measures clearly.

Since many of the challenges are related to the lack of international policy coordination, it is also important to seek to improve international policy coordination both between EU countries and between the EU and the rest-of-the-world. In the case of corporate taxation, tax coordination is needed to avoid excessive tax competition and to limit the scope for tax evasion and aggressive tax planning. It can also be argued that international coordination in corporate taxation may increase economic growth and tax revenues if it reduces tax related distortions to firms’ investment decisions that are due to differences in corporate taxation across countries.

Unfortunately, further international coordination in these areas may be difficult to achieve and does not depend on the EU alone. It would therefore be useful to also consider and prepare policies that can be applied if efforts to improve international coordination fails. As an example, the case for EU carbon tariffs increases if many of the EU’s trade partners follow lax climate policies while the EU and its member states tighten their own policies. The main rationale for such tariffs would be to limit carbon leakage and address concerns regarding the international cost competitiveness of European producers.

Another, and more complicated, example is destination-based corporate taxation. Its idea is to base corporate tax on the location of consumers (buying firm’s products) rather than on the

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134 Currently, the normal return is close to zero in the euro area. However, the rate of return that is taxed at a lower rate should include a small risk-premium to compensate for imperfect loss offset in taxation.
location of production or profits, thereby removing the incentive for firms to shift production or profits to countries with low corporate taxation and mitigating some of the problems related to the taxation of digitalised businesses. Should efforts to improve further international cooperation in corporate taxation stall, it might be useful for the EU to consider a unilateral move towards destination-based taxation.

In some cases, having a strategy that specifies what a large player like the EU would do if coordination fails may even help achieving desired international coordination. For instance, the option of imposing EU carbon tariffs may make other countries more willing to tighten their own climate policies.

Member states should obviously try to take advantage of new technologies in improving tax administration and tax compliance. For instance, technology can help sharing data with national tax administrations. Sharing data between online platforms and tax administrations could lower compliance costs for platform workers and their customers, as well as helping to secure tax revenue.

Finally, it should be clear that many of the challenges related to future trends and taxation should be addressed by policy measures that are not directly related to taxation. Examples includes pension reforms to tackle fiscal problems caused by population ageing, changes in land use regulation to address some environmental externalities, and education policies to sustain employment in the face of new labour-saving technologies.

8.3 References

GETTING IN TOUCH WITH THE EU

In person
All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at:
https://europa.eu/european-union/contact_en

On the phone or by email
Europe Direct is a service that answers your questions about the European Union. You can contact this service:
– by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
– at the following standard number: +32 22999696, or
– by email via: https://europa.eu/european-union/contact_en