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Quarterly Report on the Euro Area

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- **Shifting taxes away from labour to strengthen growth in the euro area.** Section prepared by E. Meyermans, A. Leodolter, L. Pires, S. Princen and A. Rutkowski
- **Assessing public debt sustainability: some insights from an EU perspective into an inexorable question.** Section prepared by S. Pamies and A. Reut
- **The sovereign-bank nexus in the euro area: financial and real channels.** Section prepared by M. Bellia, L. Cales, L. Frattarolo, A. Maerean, D. Monteiro, M. P. Giudici and L. Vogel
- **The natural rate of unemployment and its institutional determinants.** Section prepared by A. Hristov and W. Roeger

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EUROPEAN ECONOMY

Economic and Financial Affairs

The **Quarterly Report on the Euro Area** is written by staff of the Directorate-General for Economic and Financial Affairs. It is intended to contribute to a better understanding of economic developments in the euro area and to improve the quality of the public debate surrounding the area's economic policy.

The views expressed are the author's alone and do not necessarily correspond to those of the European Commission.

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Directorate-General for Economic and Financial Affairs

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EUROPEAN ECONOMY

Institutional Paper 130

Table of contents

Boxes

Maarten Verwey
Director-General

The ongoing crisis caused by the COVID-19 pandemic has sparked several new questions which will prompt deep analytical thinking and further economic research. While these may take economists years to ultimately resolve, the European Commission's Directorate-General for Economic and Financial Affairs (DG ECFIN) will be fully engaged in working on answers to many of these questions and policy recommendations for national and collective action. This issue of the Quarterly Review on the Euro Area (QREA) was planned long before the COVID-19 crisis erupted. It includes analytical pieces on a range of topics relevant for the euro area economy but not directly related to the ongoing crisis itself. Still, the issues addressed shed some light on a number of policy choices – e.g. how to ensure a tax structure that is least detrimental to economic growth, how to measure the sustainability of public finances, how to further limit the sovereign-banking nexus – whose urgency has only been made more acute by the crisis.

The first section investigates empirically the effects of tax reforms on employment and GDP. The section first highlights the strong differences in labour tax burden across Member States, focusing on low-income and second earners for whom both labour supply and demand is the most sensitive to variations in costs. The section thus provides an econometric analysis of the impact of taxation on output. It identifies taxes less detrimental to employment and growth and discusses the differences across Member States. The empirical analysis and illustrative simulations suggest that shifting the tax structure away from labour to other tax bases such as consumption and environmental taxes can boost output in a revenue neutral manner. However, the article also points out that the overall effect, notably in terms of distributional outcome, depends on the broader structure of the tax framework.

The second section takes stock of debt sustainability analysis (DSA) methodologies, and presents recent methodological advances in this area. Fiscal sustainability is a key pillar in the EU framework underpinning the country surveillance work. It has also become one of the central components of the crisis management framework and has led to greater cooperation with other institutions such as the European Stability Mechanism (ESM). While DSA is sometimes considered as more art than science, the recent and on-going advancements in this area are promising and provide ever firmer ground to assess sustainability risks. Recent advancements have expanded the types of approaches used by practitioners to assess debt sustainability to include probabilistic tools, a greater consideration of feedback effects, a broader scope of the fiscal risks examined, as well as more developed views on the institutional dimension of debt sustainability. This on-going work is central to assess the need for 'safety nets' for public finances. This ongoing work is an important contribution to the design of the COVID-19 economic response and to our efforts to foster debt sustainability throughout the euro area.

The third section reviews the direct (financial) and indirect (real) channels through which banks and sovereigns interact, and which may give rise to adverse feedback loops between the two sectors. The section also offers a brief summary of the institutional progress on severing the sovereign-bank loop in the euro area. As regard financial channels, and focusing on the diversification of banks' sovereign bond portfolios as a standalone measure, model-based simulations, in line with the relevant literature, suggest an ambiguous impact on systemic and bank-level risks. However, in scenarios where diversification has not taken a form that would also increase systemic contagion risk, it can deliver an important shock-absorption effect in times of crisis. The main

avenue to reduce the 'indirect' contagion channel appears to be greater cross-border integration. Indeed, model simulations show that higher cross-border integration of banking sectors would attenuate the impact of asymmetric shocks across the regions of a monetary union. In terms of policy, while significant progress has been achieved in mitigating the direct channel of the loop in recent years, the indirect channel remains largely intact and further improvements on both fronts appear warranted. Beyond measures taken to support government finances and private sector's balance sheets, the historic slowdown in economic activity linked to the lock-down may thus call for renewed policy impetus is a reminder of the need to further sever sovereign-bank loops.

The fourth section provides an econometric analysis of developments in the natural rate of unemployment across the euro area. This work confirms some of the well-known empirical factors explaining the trend in the natural rate of unemployment (e.g., unemployment benefit replacement rate, the labour tax wedge and active labour market policies) but importantly it highlights the role of demographic developments and within-country dispersions as measured by the difference between the long-term unemployment rates across regions. Overall, the analysis suggests that countries that adopted comprehensive labour market policy measures, combining labour tax reductions with activation policies and making labour income relatively more attractive in comparison with the unemployment benefit replacement rate managed to reduce structural unemployment. On the other hand, countries that concentrated on labour tax reductions but either neglected or counteracted this by reducing active labour market policies and increasing the generosity of unemployment benefits were less successful.

Altogether, this edition of the QREA, which was prepared in a 'pre-COVID-19' period, shows that a large number of the analytical issues and policy concerns relevant then will likely remain compelling in the months and years to come. At the current juncture, having a fully developed framework to gauge the sustainability of public debt and the need for external financial support is critical. So is a deeper understanding of the, at time nefarious, link between public finances and balance sheet developments in the private sector. Finally, ensuring that future reforms of the tax system and of labour market institutions are conducive to higher economic growth and lower unemployment will be a key element to guide policy through the recovery. While not directly prompted to the COVID-19 pandemic, the reflections included in these articles thus contribute to better and more encompassing euro area policy response to the economic urgency linked to the COVID-19 pandemic.

I. Shifting taxes away from labour to strengthen growth in the euro area

by Eric Meyermans, Alexander Leodolter, Leonor Pires, Savina Princen and Aleksander Rutkowski

In the euro area taxes are strongly skewed towards labour. Structural tax reforms aimed at shifting taxation away from labour are needed to strengthen the euro area's economic growth and job potential. This section examines how different tax bases affect potential growth and investigates the effect of tax shift reforms over the last decade. The section first analyses the benefits of reducing the taxation of labour in terms of increased labour market participation. Next, the section discusses other tax bases that are less detrimental to growth. Finally, applying a reduced-form regression analysis, the section investigates to what extent tax structures affected output between 2006 and 2017 in the euro area and presents scenarios that illustrate the long-run impact on output of tax shift reforms.

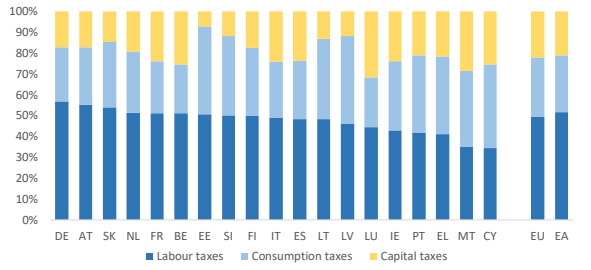
Overall, the analysis presented below confirms that shifting taxation away from labour to other tax bases can contribute to improving output. However, to stimulate growth, a shift in taxes should be part of a broader reform package that aims also to simplify and modernise tax systems, to address tax fraud, evasion and avoidance, to ensure that tax systems favour the deepening of the single market, and to remove the debt bias in taxation. ([1])

I.1. Introduction

The tax structure in the euro area is skewed towards labour, as labour taxes constitute the largest share of tax revenues in almost all euro area Member States (Graph I.1). An excessive tax burden on labour is a clear impediment to an efficient and smooth functioning of labour markets and may hamper economic activity and employment growth. As such, a well-designed shift ([2]) away from labour to tax bases that are less detrimental to growth ([3]), together with more efficient public spending and sustainable public debt, could significantly strengthen GDP growth and job creation potential in a number of euro area Member States.

Shifting taxes away from labour is high on the agenda of policy makers. ([4]) In the years prior to the 2008 economic and financial crisis, several Member States took measures to gradually reduce taxation on labour although these were often of limited ambition. In the context of the crisis, however, many Member States raised taxes, including labour taxes, to contribute to consolidation efforts. When circumstances allowed, some Member States again implemented labour tax reductions, which were often targeted at low-income earners.

Graph I.1: **Share of tax revenues according to tax type, 2017**



(1) Labour taxes comprising all taxes directly linked to wages paid by employers and employees including social security contributions.
Source: European Commission Services.

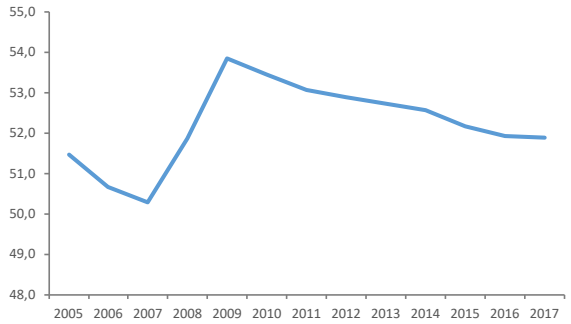
([1]) The authors wish to thank an anonymous reviewer for useful comments. This section represents the authors' views and not necessarily those of the European Commission.

([2]) See, for instance, Baiardi, D., Profeta, P., Puglisi, R. and S. Scabrosetti (2017), 'Tax Policy and Economic Growth: Does it Really Matter?', SIEP Working Paper No. 718 who argue that the design of a tax is at least as important as the type of tax.

([3]) Along with reforms that (i) simplify and modernise tax systems, (ii) address tax fraud, evasion and avoidance, (iii) ensure that tax systems favour the deepening of the single market, and (iv) remove the debt bias in taxation – see for instance European Commission (2018), 'Analysis of the Euro Area economy', Commission Staff Working Document, SWD(2018) 467 final .

([4]) For instance, in 2015, the Eurogroup reaffirmed that reducing taxation on labour is a clear policy priority and agreed on common reform principles as well as a benchmark in this policy area. The group agreed on using indicators measuring the tax wedge on labour for average wage and low wage earners. Since the benchmark was agreed, the annual assessment of draft budgetary plans is used to take stock of progress and of plans for the coming years. Moreover, in 2018, the euro area received a Council recommendation to shift taxation away from labour.

Graph I.2: **Revenues from labour taxation, as % of total tax revenues (Euro area average), 2005-17**



Source: European Commission Services.

The academic and policy debate on how tax structures affect the economy brought about a ranking of taxes in terms of their impact on growth. ([5]) Recurrent taxes on immovable property were found to be the least detrimental to growth, followed by consumption taxes and then by personal income taxes. Corporate income taxes appeared to have the most negative effect on economic growth. These findings suggested that a growth-favourable environment could be created by shifting taxation from labour taxes towards other taxes less detrimental to growth. While these findings steered economic tax policy during the last decade, the still sluggish growth in the post-crisis period renewed interest in the link between the structure of the tax system and economic growth.

Increased attention on inequality and fairness is another reason behind the reopening of the debate on the relationship between the tax structure and economic growth. Inequality issues had to be better addressed when rethinking the tax structure and shifting taxation away from labour. First, in the context of a tax shift away from labour, those in work will benefit from the labour tax reductions whereas others like pensioners will not. Moreover, when considering potential increases in consumption taxes, including taxes on energy, one should take into account the re-distributional effects of such a reform, which may be regressive if not combined with policy measures favouring the most vulnerable population groups. Likewise, raising revenue from recurrent property taxes, i.e. mainly housing taxes, would also require consideration of how housing affordability can be maintained.

This section examines how much scope there is to shift taxation away from labour to other tax bases less detrimental to growth. First, it assesses the need for reducing the labour tax burden in euro area Member States and analyses how the tax burden affects labour market participation. Next, it discusses the taxes less detrimental to employment and growth as well as the political economy barriers to tax reforms. Finally, it investigates econometrically to what extent tax structures affected potential output between 2006 and 2017. ([6]) This involves exploring illustrative scenarios in which taxation is shifted in a revenue-neutral way away from labour to other tax bases to promote growth in the long run. ([7]) The last section draws some conclusions.

I.2. The tax burden on labour

Reducing taxation on labour – which includes personal income taxes as well as employee and employer social security contributions – has the potential to stimulate labour supply and demand and hence also employment and growth. ([8]) Labour taxation also impacts consumption, cost-competitiveness and firms' profitability.

The overall tax burden on labour, as measured by the tax wedge of a single earner at average earnings ([9]), is considered very high in some euro area countries (Graph I.3). To gauge the need to reduce labour taxes it is however also necessary to consider labour market outcomes.

([5]) See, for instance, Arnold (2008), 'Do Tax Structures Affect Aggregate Economic Growth? Empirical Evidence from a Panel of OECD Countries?', *OECD Economics Department Working Papers* No. 643.

([6]) Time horizon (partly) set by data availability.

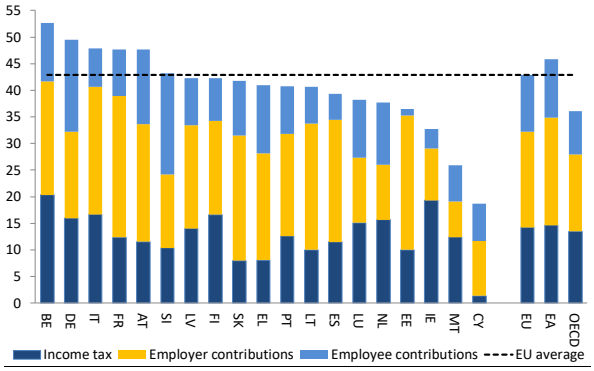
([7]) i.e., the supply side effects of tax reforms. The analysis does not provide estimates as to how in the short to medium run tax reforms may affect output via changes in aggregate demand - as in the case of, for instance, an increase in disposable income following a cut in labour income taxes (assuming a non-Ricardian setting).

([8]) For a general overview of labour taxation and labour market performance, see for instance, Econpubblica (2011), *The Role and Impact of Labour Taxation Policies*, Universita Bocconi.

([9]) The tax wedge on labour income provides a detailed insight into the burden on an individual and provides a measure of the difference between total labour costs to the employer and the corresponding net take-home pay of the employee. The tax wedge is the sum of personal income taxes and social security contributions net of family allowances, as a percentage of total labour costs (the sum of the gross wage and social security contributions paid by the employer).

When it comes to boosting labour market participation, what matters is also the distribution of the tax burden over the different income groups. ([10]) While the tax structure plays a crucial role in boosting growth and employment, the design of taxation is of even greater importance to address labour market participation and inequality issues.

Graph I.3: **Tax wedge on labour, single earner, average wage (2018)**



Source: European Commission Services based on OECD data

The negative impact of high labour taxes is particularly pronounced for groups facing more elastic labour supply and demand such as low-income and second earners. ([11]) It is therefore essential to have a special focus on those segments of the labour market and identify for which of these groups labour taxation substantially contributes to under-participation in the labour market.

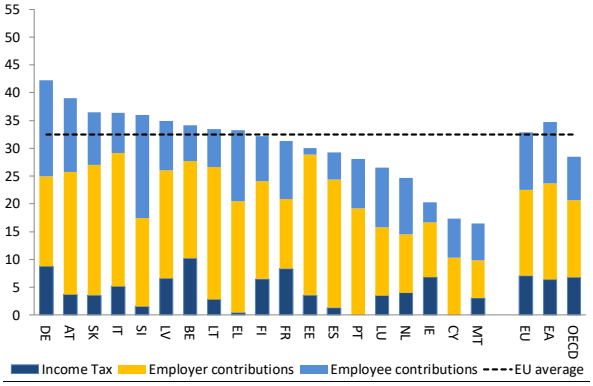
Targeting the most vulnerable groups can maximise the employment effect of labour tax reductions. At higher income levels, these effects are much less relevant, as demand elasticity tends to be lower and the fixed cost of participation in the labour market becomes comparatively lower. ([12])

Low-income earners

Several Member States have a relatively high tax wedge for low-income earners (Graph I.4), which may substantially discourage labour market participation. Workers with a low level of income are particularly responsive to changes in taxation, which tend to have a substantial impact on their decision to work or not.

Taxation, however, is only one of several factors contributing to financial disincentives to work. The level of unemployment benefits, social assistance and housing benefits may also contribute substantially to the (dis)incentive to take up work, while varying widely from one country to another.

Graph I.4: **Tax wedge on labour, single earner, 50% of average wage (2018)**



Source: European Commission Services based on OECD data

Second earners

In some Member States, labour taxation is designed in such a way that it discourages second earners from taking up work. When comparing the average tax rate for second earners with the average tax rate for a single earner at 67% of the average wage, substantial differences can be observed. Those differences are mainly due to the design of the labour tax system, which in many countries aims to ensure that families with the same total income pay the same total income tax, irrespective of who has earned the income.

While ensuring fairness between households, features of family-based taxation may also lead to an unequal tax treatment of individuals within a household. Since the primary earner benefits from the family-based features, including the lower tax brackets, the non-working partner or secondary earner will be subject to a higher effective tax rate

([10]) Kalyva, A., S. Princen, A. Leodolter and C. Astarita (2018), 'Labour taxation and inclusive growth', *European Economy Discussion Paper* No 084.

([11]) See, for instance, http://www.oecd-ilibrary.org/taxation/tax-design-for-inclusive-economic-growth_5jlv74ggk0g7-en.

([12]) See, for instance, CPB Netherlands Bureau for Economic Policy Analysis (Consortium leader) (2015), 'Study on the effects and incidence of labour taxation', *European Commission Taxation Papers*, Working Paper No. 56 – 2015

when increasing their labour supply. It should also be kept in mind that a wide variety of other policies, such as out-of-work benefits and the availability and quality of child care facilities, also impact on secondary earners' participation decisions.

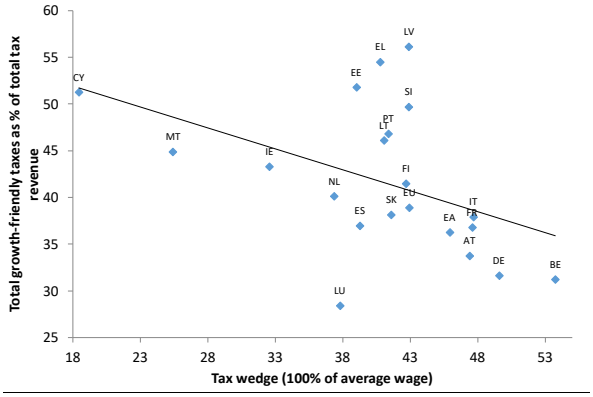
I.3. Taxes less detrimental to employment and growth

Whereas personal and corporate income taxes are considered to have a particularly negative effect on growth and employment, recurrent taxes on immovable property, consumption taxes and environmental taxes are considered less distortive in terms of market outcomes. ([13]) ([14])

A first look at the data suggests that several euro area Member States have potential scope to shift from labour taxes to consumption, property and environmental taxes as they combine a high tax wedge and rather low revenue from taxes less detrimental to growth (see Graph I.5).

This sub-section describes how changes in taxes may affect output at the margin. However, it should be remembered that some taxes less detrimental to growth have more potential than others to raise revenue because of differences in the size of the potential tax base. Consumption taxes are therefore often preferred over environmental and recurrent property taxes.

Graph I.5: **Correlation of tax wedge with total taxes less detrimental to growth, 2017**

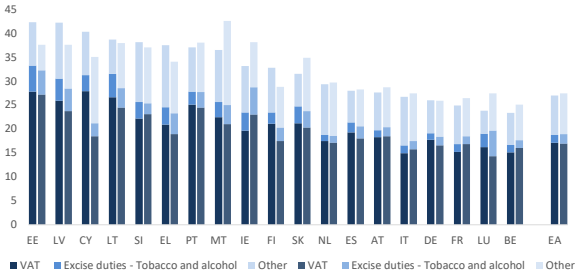


(1) Some energy taxes may be considered both as consumption and as environmental taxes.
Source: European Commission Services partly based on OECD data.

I.3.1. Consumption taxes

Given the above, consumption taxes and in particular value-added tax (VAT) are an important revenue source for most Member States.

Graph I.6: **Share of consumption taxes in total tax revenue (2017 and 2000)**



Source: European Commission Services

There are significant differences between Member States. In general, central European Member States tend to raise a higher proportion of their revenue from consumption taxes. For instance, in Belgium, Luxembourg and France consumption tax revenues constitute about 25% of total tax revenue while in Estonia and Latvia it is more than 40%. In most Member States this share remained fairly stable between 2000 and 2017 (Graph I.6).

Redistributive effect

Higher consumption taxes are often associated with lower tax progressivity and higher levels of

([13]) Some recent economic literature, though, points to heterogeneity of responses, non-linear effects and differences in amplitude between the short-term and long-term effects of a tax shift from labour to other tax bases. See, for instance, Mastrogiacomo, M., N. Bosch, M. Gielen and E. Jongen (2017), 'Heterogeneity in Labour Supply Responses: Evidence from a Major Tax Reform', *Oxford Bulletin of Economics and Statistics*, Vol.79, No. 5, pp. 769-796.

([14]) OECD (2010), Tax Policy Reform and Economic Growth.

inequality. ([15]) In fact, VAT and excise duties have a regressive effect when the cost to households is measured as a percentage of income, and are generally either proportional or slightly progressive when their effect is measured as a percentage of expenditure. ([16])

Reduced VAT rates and exemptions may not be the most (cost) efficient instrument to address distributional issues. ([17]) For instance, while many of the reduced rates introduced to support low-income households increase the purchasing power of these households, they are a poorly targeted and costly way of achieving this aim. ([18]) At best, rich households receive as much benefit from a reduced rate as do poor households. At worst, rich households benefit vastly more than poor households do. Hence, support to low-income households can be better achieved through more direct mechanisms such as income-tested cash transfers.

Allocative inefficiencies

Apart from the distributional effects described above, VAT generates allocative inefficiencies (i.e. deadweight losses), the size of which depends on the price elasticity of labour demand and supply. A consumption tax affects the real purchasing power of workers and households. As such, a rise in VAT may curb labour supply, lower work intensity and may trigger a rise in nominal wages ([19]) depending on the bargaining power of labour. ([20])

Overall, the available empirical evidence suggests that a reduction of labour taxes compensated by an increase in the implicit consumption tax rate leads to an increase in the levels of employment and GDP. ([21])

I.3.2. Environmental taxes

Environmental taxes ([22]) are used both as a way of raising revenue and to help a country achieve its environmental objectives. ([23])

To guarantee a stable level of revenue and to achieve the desired environmental outcome by internalising the external cost linked to certain goods and/or behaviours, environmental taxes need to be carefully designed. While in all Member States energy taxes are the most revenue-generating and the most macro-relevant environmental taxes, vehicle taxes also play an important role in some countries.

The revenues generated by environmental taxes differ significantly among EU Member States. Moreover, overall, revenues have not evolved much over the last decade (see Graph I.7). While total environmental tax revenues slightly dropped in 2008, by 2017 they were back at their 2005 level of 2.3% of GDP. Hence, environmental taxation seems to be underused in many Member States.

([15]) N. Pestel and E. Sommer (2015), 'Shifting Taxes from Labor to Consumption: More Employment and more Inequality', *ZEW Discussion Paper* No. 15-042.

([16]) See, for instance, Price, R., T. Dang and J. Botev (2015), 'Adjusting fiscal balances for the business cycle: New tax and expenditure elasticity estimates for OECD countries', *OECD Economics Department Working Papers*, No. 1275.

([17]) idem.

([18]) Lustig, N. (2018), 'Measuring the distribution of household income, consumption and wealth', in Stiglitz, J., J. Fitoussi and M. Durand (eds.), *For Good Measure: Advancing Research on Well-being Metrics Beyond GDP*, OECD Publishing.

([19]) In turn, higher wage cost will reduce the efficient allocation of resources if not compensated by increases in labour productivity.

([20]) The presence of a more heterogeneous workforce will amplify such effects.

([21]) See, for instance, Varga, J., Roeger, W. and J in 't Veld (2012), 'Growth effects of structural reforms in Southern Europe: the case of Greece, Italy, Spain and Portugal', *European Economy Economic Papers* No. 511. The paper reports that increasing the consumption tax in EL, IT, ES and PT to the average of the highest three euro area rates, while simultaneously lowering labour taxes in a budgetary neutral way, would increase GDP after 5 years by 0.5% in PT up to 1.4% in Greece - with the long run GDP gain ranging from 1.9% (PT) to 4.5% (EL). De Castro, Fernández, F., Perelle, M. and R. Priftis (2018), 'The Economic Effects of a Tax Shift from Direct to Indirect Taxation in France', *European Commission Discussion Paper* No. 077, making use of the QUEST III for France model, report that a 0.5% increase in the implicit VAT rate would bring about a cumulative GDP rise of 0.25% at the most after ten years. Using a panel data of 18 OECD countries, Garcia-Escribano and Mehrez (2004), report that lowering the share of direct taxes in total tax revenues by 3 percentage points compensated by a rise in indirect taxes raises growth by 0.25 percentage point.

([22]) Environmental taxes refer to taxes 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. They comprise taxes on energy, transport, pollution and resources. Officially denoted as 'environmentally related taxes'. See Eurostat (2013), Environmental taxes, A statistical guide.

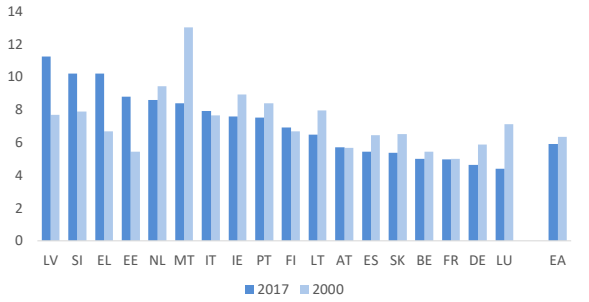
([23]) For a comprehensive discussion of the design and scope of environmental taxes, see, for instance, OECD (2011), *Taxation, Innovation and the Environment*

Relatively less distortive

Environmental taxes are considered among those taxes relatively less distortive in terms of market outcomes. ([24]) ([25]) While they may raise prices, lead to lower output and higher output prices, their positive growth impact is expected to materialise through different channels. They help reduce negative externalities, such as environmental and health damages ([26]), as well as stimulate productivity ([27]) and innovation. ([28]) Moreover, they may contribute to creating 'green jobs' ([29]) and reducing inequality ([30]) when additional revenue is used to reduce other taxes which disproportionately affect poorer households. ([31])

Moreover, a well-designed recycling of these revenues may improve overall technological and economic efficiency, especially in combination with investment in green infrastructure. ([32])

Graph I.7: **Share of environmental taxes in total tax revenue**



Source: European Commission Services.

Shrinking tax base

Finally, in the long run, this tax base will be eroded by increased energy efficiency, the development of renewable energy sources and national environmental regulations. This will in turn reduce the tax revenue from non-renewable energy taxes. ([33]) In this light, environmental taxes should be designed to achieve the desired environmental outcomes, while continuing to generate tax revenue.

I.3.3. Immovable property taxes

The share of recurrent taxes on land, buildings and other structures in total tax revenue varies markedly across Member States, although it is low on average (at about 3.3% in the euro area in 2017). In some Member States this share increased notably such as in Greece where it has increased from 0.6% in 2000 to 6.6% in 2017 (see Graph I.8).

In 2017, revenue from property taxes was equivalent to 2.6% of GDP in the euro area on

([24]) See, for instance, OECD (2010), 'Tax Policy Reform and Economic Growth', OECD Publishing.

([25]) This section does not study the impact of taxes compared to regulation to address environmental externalities in the production process – which both have their impact on technological and economic efficiency. Energy taxes are more efficient than regulation as they leave producer the choice of the level and the method of abatement and require lower administration costs, especially when environmental damages are not location-specific and do not vary with the source of pollution. This section focusses on the level of environmental tax as such.

([26]) See, for instance, Allcott, H., S. Mullainathan and D. Taubinsky (2014), 'Energy policy with externalities and internalities', *Journal of Public Economics,* Vol. 12 , pp. 72–88.

([27]) See, for instance, Franco, C. and G. Marin (2017),. 'The Effect of Within-Sector, Upstream and Downstream Environmental Taxes on Innovation and Productivity', *Environmental and Resource Economics*, No. 66, pp. 261–291.

([28]) See, for instance, Bretschger, L. (2015), 'Energy prices, growth, and the channels in between: Theory and evidence', *Resource and Energy Economics,* Vol. 39, pp. 29–52, and Karydas, C. and L. Zhang (2017), 'Green Tax Reform Endogenous Innovation and the Growth Dividend', *Journal of Environmental Economics and Management*, October.

([29]) See, for instance, Maxim, M., K. Zander and R. Patuelli (2019), 'Green Tax Reform and Employment Double Dividend in European and Non-European Countries: A Meta-Regression Assessment', *International Journal of Energy Economics and Policy,* Vol. 9, pp. 342–355.

([30]) See, for instance, Hailemariam, A. and R. Dzhumashev (2019), 'Income Inequality and Economic Growth: Heterogeneity and Nonlinearity', in Bruce Mizrach (ed.), *Studies in Nonlinear Dynamics & Econometrics*.

([31]) See, for instance, Oueslati, W., V. Zipperer, D. Rousselière and A. Dimitropoulos (2017), 'Energy taxes, reforms and income inequality: An empirical cross-country analysis', *International Economics,* Vol. 150, pp. 80–95.

([32]) For instance, Cambridge Econometrics, GHK, Warwick Institute for Employment Research and IER (2012), *Studies on Sustainability Issues – Green Jobs; Trade and Labour* estimates the impact on GDP ranging from -0.2% when revenue is recycled via a reduction in employer's social security rates to 0.75% when investment is spread across transport, machinery, buildings and renewables.

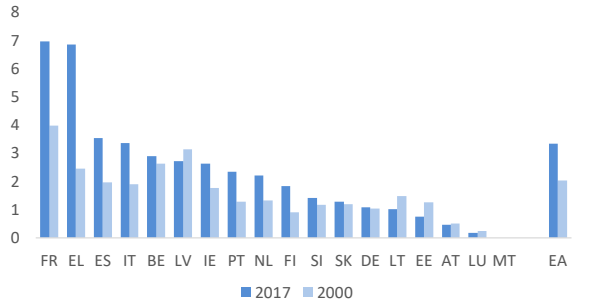
([33]) However, as energy efficiency improves and the demand for cheaper energy increase (the so-called 'rebound effect') this tax loss may be tempered somewhat. See, for instance, Barker, T., A. Dagoumas and J. Rubin (2009), 'The macroeconomic rebound effect and the world economy', *Energy Efficiency*, Vol. 2, pp. 411–427.

average and more than a third of it came from taxes on transactions.

Although recurrent property taxes ([34]) are generally considered to be the least harmful taxes to economic growth ([35]), several Member States (Malta, Croatia, Luxembourg, Austria) have either none or very little revenues collected from recurrent property taxation.

Taxes related to immovable properties used in the production process ([36]) have a direct impact on output as these properties are a production factor. Nevertheless, they are generally considered to be the least distortive taxes as they have only a negligible direct impact on decisions to work or invest. Moreover, as they are almost impossible to hide, only a limited amount of resources gets wasted evading these taxes.

Graph I.8: **Share of recurrent taxes on immovable property in total tax revenue**



(1) Recurrent property taxes are levied on land and buildings in the form of a percentage of an assessed property value based on a national rental income, sales price, or capitalised yield; or in terms of other characteristics of real property, (for example size or location) from which a presumed rent or capital value can be derived. They can be levied on proprietors, tenants, or both.
Source: European Commission Services.

Taxation of residential buildings affects incentives to purchase and invest into residential property. Residential buildings are easily identified, and taxes are hard to evade and easy to collect. While updating cadastral values may be a challenge, decisions on these are mainly political and are not more complicated than for other taxes such as labour taxes that need an in situ inspection to check labour employed and the accuracy of the declaration.

Taxation of residential buildings can also have important side effects. First, a preferential tax treatment of owner-occupied housing inherent in most Member States' tax systems in the form of untaxed imputed rents, deductibility of interest on housing loans and/or exemption from capital gains tax my lead to misallocation of capital towards housing, potentially reinforcing an emerging housing bubble. ([37])

Moreover, excessive taxes on property transactions may hinder the geographical mobility of labour which in turn may reduce overall output growth. ([38]) Transaction taxes could reduce speculation and thus help reduce the risk of housing bubbles, but the empirical evidence remains ambiguous. ([39])

([34]) Generally speaking, property taxes apply to immovable properties used in the production process such as land and buildings as well as to residential buildings – which have each their specific impact on output.

([35]) OECD (2010), Tax Policy Reform and Economic Growth, OECD Publishing.

([36]) Such taxes have to be distinguished from taxes on immovable non-productive properties such as residential buildings. The latter taxes affect GDP via their impact on disposable income which is an aggregate demand not covered in this section. See, Romer C. and D. Romer (2010), 'The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks,' *American Economic Review*, Vol. 100, No. 3, pp. 763–801.

([37]) For instance, empirical analysis by Fatica, S. and D. Prammer (2017), 'Housing and the tax system: how large are the distortions in the euro area?', *ECB Working Paper* No 2087, making use of the Household Finance and Consumption Survey for 15 euro area Member Sates, suggests that preferential tax treatment of owner-occupiers affects adversely the business and financial cycles by i) altering relative prices whereby tax benefits lead to excess investment in owner-occupied housing potentially crowding out corporate investment and by ii) lowering the cost of debt thereby incentivising household leverage which in turn limits households' capacity to adjust in the face of a negative income shock. On average, excess housing consumption is estimated at 30 percent of the holdings of financial assets in homeowners' portfolios in 2017.

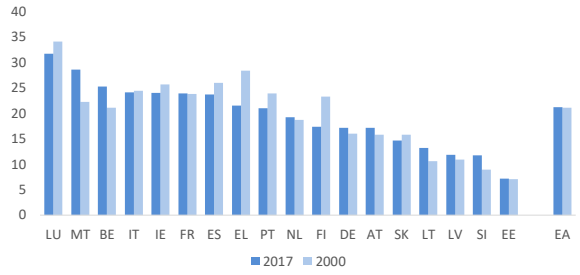
([38]) Available evidence suggests a negative impact of transaction taxes on labour mobility. For instance, using a panel data set for the Netherlands covering the x period, Van Ommeren, J. and M. Van Leuvensteijn (2003), 'New evidence of the effect of transaction costs on residential mobility', *CPB Discussion Paper* 18, report that a 1 percentage-point increase in the value of transaction costs—as a percentage of the value of the residence—decreases residential mobility rates by at least 8 percent. Focus on the system of stamp duty on residential transactions that had been in place until December 3, 2014 covering the 1996 to 2008 period, Hilber, C. and T. Lyytikäinen (2017), 'Transfer Taxes and Household Mobility: Distortion on the Housing or Labor Market?', report that a 2 percentage-point increase in the British stamp duty reduced household mobility by about 37 percent.

([39]) See Crowe, C., Dell'Ariccia, G., Igan D. and P. Rabanal (2011), 'How to Deal with Real Estate Booms: Lessons from Country Experiences', *IMF Working Papers* WP/11/91.

I.3.4. Capital taxes

Overall, revenues from capital taxes (i.e. taxes levied on the values or transfers of assets or net worth[40]) – and in particular capital income taxes are low if compared to labour or consumption taxes. In 2017 capital taxes constituted 21.2% of total tax revenue in the euro area as a whole (see Graph I.9).

Graph I.9: **Share of capital taxes in total tax revenue**



Source: European Commission Services.

Optimal tax theory suggests that a well-designed tax system should tax income from all sources — land, labour and capital — comprehensively and at equal rates. [41] However, due to the high cross-border mobility of capital, capital income taxes were long considered to be inefficient revenue sources, as they could easily be avoided. Many Member States therefore tax capital income at a lower – and often flat – rate.

However, recent advances in the automatic exchange of information have increased international cooperation on the reporting of capital income. This strengthens Member States' capacity to raise taxes from mobile tax bases such as corporate taxes.

Moreover, taxation has a central role to play in shaping a fair society and a strong economy of which the taxation of capital is an important component. Inheritance and gift taxes would be particularly well suited to counteract wealth concentration and inequality, both in terms of their behavioural effects [42] and because they are relatively easy to administer.

In practice however, revenue from these taxes is relatively low. First, political reluctance to using inheritance and gift taxation seems to be non-negligible. Another obstacle is tax avoidance and high offshore tax evasion related to inheritance taxes. Part of the tax gap due to offshore tax evasion can be attributed to missing inheritance tax revenues, which may also imply potentially large effects on the wealth distribution. [43]

I.4. Long-run impact of the tax structures on real GDP

The previous subsections highlighted that there is room to shift taxes away from labour to sources that are less detrimental to growth and employment. It also briefly discussed some of the channels via which taxes may affect growth and employment.

The following empirical analysis focusses on the long-run supply effects of tax reforms. However, it would be beyond the scope of this section to rigorously specify all channels via which taxes affect output. [44] Therefore, building on a large

[40] Capital taxes consist of taxes levied at irregular and infrequent intervals on the values of the assets or net worth owned by institutional units or on the values of assets transferred between institutional units as a result of legacies, gifts inter vivos or other transfers. They include capital levies and taxes on capital transfers.

[41] Under the comprehensive income definition, the taxable income is the total amount that an individual spends on consumption in a given period plus the increase in the economic wealth. This includes cash flows, such as wages, interest, dividends and rents, as well as accrued capital gains and imputed rents from owner-occupied housing.

[42] According to the recent empirical literature inheritance and gift taxes have little to no negative effect on the donour of the inheritance, while they act favourably on the behaviour of the recipient by making them increase their labour supply. (See Princen S., Kalyva A., Leodolter A., Denis C. and A. Reut (forthcoming), 'Taxation of household capital in EU Member States - Impact on economic revenue efficiency and redistribution', ECFIN Discussion Paper.

[43] Princen et al. (forthcoming), *op cit*.

[44] In addition, a specific challenge specifying a regression equation is also that economic theory is not unambiguous about the impact of taxes on GDP. Classical economic theory, such as the Solow model, suggests that in the long-run the tax level and its composition affect the level of output but not its growth rate as decreasing returns in production impede permanent growth. In this model trend growth is driven by exogenous technological and population growth. On the other hand, endogenous growth theory suggests that taxes affect GDP growth via their impact on key factors such as physical and human capital as well as the creation of new ideas. Importantly, in these models the accumulation of physical and human capital can persist along a balanced growth path due to externalities. At the same time, the incentive to invest in any form of capital depends on the net return, which in turn is affected by taxes. See, for instance, Ireland, P. (1994), 'Two Perspectives on Growth and Taxes', *Federal Reserve Bank of Richmond Economic Quarterly,* Vol. 80, No. 1 and Karras (1999), 'Taxes and growth: Testing the Neoclassical and Endogenous Growth Models', *Western Economic Association International*, Vol. 17, No. 2, pp. 177-188.

strand of empirical literature, this sub-section will specify a reduced-form regression equation to estimate the long-run impact of taxes on output in the euro area. ([45])

Other studies

The literature reports regression analyses in which the dependent variable is usually real GDP (per capita) ([46]) in levels ([47]) or in growth rates ([48]), while the explanatory variables cover the overall tax burden, the tax structure as well as other explanatory variables. Taxes are either measured in terms of statutory rates, effective rates or shares in total revenue. Available studies usually make a distinction between the short- and long-run impact of tax structures ([49]) and the data of countries are often pooled to increase the sample variability. ([50])

The available econometric evidence on the impact of tax structures on GDP does not all point in the same direction with some evidence even suggesting that no direct effects are to be found. ([51]) Difference in econometric findings are due, among other things, to: (i) the relative impact of direct tax rates such as labour income and profit taxes ([52]); (ii) the time-horizon which shows a stronger impact in the long run than in the short run ([53]), and (iii) level versus growth effects. ([54]) ([55])

A reduced form regression analysis

This section estimates the impact of the tax structure on real GDP (adjusted for the impact of terms of trade) per employed person across the euro area over the long run. ([56]) Within a panel data

([45]) Two alternative strategies are mentioned here. The first of these is to use dynamic stochastic general equilibrium models assessing the impact of tax polies on macro-economic outcomes. See, for instance, de Castro Fernández, F., Perelle, M. and R. Priftis (2018), 'The Economic Effects of a Tax Shift from Direct to Indirect Taxation in France', European Commission Discussion Paper No. 077, Varga et al. (2012) op cit, and Varga, J. and J. in 't Veld (2014), 'The potential growth impact of structural reforms in the EU. A benchmarking exercise', *European Economy Economic Papers* No. 541. The second strategy involves microeconometric analyses using micro-data estimating the income tax elasticity of the labour supply. See for instance, Saez, E., Slemrod, J.and Giertz, S. (2012), 'The elasticity of taxable income with respect to marginal tax rates: A critical review', *Journal of Economic Literature*, Vol. 50, pp. 3–50.

([46]) See, for instance, Johannesson Lindén, A. and C. Gayer (2012), 'Possible reforms of real estate taxation: Criteria for successful policies', *European Economy Occasional Papers* 119, for a bottom-up-approach estimating the impact of taxes on TFP and investment-to-capital ratio at industry level.

([47]) See, for instance, Arnold, J., Brys, B., Heady, C., Johansson, A., Schwellnus C. and L. Vartia (2011), 'Tax policy for economic recovery and growth', *The Economic Journal*, Vol. 121, No. 550, pp. F59-F80. Making use of a dataset covering annual data for 21 OECD countries over the period 1971 to 2004 in an error-correction set-up, the reduced-form regression analysis (complemented with an econometric analysis at industrial level of the impact of tax structures on investment and productivity) suggests that the most harmful taxes are corporate taxes, personal income taxes, consumption taxes and property taxes.

([48]) See, for instance, Acosta-Ormaechea, S. and J. Yoo (2012), 'Tax Composition and Growth : A Broad Cross-Country Perspective', *IMF Working Paper* WP/12/101.

([49]) I.e. the behavioural relations are specified as an error correction mechanisms.

([50]) As tax structures may remain stable for some time in a country, country data on their own may lack enough variability to perform meaningful tests. Such data pooling may also call for heterogeneity in the parameters across (groups of) countries. See, for instance, Xing, J. (2012), 'Tax Structure and Growth: How Robust is the Empirical Evidence?', *Economic Letters*, Vol. 17, No. 1, pp. 379-382.

([51]) For instance, Arachi, G., Bucci, V. and A. Casarico (2015), 'Tax Structure and Macroeconomic Performance, International Tax and Public Finance', *International Tax and Public Finance*, Vol. 22, No. 4, pp. 635-667 using a panel data covering 15 OECD countries from 1965 to 2011 report that there is no clear evidence supporting the claim that tax structure, either measured by implicit tax rates or by tax ratios, has an impact on GDP. Baiardi, D., P. Profeta, R. Puglisi and S. Scabrosetti (2019), 'Tax policy and economic growth: does it really matter?', *International Tax and Public Finance*, Vol. 26, No. 2, pp 282–316, making use of a sample covering 34 OECD countries over the 1995–2014 period and a sample covering 23 OECD from 1971 to 2014 report that there are no robust relationships between revenue-neutral tax shifts and economic growth. Such outcome may be due to a low income tax elasticity of labour supply so that lower income taxes have only a limited impact on labour supply in the long run.

([52]) For instance, Arnold (2008), *op cit.* show that increasing corporate income taxes has a higher negative impact than increasing personal income taxes on long-run GDP per capita across OECD countries. However, Acosta et al (2012), *op cit.* reports, using a set of 70 countries worldwide, that a reduction in personal income taxes has a stronger impact on growth rates than a reduction in corporate income taxes.

([53]) For instance, European Commission (2006), *op cit.* reports a significant negative correlation between the revenue-neutral shift from indirect to direct taxes and the level of GDP per capita in the EU15 in the long run. However, a shift from labour income tax to indirect tax in the EU15 is negative in the first year (0.11% below baseline) but turns positive in the second year and GDP is 0.7 per cent above baseline after 10 years. The differences between the short and the long run can be partly explained by lower elasticity of the labour supply in the short run and transition costs due to political constraints and administrative burden .

([54]) Mendoza, E., Milesi-Ferretti, G.M. and P. Asea (1997), 'On the ineffectiveness of tax policy in altering long-run growth: Harberger's superneutrality conjecture', *Journal of Public Economics*, vol. 66, pp. 99-126 argue using the implicit tax rate that while both theory and empirical evidence corroborate that changes in tax policy may affect investment rates and improve welfare through efficiency gains they do not affect growth.

([55]) See, for instance, Kneller, R., M.F. Bleaney, and N. Gemmell (1999), 'Fiscal Policy and Growth: Evidence from OECD Countries', *Journal of Public Economics*, 74, pp. 171-190.

([56]) It would be beyond the scope of this section to investigate also short- to medium-run dynamics, including the business cycle dynamics.

setting, covering 14 euro area and 6 non-euro area Member States ([57]) over the 2000-2017 period, real GDP per employed person is regressed upon the economy's capital intensity and a measure of human capital as well as taxes affecting technological and economic efficiency, as specified in Box I.1.

More specifically, technological and economic efficiency is assumed to be affected by labour taxes (i.e. personal income tax and social security contributions) ([58]), corporate taxes ([59]), consumption taxes ([60]) and the labour tax wedge gap ([61]), as well as by environmental taxes ([62]) and taxes on capital and real property such as land and buildings related to the production of goods and services.

The baseline regression relates real GDP per employed person to a whole range of tax categories – which are expressed as statutory tax rates or as shares in total tax revenue, depending on data availability ([63]) (see Box I.1). Various variants of the baseline equation have been estimated; these differing in terms of the variables excluded.

Across the variants, the point estimates are fairly stable, and have the expected sign. However, not all point estimates are significant, especially taxes on capital. ([64])

Making use of the point estimates in Box I.1, the next sub-section examines how past changes in the tax structure (during the 2006-2017 period) ([65]) affected GDP per employed person, while the subsequent sub-section explores the long-run GDP effects of revenue-neutral tax reforms. These scenarios are of an illustrative nature and do not prejudge any specific policy action.

The following simulations (i) focus on long-run effects on the supply side; ([66]) (ii) presuppose that the physical and human capital stock are predetermined ([67]); (iii) assume ex-ante revenue

([57]) I.e. BE, DE, IE, EL, ES, FR, IT, LV, LU,NL, AT,PT, SI and SK, as well as DK, CZ, HU, PL, SE and UK. Non-euro area Member States are included to increase sample variability.

([58]) A priori, a tax change may have an ambiguous impact on labour market participation and hours worked as the income and substitution effect of a tax change point in the opposite direction. For a general discussion of the ambiguous impact of income tax on labour supply and efficiency see, for instance, Røed, K. and S. Strøm (2001), 'Progressive Taxes and the Labour Market: Is the Trade–off Between Equality and Efficiency Inevitable?', *Journal of Economic Surveys*, Vol.16, No. 1, pp. 77-110 .

([59]) Corporate taxes have an unambiguous negative direct impact on the incentives to start a business, invest in R&D, innovate and optimise the allocation of resources. For instance, Mukherjee, A, M. Singh and A. Žaldokas, 'Do corporate taxes hinder innovation?', *Journal of Financial Economics*, Volume 124, Issue 1, April 2017, pp. 195-221 report that tax increases triggers a lower number of patents, less investment in R&D, and fewer new products coming to the market, which may suggest that higher corporate taxes reduce innovations and risk-taking. A high corporate tax rate (compared to other countries) may also reduce foreign direct investments which in turn lowers the cross-border transfer of technologies and knowledge. See, for instance, Edmiston, K. (2004), 'Tax Uncertainty and Investment: A Cross-Country Empirical Examination', *Economic Inquiry*, Vol. 42, No. 3, pp. 425-440. In addition, higher corporate tax rates lower internal cash flows, which are a major source of finance innovation. See, for instance, Himmelberg, C. and B. Petersen (1994), 'R & D and Internal Finance: A Panel Study of Small Firms in High-Tech Industries', T*he Review of Economics and Statistics*, Vol. 76, No. 1, pp. 38-51.

([60]) For instance, a loss of efficiency may arise when a VAT increase pushes some firms into the informal sector or triggers an increase in relatively inefficient household production such as production of own food. See, for instance, Piggott, J. and J. Whalley (2001), 'VAT Base Broadening, Self Supply, and the Informal Sector', *The American Economic Review*, Vol. 91, No. 4, pp. 1084-1094.

([61]) This is measured in this section as the difference between the labour tax wedge of a single person without children earning 167% of average earnings, and the labour tax wedge of single person without children with average earnings. The tax wedge gap affects relative earnings which in turn may affect the efficiency of the production process. For instance, a strong tax wedge gap (i.e. a small difference in net earnings) may discourage workers' efforts such as acquiring new skills. Higher labour income taxes may also adversely affect the effort performed during a given time period when it is imperfectly observable. See, for instance, Prendergast (1996), 'What happens within firms? Survey of empirical evidence on compensation policies', *NBER Working Paper* 5802 and Koskela E. and R. Schöb (2007), 'Tax Progression under Collective Wage Bargaining and Individual Effort Determination', *CESifo Working Paper* No. 2024. Even so, a low tax wedge gap may undermine collaboration on the work floor as workers at the lower end may envy the higher net wage earners.

([62]) Revenues from environmental taxes include taxes on transport, energy, pollution and resources - Resource Efficiency Scoreboard definition. Environmental taxes are taxes levied to correct market failures such as CO2 emissions. On their own, such taxes may have a negative impact on economic activity as they raise, for instance, energy prices. However, a well-designed recycling of these revenues may improve overall technological and economic efficiency. See, for instance, Cambridge Econometrics, et al. (2012), *op cit.*.

([63]) See footnote 2 in the Box I.1, for an interpretation of the corresponding point estimates.

([64]) This insignificance may be partly due to the fact that the data do not show enough variability, as these taxes remain fairly stable over the sample period.

([65]) The first and last year are the years for which data are available for all Member States in the sample.

([66]) Implicitly assuming that some taxes such as taxes on residential buildings do not have an impact on the production process, or more generally speaking, on economic agents' decisions related to labour market participation, production and innovation. See, for instance, Johannesson Lindén and Gayer (2012), *op cit.*

([67]) Human capital and real capital formation are responsive to taxes. However, due to their specific properties they do not react in the

neutrality of the tax shift ([68]); (iv) do not take into account possible changes in administrative and compliance costs or their impact on output efficiency; and (v) allow for time-varying tax semi-elasticities. ([69])

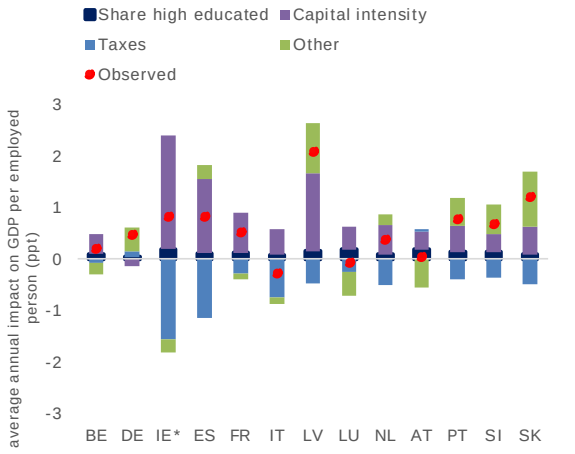
I.5. Past changes in tax structures and GDP

Graphs I.10 and I.11 show the impact of the various changes in taxes on real GDP per employed person over the 2006-2017 period ([70]) making use of the point estimates shown in variant V1 of Table C in Box I.1.

Graph I.10 suggests that tax developments had an overall negative impact on real GDP per employed person between 2006 and 2017. Focussing on the specific taxes, Graph I.11 suggests that developments in net social security contributions had a positive impact on GDP in Germany especially, followed by Portugal, but a marked adverse impact in Slovakia.

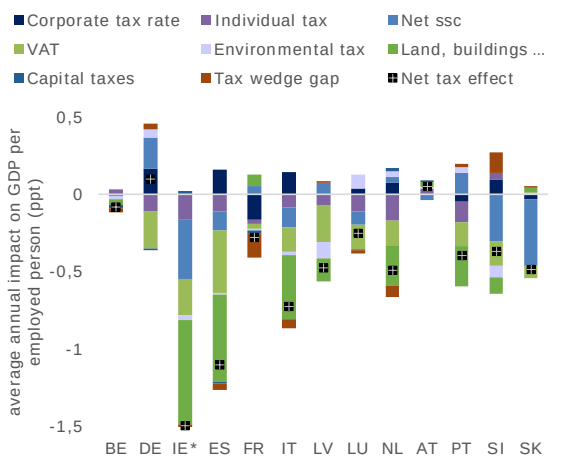
Increases in the statutory VAT rate had the strongest negative impact in Spain ([71]), followed by Germany ([72]). Changes in the taxes on land and buildings used in the production of goods and services had a particularly negative impact in Ireland, Spain and Italy.

Graph I.10: **Factors affecting GDP per employed person between 2006 and 2017**



(1) Effects estimated using variant V1 of Table C in Box I.1
(2) Ireland 2006-2013 period – structural break
Source: Authors' estimates

Graph I.11: **Breakdown of total tax effect on GDP per employed person between 2006 and 2017**



(1) Effects estimated using variant V1 of Table C in Box I.1
(2) Ireland 2006-2013 period – structural break
Source: Authors' estimates

I.6. Illustrative simulations of the long-run effects

Making use of the estimation results reported in Box I.1, this sub-section discusses two structural tax reform scenarios involving a rebalancing of labour income and consumption taxes and a cut in labour income taxes compensated by an increase in environmental taxes. These scenarios are of an illustrative nature and do not prejudge any specific policy action.

same way. For instance, individuals cannot purchase others' human capital or sell any which they accumulate themselves. Moreover, human capital also cannot be bequeathed or given away. See, for instance, Davies and Whalley (1989), 'Taxes and Capital Formation: How Important is Human Capital?', *NBER Working Paper* No. 2899. The usual approach in the available literature is to assume physical and human capital to be predetermined explanatory variables in the reduced form regression analysis is.

([68]) i.e. it does not take into account the second-round effects of tax reforms.

([69]) See footnote 1 in Box I.1.

([70]) 2006 is the first year for which all data for all Member States are available. 2007 is the last year in the sample.

([71]) In Spain, the standard VAT rate increased form 16% to 18% in 2010, and to 21% in 2013.

([72]) In Germany, the standard VAT rate increased form 16% to 19% in 2007.

Rebalancing labour income taxes and consumption taxes

Starting from the situation in 2017, Graph I.12 shows the impact on real GDP per employed person of an illustrative tax reform, in which the Member States reduce their labour to consumption tax revenue ratio ([73]) to the lowest ratio in the euro area in 2017 ([74]) by increasing consumption taxes and using the fiscal space to reduce personal income taxes (i.e. ex ante revenue neutrality).

Although the empirical results on tax reforms reported in the literature are not unambiguous, ([75]) the simulation results suggest that on average this would increase GDP per employed person by about 1.5% ([76]), with, on average, a 1.9% decrease stemming from the increase in consumption taxes and a 3.4% increase triggered by the cut in labour taxes. Among the Member States for which all data are available, Germany would record the strongest increase in GDP followed by the Netherlands and Slovakia.

Such tax shift from labour to consumption taxes towards the 'best performer' in the euro area, i.e. the euro area Member State with the lowest ratio of labour and consumption taxes, obviously translates to shifts of different size for Member States depending on how far they are from the benchmark. Alternatively, it is also insightful to look at the effects of a tax shift away from labour that is of equal magnitude for each Member State relative to their existing labour tax revenues.

([73]) Technically speaking, the amount X by which one has to increase consumption tax revenue and reduce labour tax revenue to reach the desired ratio in a budget neutral way is equal to $X= (H-z C) /(1+z)$ with H the labour tax revenue and C the consumption tax revenue in the base year, and with z the desired labour to consumption tax revenue ratio. In the available sample z is equal to the ratio observed in Latvia.

([74]) I.e. Latvia among the Member States for which the data are available.

([75]) See, the brief discussion of the literature in sub-section 5.

([76]) These simulation results based on a reduced form regression analysis are in line with results obtained from simulations with dynamic stochastic general equilibrium models reported elsewhere in the literature. For instance, making use of the estimated DSGE model QUEST, Varga, J. and J. in 't Veld (2014), 'The potential growth impact of structural reforms in the EU A benchmarking exercise', *European Economy Economic Papers* 541 report similar results and an average net impact of 1.6%.

Raising environmental taxes

Another illustrative simulation looks at the long-run effect of a 1 pp reduction in the share of labour income taxes in total tax revenue (see Graph I.13). ([77]) If this tax cut could be compensated by an increase in taxes that do not have an impact on production process such as taxes on residential buildings, real GDP would on average increase by 0.11% with the highest rise in Ireland and Italy. ([78])

However, if taxes on residential buildings cannot be increased, additional revenue has to be obtained by raising other taxes, such as environmental taxes.

For example, Graph I.13 shows a scenario in which the cut in labour income tax is compensated by an increase in environmental taxes. The increase in environmental taxes by itself decreases real GDP per employed person by about 0.08 % for the euro area on average.

All in all, the net effect of the 1 pp cut in the share of income tax in total tax revenue and the accompanying rise in environmental tax is an increase by about 0.04% in real GDP per employed person for the euro area as a whole. ([79]) Among the Member States for which all data are available, Ireland would record the strongest increase in

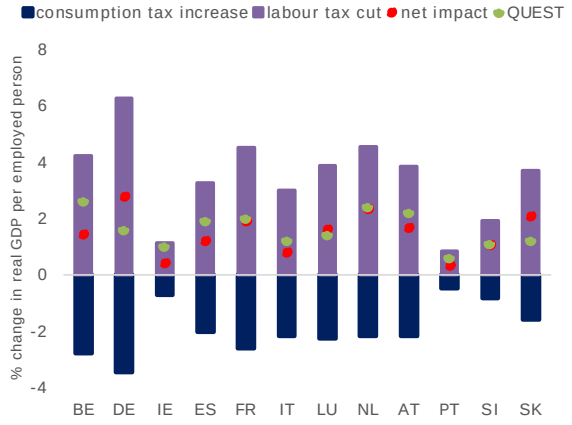
([77]) The regression analysis shows a higher point estimate for social security contributions than for income taxes, suggesting that cutting social security contributions would have a stronger impact. However, from a political-economy point of view it may be less straightforward to cut social security contributions. Reducing social security contributions can be positive from a distributional point of view. However, as they often have an upper threshold and are therefore regressive, a shifting of the financing of social benefits towards other taxes may not be politically straightforward and could instead result in a reduction of social benefits provided.

([78]) Other studies report similar results. For instance, Acosta-Ormaechea, S. and J. Yoo (2012), 'Tax Composition and Growth : A Broad Cross-Country Perspective', *IMF Working Paper* WP/12/101, applying an econometric analysis to medium- and high-income countries, report that a percentage point increase in income taxes would induce a slowdown in growth by about 0.1; Coenen, G., McAdam, P. and R. Straub (2007), 'Tax Reform and Labour-Market Performance in the Euro Area a Simulation-Based Analysis Using the New Area-Wide Model', *ECB Working Paper Series* No 747, making use of the ECB DSGE NAWM model report that lowering the euro area tax wedge (i.e. 64% in 2007) to levels prevailing in US (37%) would increase aggregate output by about 12% in the long run. Meyermans, E. (2004), 'The macro-economic effects of labour market reforms in the European Union. Some selected simulations with the NIME model.', *Belgian Planning Bureau Working Paper* 12-04, making use of the macro-econometric model NIME repots that a 1 pp cut in the social security tax rate for the euro area as a whole, accompanied by a revenue neutral increase in the indirect tax rate, would induce a 0.12% increase in GDP in the long run.

([79]) Unweighted average.

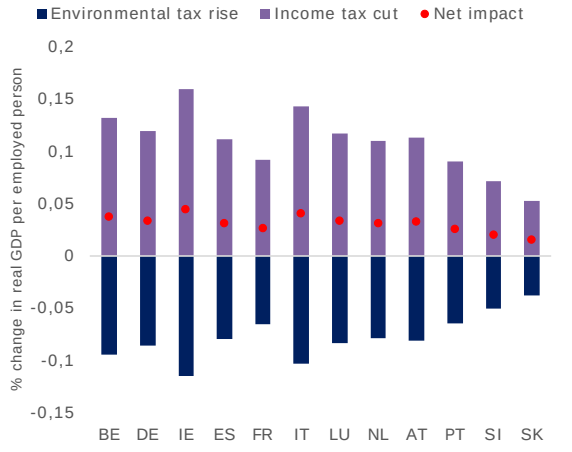
GDP followed by Italy and Belgium; while the lowest is recorded for Slovakia and Slovenia.

Graph I.12: **A labour to consumption tax revenue ratio shift – long- run effects (base year 2017)**



(1) Effects estimated using variant V1 of Table C in Box I.1 QUEST: the results reported in Varga and in't Veld (2014), op. cit. making use of the QUEST model
Source: Authors' estimates

Graph I.13: **1 ppt cut in the labour income tax share in total tax revenues and revenue-neutral rise in environmental taxes – long -run effects (base year 2017)**



(1) Effects estimated using variant V1 of Table C in Box I.1
Source: Authors' estimates

Policy insights

Subsections 2 and 3 highlighted that in several euro area Member States labour taxes are very high. At the same time, the econometric analysis shows that most taxes related to the production of goods and services have a significant impact on output in the long run. ([80]) It also shows that the size of the impact of the various taxes differs, creating room for shifting taxation. ([81])

The empirical analysis in this section therefore suggests that there is room to shift taxes away from labour, and that its net effect is highest when taxes are shifted to tax bases least detrimental to growth. The illustrative simulations suggest, for instance, that cuts in income taxes compensated by increases in environmental taxes could raise output in a environmentally sustainable way. ([82])

Nevertheless, while these simulations focus on long-run effects by impacting incentives at the margin, they do not take into account the technological innovations that may be triggered by environmental tax increases. However, such innovations will put additional downward pressure on, for instance, the use of non-renewable energy thereby eroding the tax base. This will then call for appropriate measures to offset any fall in tax revenue.

Even so, the analysis did not take into account explicitly the distributional effects of tax reforms such as the regressive nature of some environmental taxes. When not flanked by appropriate policies, such socio-economic risks may hinder a smooth implementation of structural tax reforms in the short to medium run as well as reduce the net growth effect of the reform.

I.7. Political economy barriers to fiscal reforms

The previous econometric analysis suggests that several Member States have a strong potential to shift from labour taxes to consumption, property and environmental taxes. However, while there may be room for comprehensive tax reforms, political-economy factors may hinder a speedy and full implementation of such reforms. Such barriers can take many forms.

([80]) i.e. the supply side of the economy.

([81]) As already suggested by earlier research covering other areas and time periods, such as Arnold (2008), *op cit.*

([82]) This is a net effect: the simulations are based on a reduced form regression which does not allow to disentangle the growth effect stemming from a change in tax rates on their own and from their distributional effects, such as a rise in environmental taxes may be regressive. Disentangling such effects would require more disaggregated data, which would be beyond the scope of this section.

First, a lack of clear communication about the policy goals and adequate consultation as well as a weak involvement of the main stakeholders may obstruct the reforms.

Even so, gradual reform may be necessary to ameliorate the large shifts in tax burdens that may result ([83]) and to overcome the status quo bias. ([84]) However, a gradual approach may mean that the benefits of the reforms materialise more slowly. ([85])

The implementation of tax reforms may also be obstructed when there are widely dispersed winners but the losers are politically well organised.

The international context also matters. First, a coordination of tax reforms such as a rise in the taxation of fossil fuels among the Member States of a currency union will facilitate the implementation of such reforms as such coordinated action has the potential to offset potential losses in international price competitiveness among the Member States.

Moreover, when other (neighbouring) countries have already implemented similar tax reforms successfully, political support for the reforms may rise.

I.8. Conclusions

This section examined the scope and limitations of structural tax reforms that involve shifting part of the tax burden on labour towards taxes that are less detrimental to growth.

While the available research suggests that property and consumption taxes are least detrimental to growth, the available empirical literature provides a mixed picture of the size of this potential, as results depend on the set of countries and years examined as well as methodology.

However, by focussing on the euro area since the launch of the euro, this section suggests that there might be some room for a tax shift away from labour.

Nevertheless, such a tax shift should not be seen in isolation and should be part of a more comprehensive set of tax reforms. More particularly, the EU and national tax systems are in urgent need of better capturing ongoing and accelerating technological changes and new business models in the digital world. There is also an urgent need for simpler tax systems, which can contribute to addressing tax fraud, evasion and avoidance.

([83]) This is for instance, well illustrated in the literature on property taxes. See, for instance, Slack, E. and R. Bird (2011), 'The Political Economy of Property Tax Reform', *OECD Working Papers on Fiscal Federalism* No. 18.

([84]) A bias towards the status quo may arise when, for instance, voters and politicians – as is often the case - want to avoid the uncertainty and opposition that reforms entail; or when some of the individual gainers and losers from the reform cannot be identified beforehand See, for instance, Castanheira, M., Nicodème, G. and P. Profeta (2012), 'On the political economics of tax reforms: survey and empirical assessment', International Tax and Public Finance, Vol. 19, No. 4, pp. 598–624 and Fernandez, R. and D. Rodrik (1991), 'Resistance to Reform: Status Quo Bias in the Presence of Individual- Specific Uncertainty', The American Economic Review, Vol. 81, No. 5, pp. 1146-1155. A preference for the status quo can also be an expression of legitimate concerns that too frequent policy changes create uncertainty, inconsistencies and adjustment costs, if not implemented in a credible and coherent way.

([85]) For instance, Bouis, R. and R. Duval (2004), 'Raising Potential Growth After the Crisis: A Quantitative Assessment of the Potential Gains from Various Structural Reforms in the OECD Area and Beyond', *OECD Economics Department Working Papers* No. 835, make a distinction between 'slow reform implementation', referring to phasing in reforms over 10 years, and 'fast reform implementation', referring to phasing-in over 5 years. They estimate that OECD countries cutting their labour tax wedges from 2013 onwards towards the average level observed in the six OECD countries with the highest employment rate in 2007 (i.e. Denmark, Iceland, the Netherlands, Norway, Sweden, and Switzerland) could raise employment levels by over 0.75% and 2% after 5 and 10 years respectively; while under fast reform implementation, employment levels could be raised by over 1½ and 3% over 5 and 10-year horizons respectively.

Box I.1: Tax structures and output in the long run

A. Specification

The empirical analysis seeks to assess, within a standard approach, the existence of long-run relationships between real GDP per employed person and the tax structure in the euro area. In econometric terms, this involves estimating the long-run equilibrium relation and testing for cointegration. ([1])

More specifically, the following long-run equation is estimated applying pooled least squares:

$$(1) \quad \log\frac{GDP_{i,t}}{EMPL_{i,t}} = \alpha_i + \beta\, EDUC\_HIGH\_S_{i,t} + \gamma \log(CAP_{i,t}) + \sum_{j=1}^{k} \delta_k\ TAX_{k,i,t} + u_{i,t}$$

with GDP referring to real GDP, EMPL to total employment, EDUC_HIGH_S to the share of tertiary educated people in the population (approximating human capital), CAP to capital intensity, and TAX_k to a tax indicator ([2]). The subscripts i and t refer to the country and year respectively. The country-fixed effects αi capture country-specific factors affecting overall efficiency in production not covered by the tax structure.

As in similar reduced-form regressions reported in the literature, the reduced-form equation does not allow for assessment of the impact of taxes on the accumulation of physical and human capital, nor of the impact of government expenditures (partly financed by tax revenues) on these capital stocks.

B. Data

The sample covers 14 euro area Member States as well as the Czech Republic, Denmark, Hungary, Poland, Sweden and the UK for the period from 2001 to 2017.([3]) The data sources are briefly described in Table A.

Table A: Data

AMECO database	
Real GDP per capita	Gross domestic product at 2010 reference levels adjusted for the impact of terms of trade
Capital intensity	net capital stock at 2010 prices per person employed: total economy
Eurostat - Labour force Survey	
Human capital	share of people with tertiary education level in total population
OECD Tax database (%)	
Statutory tax rates	- corporate income tax - dividend tax - Value Added Tax (VAT) - top marginal income tax rate
Tax wedge	differnce between total labour costs to the employer and the corresponding net take-home.

Eurostat - Main national accounts tax aggregates (% of total revenue)	
Capital taxes	Taxes levied at irregular and infrequent intervals on the values of the assets or net worth owned by institutional units or on the values of assets transferred between institutional units as a result of legacies, gifts inter vivos or other transfers. They include capital levies and taxes on capital transfers.
Environmental taxes	Total revenues for environmental taxes include taxes on transport, energy, pollution and resources. Resource Efficiency Scoreboard definition.
net social contributions	include employers' actual social contributions, households' actual social contributions, imputed social contributions and households' social contribution supplements. Social insurance scheme service charges are deducted from the items above to reach net social contributions.
Taxes on land, buildings and other structures	Recurrent taxes on land, buildings or other structures consist of taxes payable regularly, usually each year, in respect of the use or ownership of land, buildings or other structures utilised by enterprises in production, whether the enterprises own or rent such assets.

Table B shows the correlation between the different (standardised) tax rates, suggesting a low overall correlation between the different tax rates.

([1]) More specifically, the econometric analysis is based on the Engle-Granger two-step method. Applying this method, one estimates first the long-run equilibrium relation and tests for cointegration. Next, one estimates the short-run dynamic equation including the error correction term, i.e. the lagged residual of the first step. This section only focuses on the long-run interactions.

([2]) Limited data availability over a long period implies that some taxes are measured in terms of statutory rates (including personal and corporate income as well as consumption taxes) while others as a share in total tax revenues (including property, capital and environmental taxes as well as net social security contributions). In the case of the statutory tax rates the point estimates in equation (1) are constant semi-elasticities, whereas in the case of shares, the point estimates relate to time-varying semi-elasticities. Indeed, in that case the third term on the right-hand side of equation (1) can be rewritten as $\delta_k TAX_{kit} = \delta_k \frac{TR_{kit}\ B_{kit}}{TOTREV_{it}} = \left[\delta_k \frac{B_{ikt}}{TOTREV_{it}}\right] TR_{kit}$ with δ_k the point estimate, B the tax base, TR the tax rate and TOTREV total tax revenue so that the semi-elasticity is captured by the term between brackets - which changes over time.

([3]) The six non-euro area Member States have been added to increase variability in the sample.

(Continued on the next page)

Box (continued)

Table B – Correlation between tax rates: 2000 -2017

	Net social contributions	*Labour tax wedge*	*Labour tax wedge gap*	Statutory corporate tax	Statutory VAT	Pollution tax	Property	Capital tax	*Dividend tax*
Net social contributions	1,00								
Labour tax wedge	-0,01	1,00							
Tax wedge gap	-0,01	0,32	1,00						
Statutory corporate tax	0,05	0,24	0,30	1,00					
Statutory corporate tax	-0,11	0,01	-0,05	-0,36	1,00				
Pollution tax	-0,26	0,04	0,04	-0,11	0,40	1,00			
Property	-0,01	0,02	-0,10	-0,15	0,49	0,68	1,00		
Capital tax	-0,01	0,05	-0,02	0,07	-0,07	-0,13	-0,15	1,00	
Dividend tax	-0,07	0,30	0,47	0,17	-0,01	0,13	0,00	-0,03	1,00

Note: data standardised; correlationafter stacking data per country
Note: Tax wedge gap measures difference between tax weddge gap of single earner without children earning 167% of average eranings and tax weddge gap of single earner without children earning 100% of average eranings

C. Estimation

Various variants of the baseline equation (1) have been estimated. Variants V0 and V1 in Table C are the base variants covering (i) the euro area and (ii) the euro area plus a further six other EU Member States. The other variants differ from variant V1 by dropping each time a specific tax rate. The Null Hypothesis of no cointegration can be rejected for all variants at a fairly high confidence level applying the Kao residual cointegration test. Allowing for heterogeneous coefficients across cross-sections the Pedroni tests ([4]) confirms that the null-hypothesis of no cointegration can be rejected. See Table D.

Table C: Factors affecting GDP per employed person

Dependent variable: log of real GDP per employed person

	V0	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
Share of high educated in population	0.14 ***	0.13 ***	0.08	0.06	0.11 **	0.20 ***	0.08 *	0.10 **	0.22 ***	0.14 ***	-0,03
	(2.62)	(2.87)	(1.56)	(1.46)	(2.33)	(4.37)	(1.75)	(2.00)	(4.40)	(3.03)	(-0.28)
Capital intensity	0.74 ***	0.76 ***	0.71 ***	0.77 ***	0.77 ***	0.77 ***	0.74 ***	0.78 ***	0.69 ***	0.76 ***	0.80 ***
	(18.34)	(34.12)	(25.44)	(33.79)	(34.32)	(33.01)	(31.74)	(30.12)	(28.95)	(34.22)	-20,62
Net social security contributions	-1.32 ***	-1.12 ***		-0.94 ***	-1.12 ***	-1.25 ***	-1.07 ***	-1.35 ***	-1.09 ***	-1.09 ***	-0.75 ***
(% of total tax revenue)	(-7.96)	(-10.61)		(-9.53)	(-10.76)	(-12.46)	(-9.94)	(-12.24)	(-9.72)	(-10.39)	(-4.22)
Individual income tax	-0.84 ***	-0.51 ***	-0.03		-0.52 ***	-0.58 ***	-0.42 ***	-0.76 ***	-0.48 ***	-0.44 ***	-0.33 **
(% of total tax revenue)	(-5.64)	(-4.55)	(-0.23)		(-4.81)	(-7.94)	(-3.90)	(-6.42)	(-4.18)	(-4.18)	(-2.08)
Tax wedge gap	-0.01 ***	-0.01 ***	-0.00 ***	-0.00 ***		-0.01 ***	-0.00 ***	-0.00 ***	-0.00 ***	-0.01 ***	-0.01 ***
	(-5.26)	(-3.79)	(-2.89)	(-3.20)		(-4.81)	(-3.51)	(-3.12)	(-3.35)	(-4.21)	(-3.01)
Statutory corporate tax	-0.07 *	-0.19 ***	-0.33 ***	-0.24 ***	-0.21 ***		-0.14 ***	-0.21 ***	-0.20 ***	-0.19 ***	-0,13
	(-1.85)	(-4.58)	(-6.34)	(-5.38)	(-5.09)		(-3.56)	(-4.54)	(-4.64)	(-4.49)	(-1.46)
Statutory VAT	-0.92 ***	-0.94 ***	-0.79 ***	-0.88 ***	-0.97 ***	-0.89 ***		-1.58 ***	-0.95 ***	-0.91 ***	-1.46 ***
	(-3.50)	(-5.46)	(-4.22)	(-5.14)	(-5.61)	(-5.02)		(-9.14)	(-5.71)	(-5.25)	(-6.21)
Taxes on land, buildings etc	-2.83 ***	-4.39 ***	-5.40 ***	-4.94 ***	-4.27 ***	-4.27 ***	-5.32 ***		-4.13 ***	-4.45 ***	-4.67**
(% of total tax revenue)	(-3.97)	(-8.26)	(-9.08)	(-9.19)	(-7.85)	(-8.14)	(-10.00)		(-7.69)	(-8.34)	(-8.07)
Capital taxes	-1.73 *	-0.87 *	-0.82	-1.14 **	-0.77	-0.95 *	-0.62	-0.89		-0.81	-0,63
(% of total tax revenue)	(-1.92)	(-1.70)	(-1.61)	(-2.12)	(-1.58)	(-1.85)	(-1.37)	(-1.44)		(-1.56)	(-0.80)
Environmental taxes	-0.77 **	-0.37 *	-0.20	-0.01	-0.58 **	-0.33	-0.32	-0.76 ***	-0.56 **		0,04
(% of total tax revenue)	(-2.58)	(-1.70)	(-0.78)	(-0.03)	(-2.58)	(-1.54)	(-1.43)	(-3.11)	(-2.51)		(0.14)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	No	No	No	No	No	No	No	No	No	No	Yes
Pedroni statistic					See Table D						
Kao residual cointegration test (p-values)		0,0094	0,0005	0,0023	0,0075	0,0036	0,0018	0,0124	0,0092	0,0084	0,0013
Number of observations	272	380	380	380	380	380	380	396	398	380	380
Number of explanatory variables (including country fixed effects)	26	32	31	31	31	31	31	31	32	31	49

Note: Pooled Estimated Generalised Least Squares (cross-section weights), sample 2001-2017.
Note: t-values between brackets; ***p<0.01, **p<0.05 and *p<0.1

([4]) See Pedroni, P (2004), 'Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests With an Application to the PPP Hypothesis', Econometric Theory, Vol. 20, pp. 597–625.

(Continued on the next page)

Box (continued)

Table D: Pedroni test statistics

Table D: Perdoni test statistics

	Variables included											
	Real GDP per employed person	Share of high educated in population	Capital intensity	Net social security contributions	Individual income tax	Tax wedge gap	Statutory corporate tax	Statutory VAT	Taxes on land, buildings etc	Capital taxes	Environmental taxes	Group PP-Statistic
V1	X	X	X									**0,35**
V2	X	X	X	X	X	X	X					0,00
V3	X	X	X					X	X	X	X	0,00
V4	X	X	X	X	X			X			X	0,00
V5	X			X	X		X	X	X		X	0,00
V6	X					X	X	X	X	X	X	0,05

Note: Null Hypothesis: No cointegration

Note: Estimated with Eviews with the Pedroni test only available for groups containing seven or fewer series

For the point estimates in Table C the following caveats should be taken into consideration. First, the primary focus of the analysis is on the long-run economic relationship. Applying the Engle-Granger two-step methodology, one estimates first the long-run equilibrium relation and tests for cointegration. Next, one estimates the short-run dynamic equation including the error correction term, i.e. the lagged residual of the first step. This section only focuses on the long-run interactions between real GDP and the tax structure, it does not cover short-term dynamics. Asymptotically, there should be no simultaneity bias applying generalised least squares estimating a cointegrated long-run relationship. However, the distribution of the t-ratio is generally not known. Developing test statistics to assess the significance of each of the estimated parameters would be beyond the scope of this section

Second, while the use of the statutory tax rates and tax ratios may pose some challenges in terms of their accuracy for measuring the fiscal transmission channels, it should be noted that alternatives such as effective tax rate also pose challenges. For instance, several methodologies can be used to calculate the effective corporate tax rate, including those based on macro-data (e.g. national accounts) and those based on financial statements (e.g. BACH database). ([5])

Finally, variant (V10) includes time-fixed effects. The inclusion of time-fixed effects (measuring 'common shocks ') may prevent an omitted variable bias, provided the countries were to respond in the same way to a common shock of this nature, but that would assume that the countries' responses to a common shock would be conditioned by country specific factors. However, it would beyond the scope of this article to elaborate on this. The Kao residual cointegration test does not show an improvement in the test statistic when including time-fixed effects.

([5]) See also footnote 2 on this.

II. Assessing public debt sustainability: some insights from an EU perspective into an inexorable question

by Stephanie Pamies and Adriana Reut

The 2010-12 euro area sovereign debt crisis revealed severe debt vulnerabilities in a number of European countries. In response, international institutions have considerably strengthened the frameworks they use to assess debt sustainability. In the EU, since 2012, the European Commission has started to closely monitor and assess on a regular basis Member States' debt sustainability, as part of the EU's overall economic surveillance framework. This article takes stock of the difficulties inherent in debt sustainability analysis (DSA), as shown by the last financial crisis, and describes some important (recent and ongoing) methodological advances in DSA frameworks. Challenges include the difficulty to distinguish in real time liquidity crises from solvency problems, current debates on appropriate debt threshold levels and debt burden indicators, and striking the right balance between breadth of analysis and the need for concise and clear conclusions. The recent and ongoing changes made to DSA frameworks include the development of probabilistic tools, a greater consideration of feedback effects, the increasingly broad range of fiscal risks examined, and a greater focus on the institutional dimension of debt sustainability.

II.1. Introduction

Long thought as a question restricted to emerging countries or to the long-term dimension for advanced economies, public debt sustainability concerns have been brought to the fore by the euro area sovereign debt crisis. Since then, the EU has made several institutional changes that significantly contributed to mitigating debt sustainability risks. These changes include a strengthened European governance framework, in particular to reform the fiscal rules, and crucial components of a Banking Union, such as the Single Supervisory Mechanism (SSM), the Single Resolution Mechanism (SRM), and the Banking Recovery and Resolution Directive (BRRD). Important crisis management tools were also created such as the European Stability Mechanism (ESM) and other EU crisis management instruments.

Some 10 years since the beginning of the global financial crisis, public debt sustainability remains a critical issue in the euro area in the light of multiple challenges. Public debt ratios are still high in some – often large – countries ([86]). Significant spending pressures stemming from an ageing population are expected to materialise over the medium to long term. There are major uncertainties around future productivity trends and labour market developments. Last, but not least, major economic challenges, related in particular to climate change and environmental change, may pose new fiscal risks.

Against this backdrop, debt sustainability has become increasingly complex to define and assess. Country experiences over the last decade has revealed some shortcomings in past approaches to debt sustainability analysis. International institutions such as the IMF, the European Commission and the ECB have adapted and substantially enhanced the frameworks they use to assess debt sustainability. Despite these improvements, some authors consider that assessing debt sustainability is to some extent 'an art rather than a science' ([87]), and by others 'mission impossible' ([88]).

This article takes stock of the difficulties inherent in debt sustainability analysis (see Section II.2), and describes some important (recent and ongoing) advances in debt sustainability analysis (DSA) frameworks (see Section II.3). It focuses on the key aspects (see Graph II.1), and does not seek to cover all related issues ([89]).

([86]) In the euro area, the great recession led to an increase in government debt from 65% of GDP in 2007 to a peak of almost 95% in 2014. In 2019, three euro-area countries had a debt to GDP ratio close to or above 120% of GDP (Greece, Italy and Portugal), in four euro-area countries it was above 90% of GDP (Belgium, Spain, France and Cyprus) and in three euro-area countries it was above 60% of GDP (Ireland, Austria, Slovenia).

([87]) Sturzenegger, F. and J. Zettelmeyer (2006), 'Debt Defaults and Lessons from a Decade of Crises', *MIT Press*.

([88]) Wyplosz, C. (2011), 'Debt sustainability assessment: mission impossible', *Review of Economics and Institutions*, Vol. 2, No 3, Fall 2011.

([89]) Moreover, the article does not cover on-going developments related to the Covid-19 crisis and implications on public finances.

Graph II.1: **Debt sustainability analysis: a snapshot of the key challenges**

Source: Authors

II.2. Defining and assessing debt sustainability: challenges remain

This section discusses the conceptual difficulties and practical challenges related to debt sustainability (analysis). It focuses on the three main issues that arose during the last financial crisis: the difficulty to distinguish in real time liquidity crises from solvency problems (see Section II.2.1), the challenge of determining a universal critical level of debt and of using appropriate debt burden indicators (see Section II.2.2), and the delicate balance to strike between the 'streetlight effect' and the risk of over-complexity (see Section II.2.3).

II.2.1. Distinguishing in real time liquidity crises from solvency problems

Conceptual considerations

Economic theory traditionally equates debt sustainability to government solvency. Solvency is typically anchored to a government's intertemporal budget constraint, which essentially captures the government's ability to meet its current and future financial obligations. More precisely, the condition for solvency is that, over an indefinite time horizon, the government can continue to pursue its fiscal policies by raising enough revenue (in current value) to cover all non-interest spending and to service its outstanding debt ([90]).

Although in theory solvency is well defined, in practice it escapes an easy assessment. The condition for solvency is inherently forward-looking, and rests on a number of simplified macroeconomic and fiscal assumptions. For instance, prediction of future government debt, revenues and spending over an infinite horizon needs for being operationally implemented an approximation of the infinite horizon with a finite long-term horizon. It then requires forecasting the future course of fiscal policy (i.e. primary balances), and formulating a set of assumptions on macroeconomic variables subject to considerable uncertainty over the long term (such as economic growth, the cost of borrowing and the non-discretionary part of the primary balance).

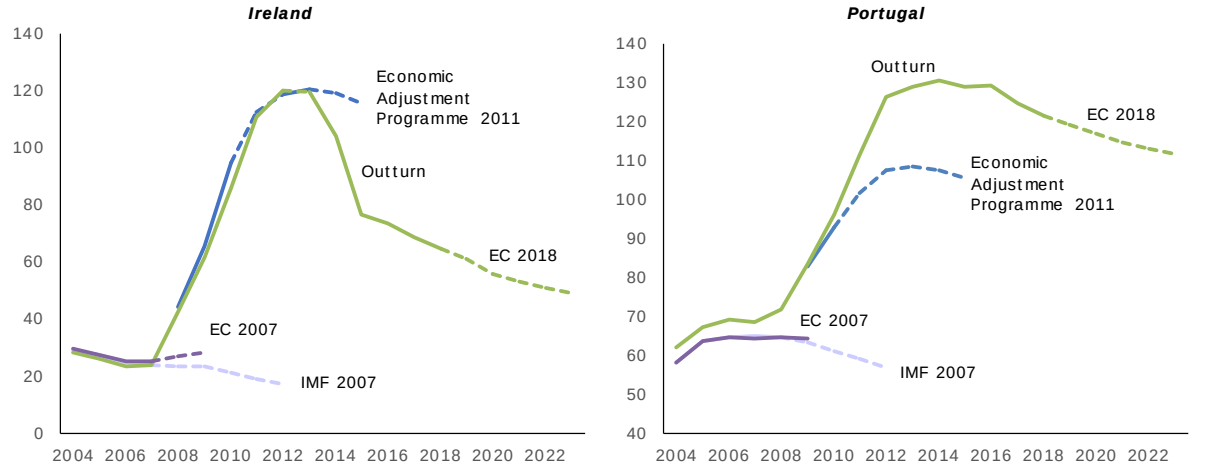
Furthermore, the traditional solvency condition imperfectly factors in potential risks associated to (existing) debt levels. The solvency condition equates to ensuring that debt trajectories are not on an increasing or explosive path over the long term. By adopting a purely forward-looking approach, it can (in theory) deem any government solvent, regardless of its current stock of debt, as long as the government's commitment to generate the required (sometimes large) primary surpluses is considered credible and consistent with macroeconomic projections ([91]). But the credibility of this commitment is likely to weaken when existing debt is high, requiring a correspondingly high and sustained primary surplus to service debt.

As the condition for solvency is in essence a medium- to long-term concept, it also largely excludes more immediate constraints that may hinder a government's ability to repay its debt. Countries with fundamentally solid public finances and deemed to have a sustainable debt, from a long-term solvency perspective, may not be immune to rapid deteriorations of their fiscal position and to refinancing risks in periods of sharp economic downturn or financial crises. Such refinancing issues can occur in the event of tensions on global financial markets giving rise to

([90]) Blanchard, O., Chouraqui, J.C., Hagemann, R.P. and N. Sartor (1990), 'The Sustainability of Fiscal Policy: New Answers to an Old Question', *OECD Economic Studies*, No 15. This definition holds under 'normal' economic conditions (i.e. for a positive interest to growth rate differential). For instance, if the interest to growth rate differential was negative (over the long term), then the government would no longer need to generate primary surpluses to achieve solvency. See Section II.4 for more on the interest-growth rate differential and debt dynamics.

([91]) For exemple, Blanchard et al. (1990, op. cit.) recall that the solvency condition may even hold if the debt to GDP ratio increases forever (to any level), as long as it does not increase asymptotically at a rate greater than the growth-adjusted interest rate. *'Because of discounting, two different levels of debt to GDP ratio far in the future can imply nearly exactly the same sustainable tax rate today. In the limit, over an infinite horizon, they make no difference.'*

Graph II.2: **Projected and outturn government debt before the crisis / pre-programme / and current situation in Ireland and Portugal**



Source: European Commission, Eurostat, IMF.

contagion effects, or when faced with a lumpy debt repayment schedule ([92]). In extreme cases, *liquidity* crises may force a debt default, despite debt being deemed sustainable according to the standard definition. As liquidity pressures often materialise through strong increases in interest rates, and the cost of government borrowing rises, with potential effect on longer-term debt dynamics, government solvency can be weakened (*self-fulfilling* crises) ([93]). Therefore, solvency and liquidity are clearly interrelated concepts, and the boundary between the two can become blurred during crises. Since a failure to service debt is the main manifestation of unsustainability, both concepts are equally important when assessing debt sustainability ([94]).

The emergence of new official lenders, such as the ESM, providing concessional loans with much longer maturities and lower interest rates than standard IMF instruments, has also led to a rethink of the liquidity versus solvency dichotomy. On the one hand, 'ESM-type' official lending can help mitigate rollover risk (through longer maturities), while containing public debt dynamics (through durably lower interest rates). On the other hand, some authors argue that by making more debt immune to rollover risk over the lending period, such official lending may raise the average stock of public debt in the long term, eventually increasing exposure to 'fundamental' risks at the time of market re-entry ([95]) ([96]).

Practical considerations based on selected examples

Assessing liquidity and solvency risks, and whether financial market stress may lead to a solvency problem, is at the core of DSA frameworks. This is not only necessary to correctly and swiftly identify potential debt sustainability risks (*surveillance*

([92]) Conversely, an insolvent government may well go for a long time without facing liquidity concerns e.g. in the event of low global risk aversion, or a too lenient appreciation of risks by investors.

([93]) Countries hit by a liquidity crisis may also be forced to apply stringent austerity measures that force them into a recession, thereby reducing the effectiveness of these austerity programmes. The combination of high interest rates and deep recessions is even more likely to turn the liquidity crisis into a solvency crisis. Such 'bad' equilibrium is discussed in De Grauwe, P. and Ji, Y., 2013, 'Self-fulfilling crises in the Eurozone: an empirical test', *Journal of International Money and Finance*, No 34.

([94]) It is important to note that, though solvency risks generally build up slowly, history teaches that they can sometimes appear more quickly. This may happen when major contingent liabilities materialise, leading to a sudden worsening of the fiscal position. The Greek case is another example where a sharp deterioration in the fiscal position as of 2008, compounded with market confidence weakening, led to a reassessment of solvency risks in 2011.

([95]) See Corsetti, G., Erce, A. and T. Uli (2018), 'Debt sustainability and the terms of official support', *CEPR Discussion Paper*, No 13292. These authors also call for DSA frameworks to give a greater focus on the analysis and management of payment flows over time, rather than simply focusing on debt shocks and trajectories. These aspects are mentioned in section II.2.3 (on gross financing needs) and in section II.3.2 (on feedback effects).

([96]) Moreover, it should be noted that requesting official financing is itself considered by international institutions (e.g. the IMF and the European Commission) to be a sign of fiscal stress (see for example, Baldacci, E., Petrova, I., Belhocine, N., Dobrescu, G. and S. Mazraani (2011), 'Assessing fiscal stress', *IMF Working Paper*, No 11/100.).

function) ([97]), but also in critical cases when countries request official financial support. Indeed, 'sustainable debt' is a pre-requisite to access official lending from key international institutions (notably the IMF and the ESM). Misjudgements on ex ante debt sustainability may later prove particularly costly (for example, leading to financial sector instability, or requiring particularly severe fiscal adjustments).

Distinguishing (pure) liquidity from broader sustainability (solvency) risks is, however, challenging in practice. For example, before the global financial crisis, countries such as Ireland, Spain and Cyprus - and to a lesser extent Portugal - had relatively low (or moderate) government debt-to-GDP ratios and were not deemed to face debt sustainability risks. During the crisis, large negative shocks to their public finances, coupled with financial market pressure, led to major hikes in government debt (see Box I.1 in SectionII.2.3 for more details on the drivers).

Given these developments, and as these countries requested official financial support, international institutions substantially reviewed their assessment of public debt sustainability risks over time. For instance, Ireland and Portugal were deemed to face substantial risks, with debt projected to peak at a high level over the projection period, and only slightly moderate by the end of the period (see Graph II.2) ([98]). Almost a decade after the crisis, these countries now have more favourable debt sustainability assessments (notably driven by more positive macro-financial assumptions) ([99]), while financial market perceptions have greatly improved. These examples show how liquidity pressures in times of crisis can substantially change investors' perception about the sustainability (solvency) of sovereign debt, and may eventually affect sustainability itself. They also illustrate how heavily debt sustainability assessments rely on underlying assumptions ([100]).

II.2.2. Factoring in debt level in the analysis

How high is 'too high' debt?

Over and above the sole consideration of future debt trajectories to assess sustainability, an abundant literature stresses the fiscal vulnerabilities associated with high levels of debt. This has notably led international institutions to factor in debt risk thresholds (or benchmarks) as a pivotal element in their DSA frameworks. Heavy debt burdens are detrimental to sustainability in multiple ways. For example, they undermine the ability of a country to withstand negative shocks (reduced 'fiscal space') ([101]), and may restrict long-term economic growth. Pioneered by Reinhart and Rogoff ([102]), this literature remains fairly controversial. The results are highly contingent on which underlying concept of risk-threshold is used, the methodology used to estimate it, the geographical sample and the time span chosen.

Table II.1 summarises the main concepts of risk threshold found in the literature, with estimation methods and results from samples of advanced economies ([103]). As the results show, determining precisely what constitutes 'too high' debt remains

([97]) For example, for the IMF, in the context of the Article IV surveillance reports; for the European Commission, in the context of the European Semester, the EU economic policy coordination framework. In this latter case, the DSA results are also used as a basis to formulate policy prescriptions (*policy advice function*).

([98]) In a 2010 staff report for Ireland, the IMF warned that 'risks to the baseline scenario are substantial, as illustrated by alternative scenarios and bound tests'.

([99]) In particular, both countries have lower implicit interest rates (outturn and projected). Ireland has also experienced a particularly robust economic growth since 2014.

([100]) Another illustration relates to the difficulty of setting plausible fiscal assumptions in a context of structural breaks, where the historical evidence of primary balances of one country may not be a good guide for the future (e.g. Greece, or outside of the EU, Turkey in the early 2000s).

([101]) The term 'fiscal space' corresponds to the difference between the current level of debt and the estimated debt 'limit' (see Table I.1). This 'limit' corresponds to the level beyond which a government is at risk of losing access to financial markets. High debt makes the debt accumulation process very sensitive to variations in interest and growth rates, which is likely to bring the debt ratio closer to its 'limit'.

([102]) Reinhart, C. M., and K. S. Rogoff (2010), 'Growth in a Time of Debt,' *American Economic Review,* No 100, May.

([103]) References used in this table are: Chudik, A., Mohaddes, K., Pesaran, M. and M. Raissi (2017), 'Is there a debt-threshold effect on output growth? *The Review of Economics and Statistics*, No 99(1), March. Gosh, A., Kim, J. Mendoza, E., Ostry, J., and M. Qureshi (2013), 'Fiscal fatigue, fiscal space and debt sustainability in advanced economies', *The Economic Journal*, No 123, February. Fall, F. and J-M. Fournier (2015), 'Macroeconomic uncertainties, prudent debt targets and fiscal rules', *OECD Economics Department Working Paper*, No 2015(48), June. European Commission (2019), 'Fiscal Sustainability Report 2018', *European Economy Institutional Paper*, No 094, January. Berti, K., Salto, M. and M. Lequien (2012), 'An early-detection index of fiscal stress for EU countries', *European Economy Economic Paper*, No 475. Pamies Sumner, S. and Berti, K. (2017), 'A complementary tool to monitor fiscal stress in European economies', *European Economy Discussion Paper*, No 049.

Table II.1: **Risk thresholds: estimations based on recent selected papers**

Concept	Paper	Estimation method	Sample	Results
Growth related threshold (debt level beyond which growth is negatively impacted)	Chudik et al. (2017)	Dynamic, heterogeneous panel data regression with cross-section-dependent errors	19 advanced economies	Weak support for 80% of GDP (no statistically significant threshold when using more advanced estimation techniques). More robust results for countries with a rising debt-to-GDP ratio.
Debt limit (debt level beyond which market access is lost)	Gosh et al. (2013)	Model that combines a fiscal reaction function with a market reaction function	Advanced economies	190% of GDP (on average). Above 90-100% of GDP, 'fiscal fatigue' sets in.
Prudent debt threshold (debt level ensuring that debt remains below a certain threshold with a high probability)	Fall and Fournier (2015)	Stochastic model with a fiscal reaction function	EA	For a debt threshold conventionally set at 65% of GDP (with a 75% probability to remain below it), prudent debt levels range from 35% in Greece and Ireland to around 50% in Austria.
Non-increasing debt cap (debt level ensuring that debt does not increas with a high probability)	European Commission (2019)	Stochastic model	EA	80% of GDP (EA), with important country differences.
Debt distress threshold (debt level beyond which a risk of fiscal stress* is detected)	Berti et al. (2012), Pamies Sumner and Berti (2017)	Signalling approach	EU + 9 OECD countries	68% of GDP

(1) The relatively high level found by Gosh et al. (2013) is driven by the low level of interest rates.
* Fiscal stress episodes correspond to situations of either public debt default or restructuring, request of (large) official financing, financial market stress (loss of market access, important increase of spreads), and internal domestic default (high inflation).
Source: See references.

an hazardous question, with studies suggesting that critical levels could lie within an *average* range of 70 - 100% of GDP for advanced economies. Despite the uncertainties surrounding these estimates, DSA frameworks may still need to use these thresholds as reference values for the assessment, especially in the context of regular surveillance, while taking into account other relevant (country-specific) factors.

Is debt the best indicator to assess debt sustainability?

Traditionally scaled by GDP ([104]), the level of government debt is arguably the central measure for sustainability analysis. For the EU and euro area, government debt presents the advantage of being defined and measured according to agreed statistical norms (known as the 'Maastricht debt') ([105]), with consistency over time and across countries. Nonetheless, growing considerations related to the maturity structure of debt, in particular in the presence of high levels of official lending, the management of payment flows over time and the liquidity dimension of debt sustainability analysis call for considering additional indicators.

A practical indicator that has gained popularity in recent years is government gross financing needs. First, this synthetic indicator, defined as the sum of the budgetary deficit ('new debt'), debt amortisations and other flows ([106]) produces a

([104]) In some cases, alternative scaling variables may be more relevant, such as GNI for Ireland, or public tax revenue for countries with a more limited capacity to levy tax revenue.

([105]) For the purpose of the Excessive Deficit Procedure (EDP) in the Economic and monetary union (EMU), as well as for the Growth and Stability Pact, the current Protocol 12, annexed to the 2012 consolidated version of the Treaty on the Functioning of the European Union, provides a complete definition of government debt. See for example Eurostat, (2016), 'Manual on Government Deficit and Debt – Implementation of ESA 2010 – 2016 edition'.

([106]) Such as bank recapitalisation costs (if not already registered in the budgetary deficit), privatisation proceeds, arrears clearance, or valuation effects.

direct measure of potential refinancing risks. In some cases, this indicator can be deemed to provide a more accurate measure of the actual government debt burden. By definition, gross financing needs (GFN) are typically highly correlated to the debt level itself. But in cases where the share of concessional debt is particularly high, this indicator can provide a different insight into the actual debt burden ([107]). This is the case of Greece, for example, given the extraordinarily concessional terms applying to its government debt ([108]) ([109]).

Some limitations should be borne in mind, however, when using this indicator in debt sustainability frameworks. Unlike government debt, GFN is neither governed by common statistical guidelines, nor defined by a common approach (it falls outside of the scope of official government finance statistics). This generates potential discrepancies in its measurement and comparability (see Table II.2). These discrepancies can relate to the accounting method used (cash versus accrual terms), the categories of debt instruments considered (only debt securities or all government debt), the scope of other flows considered, and the statistical sources used. This is a shortcoming to bear in mind, notably when applying standardised risk-thresholds to GFN ([110]).

Furthermore, gross financing needs do not capture all aspects of liquidity risk. Additional indicators related to the 'finance-ability' of GFN are required, such as the composition of the investor base (in terms of domestic versus foreign holders, institutional sectors – e.g. banks, other financial institutions, etc. – and public versus private holders), and the currency composition of debt. These complementary indicators allow assessing a country's vulnerability to sudden (foreign) outflows ([111]) ([112]).

Table II.2: **GFN estimations in 2018 across institutions in selected countries**

	Short-term / liquidity measure		Medium-term measure	
	COM (FSR 2018)	**IMF** (Fiscal Monitor Oct. 2018)	**COM** (FSR 2018)	**IMF** (Art. IV reports 2018)
BE	15,0	17,4	17,4	16,6
DE	6,9	3,5	11,0	11,6
IE*	4,0	7,0	6,3	7,0
ES	17,3	17,2	17,0	17,4
FR	15,7	10,1	18,3	6,8
IT	18,9	22,2	21,2	20,4
LV	3,7	:	3,9	5,6
CY*	2,2	7,4	18,1	8,2
NL	6,4	6,7	9,4	-0,5
PT*	12,9	13,2	12,5	13,0

(1) * Refers to post-programme countries where official loans still represent a significant share of government debt. The short-term/liquidity measure only includes debt-securities amortisations (and official loan repayments for post-programme countries in the measure computed by the European Commission). The medium-term measure includes all debt amortisations (except for the part corresponding to currency and deposits in the measure computed by the European Commission). More information can be found in the European Commission Fiscal Sustainability Report 2018.
Source: European Commission, IMF.

II.2.3. Balancing the risk of the 'streetlight effect' against the risk of over-complexity

Another challenge when assessing debt sustainability in practice is the range of factors that need to be considered in the analysis. Past sovereign debt crises proved that assessments should examine many aspects, in addition to the fiscal indicators discussed so far. As highlighted in SectionII.2.2, debt sustainability risks are not simply a matter of high (on-balance sheet) debt or GFN ratios. Restricting the analysis to the latter could result in understating debt vulnerabilities

([107]) This is because concessional debt has by definition more favourable lending terms than market debt (e.g. in terms of interest rate and repayment profile). Even in cases of countries where debt is contracted on market terms, GFN can prove an interesting complementary indicator to the debt level, by reflecting the maturity structure of debt (e.g. in case of countries issuing bonds with very long maturities).

([108]) IMF (2015), 'Greece – preliminary draft debt sustainability analysis', *IMF Country Report*, No 15/165, June.

([109]) In this case, compared to alternative measures of debt burden that explicitly factor in the repayment profile of debt (such as the present value of debt), GFN presents the advantage of not relying on a normative choice regarding the discount rate (see for example Schumacher and di Mauro (2015) in https://voxeu.org/article/debt-sustainability-puzzles-implications-greece for an illustration of the sensitivity of the present value of debt estimate to the choice of the discount rate).

([110]) For example, in its DSA framework for market-access countries, the IMF uses standard risk thresholds for GFN of 15% of GDP (for emerging countries) and 20% of GDP (for advanced economies) respectively. The European Commission makes similar estimations for European economies (see Pamies Sumner, S. and Berti, K. (2017), op. cit.).

([111]) Such indicators are traditionally monitored by international institutions (e.g. the IMF and the European Commission), although less emphasised than debt and GFN indicators. Standardised risk thresholds are also applied for some of these variables (see IMF (2013), 'Staff guidance note for public debt sustainability analysis in market access countries', May, and European Commission (2019), op. cit.).

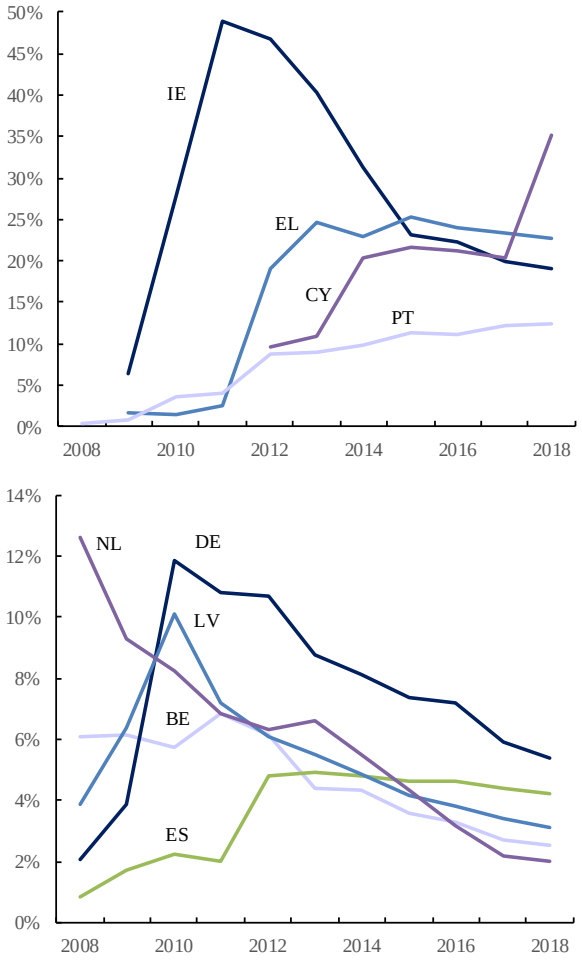
([112]) In that respect, monitoring external financing needs and the external position is also important (see Section II.2.3), particularly for non-euro-area Member States.

(and the risk of the 'streetlight effect', meaning that the analysis is focused on more direct and easily available variables). For instance, in addition to analysing actual government liabilities, looking into the presence of *contingent* liabilities ([113]), and at the broader macro-financial situation is clearly critical to assess public debt sustainability. However, including these aspects, which are often more difficult to examine and to directly link to debt sustainability, may result in an over-complex assessment.

Contingent liabilities arise from explicit or implicit government guarantees to local governments and to public and private companies. Such liabilities can have a substantial impact on public finances if the contingency materialises, posing risks to debt sustainability. The 2008 financial crisis that put a fiscal strain on public finances in several countries illustrates the importance of monitoring contingent liabilities in DSA frameworks, especially those stemming from the banking sector ([114]). For the euro area, the impact of government intervention in the financial sector on government debt peaked during the last crisis at above 10% of GDP in nine Member States including Germany, the Netherlands, Austria and Slovenia, and in the countries that benefited from EU/IMF financial assistance (Ireland, Greece, Cyprus and Portugal) (see Graph II.3) ([115]). In recent years, several of these countries seem to have recovered some of the initial costs, and their improved financial stability meant they did not need to renew the expiring government guarantees issued as part of support packages for financial institutions ([116]).

Although the contingent liabilities risks were reduced as a result of the introduction of the SSM and the SRM, as part of the Banking Union (as well as the BRRD), some risks linked to the banking sector remain.

Graph II.3: **Impact of government financial support measures on government debt in selected euro area countries, % of GDP**



Reading note: In the Netherlands, government support measures in the banking sector led to an increase of the debt-to-GDP ratio of 12.6 pps. of GDP in 2008. The fiscal costs of these support measures were largely recovered since then, with a residual effect on debt estimated at 2 pps. of GDP.

Source: Authors' calculations based on Eurostat data.

Factoring in the overall macroeconomic soundness of a country is also critical in assessing fiscal vulnerabilities. In the EU and euro area, the accumulation of both external (e.g. large current

([113]) Such liabilities typically don't appear on governments' balance sheets, although in the EU, they are subject to a specific reporting to Eurostat (see European Commission (2019), op. cit. and Section II.3.2).

([114]) The specific need to monitor contingent liabilities stemming from the banking sector is linked to the close relationship between the sovereign sector and banks. For instance, the last financial crisis triggered substantial government intervention to support the banking sector, in turn straining public finances, raising market concerns about the creditworthiness of some governments, and rises in sovereign yields. This further weakened banks' balance sheets, with the need for governments to recapitalise vulnerable domestic banks.

([115]) Eurostat (2019), 'Eurostat Supplementary Table for Reporting Government Interventions to Support Financial Institutions', *Background note*, April 2019.

([116]) European Central Bank (2018), 'Economic Bulletin', *Issue 6*, September 2018. The initial fiscal impact was reversed thanks to the income generated from the support measures, (such as dividends received on shares in financial institutions and fees received for public guarantees, and the sale of financial assets). However, this is not the case for other countries, for which the impact on debt levels appears long-lasting. Cyprus is also a notable exception, where support measures particularly added to the debt in 2018, on the back of financial support operations related to the sale of a government-owned bank.

account imbalances) and internal imbalances (an accumulation of excess private debt or housing bubbles) during the 2000s were key factors in triggering sovereign debt crises, and the need for financial assistance in some cases (see Box II.1 for selected examples). Some of the countries that turned out to be most vulnerable to such crises were considered until then to be examples of fiscal rigour.

The empirical literature highlights that the build-up of macro-financial imbalances compared to fiscal slippages played a stronger role in recent fiscal crises ([117]). In general, high public debt coupled with unfavourable developments in the real economy aggravate the prospects for debt sustainability. In the EU, these conclusions led to the creation of the Macroeconomic Imbalance Procedure (MIP) in 2011 (as part of the overall reform of the EU's economic surveillance framework) ([118]). Analysing the potential impact of macroeconomic developments on debt sustainability may, however, appear less straightforward than the monitoring of fiscal variables. The range of policy fields potentially concerned is wide, the interactions between the different variables and their link to debt sustainability complex and less direct.

Overall, balancing the risk of the 'streetlight effect' with the risk of over-complexity is a delicate task. As discussed, ensuring that there is no blind spot in the surveillance of fiscal vulnerabilities means looking at a wide range of factors. At the same time, users of DSA results, in particular policy-makers, often request synthetic assessments and clear conclusions on the risks to debt sustainability. Therefore, there may be a trade-off to make between the required scope and granularity of the assessment, and the tractability of DSA frameworks in terms of 'aggregation' of the information and sharpness of the conclusion ([119]).

([117]) Cerovic, S., Gerling, K., Hodge, A. and P. Medas (2018), 'Predicting Fiscal Crises', IMF Working paper, No 18 / 181. Bruns, M. and T. Poghosyan (2016), 'Leading Indicators of Fiscal Distress: Evidence from the Extreme Bound Analysis', *IMF Working Paper*, No. 16/28. This is also evident from the indicator used by the Commission to assess risks of short-term fiscal stress (the S0 indicator), in which macro-financial variables are found to have the highest predictive power.

([118]) The MIP also aims at addressing large current account surpluses, as they are the counterpart of external liabilities and deficits in partner countries, and may reflect growing creditor risk and a possible misallocation of resources.

([119]) Corsetti, G. (2018), 'Debt sustainability assessments: the state of the art – euro area scrutiny', *Study requested by the ECON Committee of the European Parliament*, November.

Box II.1: The role of macroeconomic imbalances in past fiscal crises in the EU / euro area: selected cases

In the euro area, the recent sovereign debt crisis was rooted in macro-financial imbalances in several countries. This Box reviews selected cases.

In **Ireland**, the government debt-to-GDP ratio increased rapidly from 25% in 2007 to almost 100% of GDP in 2010, notably due to the government's intervention to support the banking sector. Rapid credit expansion and loosening lending standards resulted in the banking sector becoming highly exposed to the buoyant housing market. When the financial and housing market collapsed in early 2000s (prior to the crisis), the banking sector faced massive losses that triggered a confidence crisis. Government bond spreads started to widen as from mid-2010. Uncertainty, both about the health of the banking system and the size and nature of the government support to the financial sector, fuelled market perceptions that government finances were unsustainable. As this 'sovereign-bank loop' gained momentum, the government lost market access at favourable interest rates and requested financial assistance from the EU and the IMF in November 2010 (1).

In **Spain**, the deterioration of public finances due to the severe crisis caused government debt to surge from a low of 35.6% of GDP in 2007 to almost 100% in 2013. Prior to the crisis, an extended credit boom had fuelled the housing and construction bubble, which had led to the build-up of several imbalances, including high indebtedness of the private sector and excessive reliance on external financing. The adjustment of the housing sector that started in mid-2008 put the banking sector under severe stress, given a high accumulation of stock of real-estate related assets and the low capitalisation of some banks. The worsening recession and uncertainty about the solvency of the Spanish banking crisis and its large recapitalisation needs, worried investors about possible government intervention and their impact on the size of the debt. In 2012, the Spanish government officially requested financial assistance to recapitalise the banking sector (2).

In **Cyprus**, government debt increased from under 60% of GDP in 2007 to over 100% by 2013, also primarily due to government support to the banking sector. Cyprus had enjoyed strong growth in the first decade of the millennium, twice that of the euro area. During this period, a strong inflow of foreign capital (mainly deposits) allowed the current account deficit to keep widening, while fuelling credit growth in the domestic economy. Dynamic activity in the real-estate sector fed the build-up of the asset boom. Losses from the high exposure to Greek debt and a deterioration in loan quality in Cyprus led to the banking sector recording substantial capital shortfalls. Concerns about the sustainability of its public finances and a weakened financial sector led to consecutive downgrading of Cypriot sovereign bonds, and the country became unable in mid-2011 to refinance itself. The Cypriot authorities requested financial assistance from the EU and the IMF in June 2012 (3).

Latvia, which originally had a negligibly low government debt, also experienced a substantial increase in the debt-to-GDP ratio from under 8% in 2007 to close to 50% in 2010. Prior to the crisis, high current account deficits, unsustainable growth, and a credit boom turned into a financial and balance of payments crisis. Despite this sharp rise, the level of government debt did not cause heightened concerns on overall fiscal sustainability. Instead, solvency concerns were over the substantial external debt burden, mainly due to high indebtedness in the household and corporate sector (4). This led the country to request financial assistance from the EU and the IMF in 2008.

(1) European Commission (2011), 'The Economic Adjustment Programme for Ireland', *European Economy Occasional Papers*, No 76. IMF (2015), 'Ireland: Lessons from its Recovery from the Bank-Sovereign Loop', *European Departmental Paper Series*.
(2) European Commission (2011), 'The Economic Adjustment Programme for Portugal', *European Economy Occasional Papers*, No. 79.
(3) European Commission (2013), 'The Economic Adjustment Programme for Cyprus', European Economy Occasional Papers, No. 149.
(4) IMF (2009), 'Republic of Latvia: Request for Stand-By Arrangement—Staff Report; Staff Supplement; Press Release on the Executive Board Discussion; and Statement by the Executive Director for the Republic of Latvia', *IMF Country Report*, No. 09.

II.3. Recent changes to DSA frameworks: state of the art and ongoing changes

The challenges identified in the previous section have led international institutions such as the IMF, the European Commission and the ECB to adopt – and strengthen over time – comprehensive frameworks to assess debt sustainability. These frameworks have in common that they take a multidimensional approach, notably encompassing both solvency and liquidity aspects, and are based on a range of fiscal and macro-financial indicators.

This multidimensional approach is well reflected in the IMF definition of debt sustainability ([120]): 'in general terms, public debt can be regarded as sustainable when the primary balance needed to at least stabilise debt under both the baseline and realistic shock scenarios is economically and politically feasible, such that the level of debt is consistent with an acceptably low rollover risk and with preserving potential growth at a satisfactory rate.' The European Commission framework provides a risk assessment by time dimension, where the analytical tools used are tailored to the type of risk analysed ([121]) ([122]). The ECB uses a rich framework and discusses the possibility to derive from it a single score for debt sustainability risk ([123]).

This section focuses on some important recent and ongoing advances in institutional DSA frameworks. In particular, it describes the development of probabilistic tools, and the consideration of feedback effects (see Section II.3.1), the increasingly broader mapping of fiscal risks (see Section II.3.2), and the greater focus on the institutional dimension of debt sustainability (see Section II.3.3).

II.3.1. Probabilistic DSAs and feedback effects

Probabilistic DSAs: using stochastic projections

Given the critical role of underlying assumptions and to assess uncertainties, probabilistic methods are increasingly being used. In recent years, various international institutions have complemented their 'conventional' (deterministic) DSA with stochastic projections. Building on the value-at-risk approach used by financial institutions, stochastic projections allow for a probabilistic analysis of debt sustainability, on the basis of a very high number of scenarios ([124]). Compared with more standard stress tests analyses, stochastic projections have the advantage of producing a distribution of debt paths corresponding to a wide set of macroeconomic conditions, with shocks calibrated to reflect country-specific historical patterns. They also take into account the interdependencies between the individual underlying variables. Interestingly, this method enables deriving a probability of occurrence of different debt paths. Hence, summarised in the form of 'fan charts', the results give information on the size of the uncertainty surrounding debt projections, and allow for an explicitly probabilistic analysis of debt sustainability (see Graph II.4). Stochastic projections can also offer a particularly useful robustness check for judgement-based baseline assumptions in DSAs, particularly in the context of programmes where such assumptions have been shown to be overly optimistic ([125]) ([126]).

([120]) See IMF (2013), op. cit.

([121]) For example, a composite indicator is used to assess short-term risks, based on a broad range of fiscal and macro-financial variables (the S0 indicator). This vulnerability indicator builds on past episodes of fiscal crises, and has the advantage of relying on outturn data (*backward-looking approach*). Medium-term risks are mainly assessed through standard debt projections (*forward-looking approach*). These projections correspond *stricto sensu* to the DSA component of the Commission's medium-term fiscal sustainability framework (complemented by a medium-term fiscal sustainability indicator, the S1 indicator). The assessment of long-term risks is based on long-term budgetary projections and a fiscal gap indicator to meet the traditional solvency condition (the S2 indicator).

([122]) The Commission analysis is published on a regular basis in several documents, in particular in the Fiscal Sustainability Report and the Debt Sustainability Monitor. For example, European Commission (2019), op. cit.; European Commission (2018), 'Debt Sustainability Monitor 2017', *European Economy Institutional Paper*, No 071, January; European Commission (2014) 'Assessing public debt sustainability in EU Member States: a guide', *European Economy Occasional Paper*, No 200, September.

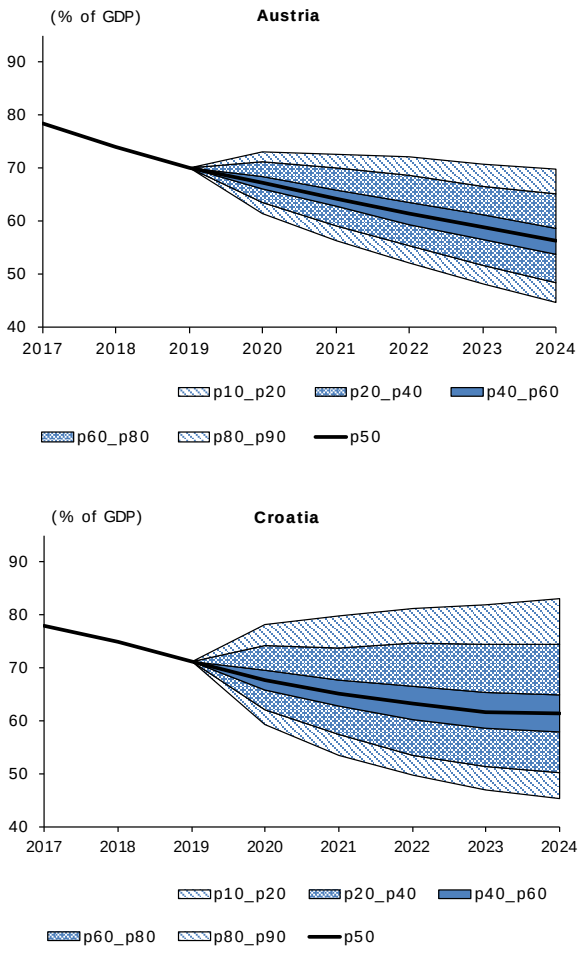
([123]) Bouabdallah, O., Checherita-Westphal, C., Warmedinger, T., de Stefani, R., Drudi, F., Setzer, R. and Westphal, A. (2017), 'Debt Sustainability Analysis for Euro Area Sovereigns: a Methodological Framework', *ECB Occasional paper series*, No 185, April.

([124]) Celasun, O., Debrun, X. and J. Ostry (2006) 'Primary Surplus Behaviour and Risks to Fiscal Sustainability in Emerging Market Countries: a Fan-Chart Approach', *IMF Working Paper*, No 06/67.

([125]) IMF (2019), '2018 Review of Program Design and Conditionality', *IMF Policy Paper*, May.

([126]) Such optimism bias would be notably driven by the fear of costly economic and political costs associated to default or debt restructuring (see Sturzenegger, F. and J. Zettelmeyer (2007), 'Creditors' losses versus debt relief: results from a decade of

Graph II.4: **Stochastic debt projections: Austria versus Croatia**



Reading note: these graphs show that the estimated uncertainty, and hence sustainability risk, is likely to be higher for Croatia compared to Austria in 2024, despite a relatively similar initial and projected debt ratio (in the central scenario). From around 70% of GDP in 2019, the debt level in Croatia is expected to range between around 45% and 83% of GDP in 2024 with a probability of 80%. For Austria, the debt level (also close to 70% of GDP in 2019) would range between 45% of GDP and 70% of GDP with a probability of 70% in 2024.

Source: European Commission Debt Sustainability Monitor 2019 (forthcoming)

However, stochastic projections should not be viewed as a silver bullet to assess debt sustainability. First, the results are only as informative as the inputs and methods used to generate them. There are different ways to generate stochastic projections, and the results are sensitive to the choice of methodology (e.g. historical variance-covariance matrix, vector auto-regression) ([127]), of variables assumed to be stochastic ([128]), of assumptions (in terms of shock distribution) ([129]) and to the quality of the data. These frameworks also require reasonably long time series to produce reliable estimations, which can make them less suitable for countries for which the availability of economic data sets are typically shorter. This approach also assumes (even more than conventional stress tests) that historical patterns (in terms of the volatility of each variable, correlation between them) are relevant to future trends. But this may not be a valid assumption, especially in case of structural change in economic policies (as for countries requesting financial assistance). Related to this, stochastic projections may tend to overestimate the magnitude of risks faced by countries coming out of difficult economic times due to the persistence of past events or policy effects ([130]).

Incorporating feedback effects

Important feedback effects are present in the 'basic' debt accumulation equation. Another methodological practical challenge when projecting debt is that all underlying variables respond to each other endogenously ([131]). For example, fiscal adjustment is likely to affect economic growth, interest rates and possibly inflation for some years. As widely documented in the literature, the fiscal

sovereign debt crises', *Journal of the European Economic Association*, April–May, 5(2-3):343–351).

([127]) The two approaches to stochastic debt analysis typically used by international institutions differ mainly in the way shocks are defined. The historical variance-covariance matrix method relies on the historical variance-covariance matrix of shocks. A second approach, which is increasingly becoming popular in DSA frameworks, relies on an unrestricted vector auto-regression (VAR) model to derive the variance-covariance matrix of shocks. The VAR approach allows for embedding a more detailed information that accounts for the historical volatility of the key non-fiscal determinants of the debt dynamics. All variables are jointly endogenous, meaning that each variable fluctuates according to its past values and the past values of all the other variables (policy persistence).

([128]) Typically, stock-flow adjustments are assumed to be exogenous, while this variable can significantly contribute to the debt dynamic.

([129]) For instance, in the historical variance-covariance matrix method, shocks are assumed to be normally distributed, when in fact their *actual* historical ('true') distribution may differ from the normal distribution. As shocks can be asymmetric or can occur more often during crises, drawing shocks from the *actual* historical distribution has the advantage of capturing the asymmetry (skewness) in the distribution of shocks to better reflect reality.

([130]) Another drawback of this method is that by appearing more sophisticated and comprehensive (than deterministic projections), stochastic projections may give the impression of providing a description of all possible future outcomes.

([131]) Corsetti, G. (2018), op. cit.

multiplier on growth itself depends on the monetary policy stance, as well as cyclical conditions. Governments are also likely to respond to a deterioration of macroeconomic conditions by discretionary fiscal policy. But as debt increases, financial market lending conditions tend to deteriorate, and governments may eventually tighten their primary balance.

With a view to making more 'realistic' debt projections, international institutions are putting a greater focus on incorporating these feedback effects in their DSA frameworks. For example, the IMF, the European Commission and the ECB take into account fiscal multiplier effects on economic growth. Some scenarios also include the 'fiscal reaction function', which explicitly factors in the endogenous reaction of the primary balance to debt accumulation (and other factors), based on econometric estimations. In addition, the reaction of market interest rates (premia) to debt increases is reflected in some of the scenarios. With a view to putting a greater focus on cash flow and debt management, the ESM proposes to explicitly account for debt financing decisions in terms of instrument maturity (and interest rates) when projecting debt and gross financing needs ([132]). The IMF's method allows for the different variables to interact in different ways in its DSA framework for market-access countries.

At the same time, it is important to ensure that DSA frameworks remain fairly simple and transparent, given their role in policy discussions. Although improving the emphasis on feedback effects is an interesting way to potentially improve the plausibility of projections, the DSA tool should remain tractable. The risk otherwise may be to replace a simple (simplistic) framework by a complex 'black box'. More sophisticated instruments do not necessarily improve the assessment ('do not break the impossibility principle'), and transparency is a virtue in and by itself for the assessment ([133]). Furthermore, except when used for the purpose of granting financial assistance (the 'hard DSA' necessitating a clear-cut assessment of debt sustainability), the DSA tool also serves a pedagogical purpose for policymakers. For instance, long-term debt paths that include the impact of population ageing should not be taken to be a forecast, but a conditional projection, *all else being equal*, illustrating the need for policy action.

Lastly, as illustrated by a wealth of empirical literature, the relationship between the different variables of interest is often non-linear, and context or time-dependent. This applies to the fiscal multiplier, the fiscal reaction function, or interest rate developments. Interest rates can be particularly delicate to model, in a context where market expectations and dynamics can switch rapidly. Hence, the assumed form of the relationship and elasticities will have a bearing on the results, and should be properly discussed in DSA frameworks (see the example of the feedback loop between interest rates and debt in the Greek DSA) ([134]).

II.3.2. Looking at a broader mapping of fiscal risks

Conventional fiscal risk analyses have underplayed the magnitude and nature of shocks affecting public finances. DSA frameworks traditionally considered a set of stress test scenarios, calibrated in a way to remain 'plausible' (e.g. based on historical patterns), and essentially capturing macro-financial risks, such as shocks to economic growth, interest rates or exchange rates. Yet, fiscal shocks tend to be much larger and more diverse in nature than assumed in conventional fiscal risk analyses. Macroeconomic shocks taking the form of sharp falls in GDP, and leading to large increases in debt ratios, have been relatively frequent. Other sources of major shocks include financial crises, the realisation of (other) contingent liabilities and natural disasters ([135]). In the euro area since the mid-1990s, during episodes of debt increases, debt-to-GDP increased by up to 10 pps. of GDP in one year (and as much as +25 pps. of GDP in Ireland and Greece), due to large stock-flow adjustments and a severe contraction in economic activity. These past events differ somehow to the type of shocks typically simulated in DSA frameworks, which have an impact of less than 5 pp. of GDP after one year, even when

([132]) Athanosopoulou, M., Consiglio, A., Erce, A., and S. Zenios (2018), 'Risk management for sovereign financing within a debt sustainability framework', *ESM Working papers series*, No 31, August.

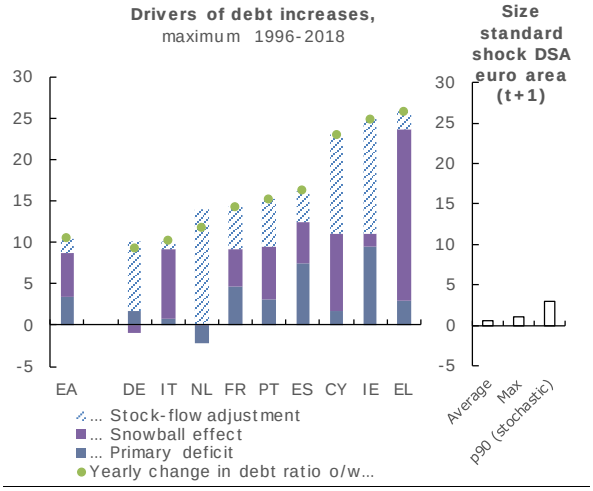
([133]) Wyplosz, C. (2011), op. cit.

([134]) Alcidi, C. and D. Gros (2018), 'Debt Sustainability Assessments: the State of the Art – Euro Area Scrutiny', *Study requested by the ECON Committee of the European Parliament*, November.

([135]) Bova, E., Ruiz-Arranz, M., Toscani, F. and H. Elif Ture (2016), 'The fiscal costs of contingent liabilities: a new dataset', *IMF Working Paper*, No 16/14.

factoring in the worst outcomes of stochastic projections (see Graph II.5) ([136]).

Graph II.5: **Drivers of large debt increases since the mid-1990s in the euro area and in selected countries, and size of a standard shock in a DSA (pps. of GDP)**



(1) Standard shocks include shocks to the interest rate, economic growth and the primary balance. Here, the effect on the debt-to-GDP ratio - after one year - of a standard combined shock on interest rate and GDP growth is shown (EA average and maximum effect), as well as the one derived from the stochastic projections (90th percentile).
Source: Ameco, European Commission.

International institutions and national authorities are progressively strengthening their debt sustainability analysis by factoring in a wider range of fiscal risks ([137]). The IMF, the European Commission and the ECB already include a tail risk analysis in their DSA frameworks, mainly focused on contingent liabilities linked to the banking sector. The European Commission and the ECB frameworks also contain a broader monitoring of contingent liabilities ([138]). With a view to assessing fiscal sustainability in the medium- to long-term, the UK Office for Budget Responsibility (OBR) provides a thorough analysis of fiscal risks that range from macroeconomic, financial sector, specific spending and tax receipts, balance sheet and interest rate risks ([139]). The European Commission, in the context of its long-standing analysis of long-term fiscal sustainability, examines a broad range of scenarios, including lower productivity growth, higher costs stemming from technological change in the healthcare sector, and higher gains in life expectancy ([140]).

Looking forward, DSA frameworks could be improved by broadening the analysis to include 'new' fiscal risks. These new risks include natural disasters and climate change risks, as well as broader environmental risks that have been on the rise in recent decades (see Graph II.6). Considering the far-reaching impact of climate change and the particularly high exposure of many of its members, the IMF recently introduced in its DSA framework for low-income countries a specific stress test related to the risk of natural disasters ([141]).

The OECD also encourages better assessments of disaster-related contingent liabilities and including the results in fiscal risk assessment processes ([142]), while the OBR sets out tentative elements of a framework for considering climate-related fiscal risks in its latest Fiscal Risks Report. In addition to including direct impacts on public finances and economic growth ([143]), there are also major risks on the financial sector stemming from climate change ([144]), with potential effects on public debt

([136]) The design of standard shocks is fairly similar in the European Commission and the IMF frameworks.

([137]) A better analysis and management of (broad) fiscal risks by national authorities is notably encouraged by the IMF (2016), 'Analysing and Managing Fiscal Risks: Best Practices', *IMF staff paper*, June.

([138]) This monitoring is supported by EU provisions: for instance, under Council Directive 2011/85/EU, Eurostat collects and publishes data on contingent liabilities (including government guarantees, off-balance PPPs, non-performing loans of government and liabilities of government controlled entities classified outside of general government). Furthermore, in the context of the EDP, Eurostat has collected and published data on government interventions to support financial institutions since 2009.

([139]) OBR (2019), 'Fiscal Risks Report', July. This report also includes a severe fiscal stress test, including a scenario of a deep recession, with asset prices and the pound falling sharply, and lasting effects on potential output.

([140]) European Commission Fiscal Sustainability Report 2018 (op. cit.) and European Commission / EPC (2018), 'The 2018 Ageing Report – Economic and budgetary projections for the 28 EU Member States (2016-2070)', *European Economy Institutional Paper*, No 079, May.

([141]) IMF (2018), 'Guidance Note on the Bank-Fund Debt Sustainability Framework for Low Income Countries', February.

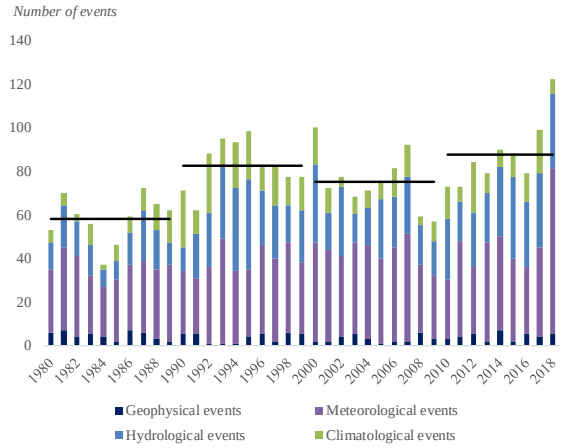
([142]) OECD (2019), 'Fiscal Resilience to Natural Disasters lessons from country experiences', *OECD publication*.

([143]) Direct impacts on public finances include higher public spending due to extreme weather events and to policies designed to ensure the transition to a low-carbon economy (the latter also likely lowering tax receipts). Indirect impacts on public finances are notably linked to reduced economic activity, at least in the short- to medium-term, as a result of extreme weather events and gradual global warming (e.g. through adverse effects on productivity).

([144]) Bank of England (2017), 'The Bank of England's response to climate change', *Quarterly report* 2017/Q2.

sustainability (in the form of a contingent liability). Assessing the impact of climate change and other environmental risks on public finances is clearly an important avenue to purse in further developing DSA frameworks. However, this is challenging given the multiple interactions and mechanisms involved. Other new fiscal risks relate to recent technological change and financial trends, such as the digitalisation of the economy, with major consequences for tax bases ([145]), and developments in the non-bank financial sector ([146]).

Graph II.6: **Incidence of relevant natural loss events in Europe since 1980**



(1) Geophysical events include earthquakes, tsunamis, volcanic activity. Meteorological events include tropical cyclones, extratropical storms, convective and local storms. Hydrological events include flood and mass movement. Climatological events include extreme temperature, drought and forest fires. Accounted events have caused at least one fatality and/or produced normalised losses greater or equal to USD 100,000, 300,000, 1 million or 3 million (depending on the assigned World Bank income group of the affected country).
Source: Munich RE, NatCatService

II.3.3. The institutional dimension of debt sustainability

In addition to fiscal and macroeconomic variables, institutional factors merit consideration when assessing debt sustainability. A vast literature suggests that deep structural and institutional features are key supporting factors to debt sustainability ([147]). Several empirical papers emphasise a broad set of institutional indicators relevant to the assessment of debt sustainability, ranging from *institutional features of fiscal policy* (fiscal governance frameworks, institutional arrangements for fiscal risks and debt management), to *broader governance aspects* of a country (such as government effectiveness, rule of law, or control of corruption), and to *broader political characteristics* (including political stability, or the nature of the political regime). Even with a similar set of financial ratios and macroeconomic performance, two countries with differences in structural and institutional features will have a very different risk profile ([148]).

Recognising the importance of governance and institutional factors in debt sustainability analysis, international institutions increasingly factor in - directly or indirectly - these aspects in their DSA frameworks. For instance, in its framework for market-access countries, the IMF makes a broad differentiation between countries (emerging markets versus advanced economies), implicitly reflecting institutional features ([149]). The ECB uses a set of 'governance and political risk' indicators, as part of its assessment of sovereign debt sustainability. The ESM considers a range of 'institutional parameters' in its analysis of sovereign vulnerabilities ([150]). Institutional features are also embedded in credit rating agencies' analyses and sovereign ratings, also as a way to capture countries' willingness to repay their debt.

Measuring institutional factors is obviously challenging, and the indicators selected determinant for the diagnosis. The most commonly used synthetic indicators are mainly based on

([145]) For instance, the OBR (2019, op. cit.) deems that it is likely that a declining share of activity will be taxable on current policies, and that the downside risks to tax bases will mainly be for the short-to-medium term.

([146]) The size of the non-bank financial sector (sometimes called shadow banking) has risen significantly over the last ten years, and can pose systemic risks (see ECB (2019), 'Financial Stability Review', May), with potential direct and indirect fiscal implications (see OBR (2019), op. cit.). Hence, this can be seen as a contingent liability.

([147]) Reinhart, C., Rogoff, K. and Savastano, M. (2003), 'Debt Intolerance', *Brookings Papers on Economic Activity 1*, 1-74. Reinhart, C.M. and K. S., Rogoff (2009), 'This Time is Different: Eight Centuries of Financial Folly', Princeton University Press.

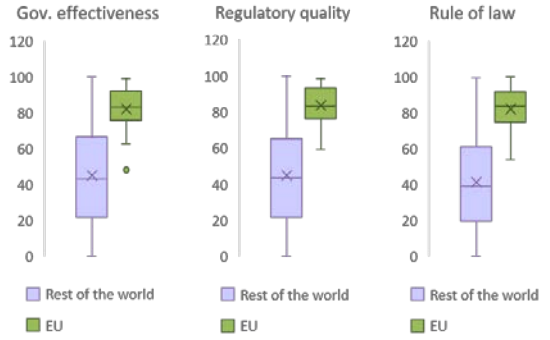
([148]) Fournier, J. M. and M. Bétin (2018), 'Sovereign defaults: evidence on the importance of government effectiveness', *OECD Economics department working papers*, No 1494.

([149]) This manifests itself through the use of higher risk thresholds for countries considered to have a stronger debt-carrying capacity (such as advanced economies). In the IMF framework for low-income countries, the consideration of institutional factors is even more explicit with the use of the CPIA (*Country Policy and Institutional Assessment*) in the composite indicator of debt-carrying capacity, which is the basis for benchmark differentiation.

([150]) Lennkh, R. A., Moshammer, E. and V. Valenta (2017), 'A comprehensive Scoreboard for Assessing Sovereign Vulnerabilities', *ESM Working Paper series*, No 23.

perception-based measures of governance, and could be subject to systemic biases ([151]). The empirical evidence that links debt sustainability to such measures has also mainly been collected on a set of emerging countries. In the EU and euro area, the quality of institutions appears on average higher and less heterogeneous than in other parts of the world (see Graph II.7).

Graph II.7: **Selected governance indicators, EU versus other countries**



Source: World Bank.

A broader (qualitative) approach should be favoured, examining the full range of stakeholders, institutions and arrangements supporting debt sustainability. For instance, in the euro area, several actors and governance frameworks contribute to debt sustainability. Given the decentralised fiscal policy setup, national governments are pivotal players to debt sustainability. Nonetheless, the high degree of economic and monetary integration in the EU and euro area implies the presence of significant spillovers, so debt sustainability issues in one country matter to the rest of the Union.

In this context, the EU has created and strengthened a significant suite of common institutional arrangements over the years. These include a stronger European governance framework, in particular on reformed fiscal rules, the new MIP and the European Semester process, crucial components of a Banking Union, such as the Single Supervisory Mechanism and the Single Resolution Mechanism, and the Banking Recovery and Resolution Directive. Important crisis management tools were also created such as the European Stability Mechanism (ESM) and other EU crisis management instruments.

II.4. Conclusion

The euro area sovereign debt crisis was a stark reminder that debt sustainability must be closely monitored, even in advanced economies. Although the current low level of interest rates contribute, to some extent, to reducing risks to debt sustainability ([152]), disruptive events in the short-term, and longer-term expected increases in public spending (notably linked to an ageing population and to climate change phenomenon) are significant challenges. Furthermore, fiscal buffers in many EU countries are substantially more limited than they were before the global financial crisis (six Member States, including some large economies, have debt ratios close to 100% of GDP).

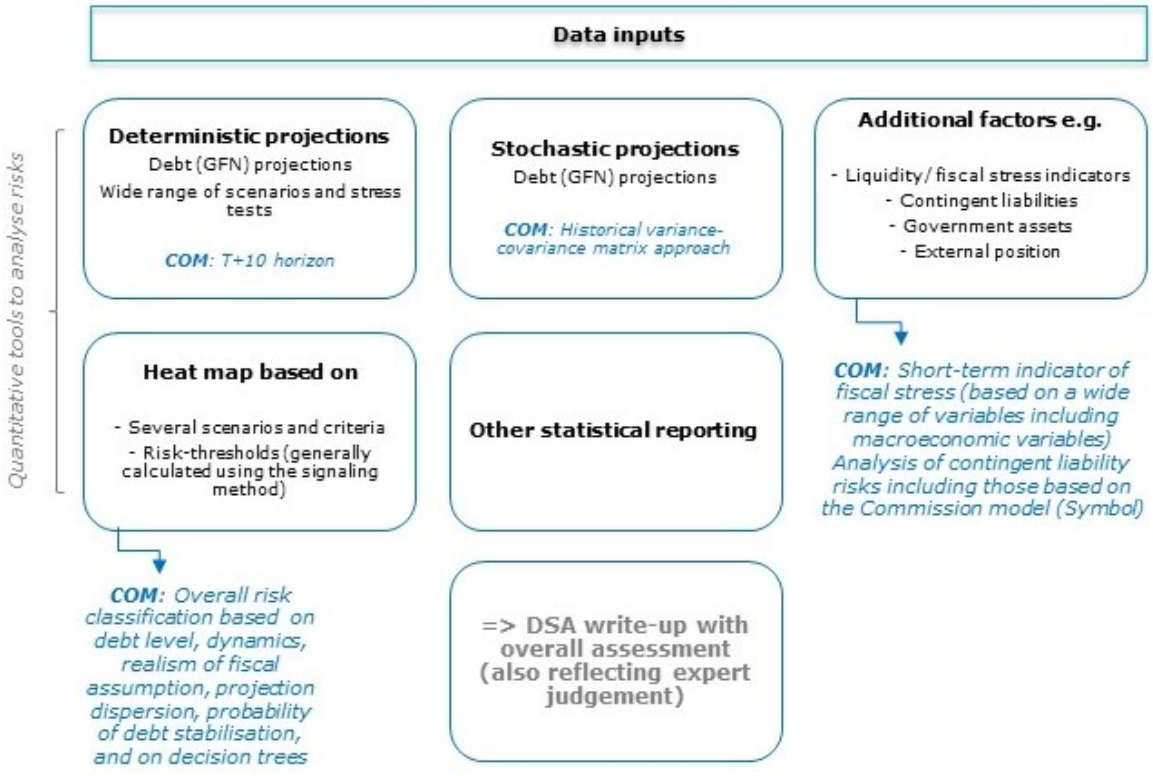
Debt sustainability analysis therefore remains an essential component in the fiscal risk management toolkit, serving multiple purposes (ranging from macroeconomic surveillance, economic policy recommendations, to financial assistance). In the EU and euro area, this analysis is an integral part of the overall fiscal and macroeconomic governance framework.

To meet new challenges, international institutions (notably the IMF, the European Commission and the ECB) have strengthened their debt sustainability frameworks over the past years (Graph II.8 illustrates the current frameworks), and several additional improvements are ongoing. A wide range of fiscal risks, multiple interactions, and institutional factors are some of the many aspects that need to be reflected in the analysis. That way, debt sustainability analysis is an analytical framework, based on an increasing number of tools, rather than relying on a single calculation However, the 'art' element to the assessment is here to stay, given the inevitable conceptual and practical difficulties of the analysis, and the need to carefully interpret quantitative results.

([151]) For a detailed discussion of the concept of institutional factors, see European Commission Fiscal Sustainability Report 2018, Box 1.2.

([152]) Recently, Blanchard (2019, 'Public Debt and Low Interest Rates', *American Economic Review*, *American Economic Association*, Vol. 109(4), April.) argued that (durably) lower interest rates decrease the fiscal and the economic costs of public debt, providing a less negative insight on risks associated to high public debt. At the same time, other authors challenge the fact that the interest-growth rate differential has been (and will remain) negative for long periods (see Checherita-Westphal, C. (2019), 'Interest rate-growth differential and government debt dynamics', *ECB Economic Bulletin*, Issue 2/2019).

Graph II.8: **Debt sustainability analysis frameworks in the main international institutions: stylised presentation**



(1) This chart illustrates in a stylised fashion the key components of the main international institutions current DSA frameworks (IMF, European Commission and ECB). The blue text highlights the specific features of the Commission's framework.
Source: Authors

III. The sovereign-bank nexus in the euro area: financial and real channels

by Mario Bellia, Ludovic Cales, Lorenzo Frattarolo, Andreea Maerean, Daniel Monteiro, Marco Petracco Giudici and Lukas Vogel

The sovereign-bank nexus played a key role in the 2010-2012 European debt crisis by enabling pernicious dynamics whereby governments and domestic banking sectors mutually weakened each other. This article reviews the direct (financial) and indirect (real) channels through which banks and sovereigns interact, and which can give rise to feedback loops between them. While significant progress has been achieved in recent years in mitigating the direct channel, its indirect mechanisms have remained largely intact. Policy options for improving the financial stability of euro area banks and sovereigns continue to be discussed in policy circles, including measures to diversify banks' sovereign debt holdings. While a review of the literature and model-based simulations do not demonstrate that diversification in itself has a clear impact on systemic risk, where it does reduce (or at least cap) total risks it can help significantly in absorbing shocks in crisis periods. Similarly, simulations show that greater cross-border integration in banking can dilute the impact of asymmetric shocks across regions in a monetary union. ([153])

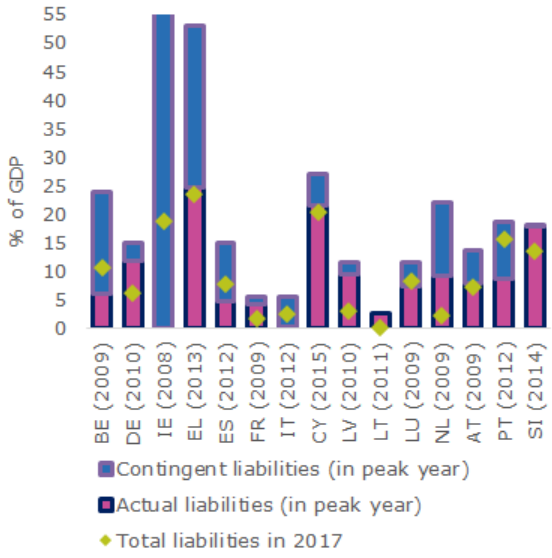
III.1. Introduction

The 2008 financial crisis and the ensuing sovereign debt crisis exposed a gradual intertwining of risks between euro area sovereigns and their domestic banking sectors. While various theoretical mechanisms may underlie this phenomenon (see below), we can register upfront a number of empirical facts that characterised the crisis:

- Bank failures led to government intervention in the financial sectors in several euro area countries, putting significant pressure on public finances (Graph III.1);
- Banks' sovereign credit risk exposures have remained biased towards their domestic sovereign across the euro area (Graph III.2); and
- Euro area sovereigns saw hikes in their default risk (Graph III.3) that correlated with hikes in the default risk of domestic banks.

Academics, economists and policymakers have come to refer to this mutual reinforcement of weak bank balance sheets and sovereign fragility as 'diabolic loops' ([154]) and to see it as a key feature of the euro area crisis.

Graph III.1: **General government liabilities due to interventions to support financial institutions**

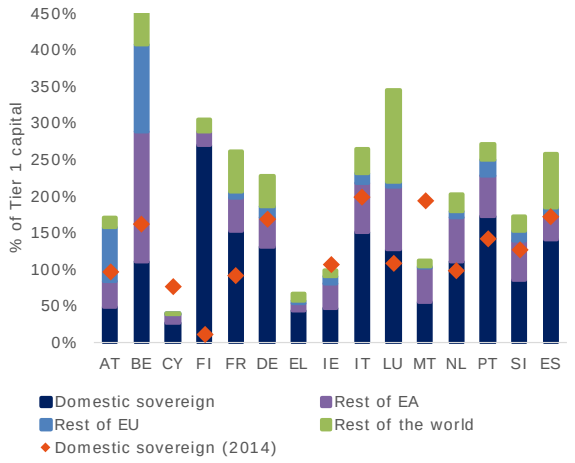


(1) Total liabilities are the sum of actual and contingent liabilities; contingent liabilities relate mainly to the provision of government guarantees on assets and liabilities of financial institutions and special purpose vehicles; actual liabilities are those having an immediate impact on government debt. Each country's peak year for total liabilities is indicated on the x axis; EE, MT, SK and FI are not plotted, as they have no government liabilities linked to the support of financial institutions.
Source: own calculations based on Eurostat data.

([153]) The authors would like to thank Gabriele Giudice, Davide Lombardo and an anonymous reviewer for their useful comments.

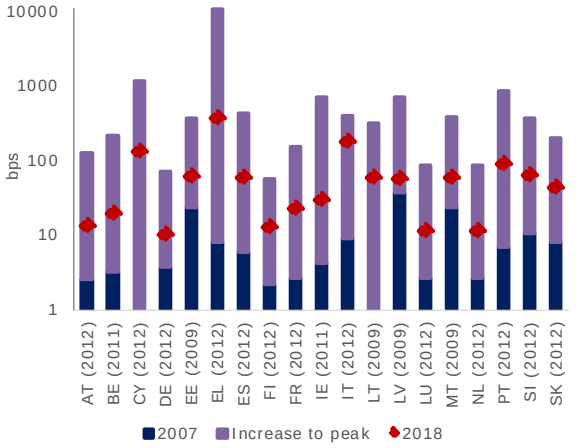
([154]) The term was coined in 2011 by the Euro-nomics group of academic economists from various euro area countries.

Graph III.2: **Geographical breakdown of sovereign exposures of euro area banking sectors (June 2018)**



Source: own calculations based on consolidated data for banking groups from the EBA's 2018 and 2015 transparency exercises.

Graph III.3: **5-year sovereign credit default swap (CDS) spreads**



(1) Non-linear scale; the year in the x axis refers to the peak year for CDS spreads; no 2007 data for CY and LT.
Source: Bloomberg, own calculations.

The situation in the euro area has improved significantly since the peak of the crisis, thanks to a better institutional framework and a more favourable economic environment. Sovereign risk has receded markedly (although it remains well above pre-crisis benchmarks in most countries) and government liabilities linked to financial sector intervention are unwinding (Graphs III.1 and III.3).

While it appears to have dropped in some countries in recent years, home bias in banks' sovereign debt holdings remains high (Graph III.2). ([155]) Many of the financial and real channels that drive the sovereign-bank nexus remain in place and could re-ignite harmful dynamics in some form or other.

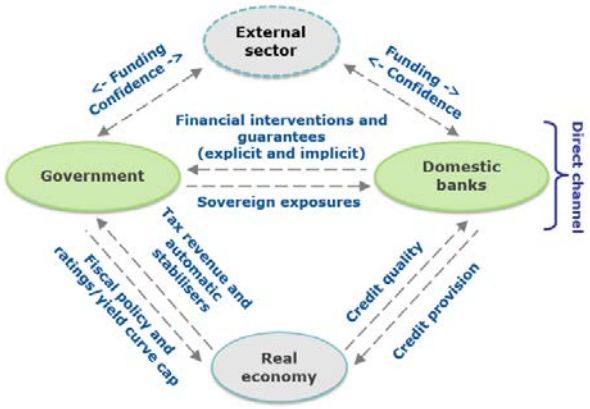
The remainder of this article is structured as follows. Section III.2 reviews the direct and indirect channels of the sovereign-bank loop, with references to the literature. Section III.3 considers the progress achieved as regards the institutional set-up in the euro area, discusses remaining challenges and explores possible policy responses. Section III.4 assesses the sovereign-bank loop using the Commission's SYMBOL and QUEST models. It considers baseline simulations and counterfactual scenarios involving the diversification of banks' debt holdings and greater cross-border integration in banking sectors; and conclusions are set out in Section III.5.

III.2. The sovereign-bank loop

Governments and banking interact through various channels. Graph III.4 provides a visual reference for the following subsections on direct channels (which operate via financial exposures between banks and sovereigns) and indirect channels (which operate via real economy mechanisms).

([155]) The large increase in the degree of home bias in Finland is driven by a very large increase in the domestic sovereign exposures of one institution and the inclusion of a new institution in the sample, which itself is highly exposed to the domestic sovereign. The choice of 2014 in Graph III.2 to illustrate the evolution of the exposures to the domestic sovereign is driven by comparability considerations regarding the EBA sample.

Graph III.4: **Sovereign-bank loops**



Source: adapted from the sovereign-bank loop literature (e.g. Schnabel, I. and Véron, N. (2018), Completing Europe's banking union means breaking the bank-sovereign vicious circle, VoxEU.org)

Direct (financial) channels

The direct channels of the sovereign-bank loop (whereby banks and their domestic sovereigns weaken each other) are essentially based on:

- banks' financial exposures to domestic sovereign debt; and

- (the possibility of) governments' financial intervention in the domestic banking system through: (i) nationalisation; (ii) bail-outs; (iii)capital injections; ([156]) (iv) the provision of guarantees (including on deposits); ([157]) (v) the purchase of toxic assets; and (vi) taking on other forms of contingent liability.

Other measures by public authorities for dealing with banking crises include liquidity support from the central bank and deposit. ([158])

The loop can occur via a direct channel where bank losses lead a government to sponsor recapitalisations, provide guarantees or otherwise increase its contingent liabilities, in actual or expected value terms. This leads to a rise in actual or expected government debt levels, which depresses sovereign bond prices. As banks have holdings of domestic sovereign debt, this further weakens their balance sheets (in market value terms), thus iterating the loop. ([159]) In addition, since sovereign bonds serve as collateral for financial transactions, the banks' ability to secure funding can decline if the sovereign experiences financial difficulties. ([160])

The direct channel can also originate on the side of the sovereign, as when unsound fiscal policies can lead to higher government debt and sovereign risk, which transmit to domestic banks via valuation losses on sovereign debt. ([161])

Government guarantees and the possibility of intervention can generate moral hazard by encouraging banks to take on more risk on their balance sheets and lowering their financing costs. Moral hazard can arise, for example, through rescue packages that transfer credit risk from the banking sector to the government. Evidence from credit default swap (CDS) spreads for the euro area countries and banks shows that the introduction of bank bailouts around October 2008 caused bank CDS premia to fall, while sovereign risk spreads surged. ([162]) Such risk-shifting has led to EU policy action to break this direct channel by requiring the 'bail-in' of creditors in the event of bank failure as a pre-condition for public intervention. ([163])

([156]) A capital injection may not constitute a bail-out in the strict sense, if it serves to reinforce the capital base of a bank that already satisfies the minimum capital requirements in the banking regulations.

([157]) Given the seniority of deposits over other bank liabilities and the existence of deposit guarantee schemes that are funded *ex ante* to protect deposits of up to €100,000 in the event of a bank failure, any implicit governmental guarantee on deposits is only partial.

([158]) For details of different countries' support measures in 1970-2011, see Laeven, L. and Valencia, F. (2012), 'Systemic banking crises database: an update', *IMF Working Paper No 12/163*.

([159]) See, for example, Schnabel, I. and Schüwer, U. (2016), 'What drives the relationship between bank and sovereign credit risk?', *German Council of Economic Experts Working Paper 07/2016*. The authors confirm a positive correlation between the strength of the sovereign-bank nexus and factors such as a high degree of home bias, low bank capital ratios and high sovereign debt ratios.

([160]) See Bank for International Settlements (2011), 'The impact of sovereign credit risk on bank funding conditions', *CGFS Papers No 4*.

([161]) See, for example., Stournaras, Y. (2016), 'The impact of the Greek sovereign crisis on the banking sector — challenges to financial stability and policy responses by the Bank of Greece', speech at the American School of Classical Studies, Athens, 8 June 2016.

([162]) Ejsing, J. and Lemke, W. (2011), 'The janus-headed salvation: sovereign and bank credit risk premia during 2008–2009', *Economics Letters 110*.

([163]) Bail-in is a resolution tool whereby bank creditor positions are converted into equity positions in the event of a bank failure. See also Subsection 0.

Indirect (real) channels

The indirect channel consists of real economy linkages and operates even in the absence of government intervention or banks' direct financial exposures to sovereigns. A loop via the indirect channel can occur when a shock leads to constraints in banks' supply of credit, which then harm private investment, consumption and the broader economy. In turn, an economic slowdown increases the government deficit through lower tax revenues and the operation of automatic stabilisers. Experience shows that government debt can rise dramatically following banking crises and that these surges are not necessarily due to bailout costs, but can be driven by a combination of collapsing tax revenues in the wake of output contractions and countercyclical fiscal policies aimed at mitigating the downturn. ([164])

In the face of such a downturn, government may see its debt increase (which can trigger the direct channel) or embark on a course of fiscal consolidation (e.g. to avoid losing market access), further slowing down the economy by withdrawing stimulus. As economic activity is further depressed, banks' balance sheets suffer valuation and loan losses. This further lowers their capital ratios and lending ability, ([165]) iterating the loop.

The loop can also start on the government side, or simultaneously on both sides, e.g. when an adverse macroeconomic shock affects both government revenues and banks' assets.

The indirect channels also include other mechanisms, e.g. empirical evidence indicates that increases in government risk premia spill over to risk premia in the domestic private sector, ([166]) while sovereign ratings act as a *de facto* cap on domestic companies' ratings. ([167]) External financing may disappear in a banking crisis, due to a fall in confidence among foreign investors. As a result, governments will be less able to roll over and service their external debt, ([168]) with sudden stops in capital flows often generating sovereign defaults.

Finally, the real economy also mediates the loop through its effect on the sustainability of public finances (e.g. weak or negative growth leads to less favourable government debt-to-GDP ratios, which in turn tend to depress sovereign bond valuations).

Modelling the feedback loop

We have explored how the sovereign-bank loop can be transmitted through direct and indirect channels. We now look at how the loop has been modelled in the literature.

Most empirical papers explore the relationship between sovereigns and banks by measuring their credit risk through CDS spreads.

Acharya *et al.* (2014) ([169]) construct a theoretical model whereby bailouts and sovereign bond holdings link financial sector and sovereign default risk. Using CDS data in an empirical application, they show that:

- bailouts have lowered banks' default risk while sovereigns' risk increased; and
- changes in sovereign CDS spreads have driven changes in banks' CDS spreads in the post-bailout period (i.e. sovereign stress is transmitted to the financial sector) in the post bail-out period.

([164]) See Reinhart, C. M. and Rogoff, K. S. (2009), 'The aftermath of financial crises', *American Economic Review* vol. 99(2) and Baldacci, E. and Gupta, S. (2009), 'Fiscal expansions: what works', *IMF Finance & Development 46*.

([165]) For an analysis of how the need to improve capital ratios may constrain bank lending see, for example, Monteiro, D. and Priftis, R. (2017), 'Bank lending constraints in the euro area', *European Economy*, Discussion Paper 43.

([166]) See, for example, Theobald, T. and Tober, S. (2019), 'Euro area sovereign yield spreads as determinants of private sector borrowing costs', *Economic Modelling* and Augustin, P., Boustanifar, H., Breckenfelder, J. and Schnitzler, J. (2016), 'Sovereign to corporate risk spillovers', ECB, *Working Paper Series no 1878*. For the role of country risk in driving the risk premia of non-financial companies, see also Horny, G., Manganelli, S. and Mojon, B. (2016), 'Measuring financial fragmentation in the euro area corporate bond market', *Banque de France Working Paper 582*.

([167]) Bank for International Settlements (2011) *op cit* shows that sovereign downgrades often translate into lower ratings for domestic banks, which in turn can worsen their access to foreign financing and affect their borrowing conditions.

([168]) Reinhart, C. M. and Rogoff, K. S. (2009), 'This time is different — eight centuries of financial folly', Princeton University Press.

([169]) Acharya, V., Drechsler, I. and Schnabl, P. (2014), 'A pyrrhic victory? Bank bailouts and sovereign credit risk', *The Journal of Finance 69* (6).

Alter and Schüler (2012) ([170]) use CDS data to show how bank default risk affected their host sovereign's at the beginning of the crisis, and confirm that bailouts strengthen the reverse causal relationship.

Mody and Sandri (2012) ([171]) proxy sovereign default risk through bond spreads and banks' fragility through the relative equity index of the financial sector. Their modelling of sovereign risk can be combined with the Commission's SYMBOL model to obtain another empirical tool to assess the loop (see Subsection III.4.1).

As regards the theoretical literature, Brunnermeier *et al.* (2016) ([172]) use a model to show how such loops can be avoided by restricting banks' domestic sovereign exposures, in particular by shifting them to the senior tranche of a diversified sovereign bond portfolio (i.e. 'ESBies'). In Brunnermeier *et al.* (2017), ([173]) they extend their theoretical model to study the equilibrium effects of different ESBie portfolios. Farhi and Tirole (2018) ([174]) contribute to the theoretical literature with a comprehensive model of the feedback loop that covers the supervisory function and explores the mechanisms behind domestic bailouts of the banking system and sovereign debt forgiveness by international creditors, or solidarity by other countries. Cooper and Nikolov (2018) ([175]) highlight the role of banks' decisions on equity issuance in preventing or enabling the loop. Finally, dynamic stochastic general equilibrium (DSGE) models with a banking sector can generally capture at least some elements of the sovereign-bank nexus. For instance, Gourinchas *et al.* (2016) ([176]) examine the Greek crisis of 2010 through the lens of such a model to examine the role of various drivers, including sovereign risk, credit costs and non-performing loans. A model from the same DSGE class – the Commission's QUEST model – is employed in Subsection III.4.2.

III.3. Policy challenges and achievements

In Subsection III.3.1, we summarise institutional progress in the euro area on weakening the sovereign-bank loop; in subsection III.3.2, we look at remaining challenges.

III.3.1. The new institutional setup of the euro area

In general, safety buffers in the euro area banking system have increased, thus reducing the need for public interventions such as those that have added to debt levels in several Member States in the past decade (Graph III.5). Despite profitability challenges and still-high levels of non-performing loans in some jurisdictions, euro area banks are now much more capitalised, owing to the introduction of more stringent capital requirements. At the same time, the crisis took a toll on public finances and government debt ratios remain high in some Member States.

A decisive improvement compared with the pre-crisis period has been the introduction of single bank supervisory and resolution mechanisms at EU level. The single supervisory mechanism has promoted the convergence and effectiveness of supervisory practices across the EU, thereby helping to reduce insolvency risks *ex ante*. The new bank resolution framework gives authorities the wherewithal to restructure failing banks while avoiding, or limiting, the use of public money and impacts on the broader financial system. ([177]) The entry into force of the Bank Recovery and Resolution Directive ([178]) and of the main operational aspects of the single resolution

([170]) Alter, A. and Schüler, Y. S. (2012), 'Credit spread interdependencies of European states and banks during the financial crisis', *Journal of Banking & Finance 36* (12).

([171]) Mody, A. and Sandri, D. (2012), 'The eurozone crisis: how banks and sovereigns came to be joined at the hip', *Economic Policy 27* (70).

([172]) Brunnermeier, M. K., Garicano, L., Lane, P. R., Pagano, M., Reis, R., Santos, T., Thesmar, D., Van Nieuwerburgh, S. and Vayanos, D. (2016), 'The sovereign-bank diabolic loop and ESBies', *The American Economic Review Papers and Proceedings 106* (5).

([173]) Brunnermeier, M. K., Langfield, S., Pagano, M., Reis, R., van Nieuwerburgh, S. and Vayanos, D. (2017), 'ESBies: safety in the tranches', *Economic Policy 32* (90).

([174]) Farhi, E. and Tirole, J. (2018), 'Deadly embrace: sovereign and financial balance sheets doom loops', *Review of Economic Studies* vol. 85.

([175]) Cooper, R. and Nikolov, K. (2018), 'Government debt and banking fragility: the spreading of strategic uncertainty', *International Economic Review* (forthcoming).

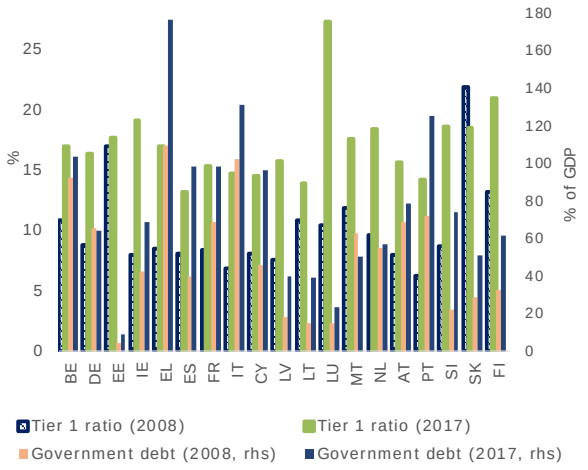
([176]) Gourinchas, P., Philippon, T. and Vayanos, D. (2016), 'The analytics of the Greek crisis', *NBER Working Paper No 22370*.

([177]) For the strategic importance of having a good resolution 'technology' available, see DeYoung, R., Kowalik, M. and Reidhill, J. (2013), 'A theory of failed bank resolution: technological change and political economics', *Journal of Financial Stability*, vol.9, issue 4.

([178]) Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014.

mechanism (SRM) in January 2016 provided a bank resolution toolbox: bail-in, asset separation, sale of business and bridge institution. Bail-in, in particular, allows for a clear shifting of risk from governments to bank creditors through the conversion of certain creditor positions into equity positions if the need arises to recapitalise a failing bank. Linked to the entry into force of the bail-in tool, banks must now comply with minimum requirements for own funds and eligible liabilities (MREL) to ensure the issuance of sufficient 'bail-in-able' instruments. In addition, the banking industry is in the process of capitalising a single resolution fund (SRF) that can be tapped to finance the restructuring of failing systemic banks when other options (such as bail-in) have been exhausted.

Graph III.5: **Banks' tier 1 capital ratio and government debt, by EA Member State**



(1) The calculation of tier 1 capital is subject to a statistical break, with the 2017 figure based on the Basel III concept.
Source: ECB, Eurostat, own calculations

Together with improved supervisory practices, the new resolution tools carry the potential to break the direct channel from distressed banks to the domestic sovereign. The Commission's 2018 *Fiscal sustainability report* ([179]) uses SYMBOL ([180]) to assess the bank-originating risks to public finances of a systemic event of a magnitude comparable to the 2008-2012 crisis. It finds that, given banks' improved capitalisation levels, the possibility of bail-in and the existence of an SRF, such risks are minor for most Member States, and exist essentially only over the short term.

Other improvements to the institutional framework in the euro area include:

- the establishment of a European Stability Mechanism (ESM), which can grant loans to euro area governments in need of financial assistance;
- the deployment of new monetary policy tools that can provide the market with ample liquidity, such as asset purchase programmes, targeted long-term refinancing operations and outright monetary transactions; and
- enhancement of macroeconomic surveillance mechanisms through the introduction of a macroeconomic imbalance procedure, the reform of fiscal rules and the institutionalisation of the European Semester, an annual economic policy coordination exercise.

These improvements should also hinder the operation of the indirect channels of the loop.

III.3.2. Remaining challenges and possible policy responses

Notwithstanding the progress achieved in severing the sovereign-bank loop, a number of challenges remain:

- deposit insurance is still compartmentalised along national lines;
- banks are still building up their MREL capacity;
- supervisory practices and rules are not yet fully aligned (particularly as regards less significant institutions); and
- the SRF is still being capitalised, with a view to reaching the equivalent of at least 1% of euro area deposits by year-end 2023.

It has been agreed in principle that the ESM will provide a common backstop to double the firepower of the SRF, but this is not yet operational.

Also, while the new resolution framework carries evident potential, not all available resolution tools

([179]) European Commission (2019), 'Fiscal sustainability report 2018 — volume 1', *European Economy Institutional Paper* 94.

([180]) The sample and assumptions differ from those underpinning the stylised simulations in Subsection III.4.1.

have been tested in actual bank failure cases. For instance:

- the failure of Spain's Banco Popular in 2017 was dealt with by selling the bank at no cost to Santander, another Spanish bank. It was a resolution with write-down of own funds but without a proper bail-in, and which relied on the liquidity and solvency of the acquiring bank.

- also in 2017, the failures of Italy's *Banca Popolare di Vicenza* and *Veneto Banca* were managed through normal insolvency proceedings; ([181]) and

- *Monte dei Paschi di Siena* underwent a precautionary recapitalisation.

State aid was used in the last three cases.

In 2015, the Commission proposed a European deposit insurance scheme (EDIS) as the third pillar of the banking union. EDIS would ultimately ensure that the euro area banking system funds a common scheme providing guarantees on deposits of up to €100,000, thus severing the link between national deposit guarantees and the domestic banking system. Negotiations between Member States on the adoption of EDIS have not yet started.

Another issue relates to the high degree of home bias in banks' holdings of sovereign debt, which is seen as having delayed progress on EDIS. ([182]) It has been argued that this is facilitated by the current regulatory exemption of banks' exposures to the sovereign debt of euro area Member States from capital charges or quantitative limits. ([183]) These exemptions, together with liquidity requirements and Eurosystem collateral policy, create a specific regulatory environment for bank holdings of sovereign debt. At the same time, since the integration of sovereign bond markets was reversed during the financial crisis, these holdings have become more strongly skewed towards the domestic sovereign in some countries. This has been explained both as a kind of 'carry trade', whereby banks resort to easily available funding to load up on high-yielding bonds, and as the result of moral suasion, whereby governments put pressure on banks to absorb their debt issuance in periods of distress. ([184]) It has also been claimed that greater sovereign home bias in the crisis period reallocated credit from the private to the public sector, displacing productive investment. ([185]) On a more positive note, domestic banks' absorption of sovereign debt in times of distress can have a stabilising effect by containing interest-rate volatility and facilitating the smooth conduct of fiscal policy. ([186]) It could also act as a commitment device for governments, ([187]) as a sovereign default in the context of strong home bias is particularly damaging for the domestic banking sector and for the domestic economy as a whole. As a result, greater home bias in times of stress tends to increase the tail risks confronting the economy.

Discussion in recent years has centred on several options for incentivising banks to reduce their home bias. Some focus on adjusting bank regulations, e.g. through capital charges to sovereign exposures (based on assessed risk or degree of concentration), or quantity-based

([181]) Normal insolvency proceedings also applied to ABLV, a small bank under the remit of the SRM that failed in 2018.

([182]) Véron, N. (2017), 'Sovereign concentration charges — a new regime for banks' sovereign exposures', study submitted to the European Parliament at the request of the Economic and Monetary Affairs Committee.

([183]) This contrasts with the capital requirements for credit risk and the large exposures limit that generally apply to other forms of bank lending. In particular, given a large exposures limit, banks may not hold claims worth more than 25% of their tier 1 capital with respect to a single counterparty.

([184]) See, for example, Altavilla, C., Pagano, M. and Simonelli, S. (2016), 'Bank exposures and sovereign stress transmission', *ECB Working Paper 1969* and Acharya, V. V. and Steffen, S. (2013), 'The 'greatest' carry trade ever? Understanding eurozone bank risks', *Journal of Financial Economics* vol. 115, issue 2. Also, for how the ownership structure of euro area banks may render them prone to political interference, see Véron, N. (2017), 'The governance and ownership of significant euro-area banks', *Bruegel Policy Contribution*, 30 May.

([185]) See, for example, Broner, F., Erce, A., Martin, A. and Ventura, J. (2014), 'Sovereign debt markets in turbulent times: creditor discrimination and crowding-out effects', *Journal of Monetary Economics*, vol. 61 and Altavilla, C., Pagano, M. and Simonelli, S. (2012), 'Bank exposures and sovereign stress transmission', *Review of Finance*.

([186]) Tabellini, G. (2018), 'Risk sharing and market discipline: finding the right mix', *VoxEU.org*, argues that domestic banks may have an incentive to perform this stabilisation function, as their own survival may be at risk in the event of a sovereign default.

([187]) See, for example, Asonuma, T., Bakhache, S. and Hesse, H. (2015), 'Is banks' home bias good or bad for public debt sustainability?', *VoxEU.org*. For a rationalisation of home biases in capital markets, see also Coeurdacier, N. and Rey, H. (2013), 'Home bias in open economy financial macroeconomics', *Journal of Economic Literature*, American Economic Association, vol. 51(1).

limits. ([188]) However, regulatory diversification incentives have to address at least four challenges:

- They may result in pro-cyclical effects, i.e. impose harsher conditions on banks and issuing sovereigns in crisis periods;
- Uncertainty as to banks' behaviour under different regulatory arrangements makes it difficult to assess the likely impact of such reforms;
- In some circumstances, diversification may make banks' sovereign bond portfolios more risky and more vulnerable to cross-border spillovers; ([189]) and
- Less concentration in banks' exposures should not lead to excessive concentration in other financial institutions, which may also be subject to a sovereign risk nexus.

Besides other possible benefits, a common European safe asset could help to weaken sovereign-bank loops by reducing the scale and riskiness of (domestic) national exposures in banks' balance sheets. In particular, it could resolve the fundamental tension in simultaneously reducing concentration and sovereign risk in banks' portfolios. ([190]) Various options for such an instrument have been discussed, including sovereign bond-backed securities ([191]) and senior sovereign debt issuance by a common European institution. ([192]) In both cases, one important aim is to increase the supply of safe assets, which would then partially replace national sovereign bonds in banks' balance sheets. Given their intrinsic diversification and low sovereign risk, research suggests that portfolio reallocation towards safe assets could break the direct channel of the loop. ([193]) A common safe asset could, in addition, help to overcome the fracturing of sovereign debt markets along national lines, which may be detrimental for the functioning of the European economy. Indeed, such fracturing appears to have been driven in crisis times by divergent market sensitivities or other factors unrelated to economic fundamentals. ([194])

While the direct channels of the loop have been the focus of policy measures and discussion to date, the indirect channels remain essentially intact. To address them, stronger cross-border integration of banking and financial markets is needed, to make economies less dependent on the health of the domestic banking sector, and *vice versa*. Banks' home biases as regards private-sector lending appear to be a key obstacle to improving private-sector risk-sharing in the euro area, which seems to lag behind that in the United States. ([195])

III.4. Financial and real channels: a model-based assessment

This section presents stylised simulations that illustrate the workings of the direct and indirect channels of the loop using the Commission's SYMBOL and QUEST models. The benefits of

([188]) See European Systemic Risk Board (2015), 'ESRB report on the regulatory treatment of sovereign exposures', Basel Committee on Banking Supervision (2017), 'The regulatory treatment of sovereign exposures' and Véron, N. (2017), *op cit.*

([189]) Research suggests that, depending on the combination of specific factors (such as banks' diversification patterns, their capitalisation levels and the severity of shocks), diversification can increase systemic risk and render financial institutions more vulnerable by exposing them to foreign shocks in addition to domestic ones. See, for example, Bolton, P. and Jeanne, O. (2011), 'Sovereign default risk and bank fragility in financially integrated economies', *IMF Economic Review* 2011, vol. 59, issue 2, Wagner W. (2010), 'Diversification at financial institutions and systemic crises', *Journal of Financial Intermediation*, Vol 19, Issue 3 and Acemoglu, D., Ozdaglar, A. and Tahbaz-Salehi, A. (2015), 'Systemic risk and stability in financial networks', *American Economic Review* 2015, 105(2). In addition, if low-risk sovereign bonds are scarcely available, the sovereign debt portfolio of some banks can see an increase in their credit risk as a result of diversification, given that banks with initially low-risk exposures may have little option but to diversify into higher-risk assets. See Alogoskoufis, S. and Langfield, S. (2018), 'Regulating the doom loop', *ESRB Working Paper Series no 74* and Craig, B., Giuzio, M. and Paterlini, S. (2019), 'The effect of possible EU diversification requirements on the risk of banks' sovereign bond portfolios', *ESRB Working Paper Series no 89*.

([190]) See Alogoskoufis, S. and Langfield, S. (2018), *op cit.*

([191]) See, for example, ESRB High-Level Task Force on Safe Assets (2018), 'Sovereign bond-backed securities: a feasibility study'.

([192]) See, Monti, M. (2010), 'Supporting the single market and financial integration, through the issuance of E-bonds' in *A new strategy for the Single Market: at the service of Europe's economy and society* (report to the President of the European Commission, José Manuel Barroso), Leandro, Á. and Zettelmeyer, J. (2018), 'The search for a euro area safe asset', *Peterson Institute for International Economics Working Paper 18-3* and Giudice, G., De Manuel, M., Kontolemis, Z. and Monteiro, D. (2019), 'A European safe asset to complement national government bonds'.

([193]) See Brunnermeier *et al.* (2016), *op cit.*

([194]) See Monteiro, D. and Vašíček, B. (2019), 'A retrospective look at sovereign bond dynamics in the euro area', *Quarterly report on the euro area*, Vol 17, No 4.

([195]) See Nikolov, P. (2016), 'Cross-border risk sharing after asymmetric shocks: evidence from the euro area and the United States', *Quarterly report on the euro area,* Vol 15, No 2.

weakening domestic banks' and sovereigns' embrace are illustrated in counterfactual scenarios that show the effects of:

- greater diversification in banks' sovereign debt holdings; and
- the cross-border diversification of bank ownership (in the case of QUEST).

These counterfactuals quantify the risk-reduction and risk-sharing potential of reducing banks' home bias and increasing cross-border integration in banking sectors.

III.4.1. Direct channel loops: SYMBOL assessment

SYMBOL is a micro-simulation credit portfolio model designed, *inter alia*, to assess the risks to public finances emanating from the banking sector. It is particularly suitable for assessing loops via the direct (financial) channel, based on detailed banking sector data and a fine geographical breakdown. The inputs include variables capturing the (initial) riskiness of banks and sovereigns, and the formers' exposures to the latter. By considering shocks to banks' assets and sovereign bond prices, the model estimates 'excess losses' corresponding to the possible impact on public finances via recapitalisation needs (see Box III.1).

Here, the model covers a sample of euro area banks from eight Member States participating in the 2018 transparency exercise organised by the European Banking Authority (EBA). Together, these banks' sovereign exposures represent roughly 70% of the exposures involved in the transparency exercise. For the sake of clarity, the simulation results in this subsection are:

- scaled up to reflect the size of the domestic banking sector in each Member State; and
- grouped from bank-level results into three blocs: (i) countries that were more severely affected by the crisis (Ireland, Spain, Italy and Portugal); (ii) countries less severely affected (Belgium, Germany, France and the Netherlands); and (iii) an EA-8 bloc (i.e. the sum of the above).

The bank-level data refer to year-end 2017, unless noted otherwise.

Graph III.6 compares 'excess losses' (divided by total bank assets) arising from a severe systemic shock to EA-8 banking sectors. Here and elsewhere, excess losses are defined as the losses incurred by banks bringing the tier 1 capital ratio below a threshold of 10.5%. They are therefore the losses to be covered by government-sponsored recapitalisation if a bank is to continue to operate under a minimum required capital ratio of 10.5%. They include losses from an initial shock to banks' assets and additional losses resulting from the sovereign-bank loop. Here and elsewhere, a severe shock is based on a loss percentile reflecting the order of magnitude of the 2008 financial crisis. In other words, the shock is set to a very high magnitude, corresponding to losses beyond the 99.95th percentile of the loss probability distribution function under the Basel credit risk model. ([196]) For presentational purposes, and taking account of the stylised and illustrative nature of the simulations, excess losses are presented in relative terms, with the maximum in-sample losses set at 100 in the following graphs. Thus, the region and scenario with the highest loss were normalised to 100, with the results for the other regions and scenarios expressed in relation to that maximum. ([197])

As can be observed, excess losses (and related governmental capital injections) can be significantly reduced through the bail-in of bank creditors and the use of a euro area-wide SRF. ([198]) Both measures are denoted hereafter as the 'safety net'. While all three scenarios in Graph III.6 are merely illustrative and should not be taken as precise

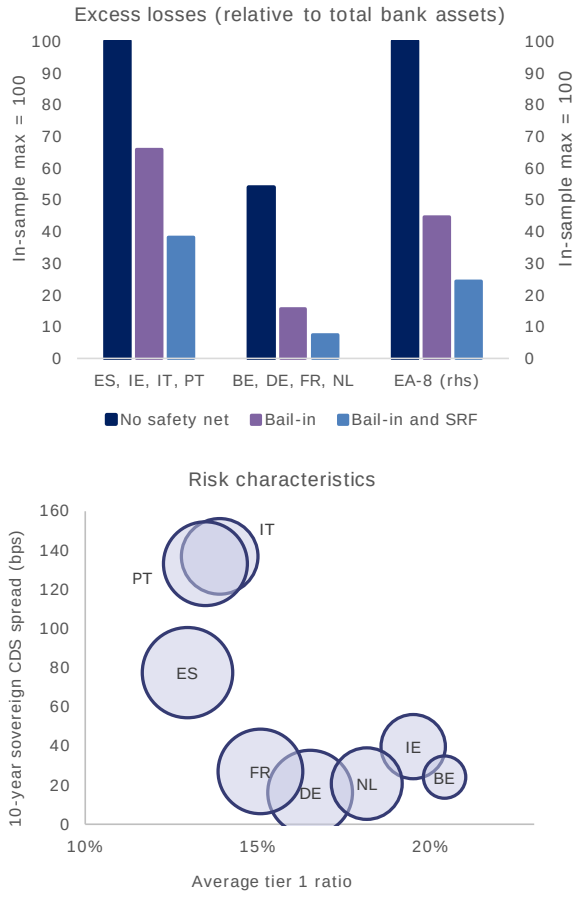
([196]) The 99.95th loss percentile is a theoretical one, chosen to make model results agree with observed losses during the crisis. It should not be taken as an actual probability. In particular, SYMBOL is consistent with probabilities of default under the Basel credit risk model, which is understood to underestimate actual bank default probabilities. The Basel model (and therefore SYMBOL) puts the probability of failure for a bank holding its minimum capital requirement at 0.1% in a given year.

([197]) Due to differences in scale, the EA-8 aggregate is represented on the secondary axis independently of the constituent regions, with its maximum across scenarios also set to 100.

([198]) Bail-in is a resolution tool whereby bank creditor positions are converted into equity positions in the event of a bank failure. Resolution funds are capitalised by the banking sector and can be tapped to finance the restructuring of failing systemic banks. See also Subsection 0. In the present simulations, bail-in was modelled as a worst-case scenario, where total loss absorbing capacity (bail-in capacity plus regulatory capital) is set at 8% of total assets. The SRF is assumed to have been phased in to 40% of its target level and to contribute to resolution by absorbing losses of up to 5% of the insolvent bank's total assets, provided that bail-in has already occurred.

estimates, the 'no safety net' scenario is entirely theoretical given the new resolution framework (see Section III.3). The drivers of excess losses correlate with initial levels of bank capitalisation and sovereign risk (e.g. Graph III.6 shows that three of the countries in the group with the biggest relative losses are also those with the highest sovereign CDS spreads and lowest tier 1 ratios).

Graph III.6: **Excess losses (relative to total bank assets) from a severe systemic shock vs risk characteristics**



(1) Excess losses relative to total bank assets correspond to losses incurred by banks bringing the tier 1 capital ratio below 10.5% divided by the banks' total assets; the maximum figure was normalised to 100. The severe systemic shock reflects a loss beyond the 99.95th percentile in the Basel credit-risk framework. In the second chart, the bubble diameter represents the degree of home bias.
Source: EBA, Bloomberg, SYMBOL simulations and own calculations

Graph III.7 shows the progress achieved in recent years in reducing risk levels in sovereign and banking sectors, and in mitigating the feedback loop between them. In particular, it compares banks' excess losses based on 2017 and 2012 data for the same systemic shock seen earlier. ([199])

Overall, the results suggest that the new regulatory framework, other policy action and changes in the economic environment have worked to reduce potential losses to a very small fraction of those in 2012. This is especially clear when comparing the results for 2017 under bail-in and an SRF to the 'no safety net' scenario in 2012. We also see large reductions when we remove the effects of the bail-in tool and the SRF, which were not available in 2012 (see blue bars). The same holds true when assuming bail-in and an SRF at both points in time (yellow bars). Overall, the remarkable improvement owes much to the new 'safety net', the higher capitalisation of euro area banks, the lower perceived sovereign credit risk, a lower degree of home bias and, in some cases, the lower implied risk in banks' portfolios.

Graph III.7: **Total excess losses from a severe systemic shock, 2017 vs 2012**

(1) Excess losses correspond to the losses incurred by banks bringing the tier 1 capital ratio below 10.5% (2017) or 8% (2012). The severe systemic shock reflects a loss beyond the 99.95th percentile in the Basel credit-risk framework.
Source: SYMBOL simulations

([199]) Data for year-end 2012 are based on the results from the EBA's 2013 transparency exercise. Given that the bank samples in the 2017 and 2012 vintages do not fully overlap, caution should be exercised in drawing comparisons. Also, given the lower capital requirements in 2012, the minimum tier 1 capital ratio is set at 8% for that year.

Box III.1: The SYMBOL model

The systemic model of banking-originated losses (SYMBOL) is a tool developed by the European Commission's Joint Research Centre, in collaboration with academics and other experts, to simulate banking crises. The model is flexible and allows for the inclusion of modules to incorporate the effects of interbank contagion and the direct channel of the sovereign-bank loop. ([1]) As input, it takes a rich dataset covering actual balance-sheet data of banks in many euro area countries. Coupled with data on sovereign exposures, it can be used to explore how losses originating in banks' balance sheets or hikes in sovereign risk premia can be mutually reinforcing, potentially driving increases in government debt due to interventions to recapitalise banks. ([2])

The sovereign side of SYMBOL is based on the Mody-Sandri model, ([3]) which calculates a non-arbitrage sovereign credit risk spread based on a country's debt level D, the GDP level G, the risk-free rate r^f, a long-term average GDP growth rate g and standard deviation σ, a recovery rate in the event of sovereign default R, the debt-to-GDP ratio at which the country is inferred to default $\overline{DY}$ and the current CDS spread C. As G, r^f, g, σ, R and $\overline{DY}$ are assumed to remain constant in the simulations, the Mody-Sandri function MS returns a new credit-risk spread C' as a function of the initial spread and the new debt level D':

$$C' = MS(D', C|G, r^f, g, \sigma, R, \overline{DY}).$$

The haircut H_i is the percentage loss on bank i's holdings of sovereign debt induced by changes in its market value. ([4]) It is a function of the risk-free rate r^f, the CDS spread C and the change in the spread ΔC:

$$H_i = Haircut(r^f, C, \Delta C).$$

Bank-level losses on sovereign debt holdings are obtained from the set of all bank-level haircuts H, and the matrix of banks' exposures to different sovereigns, E. Together with banks' actual and minimum required capital ratios, CR and CR^{min} respectively, ([5]) one can determine the amount of losses L incurred by the domestic sovereign through recapitalisations aimed at raising the capital ratio of domestic banks to their regulatory minimum following a change in the valuation of existing sovereign exposures: ([6])

$$L = Loss(H, E, CR, CR^{min}).$$

The simulation procedure starts with the calibration of G, r^f, g, σ, R and initial D. Subsequently, $\overline{DY}$ is calibrated as the only remaining unknown in the MS function given the current sovereign CDS spreads C.

An initial shock may occur on the side of the sovereign, via an increase in the sovereign risk spread ΔC, or the banks, via losses on their assets (see below). Such losses may then translate into a sovereign loss L through recapitalisation needs. This increases government debt, so that $D' = D + L$, which in turn increases the sovereign risk spread, ΔC, via the MS equation. From this point onward, the iterations are the same whether the initial shock was on the side of the sovereign or of the bank. In particular, ΔC implies a haircut H, which increases L, which increases D, which further increases C. This loop is iterated until convergence to final levels of government debt, spreads and bank losses is achieved.

([1]) For full details, see De Lisa, R., Zedda, S., Vallascas, F., Campolongo, F. and Marchesi, M. (2008), 'Modelling deposit insurance scheme losses in a Basel 2 framework', *Journal of Financial Services Research*, Vol 40 and Fontana, A. and Langedijk, S. (2019), 'The bank-sovereign loop and financial stability in the euro area', *JRC Working Papers in Economics and Finance 2019/10*. The interbank contagion channel is not considered in the present implementation of the model.

([2]) Sovereign interventions are regulated at EU level. In the present exercise, we avoid a discussion of the conditions and limits imposed on such interventions, and focus on abstract 'worst case' scenarios.

([3]) Mody, A. and Sandri, D. (2012), 'The eurozone crisis: how banks and sovereigns came to be joined at the hip', *Economic Policy 27*.

([4]) SYMBOL assumes that losses on assets that are not mark-to-market impact investors' perceptions of banks' capitalisation levels and may lead to *de facto* recapitalisation needs through market discipline mechanisms.

([5]) In the present exercise, the minimum required tier 1 capital ratio is set at 10.5%, which includes requirements linked to the capital conservation buffer.

([6]) The model assumes that investors consider banks' balance sheets in market-value terms in their risk assessments, so that market pressure renders all sovereign exposures *de facto* mark-to-market for recapitalisation purposes.

(Continued on the next page)

Box (continued)

In order to simulate initial bank losses, the average implied probability of default on a bank's asset portfolio is first derived on the basis of the Basel asymptotic single risk factor (ASRF) model using bank balance-sheet data. (7) Starting from this probability of default, SYMBOL uses Monte Carlo simulations, the ASRF loss distribution and assumptions for cross-bank asset correlation to produce loss realisations at bank and national level. After taking account of actual capitalisation levels in excess of minimum requirements and the presence of safety nets (e.g. bail-in and resolution funds), some of these losses may then be passed on to the government sector.

For the purposes of the present exercise, the main input data were taken from the EBA (risk-weighted assets, total capital and sovereign exposures), Bloomberg (10-year sovereign CDS spreads), AMECO (GDP and government debt levels), Orbis BankFocus and SNL (total bank assets, capital and risk-weighted assets) and the ECB data warehouse (total assets of national banking sectors, used to scale up losses derived from the available subsamples).

(7) In particular, data on 'fully loaded' effective capital and risk-weighted assets, taking into account the full application of Basel III/CRD IV rules.

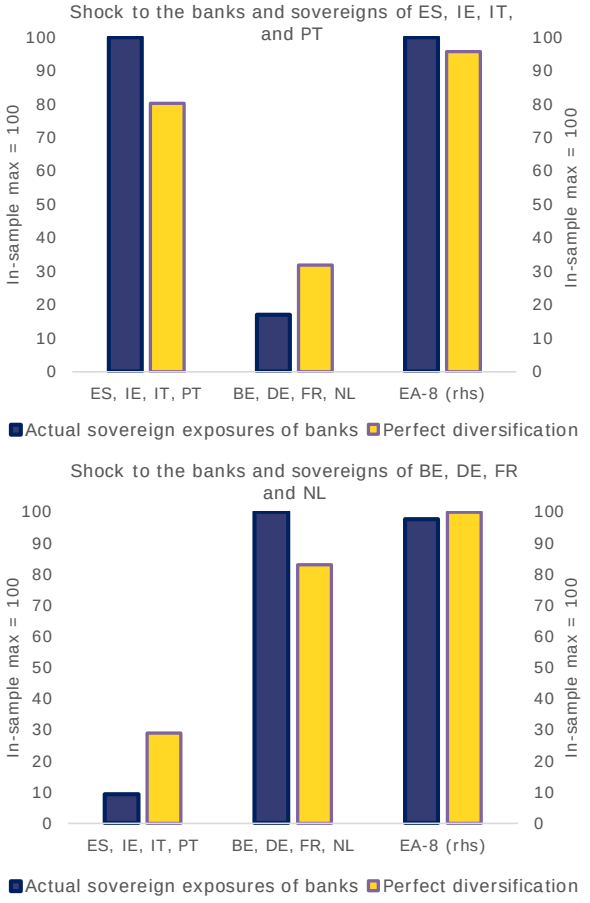
Graph III.8 shows total excess losses caused by shocks to banks and sovereigns in different regional blocs. The results are based on actual sovereign exposures and counterfactual scenarios where the exposures have been perfectly diversified (i.e. sovereign portfolio shares are the same for all banks and equal to that sovereign's share in total sovereign exposures). This can be regarded as an extreme case where home bias has been eliminated across the euro area.

As we can see, perfect diversification can have a significant risk-sharing effect and different risk-reduction implications depending on the regional bloc affected by the asymmetric shock. The results suggest that, in the case of a severe shock to the banks and sovereigns in countries more affected by the crisis, diversification makes it possible to mitigate losses in the affected region and share some of them with the unaffected region, while reducing total losses for the euro area aggregate (see top part of Graph III.8). There is a similar distribution of impact in the case of an asymmetric shock to less affected countries (see lower part of Graph III.8). However, in that case, total euro area aggregate losses increase marginally. This is because stronger diversification and risk distribution can foster sovereign-bank loops and debt valuation losses in the more vulnerable region (generated by losses in less vulnerable countries). (200)

In some cases, the risk-reduction potential of diversification appears uncertain. While perfect diversification of banks' sovereign debt holdings should frequently lead to a reduction in total losses, it can also increase them in certain cases. Graph III.9 shows the simulated risk-reduction potential of perfect diversification in different shock scenarios. The impact of diversification on total losses appears largely neutral in the case of a symmetrical shock to all euro area banks or sovereigns. Diversification allows for risk reduction in the case of an asymmetric shock to the banks and sovereigns of the most vulnerable bloc. To the extent that idiosyncratic shocks are more likely to affect the more vulnerable regions, diversification should often lead to overall risk reduction. However, it can also increase total losses somewhat in the (arguably less likely) case of a severe asymmetric shock to the banks and sovereigns of the 'core' economies, by triggering loops in the more vulnerable Member States. This result is in line with other findings in the literature, according to which diversification of debt holdings has an ambiguous effect on systemic and bank-level risk (see Subsection III.3.2). It also highlights the possible limitations of diversification as a policy measure carried out in isolation.

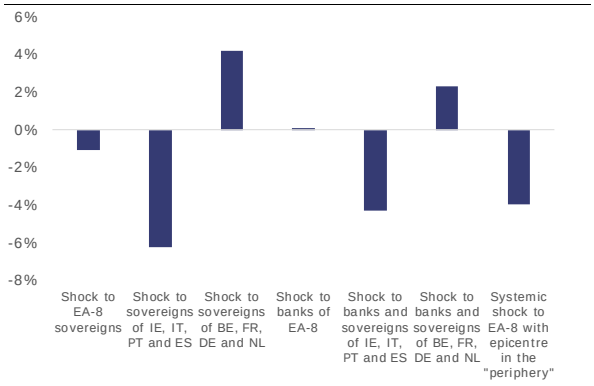
(200) This qualitative result persists when sovereign shocks are excluded from the simulations and only bank-level shocks are retained.

Graph III.8: **Total excess losses from severe asymmetric shocks to both banks and sovereigns**



(1) Excess losses correspond to losses incurred by banks bringing the tier 1 capital ratio below 10.5%. The bank-level shock reflects a loss falling beyond the 99.95th percentile under the Basel credit risk framework. The sovereign shock reflects an initial increase of 200 bps in risk premia. In each graph, the initial shocks are imposed in one region only. Assuming a safety net (bail-in and SRF).
Source: SYMBOL simulations

Graph III.9: **Change in total excess losses due to perfect diversification**



(1) Shocks to banks reflect a loss beyond the 99.95th percentile under the Basel credit risk framework; shocks to sovereigns represent an increase of 200 bps in their risk premia; in the last scenario (systemic shock with epicentre in the 'periphery'), the banks and sovereigns of IE, IT, PT and ES suffer a shock beyond the 99.95th percentile and of 300 bps, respectively, while those of BE, FR, DE and NL suffer smaller shocks (beyond the 99.9th percentile for banks and of 100 bps for sovereigns); total excess losses are from all banks in the sample; assuming a safety net (bail-in and SRF) for bank-originated losses
Source: SYMBOL simulations

III.4.2. General equilibrium dynamics: QUEST assessment

The QUEST model, with a banking sector extension, has been used as a complementary tool to analyse the bank-sovereign feedback loop and the macroeconomic effects of bond valuation and loan losses. Starting from a baseline in which euro area banks retain a largely domestic footprint, implying powerful indirect linkages via the domestic economy, this section discusses the effects of stronger geographical integration in banking sectors. This can take three main forms:

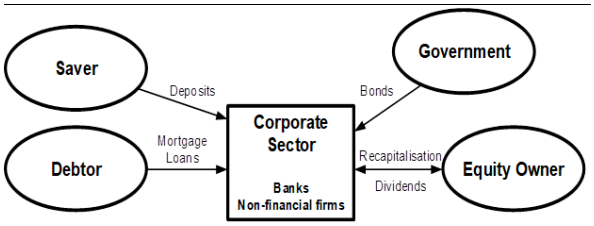
- cross-border lending and other banking activities;
- cross-border funding, including deposit-taking; and
- cross-border ownership of bank equity.

This subsection considers versions of the first and third main form, namely stronger diversification of banks' sovereign bond portfolios and stronger

diversification of bank ownership across countries or regions. ([201])

QUEST uses a higher level of institutional and geographical aggregation than SYMBOL. Here, we use a two-region version of the monetary union, with one representative (or aggregate) bank and one fiscal authority in each region (see Box III.2 and Graph III.10).

Graph III.10: **Overview of the QUEST model with a banking sector**



Source: own presentation

In principle, the model's general-equilibrium approach can capture both the direct and indirect channels (see Section III.2), i.e. those involving recapitalisation by the government, and a deterioration of the economic situation, leading to lower tax revenue and higher government spending.

However, the simulations presented below do not consider the possibility of bank recapitalisation by the government. This is in line with the objectives of the Bank Recovery and Resolution Directive, ([202]) which seeks to avoid the use of public money when managing bank failures. Rather, recapitalisation comes from equity owners in the form of lower dividend payments (or capital injections, in more extreme cases). Recapitalisation by shareholders over time can be taken as reflecting the existence of an SRF that can ensure banks' continued activity by immediately recapitalising them to the minimum required ratio, in return for lower dividends and higher bank contributions over time to the SRF.

Ruling out government bail-outs excludes the possibility of loops starting via the direct channel. Therefore, diversification measures tend to act as risk-sharing mechanisms without affecting aggregate losses. To the extent that risk sharing acts as an insurance mechanism for risk-averse households in both regions, it is in itself welfare-increasing.

Graph III.11 presents simulation results for the level of real GDP for shocks starting on the government or the bank side. The trigger of the sovereign-induced loop ('gov risk shock') is a temporary 10 pp (annualised) rise in the sovereign credit risk premium (a shock of the order of magnitude of risk premia in the 'periphery' at the height of the euro area crisis), with a half-life of 1 year. The bank-induced loop ('loan loss shock') is triggered by frontloaded loan defaults that cumulate to 10% of outstanding mortgage debt over 3 years. This is broadly consistent with peak ratios for non-performing loans in 'periphery' countries during the crisis. ([203]) The shock occurs in the 'home' region, which is calibrated to account for around a quarter of euro area GDP. Underlying the scenarios in Graph III.11 is an assumption of full home bias in banking, i.e. banks hold only domestic sovereign debt, receive deposits from and lend to domestic households only, and are exclusively owned by domestic equity investors. We add a second variant of the sovereign risk scenario, in which 20% of the government risk premium shock spills over to private-sector financing costs, as discussed in Section III.2. ([204])

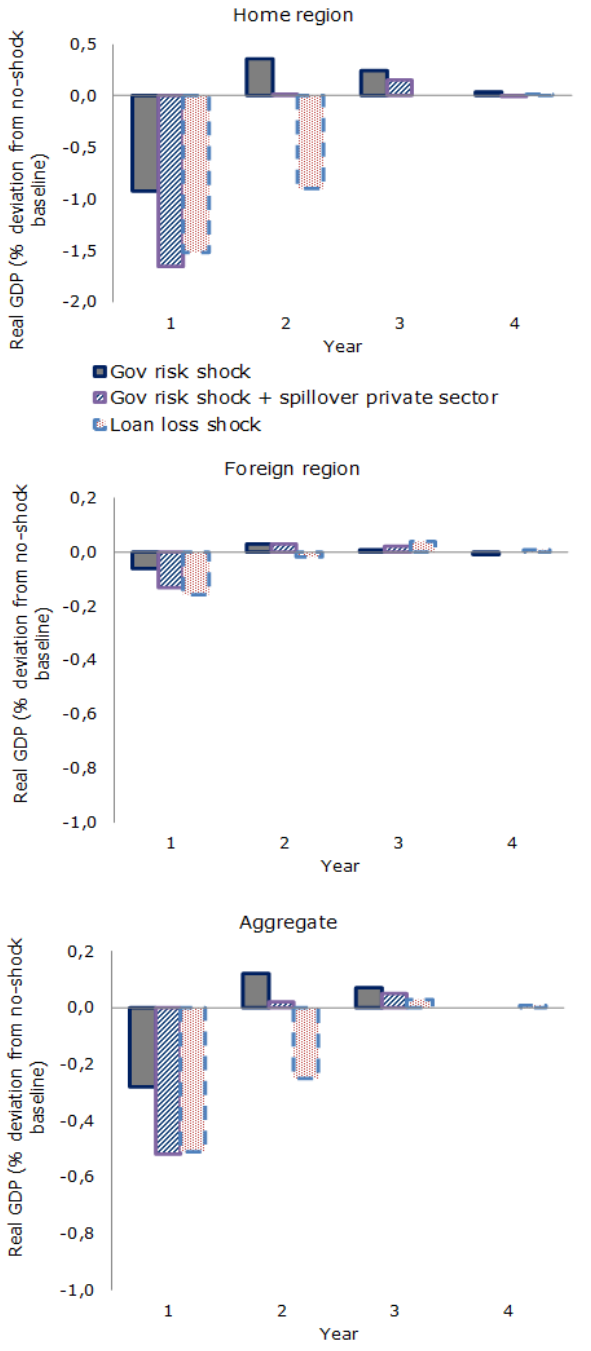
([201]) While cross-border private-sector lending constitutes an important element of cross-border risk-sharing (see Nikolov, P. (2016), *op cit.*), simulating this aspect of integration requires further assumptions as to banks' investment decisions, which we leave for future research. Cross-border ownership of bank equity, as discussed in this subsection, is expected to mimic to some extent the effects from cross-border bank lending.

([202]) Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014 establishing a framework for the recovery and resolution of credit institutions and investment firms (OJ L 173, 12.6.2014, p. 190).

([203]) The stock of non-performing loans reached some 15% of total loans in Portugal and Italy, close to 10% in Spain and some 40% in Cyprus and Greece. Taking into account that a part of non-performing loans is recoverable, this suggests an upper bound for the magnitude of the loan loss shock.

([204]) The strength of assumed spillover from domestic sovereign to domestic private-sector financing costs is in line with the evidence in Augustin, P., Boustanifar, H., Breckenfelder, J. and Schnitzler, J. (2016), *op cit.*

Graph III.11: **Real GDP under full home bias in the banking sector**



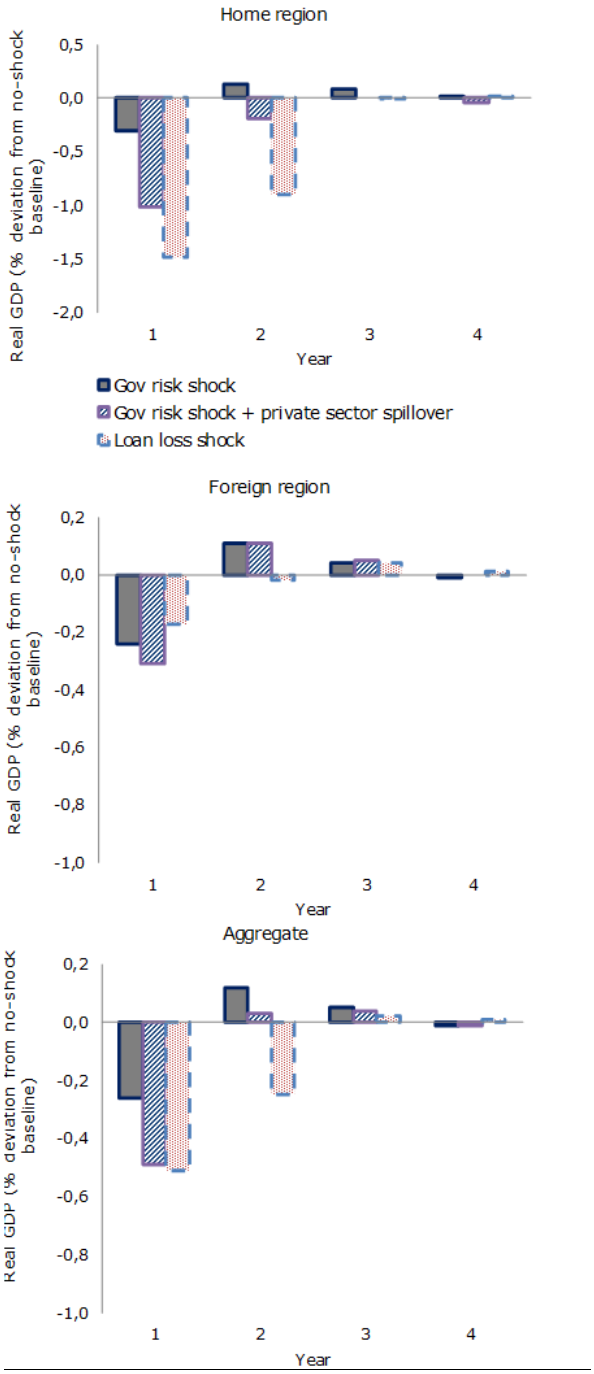
(1) 'gov risk shock' corresponds to a 10 pp increase in the sovereign risk premium; the spill-over to the private sector corresponds to a 2 pp increase in its financing costs; the 'loan loss shock' corresponds to 10% losses of 10% on loans, cumulated over 3 years.
Source: QUEST simulations

Sovereign-induced and loan-induced bank losses require recapitalisation by domestic equity owners, which reduces private sector consumption and investment demand. As the sovereign risk shock is large but relatively short-lived, negative demand and GDP effects are stronger on impact, but less persistent than in the loan-loss scenario. GDP is seen to bounce back in the 2nd and 3rd years in the sovereign shock scenario, mainly because the fading-away of the shock produces valuation gains on banks' balance sheets. As the recapitalisation efforts are concentrated in the 1st year, subsequent valuation gains allow for additional dividend pay-outs, which temporarily boost equity-owners' consumption and investment. The spillover of sovereign risk to private-sector financing costs in the domestic economy amplifies the contraction of domestic demand and activity.

In the case of full home bias in banking, spillovers to the foreign region in response to financial-sector shocks in the domestic region are small and restricted to the trade channel (i.e. lower import demand and real effective exchange-rate depreciation in the domestic region).

Graphs III.12 and III.13 illustrate how cross-border diversification in banking mitigates the sovereign-bank loop and its macroeconomic implications. Graph III.12 shows a scenario in which the shocks underlying Graph III.11 hit banks with geographically diversified sovereign exposures. The scenario assumes perfect diversification of government bond holdings, i.e. the domestic banking sector's holdings of domestic and foreign government bonds reflect their respective shares in aggregate euro area government debt. Given the smaller calibrated size of the home economy, home banks hold predominantly foreign sovereign bonds in this scenario.

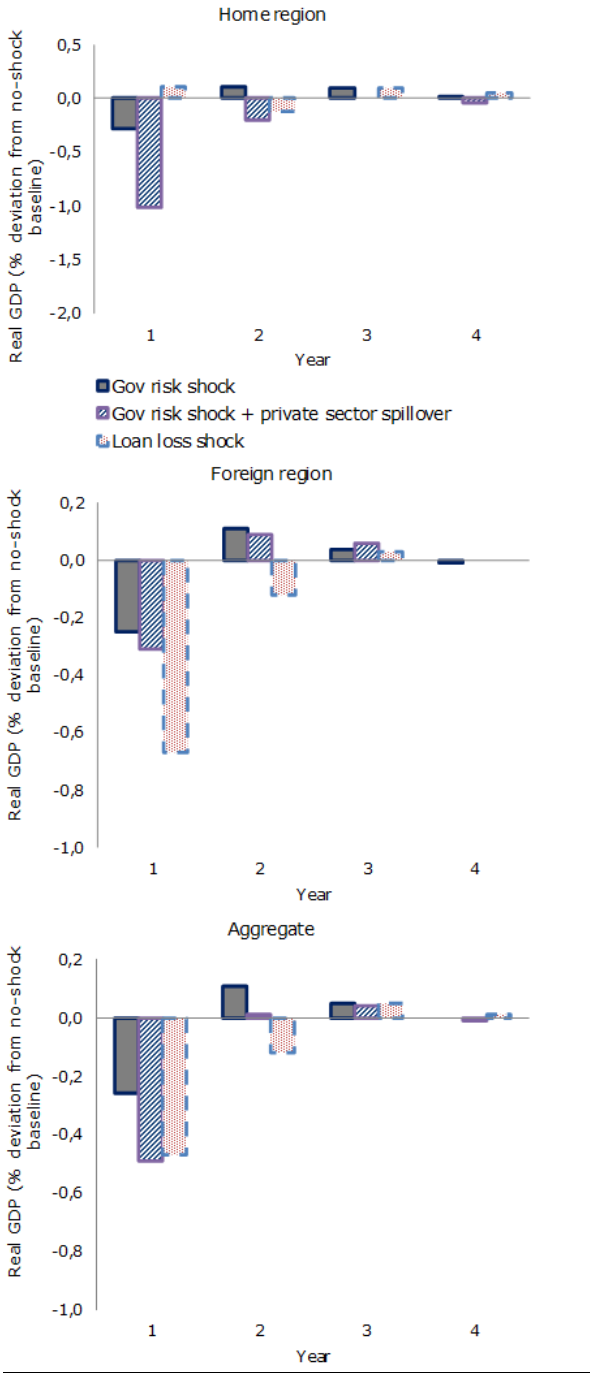
Graph III.12: **Real GDP under no home bias in bank holdings of sovereign debt**



(1) 'gov risk shock' corresponds to a 10 pp increase in the sovereign risk premium; the spillover to the private sector corresponds to a 2 pp increase in its financing costs; the 'loan loss shock' corresponds to 10% losses on loans, cumulated over 3 years.

Source: Quest simulations

Graph III.13: **Real GDP under no home bias in bank equity ownership**



(1) 'gov risk shock' corresponds to a 10 pp increase in the sovereign risk premium; the spillover to the private sector corresponds to a 2 pp increase in its financing costs; the loan loss shock corresponds to 10% losses on loans, cumulated over 3 years.

Source: Quest simulations

The GDP effects in Graph III.12 show that balance-sheet diversification can have a powerful effect in mitigating the impact of higher government risk premia on the domestic economy. In particular, valuation losses have less of an impact on the balance sheet of domestic banks, so their recapitalisation needs are lower. The initial real GDP contraction is reduced by around two thirds, from 0.9% to 0.3%. The contraction in activity is larger when higher sovereign risk spills over into private-sector financing costs. Diversification of bond holdings makes it possible to reduce the impact by about a third in this case, from -1.7% to -1.0% on impact. As expected, diversification strengthens international risk-sharing mechanisms through greater spillovers to foreign banks, which now hold the majority of risky 'home region' sovereign bonds and are thus subject to capital losses via this channel.

Diversification does not materially change results in the loan loss scenario, because there are no government bail-outs in this version of the model and banks can continue to operate (well) below target capital ratios. This differs from the assumptions underlying the SYMBOL model, where diversification can change overall losses. As mentioned, the model used in this subsection is akin to the existence of a large SRF that can immediately recapitalise banks in return for higher bank contributions to the SRF.

Bank equity can also be subject to diversification. Even with full home bias in bank portfolios, a distribution of bank losses between equity owners across the monetary union can dampen the contractionary impact on economic activity in the region in which the shocks occur.

The private recapitalisation of the domestic banking sector in this case involves lower dividend payments to home and foreign equity owners alike, whereas the former still receive dividends from their ownership of part of the foreign banking sector that is not hit by shocks. An alternative institutional interpretation relates cross-border bank ownership to the existence of a monetary union-wide SRF that immediately recapitalises the ailing bank and is itself recapitalised by both regional banking sectors over time.

Graph III.13 shows a scenario with the same shocks that underlie Graph III.12, but with bank equity fully diversified across the two regions. This means that domestic equity owners' holdings of domestic and foreign bank equity reflect home and foreign banks' respective shares in aggregate euro area bank equity. Given the limited size of the home economy's banking sector, domestic equity owners hold predominantly foreign bank equity.

Graph III.13 shows that the diversification of bank equity and bank losses is an effective shock absorption tool, whether the loop is triggered by the sovereign (sovereign debt valuation loss) or the private sector (loan losses). The stabilisation gains in the sovereign risk shock scenario (with or without contagion to private financing costs) are practically identical to those with bank portfolio diversification in Graph III.12.

Bank equity diversification also distributes the losses from loan default more evenly. The initial 1.5% decline of real GDP in the home region in Graphs III.11 and III.12 is fully offset in Graph III.13. Instead, we observe a small positive home GDP effect in the 1st year, as default means that domestic households benefit from a lower debt burden. At the same time, the costs of default fall mainly on bank shareholders in the foreign region, given its larger size. An expansionary monetary policy, i.e. reduction of policy (risk-free) rates by the common central bank, stimulates interest-sensitive demand in both regions. To the extent that diversification helps to synchronise business cycles across regions, it should also allow for a more effective monetary policy with a more symmetrical impact.

Bank equity diversification amplifies spillovers to the foreign region, where real GDP falls by 0.7% on impact (Graph III.13), compared to 0.2% in Graphs III.11 and III.12. Stronger regional spillovers flow from a contraction in domestic demand in the foreign economy (where households bear some of the bank losses), in addition to (now reduced) spillovers from lower import demand in the home region.

The bank portfolio or bank loss diversification in Graphs III.12 and III.13 leaves GDP effects in the monetary union aggregate of the model practically unchanged. As mentioned, this is due to the assumption of no government bail-outs, which breaks the direct channel of the loop. It is also a consequence of the assumed linear response of government risk premia to the government debt ratio. Finally, the mechanism achieves a distribution of losses and associated negative demand effects across the two regions that would

also occur if the initial shocks were applied to the foreign region.

Given standard risk-aversion assumptions in households' utility functions, a sequence of smaller losses tends to be preferred to fewer large losses of the same aggregate size, so that a broader distribution of losses through diversification can increase welfare even in the absence of aggregate risk reduction. ([205])

III.5. Conclusion

In this article, we have reviewed the sovereign-bank nexus in the euro area, partly in the light of its past crisis experience. Salient empirical observations from this period include the following:

- government-sponsored financial sector interventions put strong pressure on the public finances of several euro area Member States in the form of actual and contingent liabilities;
- there is evidence of a clear home bias in banks' sovereign debt holdings and this tended to increase during the crisis; and
- hikes in government risk premia correlated with similar hikes in the domestic corporate sector, both financial and non-financial.

Banks and sovereigns interact via:

- direct channels – these relate to banks' holdings of domestic sovereign debt and possible public intervention to bail out, or otherwise safeguard, the financial sector; these carry fiscal implications for the sovereign; and
- indirect channels – these capture real economy dynamics, including the possibilities of (i) the mutual reinforcement of credit constraints and restrictive fiscal policies; and (ii) private-sector funding costs experiencing contagion from rises in sovereign funding costs.

A review of the literature and analysis using the SYMBOL and QUEST models shows how adverse loops may emerge through both types of channel.

When it comes to mitigating the sovereign-bank loop, we can conclude that significant progress has been achieved as regards the direct channel. While government debt levels are higher than in the pre-crisis period, the banking sector is more strongly capitalised and the institutional framework in the euro area has seen major improvements. Chief among these are a single supervisory mechanism and a new resolution framework, including the creditor bail-in tool and a fledgling SRF. SYMBOL simulations show a marked reduction in risks to the government sector from a banking crisis when comparing the current situation with the crisis year of 2012. This is particularly true when one factors in the bail-in tool and the SRF, which suggests that policy action has helped to reduce potential losses to a small fraction of those previously possible.

While the new institutional framework carries many real and potential benefits, it still lacks a European deposit insurance scheme that could further weaken the direct channel between banks and sovereigns. Other policy options include regulatory action to reduce concentration and other risks in banks' sovereign debt portfolios. However, regulatory options promoting pure diversification should be approached with caution, as the literature and SYMBOL simulations suggest that this can have an ambiguous effect on systemic- and bank-level risk in some cases. However, the diversification of banks' sovereign debt holdings can help significantly to distribute the impact of shocks, as also confirmed in QUEST simulations. These positive results could also be achieved through the further cross-border integration of banking sectors. QUEST simulations assuming a particular form of integration (cross-border bank equity ownership) show how asymmetric shocks can be diluted across regional blocs.

([205]) Other non-linearities, not considered in the simulated model, could also mean that losses that are more frequent, but smaller, are preferable from a welfare viewpoint.

Box III.2: The QUEST model with a banking sector

QUEST is a neoclassical–Keynesian synthesis ('new Keynesian') dynamic general-equilibrium macroeconomic model, combining a neoclassical growth model with nominal rigidities (price and wage stickiness) and real rigidities (including capital and employment adjustment frictions). Its equations characterising the aggregate dynamics of the economy are derived from microeconomic theory of household and firm behaviour. Like other macroeconomic models, QUEST offers a stylised and simplified representation of economic agents (households, firms and government) and their interactions in goods and factor markets. ([1])

The version of QUEST used in this paper covers two regions in a monetary union. The same parameters determining the speed of price, wage, employment and investment adjustment are set for each. Baseline (steady state) values of the variables are calibrated to available data, so in the steady state the regions differ with respect to (bilateral) trade openness, fiscal policy variables, employment rates and bank assets and liabilities. Each regions has a representative (or, consolidated) bank, which collects deposits from risk-averse saver households, invests in government and foreign bonds, and provides loans to the private sector. The banks maximise their profits, i.e. the difference between the return on their asset portfolios (loan rates and return on government bonds) and the interest they pay on deposits (plus some operating costs). They pay the profits to equity-owner households. The equity owners use the profit income for consumption and investment in productive corporate capital. ([2])

Bank assets are risky. In particular, government bonds are subject to valuation and (partial) default risk, and loans to the private sector face the risk of loan losses (i.e. defaults by debtors). In the event of valuation or loan losses, banks need recapitalisation in order to re-converge on a target capital ratio; this can take the form of:

(i) recapitalisation by the government; or

(ii) recapitalisation via retained earnings, where banks increase their capital base by making lower dividend payments to their equity owners.

Recapitalisation by the government triggers the direct channel of the feedback loop (see Section II.2), because the value of government bonds depends (*inter alia*) on the level of public debt, so that rising government debt in response to bank rescues increases government financing costs and depreciates the value of government bonds held by banks, which then require further recapitalisation.

Recapitalisation by bank equity holders triggers the indirect feedback loop by lowering consumption and productive investment in the economy, which in turn reduces aggregate demand, activity and the economy's productive potential. Contracting economic activity deteriorates the government's fiscal position (through lower tax revenues, increased spending on automatic stabilisers and adverse denominator effects), which lowers the value of government debt and feeds back adversely to the asset side of the bank balance sheet.

In the baseline version of the model, we assume full home bias in the banking sector, i.e. domestic banks:

(i) hold only domestic government bonds;

(ii) are owned exclusively by domestic households; and

(iii) provide loans only to the domestic private sector.

The assumption will be relaxed in the counterfactual scenarios, by geographical diversifications of:

([1]) See Ratto, M., Roeger, W. and in 't Veld, J. (2009), 'QUEST III: an estimated open-economy DSGE model of the euro area with fiscal and monetary policy', *Economic Modelling*, vol. 26(1), pp. 222-233, for a presentation of the basic QUEST model. The model extension with tradable goods, non-tradable goods and a housing sector is described in Roeger, W. and in 't Veld, J. (2009), 'Fiscal policy with credit constrained households', *European Economy Economic Papers* 357.

([2]) Breuss, F., Roeger, W. and in 't Veld, J. (2015), 'The stabilising properties of a European banking union in case of financial shocks in the euro area', *European Economy Economic Papers* 550, provides a detailed presentation of the version with a banking sector.

(Continued on the next page)

Box (continued)

(i) banks' government bond portfolios, i.e. domestic banks will hold bonds of domestic and foreign governments, so bond valuation losses will be diversified across domestic and foreign banks; and

(ii) bank ownership, i.e. domestic banks' equity is held by domestic and foreign households, so bank losses will be diversified across domestic and foreign owners of bank equity.

IV. The natural rate of unemployment and its institutional determinants

by Atanas Hristov and Werner Roeger

This chapter explains movements in the natural rate of unemployment by considering both institutional labour market measures and persistent demand shocks. The study uses a panel data set for 28 EU countries covering 1985-2018. The following institutional variables are found to be key drivers of the natural rate: (i) a measure of the unemployment benefit replacement rate; (ii) a labour tax wedge indicator; and (iii) spending on active labour market policies. Additional elements that have a bearing on the natural rate include demographic factors associated with population ageing - have played a historical role, and persistent demand shocks. The latter developments are related to crisis episodes, such as the unwinding of unsustainable expansions in the housing market. The results suggest that, for a number of countries, the natural rates in 2018 were lower than during the previous business cycle peaks - for example, in 2000 or in 2007 - mainly because of changing demographics, rather than positive cyclical developments (the demand shocks).

IV.1. Introduction

Since 2013 the unemployment rate and its natural rate - the unemployment rate at which price/wage inflation is stable independently of the stage of cycle - are declining in the euro area and European Union (EU). The forecast for the unemployment and natural rate for 2020 is 7.4% and 6.2%, respectively. This is lower than the unemployment rate observed in the pre-crisis boom - 7.5% and 7.2% in the euro area and the EU in 2007, respectively([206]). These changes are partly due to cyclical factors, and partly due to structural causes such as policy changes and other slower-moving factors.

This chapter aims to quantify the structural factors behind these developments. For this purpose, we statistically test the significance of a large set of structural and macroeconomic indicators that are commonly suggested by economic theory and used in empirical studies([207]). Since the focus is to explain movements of the natural rate of unemployment, the analysis considers both structural labour market measures and persistent demand shocks which can drive medium-term fluctuations of the natural rate, e.g. via hysteresis mechanisms. Although the chapter gauges the effects of the natural rate determinants based on a panel of 28 EU economies covering 1985-2018, it pays particular attention to developments in the euro area.

Among the various structural variables tested, several have high explanatory power and appear to be important drivers of the natural rate across the various specifications. These include a measure of the unemployment benefit replacement rate, a labour tax wedge indicator, spending on active labour market policies (ALMPs) and union density. This confirms previous findings([208]). Demographic factors are also found to play a role, especially for the Member States that have joined the EU since 2004. In particular, the fall in the natural rate since 2000 is largely driven by population ageing.

Persistent demand shocks also have a bearing on the natural rate. Such shocks are related to crisis episodes (i.e. unwinding of unsustainable developments). In particular, housing boom-bust episodes have a statistically significant impact on developments in the natural rate. Real interest rate and total factor productivity (TFP) growth, which control more generally for the presence of shocks, also matter. Finally, within-country unemployment

([206]) European Commission, (2019), 'A challenging road ahead', Autumn 2019 Economic Forecast.

([207]) See, for example: Nickell, S. (1997), 'Unemployment and labor market rigidities: Europe versus North America', *Journal of Economic Perspectives*, Vol. 11, No. 3, pp. 55-74; Blanchard O. and J. Wolfers (2000), 'The role of shocks and institutions in the rise of European Unemployment: the aggregate evidence', *The Economic Journal*, 110, C1-C33; Bassanini, A. and R. Duval (2006a), 'Employment patterns in OECD countries: reassessing the role of policies and institutions', OECD Economics Department Working Papers, No. 486; Bassanini, A. and R. Duval (2006b), 'The determinants of unemployment across OECD countries: reassessing the role of policies and institutions', *OECD Economic Studies*, No. 42, 2006/1; Orlandi, F. (2012), 'Structural Unemployment and its Determinants in the EU countries' *European Economy – Economic Papers*, No. 455, Directorate General Economic and Monetary Affairs (DG ECFIN), European Commission; Gal, P. and A. Theising (2015), 'The macroeconomic impact of structural policies on labour market outcomes in OECD countries: A reassessment', *OECD Economics Department Working Papers*, No. 1271, OECD Publishing, Paris.

([208]) See, for example: Orlandi, op. cit.

dispersion (across different NUTS2 regions) in the EU Member States - signalling labour mobility across regions - is also a significant factor for medium-term changes in the natural rate([209]).

IV.2. Natural rate of unemployment in the euro area and the Member States

From the first quarter of 2013 to the end of 2018, employment in the euro area rose by about 9 million (about 14 million in the EU). The employment recovery accelerated in the course of 2014 and gained strength thereafter. In 2018, the euro area unemployment rate fell to 8.2% (6.6% in the EU), about one percentage point below the rate one year earlier (see Graph IV.1). The fall of unemployment in Central and Eastern European countries has been even greater. Whereas improvements in macroeconomic conditions in the aftermath of the global financial crisis have greatly contributed to the fall in the unemployment rate, arguably, the main factor for this decline between 2012 and 2018 in several countries was the fall in the natural rate.

We present results for five group of countries: the euro area Member States (EA); the 10 newly-accepted EU countries without Croatia (EU10); the 13 EU economies which were part of the EU prior to 2004 (AT, BE, DE, DK, ES, IE, IT, FI, FR, NL, PT, SE, UK (EU13)); Member States in the euro area for which the natural rate was falling by more than 1 percentage point since 2012 (BE, DE, ES, FI, IE, MT, PT, EE, LT, LV, SK (EA(FA)); and euro area Member States for which the natural rate was stagnant or even rising since 2012 (AT, CY, EL, FR, IT, LU, NL, SI (EA(ST))([210]). We present aggregates for the country groups weighted by the size of the labour force (aged 15-74) of the respective country relative to the labour force of the whole group.

We look at behaviour and the determinants of the 'natural' rate of unemployment broadly defined as the unemployment rate at which, excluding the effects of supply-side factors such as labour market reforms, inflation remains stable([211]). For the purpose of this study, we analyse the behaviour of the nonaccelerating wage rate of unemployment (NAWRU). We use the latter term interchangeably with the natural rate (see Box IV.1). To put things in context, we rely on a Phillips curve relation between wage inflation and unemployment, which has a long history in macroeconomics. The concept of the natural rate is often attributed to Milton Friedman and Edmund Phelps([212]).

The point of departure in this study is a simple decomposition of the unemployment rate,

$$u_t = \tilde{u}_t^* + \underbrace{(u_t - u_t^*)}_{u_t^{gap}} + \underbrace{(u_t^* - \tilde{u}_t^*)}_{u_t^{med-term}} \quad \text{IV.1}$$

where $\tilde{u}_t^*$ is the structural unemployment and u_t^* is the natural rate. The structural unemployment, $\tilde{u}_t^*$, captures the elements of the unemployment rate that are driven by slow-moving factors such as policy institutions, demographics and even changes in social norms. The unemployment gap, u_t^{gap}, defined as the difference between the observed unemployment rate from the natural rate, is arguably one of the main inputs in the decision-making process in monetary and fiscal policy. Conceptually, it follows that the natural rate of unemployment is the sum of the structural unemployment and a medium-term macroeconomic component, $u_t^{med-term}$. As a result, the logic of the decomposition implies that the natural rate converges to the structural unemployment $\tilde{u}_t^*$ over time as the disturbances driving the medium-term fluctuations $u_t^{med-term}$ fade away.

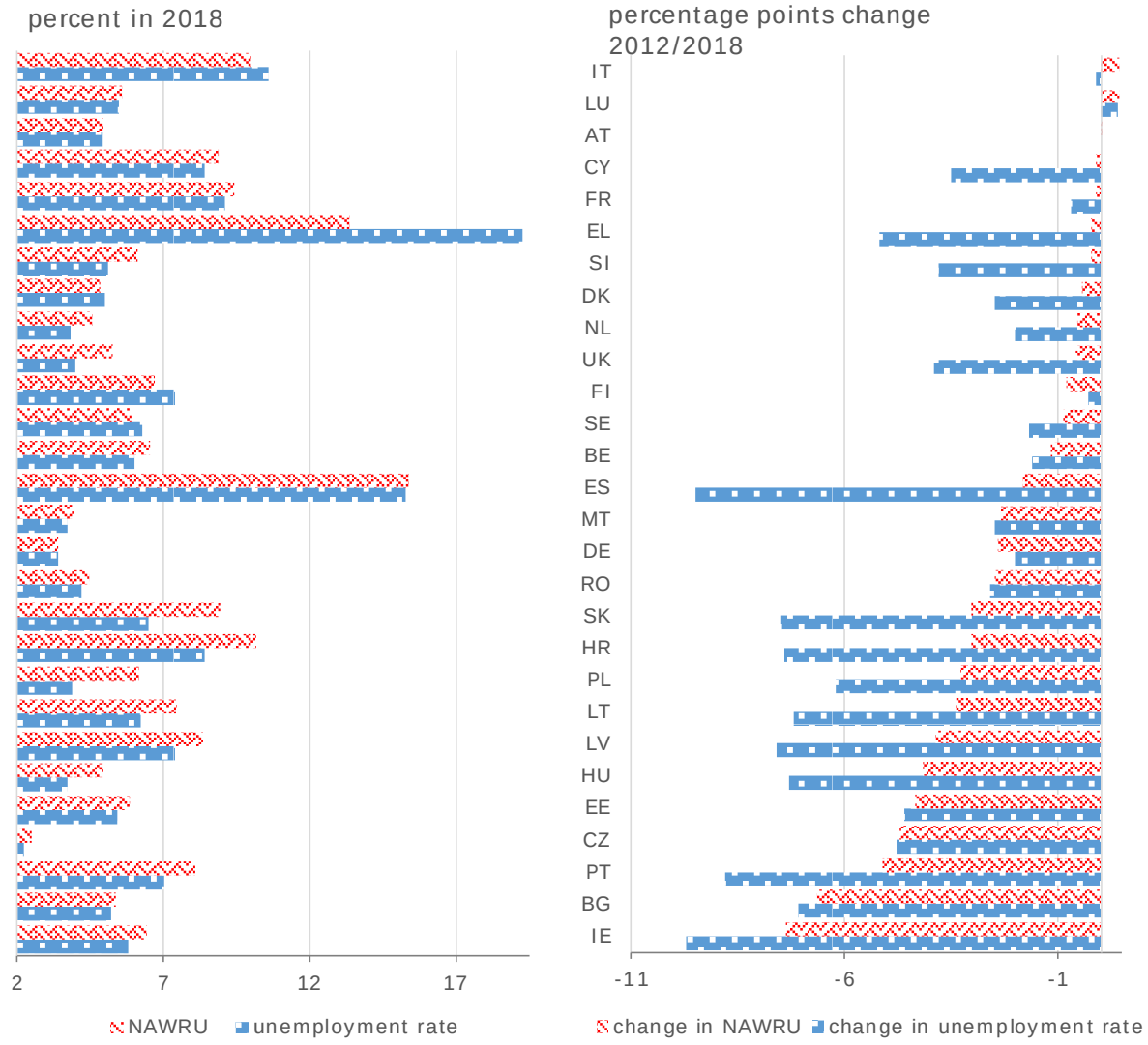
([209]) NUTS stands for Nomenclature of Territorial Units for Statistics, a geocode standard for referencing the subunits of countries established for statistical purposes. Eurostat defines a hierarchy of three NUTS levels for each EU Member State.

([210]) We include Croatia in the panel data estimation but due to its short data span exclude it from the newly-accepted EU countries.

([211]) The very extensive literature on the natural rate of unemployment over the years has equated 'natural' with long-term, frictional, average, equilibrium, normal, full employment, normal, steady state, lowest sustainable, efficient, Horrick-Presscot trend. Rogerson (1997) discusses how the imprecision in the language used has often led to ambiguity in relation to the concept. Rogerson, R. (1997), 'Theory ahead of language in the economics of unemployment', *Journal of Economic Perspectives*, Vol. 11, pp. 73-92.

([212]) Friedman, M. (1968), 'The role of monetary policy', *American Economic Review*, Vol. 58, pp. 1-17; Phelps, E. S. (1967), 'Phillips curves, expectations of inflation and optimal unemployment over time', *Economica*, Vol. 34, pp. 254-281; Phelps, E. S. (1968), 'Money-wage dynamics and labor-market equilibrium', *Journal of Political Economy*, Vol. 76, pp. 678-711.

Graph IV.1: **Actual and natural rate of unemployment**



The natural rate refers to the nonaccelerating wage rate of unemployment (NAWRU) estimated according to the EU's commonly-agreed methodology (see Box 1). Countries are ranked according to the degree of change in their natural rates between 2012 and 2018.
Source: Eurostat, Ameco

Some may find the distinction between natural and structural unemployment rate confusing. More precisely, one may ask what drives the wedge between the two unemployment rates, $u_t^{med-term}$. Here, similar to Blanchard (2018), we point out that if, say, a temporary demand shock such as an unexpected rise in the short-term interest rate by the central bank triggers a persistent rise in the natural rate([213]), the tightening of monetary policy could cause a recession. Olivier Blanchard reports that in a 'standard' dynamic stochastic equilibrium model, because of for instance nominal rigidities and/or matching frictions in the labour market, the decline in output will likely accompany a decline in employment. Since capital and labour are quasi-fixed in the short run, by implication, a temporary disturbance may affect the natural rate. This is true both in a 'standard' model and in a model that emphasises 'hysteresis' effects. This implies that the natural rate will steer toward structural unemployment in the long run.

([213]) Blanchard, O. (2018), 'Should we reject the natural rate hypothesis?' *Journal of Economic Perspectives*, Vol. 32, No. 1, pp. 97-120.

Box IV.1: **NAWRU estimation**

The NAWRU is implicitly defined as the equilibrium point of a dynamic system of labour supply and labour demand equations. This equilibrium concept is linked to the Phillips curve debate which is crucial in monetary policy discussions (see, e.g., Phelps, 1967; Friedman, 1968)([1]). The Phillips curve embodies the process through which wages adjust to economic conditions, with adjustment delays reflecting the effects of limited information in the formation of expectations or institutional rigidities. In particular, this implies that different assumptions on the formation of expectations have a bearing on the specification of the Phillips curve. Notable cases include the static or adaptive expectation case which yields the traditional Keynesian Phillips (TKP) curve specification and the rational expectations case which yields the new-Keynesian Phillips (NKP) curve.

Since 2014, the CAM applies a Phillips curve augmented with rational expectations (i.e. the NKP) for 21 EU countries. In addition, it applies the Phillips curve with static/adaptive expectations (i.e. the TKP) to 7 countries([2]). The Phillips curve specification for any particular country is chosen based on the statistical fit of the regression. For example, for Germany CAM applies the Phillips curve with adaptive expectations because such a regression explains changes in wage inflation better. Both the TKP and the NKP specifications are based on identical labour market concepts, differing only in terms of underlying timing and expectation assumptions. Considering both the TKP and the NKP provides a fuller encompassing implementation of the Phillips curve concept, which covers a wider set of alternative expectation assumptions.

The CAM resorts to the standard unobserved component framework which has been proposed by Kuttner (1994) and Gordon (1997) among others to estimate conceptual variables with time-varying behaviour([3]). The unemployment rate u_t is decomposed into the NAWRU, u_t^*, and the unemployment gap, u_t^{gap}, assuming that their dynamic is generated by the stochastic linear processes:

$$\Delta u_t^* = \varepsilon_{u^*t} + n_{t-1},$$

$$\Delta n_t = \varepsilon_{nt},$$

$$\theta(L) u_t^{gap} = \varepsilon_{u^{gap}\,t},$$

where L denotes the lag operator, $\Delta \equiv 1 - L$ the first-difference, $\theta(L) = 1 - \theta_1 L - \theta_2 L^2$ is an autoregressive polynomial with complex roots, and ε_{u^*t}, ε_{nt}, and $\varepsilon_{u^{gap}\,t}$ are independent and normally distributed white noises with variance $V_l, l = u^*, n, u^{gap}$. The choice of an integrated random walk process for capturing the NAWRU dynamics is first motivated by its generality: if $V_n = 0$ it reduces to a random walk; if instead $V_{u^*} = 0$, it yields the I(2) model $\Delta^2 n_t = \varepsilon_{nt}$. In addition, the unemployment gap drives the fluctuations of a labour cost indicator in the Phillips curve with either backward or forward-looking expectations, depending on the country. The backward-looking version in current use is such that:

$$\Delta \pi_t^w = \mu_\pi + \beta_0 u_t^{\text{gap}} + \beta_1 u_{t-1}^{\text{gap}} + \gamma' x_t + \varepsilon_{\pi^w t},$$

where $\Delta \pi_t^w$ represents the change in wage inflation. A second lag of the gap may be added. The vector x_t contains exogenous information about terms-of-trade, labour productivity, and the change in the wage

([1]) Phelps, E. S. (1967), 'Phillips curves, expectations of inflation and optimal unemployment over time', *Economica*, Vol. 34, pp. 254-281. Friedman, M. (1968), 'The role of monetary policy', *American Economic Review*, Vol. 58, pp. 1-17.

([2]) CAM uses NKP for 21 countries which include Bulgaria (BG), Croatia (HR), Cyprus (CY), Czechia (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Greece (EL), Hungary (HU), Ireland (IE), Latvia (LV), Lithuania (LT), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE) and the United Kingdom (UK). The 7 countries which rely on TKP include Austria (AT), Belgium (BE), Germany (DE), Italy (IT), Luxembourg (LU), Malta (MT) and the Netherlands (NL).

([3]) Kuttner, K.N. (1994), 'Estimating potential output as a latent variable', *Journal of Business and Economic Statistics*, Vol. 12, No. 3, pp. 361-368. Gordon, R.J. (1997), 'The time-varying NAIRU and its implications for economic policy', *Journal of Economic Perspectives*, Vol. 11, pp. 11-32.

(Continued on the next page)

Box (continued)

share, with country-specific loadings via the vector of coefficients γ. For the other EU countries use is made of the forward-looking version with solution:

$$\Delta rulc_t = \alpha\, \Delta rulc_t + \beta_0 u_t^{gap} + \beta_1 u_{t-1}^{gap} + \gamma' x_t + \varepsilon_{rulc\ t},$$

where *rulc* represent real unit labour cost and β_1 satisfies the constraint $\beta_1 = \beta_0\theta_2(\alpha - .99)/(.99\alpha - 1)$. The shocks $\varepsilon_{\pi^w t}$ and $\varepsilon_{rulc\ t}$ to the two Phillips curves are normally distributed white-noise variables which are independent to the other shocks in the model.

This study does not compute the NAWRU but relies on estimates by the EU's commonly-agreed methodology (CAM). The approach used by CAM seeks to identify the natural rate by exploiting the connection between wage inflation and the state of the labour market based on a version of an accelerationist expectations-augmented Phillips curve([214]).

While the level of the natural rate of unemployment is not known with certainty, estimates by the Commission's Directorate-General for Economic and Monetary Affairs (DG ECFIN) as well as various institutions suggest that it has dropped over time: According to CAM the NAWRU for the euro area aggregate declined by more than 1 percentage point from 9.4% to 8.1% in 2018. To the extent that the effects of structural reforms are captured by estimates of the natural rate of unemployment only with a lag, the effective size of the labour market slack (i.e. the distance between the unemployment rate and its structural level) would be higher than the one currently observed.

IV.3. Determinants of the natural rate: a brief literature review

Various factors have been proposed as contributing to developments in unemployment and its natural rate. This chapter divides the determinants of natural rate into two types, namely *structural* and *macroeconomic/cyclical*([215]). Structural determinants are features of the labour market that have a bearing on its long-term functioning. The four *labour market policy* indicators used in this chapter that fall into this category and are directly related to institutional features are: the *unemployment benefit net replacement rate*, the *labour tax wedge*, the *degree of union density*, and the *expenditure on active labour market policies*. This study also takes a more general view, arguing that changes in *demographic structure* - defined as variations in shares of the working-age population in each age group over time - matter for labour market outcomes, particularly unemployment.

The second category includes macroeconomic determinants, which include changes in the *long-term real (inflation-adjusted) interest rate*, variations in *technological progress*, *construction activity* (housing boom-bust) effects, and *industrial confidence*. In addition, this report finds *within-country unemployment dispersion* (across different NUTS2 regions) - signalling labour mobility across regions - to be an important factor for NAWRU.

The following paragraphs include a brief literature review and a discussion of recent developments in the determinants of the natural rate of unemployment.

IV.3.1. Labour market policy indicators

The focus of this study is to empirically quantify the effect of labour market institutions on the level rather than on the nature of the natural rate and in turn on the structural unemployment. Not all labour market policies have a clear-cut, identifiable, theoretically- or empirically-significant effect. This is partly because the labour market institutions jointly determine structural unemployment by looking at the system as a whole and interactions between its separate parts, rather than at individual policies. Another reason is the complexity even of individual labour market instruments. The inability to summarise complicated reforms into a single number, in addition to the lack of a sufficiently

([214]) Havik, K., Mc Morrow, K., Orlandi, F., Planas, C., Raciborski, R., Roeger, W., Rossi, A., Thum-Thysen, A., and V. Vandermeulen (2014), 'The production function methodology for calculating potential growth rates and output gaps', *European Economy – Economic Papers*, No. 535, Directorate-General for Economic and Monetary Affairs (DG ECFIN), European Commission.

([215]) Blanchard and Wolfers, op. cit. Orlandi, op. cit.

long time-series, may lead to the conclusion that a policy's effects are insignificant, even if the theory predicts otherwise. Instruments that have been revealed as statistically significant are discussed below. Note that the study's authors could not find that interactions between policy instruments or between instruments and macroeconomic shocks have an effect on the level of the natural rate([216]).

Unemployment benefit net replacement rate: The net replacement rate in unemployment measures the proportion of previous in-work income that is maintained after several months of unemployment. This insurance framework points to two separate effects of insurance on unemployment. The first is through its effect on search intensity, and thus the matching between unemployment and vacancies. The second is through the reservation wage, as higher unemployment benefits are likely to lead to an increase in the bargained wage. Both effects in turn imply an increase in equilibrium unemployment duration, and thus an increase in the natural rate. Guided by search theory, much empirical work has looked into the effects of the schedule of unemployment benefits on job searching by the unemployed. There has been however little empirical micro work on the other channel, namely the effects of unemployment insurance on bargained wages. This reflects a more general shortcoming, a still poor empirical understanding of wage determination in environments especially such as in Europe where both individual and collective bargaining are likely to play a role.

Due to their costs, net replacement rates are higher in the wealthier EU Member States (see Graph IV.2). These expenditures had been declining in the EU13 economies while remaining fairly stable in the EU10 states. Even at the height of the global financial crisis, these expenditures in the EU10 never exceeded one-third of the spending in the old Member States. The recent increase in 2015 of net replacement rates in the EU13 is related to policy reforms in Italy. Italy replaced the previous system of unemployment benefits by increasing the coverage in relation to eligibility for unemployment benefit support.

Tax wedge: Taxes on labour income comprise income taxes and contributions to the social security system (both by employers and by employees). Taxation on labour income creates a wedge between the real producer labour costs and the purchasing power of the net wage. Higher taxes increase marginal costs for firms. Furthermore, trade unions demand a higher gross wage rate after rises in labour tax. Both effects lead to higher unemployment([217]).

Graph IV.2 plots the tax wedge. The tax wedge has steadily gone down in most EU countries since the 1990s. In many countries, it stands at below 30%. The tax burden on labour nevertheless remains high. After the Eurogroup agreement in September 2015, several Member States have undertaken reforms to address the high tax wedge on labour([218]). More recently, however, reform efforts have decreased, with Member States pointing to the financing of labour tax reductions as a key challenge.

Union density: Greater unionisation is commonly found to be associated with higher unemployment levels([219]). The likely explanation for this is that higher union density reduces competition in labour markets, leading to relatively higher labour costs. Graph IV.2 plots union density - the proportion of union membership, based either on survey data or calculated on the basis of administrative data. However it does not show the significant differences between country groups (EU10 vs EU13) and countries. A number of EU13 countries witnessed a significant drop in union density, most notably Austria, Germany, France, Ireland, the Netherlands, Portugal and the UK. During their transition to market-based economies, the EU10 experienced a significant fall in trade union

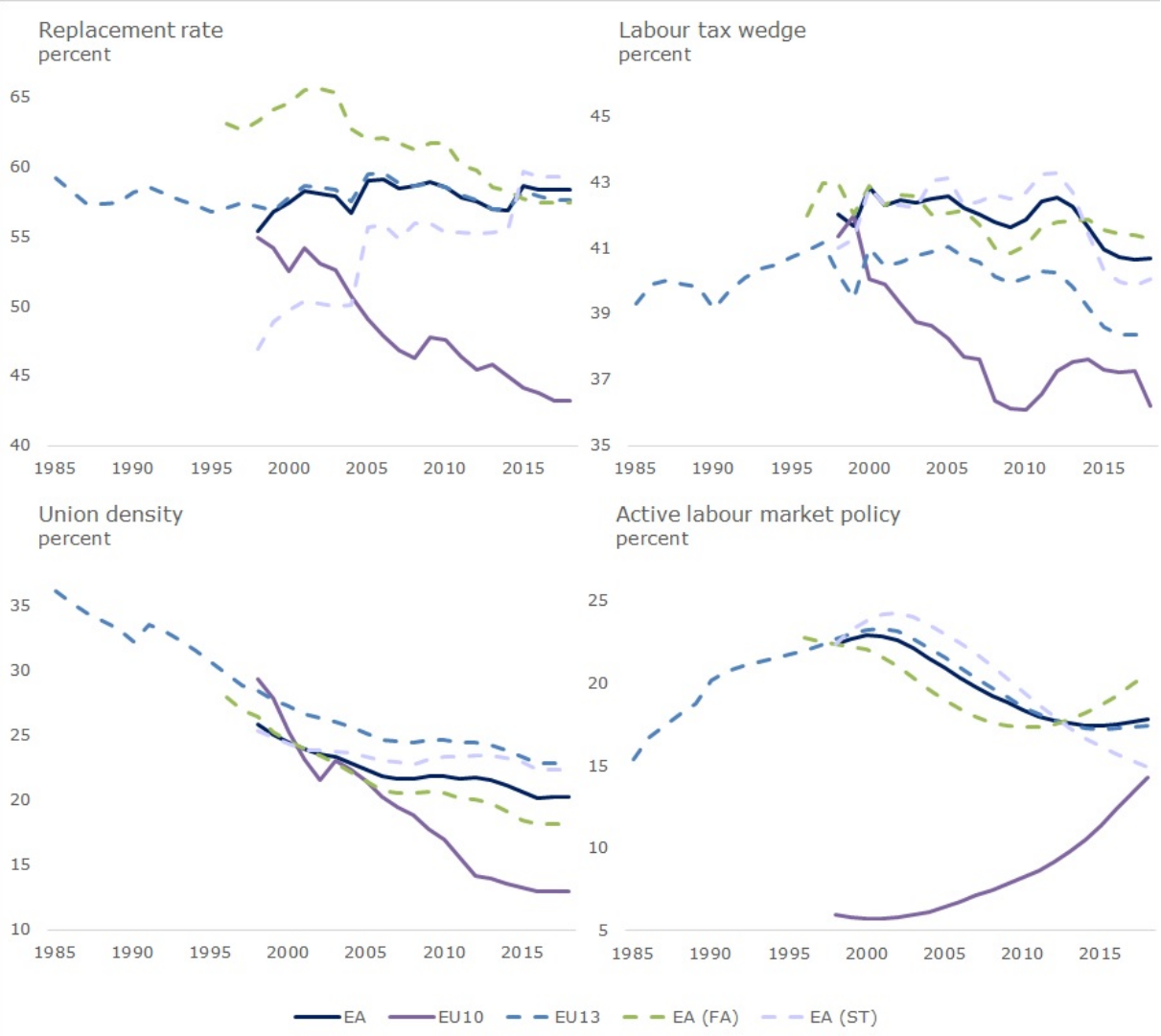
([216]) While the results suggests that union density does not have an effect on unemployment, the study nevertheless uses it in the regressions. Box I.3 discusses the reasons.

([217]) Some authors (e.g., Blanchard 2006) argue that consumption taxes have no effect on unemployment since they are a burden both on employed and unemployed people and therefore have no effect on the reservation wage. Analogue to this argumentation Pissarides (1998) finds in different wage bargaining models that taxes on labour income hardly influence the unemployment rate if the replacement rate is proportional to the after-tax earnings. However, this is not always the case and one can argue (Nickell, 2006) that a certain degree of real wage rigidity will lead to higher labour costs when labour taxes go up.

([218]) Kalyva, A., Princen, S., Leodolter, A., and C. Astarita (2018), 'Labour Taxation and Inclusive Growth', *European Economy – Discussion Papers*, No. 84, Directorate General Economic and Monetary Affairs (DG ECFIN), European Commission.

([219]) Nickell S., Nunziata L. and W. Ochel (2005), 'Unemployment in the OECD since the 1960s. What do we know?', *The Economic Journal*, Royal Economic Society, Vol. 115, No. 500, pp. 1-27.

Graph IV.2: **Labour market policies**



The graph shows the evolution of indices of the unemployment benefit net replacement rate, the labour tax wedge, union density and spending on active labour market policies for five group of countries since 1985. The unemployment benefit net replacement rate measures the average net unemployment benefit as a percent of previous in-work income before the job loss across wage levels (100% and 67% of average wage income), family status (a recipient has no children and is either single, married with a partner that has no income or with a partner that has an income) and benefit durations (selected unemployment periods include 2, 7, 13 and 60 months). The net unemployment benefits include general unemployment benefit, housing benefit and social assistance. The labour tax wedge is defined as income tax on gross wage earnings plus the employee's and the employer's social security contributions, expressed as a percent of the total labour costs of the earner (gross earnings plus the employer's social security contributions plus payroll taxes). Due to data availability, we use the labour tax wedge for single people without children earning 67% of the average wage income. Union density is measured as the proportion of union members of the total number of wage and salary earners, adjusted for non-active and self-employed members. Active labour market policy is measured as the trend (HP-filter) of spending per unemployed as a percent of GDP/per capita. Spending includes all labour market interventions except out-of-work income maintenance and support, and early retirement. The country indices are aggregated into country groups by using the share of country's labour force to the labour force of the group as a weight. Mnemonics on country groupings are listed in Chapter IV.2.
Source: Eurostat, Ameco, OECD, DG EMPL

membership. The institutional framework put in place during the socialist era to protect labour did not survive the transition period.

Active labour market policy: By helping potential employees find vacancies and refresh their skills in line with the latest job market requirements, ALMPs present an opportunity to decrease unemployment and increase labour market participation. This may be mainly for two reasons([220]). First, some ALMPs, such as training programmes, aim to decrease the risk of people becoming unemployed again by improving

([220]) Boone, J., and J. C. van Ours (2004), 'Effective active labor market policies', *CEPR Discussion Paper*, No. 4707.

workers' competencies. Second, besides facilitating job-search, ALMPs can be used for 'activation'. This makes them more likely to motivate job-search, given that some people who receive benefits try to avoid complying with programme requirements. This latter effect is likely to be greater when unemployment benefits amount to more than the wage of potential job offers. Indeed, the literature on programme evaluation has shown that careful combination of active and passive policies can be effective in reducing the disincentivising effect of generous unemployment benefits([221]).

Graph IV.2 shows that ALMPs have increased in the EU10 but decreased in the EU13, after a peak around the beginning of the 2000s. Spending on ALMPs is expressed as the trend of spending per unemployed person as a percentage of GDP per capita. The series is de-trended in order to take out cyclical and automatic changes due to increases in unemployment unrelated to policy changes. Most EU10 countries entered the 1990s with their economic model relatively uncompetitive compared to the other Member States. The closing down or restructuring of businesses led to massive lay-offs. At the same time, these countries did not have the resources to introduce costly labour market measures such as more generous unemployment benefits and ALMPs. Such measures were either non-existent at the beginning of the transition or much less generous. Over time however and also due to the global financial crisis, several EU10 countries have ramped up spending on ALMPs.

Demographic developments: When studying structural unemployment one usually considers aggregate indicators such as tax wedges, union density, benefit replacement rates, etc. However, this approach implicitly assumes that one can define a homogenous aggregate wage equation. This has also been the approach followed in the literature for estimating aggregate structural unemployment([222]). But this is most likely a very strong assumption, since wage behaviour probably differs across different groups. One could, for example, imagine that wage behaviour differs by skill.

Another interesting dimension, the one pursued in this study, is to consider age-specific wage setting and labour demand. There is evidence that middle-aged workers are employed in relatively stable jobs due to considerable work experience but also have a relatively low labour supply elasticity because of family and financial commitments([223]). Because of commitments, for instance related to paying down a mortgage, such workers may delay retirement, are less likely to quit a job and have a higher job-finding rate following a spell of unemployment([224]).

Younger workers on the other hand are less likely to have stable jobs, as they are generally less experienced and are still searching for new job opportunities. They may also be more mobile both regionally (within a country but also across countries) and professionally. Older workers are sometimes confronted with more adverse labour demand conditions because of doubts about their resilience and they may also be more costly for firms([225]). However, at least historically, they also have the option of early retirement. It is therefore likely that there is a difference in structural unemployment across age groups. Thus, changes in the demographic composition of the labour force (population of working age) can have an impact on the structural unemployment rate. There is also a

([221]) Autor, D., Li, A., and M. Notowidigdo (2019), 'Preparing for the work of the future' Cambridge, MA: Abdul Latif Jameel Poverty Action Lab.

([222]) The microeconomic literature, in contrast to the macroeconomic one, has long recognised the significance of demographic trends. For example, many microeconomic studies have tried to assess the importance of individual or family socio-economic aspects as determinants of individual labour market outcomes (Ashenfelter and Ham, 1979; Stratton, 1993). Ashenfelter, O., and J. Ham (1979), 'Education, Unemployment, and Earnings', *Journal of Political Economy*, Vol. 87, No. 5, pp. S99-116. Stratton, L. (1993), 'Racial Differences in Men's Unemployment', *Industrial and Labor Relations Review*, Vol. 46, No. 3, pp. 451-463.

([223]) The literature suggests that the labour supply of low-income workers, second earners and older workers is more responsive to taxation than that of other groups of workers. Diamond, P.A. (1980), 'Income taxation with fixed hours of work', *Journal of Public Economics*, Vol. 13, pp. 101-110. Pissarides, C. (1998), 'The impact of employment tax cuts on unemployment and wages; The role of unemployment benefits and tax structure', *European Economic Review*, Vol. 47, pp. 155-183. Saez, E. (2000), 'Optimal income transfer programs: Intensive versus extensive labor supply responses', NBER Working Paper, No. 7708.

([224]) Zator, M. (2019), 'Working more to pay the mortgage: Household debt, consumption commitments and labor supply', Working Paper, Northwestern University.

([225]) Axelrad, H., Malul, M. and I. Luski, (2018), 'Unemployment among younger and older individuals: does conventional data about unemployment tell us the whole story?', *Journal for Labour Market Research*, Vol. 52, No. 3; Marmora, P., and M. Ritter (2015), 'Unemployment and the retirement decisions of older workers', *Journal of Labor Research*, Vol. 36, No. 3, pp. 274–290; Johnson, R.W. (2004), 'Trends in job demands among older workers, 1992–2002', *Monthly Labor Review*, Vol. 127, No. 48.

second dimension - the structural unemployment rate is likely to respond differently to structural policy measures by age group, i.e. there may be interaction effects between demographic and structural policy indicators.

This chapter quantifies the effect of demographics on unemployment (see Box IV.2). This is not the first study to rely on demographic changes to clean the unemployment rate of composition effects in the labour force. There is a strand of the labour economics literature which infers the natural rate by using observable labour market indicators such as measures of job vacancies and the flows into and out of unemployment, demographic composition of the labour force, or using mismatch indicators of unemployment([226]).

The chapter contributes to the existing literature by using age-cohort models to estimate aggregate trends for unemployment([227]). The novelty of the study is to gauge the demographic effects and compute the aggregate structural unemployment in a unified framework. In contrast, previous research has separately quantified the cohort-specific structural unemployment and, then, in a second step constructed the aggregate unemployment trend. To avoid the two-step procedure, we present a simple model that motivates the regression framework for studying demographic effects in a structural unemployment regression (see Box IV.2)([228]). The bottom line of the analysis is that since age-specific characteristics co-determine the unemployment rate for each cohort, structural unemployment across age groups may be significant. This implies that demographic changes may alter the aggregate structural unemployment, everything else being equal.

One challenge for the model presented here is that the cohort-specific effect is constant, pinned down by age-specific characteristics. There is evidence however that this effect my change over time. For example, today, older workers participate in the labour market at a higher rate than three decades ago. Similarly, young workers (aged 15-24), due to the increasing length of their education, participate at a much lower rate than in the 1990s. The results discussed here are broadly preliminary, meant to present the size of the demographic effects. The extension of this work would necessarily need to capture the evolution of these age effects on unemployment, for instance by using additional explanatory variables, such as educational attainment and the organisation of the pension system.

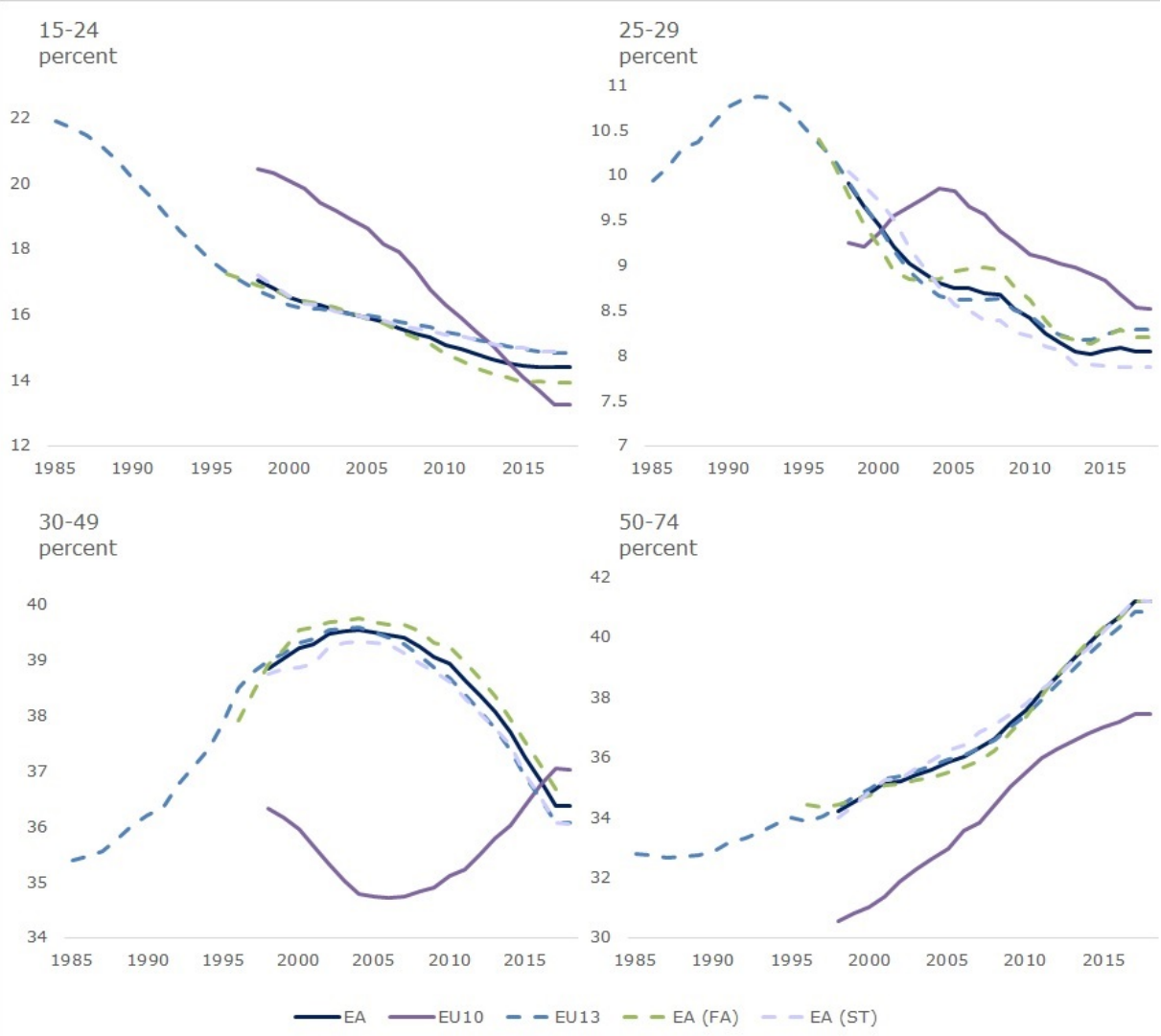
Graph IV.3 shows that the developments for all the main demographic groups, both in the old and the new EU Member States. These graphs, similar to the conclusions in numerous studies, suggest that the EU's population is likely to decrease in the coming decades as a result of an extended period of relatively low fertility, coupled with - specifically in the case of the new Member States - migratory patterns. The falling share of children and young people in the working-age cohort and total population could result in labour market shortages in specific countries and in particular occupations. By contrast, the rise in life expectancy (for both men and women) in the EU means that the number and share of the elderly in the total population will continue to increase.

([226]) Blanchard, O.J., and P. Diamond (1989), 'The Beveridge curve', *Brookings Papers on Economic Activity*, Vol. 20, pp. 1-76. Daly, M.C., Hobijn, B., Sahin, A., and R.G. Valletta (2012), 'A search and matching approach to labor markets: Did the natural rate of unemployment rise?', *Journal of Economic Perspectives*, Vol 26, pp. 3-26. Perry, G.L. (1970), 'Changing labor markets and inflation', *Brookings Papers on Economic Activity*, Vol. 1, pp. 411-448. Summers, L. H. (1986), 'Why is the unemployment rate so very high near full employment?', *Brookings Papers on Economic Activity*, Vol. 17, pp. 339-396. Shimer, R. (1998), 'Why is the U.S. unemployment rate so much lower?', In: Bernanke, B., Rotemberg, J. (eds.), *NBER Macroeconomics Annual*, MIT Press, Vol. 13, pp. 11-61. Brauer, D. (2007), 'The natural rate of unemployment', Working Paper 2007-06, Congressional Budget Office. Barnichon, R., and G. Mesters (2018), 'On the demographic adjustment of unemployment', *Review of Economics and Statistics*, Vol. 100, pp. 219-231. Sahin, A., Song, J., Topa, G., and G.L. Violante (2014), 'Mismatch unemployment', *American Economic Review*, Vol. 104, pp. 3529-3564.

([227]) Aaronson, S., Cajner, T., Fallick, B., Galbis-Reig, F., Smith, C., and W. Wascher (2014), 'Labor force participation: Recent developments and future Prospects', *Brookings Papers on Economic Activity*, Vol. 2014, pp. 197-275. Hornstein, A., and M. Kudlyak (2019) 'Aggregate labor force participation and unemployment and demographic trends', Federal Reserve Bank of Richmond Working Paper No. 19-08, March 2019.

([228]) The Box presents in detail the sources and computation of the demographics dataset used in the analysis.

Graph IV.3: **Shares of working - age population in several age cohorts**



The country indices are aggregated into country groups by using the share of country labour force to the labour force of the group as a weight. Mnemonics on country groupings are listed in Chapter IV.2.
Source: Eurostat

Box IV.2: **Labour market model with demographics**

This Box outlines the main insight from the model in Hristov and Roeger (2020) which studies the long-term effect of demographic changes on labour market outcomes[1]. The modelling framework focuses on demographic heterogeneity and leaves aside short-term dynamics. Think of a competitive labour market composed of the four age groups, $i = vy, y, m, o$; that is, very young, young, middle-aged, and old cohorts. The innovation to other standard models is that the labour market is segregated in the sense that workers belonging to different age groups have different wage behaviour. Aggregate production is a composite of age-specific labour, with age-specific output elasticities. The age-specific real wage clears the market and determines the equilibrium employment for each cohort. Since wage is a function of age-specific characteristics, the model predicts that differences in structural unemployment *across age groups* may be sizeable. This allows one then to augment a standard regression in the empirical literature on labour market institutions with the role of demographics. This yields the following structural unemployment equation (exluding the error term)

$$\tilde{u}_t^* = (\tau_i + mup_m) + (mup_{vy} - mup_m)s_{vyt} + (mup_y - mup_m)s_{yt} + (mup_o - mup_m)s_{ot} + \sum_k \gamma_k S_k,$$

where mup_i denotes an age-specific demographic fixed effect for one of the four age groups; τ_i is country-specific dummy; s_{it} stands for the share of the cohort size i to the working age population in time t. Structural unemployment, $\tilde{u}_t^*$, is also a linear function of structural labour market indicators, S_k. The sensitivity of structural unemployment to the latter is given by γ_k.

In this equation, the country-fixed effect contains the mark-up of the middle-aged group (note this mark-up can be negative or positive), while the coefficient of the population shares for the old and the young must be interpreted as mark-up differences between the respective age cohort and the middle-aged group. The interpretation of these coefficients is straightforward. If, on average, the unemployment rate of age group i is higher/lower than age group m, we expect a positive/negative coefficient. The coefficient should approximately measure the average difference in the unemployment rate between age group i and the middle-aged cohort, m,

$$Mean(\tilde{u}_{it}^*) - Mean(\tilde{u}_{mt}^*) = mup_i - mup_m, \text{ for } i \neq m.$$

For implementing this in the panel regression, the following demographic variable is constructed

$$DEMO_t = \left(Mean(u_{vyt}) - Mean(u_{mt})\right)s_{vyt} + \left(Mean(u_{yt}) - Mean(u_{mt})\right)s_{yt} + \left(Mean(u_{ot}) - Mean(u_{mt})\right)s_{ot}$$ [2]

Finally, using the newly constructed variable and constraining its coefficient to one, $1^{constrained}$, one arrives at a definition of the structural unemployment rate, a building block in the regression analysis in the paper

$$\tilde{u}_t^* = (\tau_i + mup_m) + 1^{constrained}\ DEMO_t + \sum_k \gamma_k S_k.$$

Statistically, one cannot reject the hypothesis that the coefficient for the demographic variable equals 1.

[1] Hristov, A. and W. Roeger (2020), 'Demographic trends and structural unemployment', forthcoming.

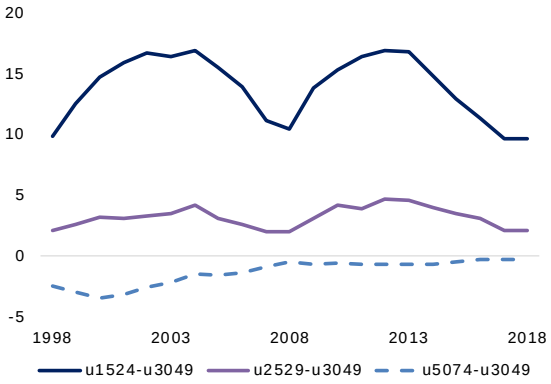
[2] Observe that $Mean(u_{vyt}) - Mean(u_{mt}) = Mean(\tilde{u}_{vyt}^*) - Mean(\tilde{u}_{mt}^*)$; that is, to avoid complicating the analysis, one uses the difference between the *actual* cohort-specific unemployment rates, instead of the difference between the *structural* cohort-specific unemployment rates.

(Continued on the next page)

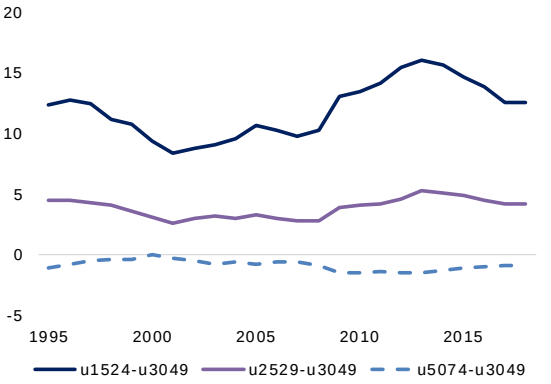
Box (continued)

What are the stylised facts about unemployment by age across countries? There is a noticeable unemployment pattern across age groups. Graph 1 shows that in all countries groups with younger workers – i.e. the 15-25 and 25-29 age groups - have higher unemployment rates compared with middle-aged workers - the 30-49 cohort, while the unemployment rate of older workers aged 50-74 is close to that of middle-aged ones([3]).

Graph 1a: **EU10**



Graph 1b: **EU13**



Source: Eurostat

The relative stability of unemployment rate differentials across age groups supports the hypotheses that the demographic effect should largely show up as an age-specific fixed effect.

([3]) The graph presents the difference in unemployment rates between different cohorts (15-24, 25-29, 50-74) and the middle-aged (30-49). Differences in country cohort-specific unemployment rates are aggregated into country groups by using the share of country labour force to the labour force of the group as a weight.

IV.3.2. Macroeconomic effects

Apart from institutional measures, medium-term economic developments and cyclical factors also affect the NAWRU. A number of studies have identified a theoretical link between demand conditions and the NAWRU([229]). These studies have usually relied on models featuring labour market rigidities. To keep it short, this study briefly outlines only the most significant factors, namely total productivity growth, real interest rate developments, construction activities and industrial confidence. We find that within-country unemployment dispersion may also cause fluctuations in the NAWRU.

Total factor productivity: The effects of TFP on unemployment are theoretically ambiguous. An increase in TFP growth can reduce the demand for labour and therefore increase unemployment. But productivity growth can also reduce the unemployment rate by driving a wedge between wages and the reservation wage (proxied by unemployment benefits) if the reservation wage is not fully indexed to the market wage. This latter effect seems to be the dominant factor. In sum, this implies that a subpar productivity growth pushes up the unemployment rate.

Average annual TFP slowed down below 1.5% in the 1990s in the EU13 and below 0.5% after the onset of the great financial crisis (Graph IV.4). In other words, the ability of the firms to pay out the wages prevalent prior to the slowdowns had decreased. This phenomenon partly explains the rise in the natural rate during periods of slowdowns in TFP.

Real interest rate: The real interest rate can potentially affect employment due to its effect on investment. The episode of strongly declining real rates after 2009 stabilised both investment and unemployment (see Graph IV.4).

([229]) Blanchard and Wolfers, op. cit. Orlandi, op. cit.

Construction activity: Buoyant credit growth, or 'credit booms', sometimes associated with a rise in construction activity, often presents a trade-off between immediate, strong economic performance and the risk of a future economic bust. The risk of a bust - where a phase of significant credit growth is followed by a financial crisis or economic stagnation – can notably increase when there is a boom in house prices.

This study finds that the NAWRU is negatively related to the size of the construction sector. During housing booms the construction sector provides employment opportunities to low skilled workers who in turn face difficulties getting reallocated to new jobs if there is a bust. Graph IV.4 shows how the build-up of construction activity prior to the global financial crisis in 2008-2009 led to a major scaling down of the sector in the subsequent years.

Unemployment dispersion: This indicator cannot be traced back to any particular policy but to a number of them. More specifically, within-country unemployment dispersion depends on regional-specific factors, such as population, available capital, ideas and skills, formal and informal collaborations, and capacity to evolve, create and disseminate knowledge, and react to changes. Variations in macroeconomic and policy trends, including those that are unrelated to labour markets - such as housing policy, interact with the regional characteristics to generate a variety of unemployment rate patterns.

For example, after the accession of the economies of Central and Eastern Europe to the EU, these interactions may have contributed to the fall in aggregate and within-country regional unemployment rates, with an associated convergence of less-developed regions to the EU average income levels([230]). On the other hand, since the onset of the new millennium, they may have led to a rise in within-country unemployment dispersion in a number of EU countries. These economies have observed a decrease in their labour mobility and a formation of regional 'pockets' of low-skill, low-income population([231]).

Graph IV.4 plots the unemployment dispersion indicator([232]). Except for the EA(ST) Members States, average subnational regional disparities in all country-group economies have trended down since 2014, after rising from the early 2000s. For the EA(ST) economies, however, regional dispersion still hovers around the levels observed during the euro area debt crisis in 2012-2014.

IV.4. Structural unemployment

What are the macro outcomes of these institutional differences? The study focuses on the impact of labour market institutions on unemployment. As noted in Chapter IV.2, the evolution of the NAWRU across regions is quite heterogeneous. In the old Member States (EU13) the NAWRU has been fairly stable and declined somewhat after 2013. New Member States started with a higher NAWRU but had a significantly lower NAWRU at the end of the sample period. This declined further after 2013. However there is also substantial heterogeneity between individual EU countries. A divergence occurs around mid-2000.

Graph IV.5 plots the main results based on the panel regression with institutional and demographic trends for the EA, EU13 and EU10 as well as for EA(FA) and EA(ST). The graph shows how changes in labour market indicators and demographics translated into changes in structural unemployment. The latter are explained in Box IV.3.

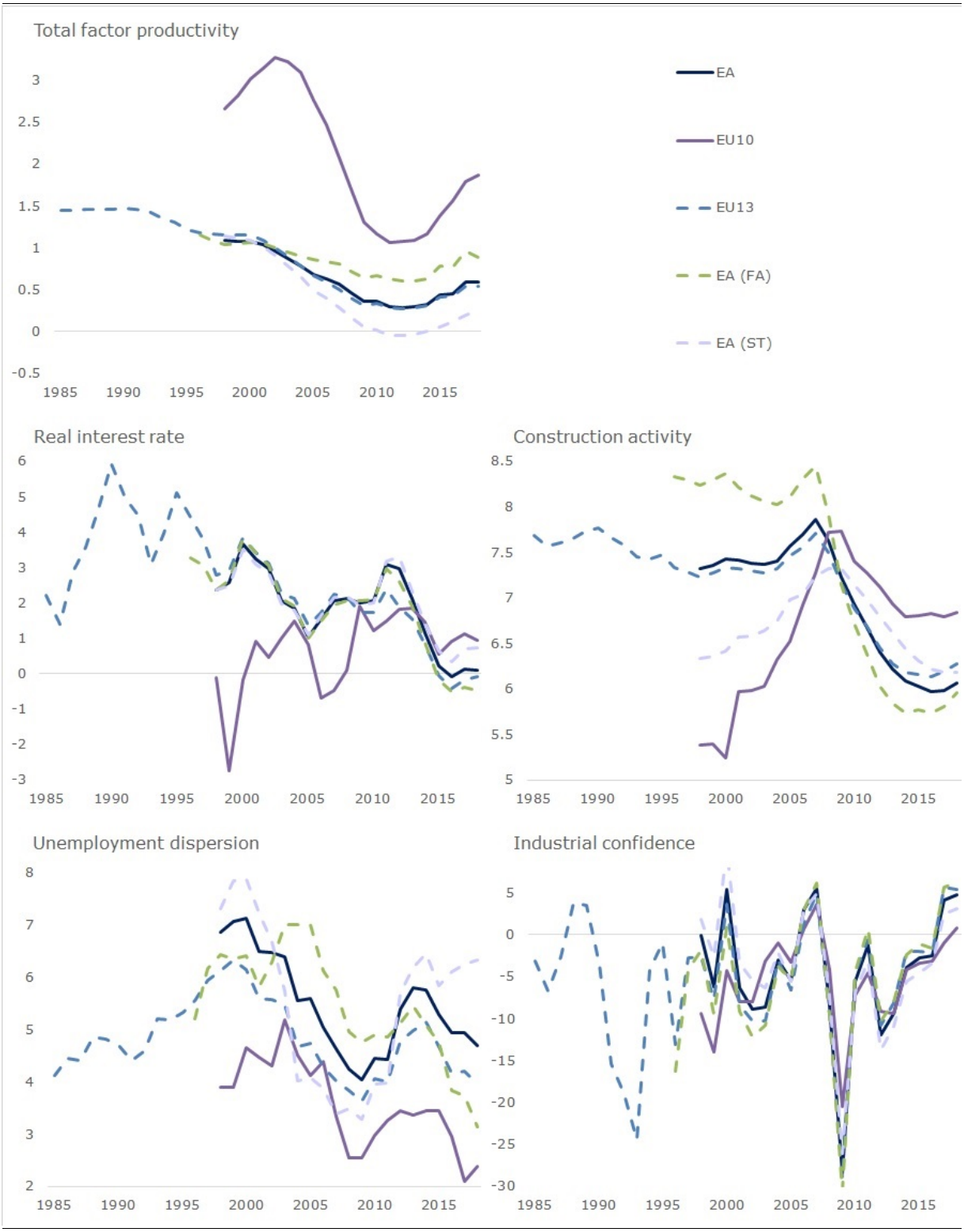
For EA and EU13 countries structural policy measures have helped reduce the unemployment rate. A fall in the labour tax wedge has been especially instrumental in the decline. This effect was partly counteracted by reductions in ALMP measures. If one adopts a somewhat longer perspective, one can see that demographic trends

([230]) Żuk, P., and L. Savelin (2018) 'Real Convergence in Central, Eastern and South-Eastern Europe', *ECB Occasional Paper*, No. 212.

([231]) Iammarino, S., Rodriguez-Pose, A., and M. Storper (2019), 'Regional inequality in Europe: evidence, theory and policy implications', *Journal of Economic Geography*, No. 19, pp. 273–298.

([232]) The construction of the within-country unemployment dispersion (across different NUTS2 regions) in the EU Member States is based on the long-term unemployment rates in the regions, but excludes outliers. The regional 90/10 disparity is defined as the difference between the long-term unemployment rates in the region at the 90th percentile of the country's regional unemployment distribution minus the region at the 10th percentile.

Graph IV.4: **Macroeconomic variables**



The country indices are aggregated into country groups by using the share of country labour force to the labour force of the group as a weight. Mnemonics on country groupings are listed in Chapter IV.2.
Source: Eurostat, Ameco, DG ECFIN

exert secular downward pressure on the unemployment rate. In the context of this study, this is the result of a decline in younger age cohorts that typically have higher average unemployment

rates. This is partly due to population ageing, but is also related to migration.

The results suggest that for a number of countries the gauged structural unemployment rates in 2018 were lower than during the previous business cycle peaks - for example, in 2000 or in 2007 - mainly because of the changing demographic structure rather than changes in the institutional measures. This implies that without strong cyclical headwinds in the coming years and without comprehensive restructuring of the economies due to the coronavirus-related recession in 2020 - for example, due to a spike in labour-replacing automation, the natural rate will continue to trend downwards.

The stronger decline of unemployment in EU10 countries can be explained from a structural perspective by a more comprehensive labour market approach, namely by using all structural labour market policies in an employment-friendly way([233]). In particular, EU10 countries have increased ALMP measures, albeit from a low level. These economies have also reduced the labour tax wedge and the level of their net replacement rate of unemployment benefits.

It is also interesting to look at why some countries have managed to reduce structural unemployment while others have been less successful. For this purpose, the study separates the euro area countries into two groups. Comparing EA(FA) to EA(ST) countries shows that the difference in performance is explained by the comprehensiveness of the measures. Successful countries have combined labour tax reforms with ALMP measures but have simultaneously made in-work income relatively more attractive reducing the level of their net replacement rate of unemployment benefits. This can be framed as a carrot and stick approach to labour markets. Those countries that were less successful in reducing the structural unemployment rate, concentrated more on tax policies. But they did not accompany these measures with other labour market policies. Neither did they increase their spending on ALMPs or redesign their unemployment benefit system to be more employment-friendly, i.e. progressively decreasing benefits in line with unemployment duration([234]).

IV.5.Conclusions

After a period of rising unemployment following the 2009 recession, the unemployment rate has now fallen to 7.6% in 2019. This is more than 1 percentage point lower than the unemployment rate in the early 2000s when the euro area (EA) economy was in a similar cyclical position. The nonaccelerating wage rate of unemployment (NAWRU) is also declining, especially since 2013. This chapter explores the possible structural factors that can explain this development.

The study finds that demographic factors associated with population ageing helped reduce unemployment over the last two decades. Results suggest that for a number of countries the gauged natural rates in 2018 are lower than during the previous business cycle peaks - for example, in 2000 or in 2007 - mainly because of the changing demographics structure rather than positive cyclical developments.

On policy measures, the study can broadly distinguish between one group of countries that has managed to reduce structural unemployment, and another group that has been less successful. The first group has adopted comprehensive labour market policy measures, combining labour tax reductions with activation policies and making in-work income relatively more attractive by reducing the level of their net replacement rate of unemployment benefits. The second group focused on labour tax reductions but either negated or counteracted this by reducing their active labour market measures and increasing the net replacement rate of unemployment benefits.

([233]) Arpaia A., Kiss, A., and A. Turrini (2014) 'Is unemployment structural or cyclical? Main features of job matching in the EU after the crisis', *European Economy - Economic Papers 2008 – 2015*, No. 527, Directorate General Economic and Monetary Affairs (DG ECFIN), European Commission.

([234]) Implementing effective active labour market policies is difficult and costly. It should be stressed that the efficacy of the different components of ALMPs may be quite heterogeneous.

Box IV.3: **Estimating structural unemployment**

For the empirical investigation, the paper uses a panel data set for 28 EU countries for the period 1985-2018. For the countries that joined the EU in 2004 (CZ, EE, HU, LT, LV, PL, SI and SK), in 2007 (BG and RO) and in 2013 (HR), the analysis focuses on the period after 1997. Due to a lack of measurable data for all countries as well as policy and institutional reforms over time, the panel is not balanced. Short time-series make it difficult to plausibly and correctly measure the effects of structural reforms on unemployment, especially for the 'new' EU countries. That is, the absence of long enough time-series fails to guarantee enough variability in individual countries' labour market institutions. On the other hand, the shorter sample for these countries is more meaningful for the analysis, as one can exclude the effect of the transition from a centrally-planned to a market-based economy as a confounding factor on the level and dynamics of their unemployment rate. The chosen period therefore guarantees that the 28 countries operated under similar institutions and rules, as they were either part of the EU or striving to join it. Then, if no additional confounding effects were present, one can 'directly' measure the effects of structural policy changes on unemployment.

The goal of this paper is to gauge the long-term effects of changes in policies - exogenous variations independent of the current state of the economy - rather than comparing countries with a different institutional mix([1]). If the modelling framework can plausibly quantify these effects, one can then confidently claim to have measured the long-term fixed point towards which the unemployment/NAWRU rate converges, in the absence of any further policy movements. The most straightforward way to obtain this is to use the fixed-effect panel estimation, which can be calculated by relying on time-series variations within countries. Including country fixed-effects in the estimation controls for unobserved as well as difficult to capture time-invariant features related to the historical relations, institutional setup, social norms, etc. Observe that many of the country policies are directly associated with these broader country features. For this reason, omitting the fixed-effects in the estimation could lead to a bias in the gauged policy effects. Similar to the empirical literature on labour market institutions, the paper relies on a straightforward linear model of the form

$$u^*_{ct} = \tau_c + \sum_k \gamma_{kc} S_{kct} + \sum_j \alpha_{jc} M_{jct} + \epsilon_{ct} ,$$

where the index c denotes the country, the index t the year and the idiosyncratic error term ϵ_{ct} is independent and normally distributed white noise; τ_c is a country-specific intercept accounting for the heterogeneity of the dependent variable not captured by the time-varying factors; M_j is a vector representing a macroeconomic variable j; S_k denotes a vector for policy indicator k. Two comments are in order. First, the dependent variable in the regression is the NAWRU estimate, provided by DG ECFIN according to CAM. Second, as shown in Box 2, the study augments the standard regression by a demographic index

$$u^*_{ct} = \tau_c + 1^{constrained}\ DEMO_{ct} + \sum_k \gamma_{kc} S_{kct} + \sum_j \alpha_{jc} M_{jct} + \epsilon_{ct} .$$

The key results are presented in Table 1. The first variant of the regression restricts the set of explanatory variables to labour market institutional indicators and the role of demographics. Three of the institutional factors are highly significant. These alone can explain 40% of the variation in the NAWRU. Union density is insignificant and its effect is null in a multivariate specification with all countries. One reason for this is the possibility that the latter interacts with other labour market institutions. There is evidence for this proposition, but for the sake of brevity, this will be investigated in more detail in future work. The study also looked at the robustness of the results for the set of countries. In general, dropping one country at a time makes little difference to the reported evidence (not shown here). There are two notable exceptions. First, the UK is very important for determining the coefficient of union density. This again supports the intuition that either heterogeneity among countries or interactions among institutions, or both together, may be responsible for the insignificance of union density. The other exception is the importance of Denmark and Sweden in determining the effect of the net wage replacement rate.

([1]) These two are likely related. Due to conciseness, the issue goes beyond the scope of the current analysis.

(Continued on the next page)

Box (continued)

Table 1:

Estimated effects of labour market institutions on NAWRU

	EU	EU
Data ends	2018	2018
Data starts	1985	1985
Dependent Variable	NAWRU	NAWRU
	(1)	(2)
Replacement rate (rr)	0.074**	0.057**
	0,03	0,03
Labour tax wedge (tw)	0.283***	0.232***
	-0,05	0,03
Union density (ud)	-0,034	-0,007
	0,03	0,03
ALMP (HP filtered trend)	-0.094***	-0.088***
(almptr)	0,02	0,02
Demographics	1,000	1,000
	constr	constr
Regional dispersion 90/10		0.252**
(disp)		0,10
Total factor productivity		-0.340**
(PF trend)		0,14
Real interest rate		0,059
r		0,06
Construction activity		-0.398***
(cons)		0,14
Industrial confidence		-0.022**
(conf)		0,01
SD residuals (all MS)	1,37	1,17
Observations	704	704
Number countries	28	28

* p < 0.1, ** p < 0.05, *** p < 0.01, robust standard errors.
The table reports different panel regression results with country fixed effects. Heteroskedasticity-robust controls both for cross-sectional dependence as well as for autocorrelation. The coefficient of the demographic index is constrained to 1. The row 'SD residuals' reports the standard deviation of the estimated error terms.

It appears that in these two countries, most likely due to the interactions of the replacement rate with other labour institutions, the NAWRU is less sensitive to this variable.

In the second regression, a variety of macroeconomic variables control for medium-term variation in the NAWRU. This paper extended the dataset of Orlandi (2012) by looking at a broad set of macroeconomic variables proposed in various related studies - namely, changes in share prices, government budget balances, terms-of-trade shocks, variation in CPI inflation, household debt, industrial confidence, etc. Among these, all but the last two and within-country unemployment dispersion - which this study detected as an important factor for aggregate unemployment - proved robust and significant. In the reported multivariate regression results, the paper does not control for changes in household debt due to multicollinearity issues, related to total factor productivity and the latter variable. As seen in Table 1, all estimated coefficients of the labour market institutions remain broadly unchanged with respect to the previous variant, signalling their robustness.

Recognising that medium-term changes are captured by the deviations of the macroeconomic variables from their historical averages

$$\underbrace{(u^*_{ct} - \tilde{u}^*_{ct})}_{u_{ct}^{med-term}} = \sum_j \alpha_{jc} \left(M_{jct} - \bar{M}_{jc}\right),$$

(Continued on the next page)

Box (continued)

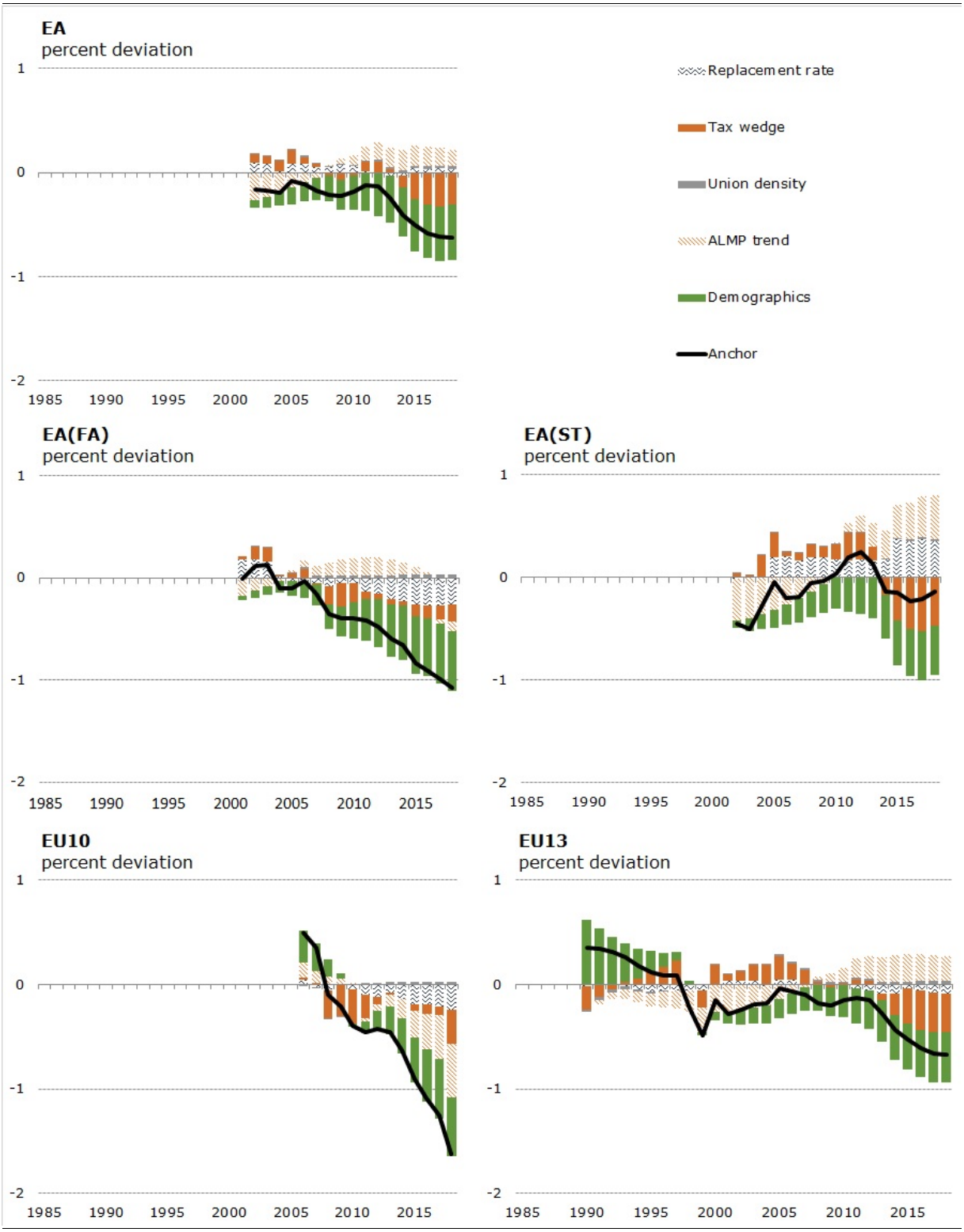
one can compute structural unemployment based on the estimated panel regression

$$\tilde{u}^{*}_{ct} = \tau_c + 1^{constrained}\ DEMO_{ct} + \sum_k \gamma_{kc} S_{kct} + \sum_j \alpha_{jc}\, \bar{M}_{jc}\,.$$

where $\bar{M}_{jc}$ denotes the historical average of the respective macroeconomic variables. As discussed above, the structural unemployment captures the elements of the unemployment rate that are driven by slow-moving factors such as policy institutions, demographics and changes in social norms. Conceptually, one would expect the natural rate of unemployment to converge to the structural over time in the absence of shocks, $\epsilon_{ct+n} = 0$, and policy changes, $\Delta S_{kct+n} = 0$, for all n > 0. Hristov et al (2017) use this particular feature of structural unemployment to anchor the NAWRU estimation at sample end(2). In general, the use of unobserved component models to estimate the NAWRU has been strongly criticised due to some excessive pro-cydicality at the sample end, especially in the neighbourhood of turning points. The issue is the intrinsic uncertainty of the future path of unemployment that drives the gauged NAWRU dose to the observed unemployment rate at sample end. This uncertainty may however be reduced by augmenting the information set with structural labour market indicators to which the NAWRU is supposed to converge in a certain number of years. The resulting NAWRU estimates in turn incorporate information about both the business cyde and labour market characteristics.

(2) Hristov, A., C. Planas, W. Roeger and A. Rossi (2017), 'NAWRU Estimation Using Structural Labour Market Indicators', *European Economy Discussion Papers*, No 069, European Commission.

Graph IV.5: **Determinants of structural unemployment**



Deviations of the structural unemployment rate from its sample average derived from a panel regression of EU-28 standardised unemployment rates on an index of net replacement rate, tax wedge, union density, expenditures on active labour market policies, index of demographic changes as well as an index of macroeconomic indicators (see Box 3). Mnemonics on country groupings are listed in Chapter IV.2.
Source: Authors' estimates

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