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RECENT IMPROVEMENTS TO THE PUBLIC FINANCE BLOCK OF THE OECD'S LONG-TERM GLOBAL MODEL

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By Yvan Guillemette

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ABSTRACT/RESUMÉ

Recent improvements to the public finance block of the OECD's long-term global model

This paper documents recent extensions and revisions made to the model underlying the long-run global macroeconomic scenarios that are published every few years. First, a fiscal block is added for 11 countries that previously lacked one. Second, public pension expenditure projections are made endogenous to the projected ratio of retirees to workers and to a hypothesis on the future evolution of benefit ratios. Cross-country differences in projected public pension expenditure thus reflect many factors, including the speed of population ageing, the evolution of employment rates for older people, especially females, and rules regarding the evolution of statutory retirement ages. Third, revised public health expenditure projections introduce a higher income elasticity in middle-income than high-income countries and makes the excess of health care inflation over GDP inflation (Baumol effect) endogenous to the projected labour productivity growth rate. And fourth, the determination of long-term interest rates is revised to associate the fiscal risk premium to net, as opposed to gross, government debt, and make its size conditional on euro area membership, the quality of public governance and the occurrence of systemic banking crises, while allowing a flight-to-safety effect during such crises to lower bond yields in countries that are providers of global safe assets.

JEL codes: E17, E43, H51, H55

Keywords: Public pension expenditure, public health expenditure, interest rates, long-term scenarios

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Améliorations récentes au bloc finance publique du modèle global à long terme de l'OCDE

Ce document décrit les dernières extensions et révisions apportées au modèle sous-jacent aux scénarios macroéconomiques globaux à long terme publiés tous les deux ou trois ans. Premièrement, un bloc fiscal est ajouté pour 11 pays qui en manquaient auparavant. Deuxièmement, les prévisions de dépenses de pensions publiques sont rendues endogènes au ratio projeté des retraités sur les travailleurs et à une hypothèse sur l'évolution future des ratios de prestations. Les différences entre les pays en ce qui concerne les dépenses de retraite publiques projetées reflètent donc de nombreux facteurs, incluant la vitesse du vieillissement de la population, l'évolution des taux d'emploi des personnes âgées, en particulier des femmes, et les règles relatives à l'évolution de l'âge légal de la retraite. Troisièmement, les projections révisées des dépenses de santé publique introduisent une élasticité-revenu plus élevée dans les pays à revenu intermédiaire que dans les pays à revenu élevé, et rendent l'excès d'inflation des dépenses de santé par rapport à l'inflation du PIB (effet Baumol) endogène au taux de croissance projeté de la productivité du travail. Et quatrièmement, la détermination des taux d'intérêt à long terme est révisée pour associer la prime de risque à la dette publique nette plutôt que brute, et pour rendre l'importance de cette prime conditionnelle à l'adhésion à la zone euro, à la qualité de la gouvernance publique et à la survenue de crises bancaires systémiques, tout en permettant à un effet de fuite vers la sécurité lors de telles crises de réduire les taux d'intérêt dans les pays fournisseurs d'actifs globaux sûrs.

Codes JEL: E17, E43, H51, H55

Mots-clés: Dépense publique de retraite, dépense publique de santé, taux d'intérêt, scénarios à long terme

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Main Findings

This paper documents recent extensions and revisions made to the public finance block of the OECD Economics Department's long-term model, which is used for making global macroeconomic scenarios.

A new public finance block for 11 countries

- The revised model adds fiscal coverage for eight non-OECD G20 countries and three OECD countries using fiscal information from the IMF World Economic Outlook database.

New public pension expenditure projections

- The previous set of projections treated pension expenditure as exogenous. The revised approach endogenises pension expenditure to other model outcomes, allowing policy shocks, such as changes to statutory retirement ages, to affect its evolution.
- Public pension expenditures are projected to change by between zero and 11 percentage points of GDP by 2060. Cross-country differences reflect many factors, including the speed of population ageing, the evolution of employment rates for older citizens, especially women and rules regarding the evolution of statutory retirement ages.

New public health expenditure projections

- New public health expenditure projections introduce a higher health spending income elasticity in middle-income than high-income countries. This change is based on empirical evidence and implies a more rapid increase in health spending for some non-OECD G20 countries.
- In the revised equation, the projected excess of health care inflation over GDP inflation due to the Baumol effect is endogenous to the projected rate of labour productivity.
- Public health expenditure is projected to increase by 2.3 percentage points of GDP in the median country by 2060, ranging from 0.7 (the Netherlands) to 3.8 (Brazil). Differences across countries stem from initial income levels, population ageing and projected income growth.

A new equation for long-term interest rates

- The equation for long-term interest rates is revised to make the fiscal risk premium a function of net as opposed to gross government debt and make it conditional on a number of factors. Only sovereigns that are not providers of safe assets pay a risk premium on net debt if it is positive, and only during financial crises. The size of the premium also depends on the quality of a country's governance and on whether or not it can issue its own currency. Countries that provide safe assets pay no risk premium and benefit from a flight-to-safety effect during crises.

Recent improvements to the public finance block of the OECD's long-term global model

By Yvan Guillemette[1]

1. Introduction

1. Since the release of the last set of long-term scenarios in July 2018 (Guillemette and Turner, 2018[1]), a number of improvements have been made to the projection framework, in particular to the public finance part of the model, so as to enrich fiscal sustainability analyses. Section 2 describes the work done to add a public finance block to the long-term model for the non-OECD G20 countries and the OECD countries that lacked one. Sections 3 and 4 present the approaches used to endogenise pension and health expenditure projections. Section 5 documents the revisions made to the framework used to project long-term interest rates.

2. New public finance block for 11 countries

2. The current revision adds a public finance block for all non-OECD G20 countries (Argentina, Brazil, China, India, Indonesia, Russia, Saudi Arabia and South Africa) and the three OECD countries (Chile, Mexico and Turkey) that lacked one. The main reason why these countries had no public finance block is that the main source database for the long-term model, the OECD Economic Outlook (EO) database, contains little or no fiscal information and no short-run fiscal projections for these countries. The fiscal information is instead sourced from the latest IMF World Economic Outlook (WEO) database, which contains historical values and short-run projections for the main fiscal concepts used in the long-term model:[2]

- General government gross financial liabilities
- General government primary balance
- General government net lending
- General government gross interest payments

[1] The author is a member of the OECD Economics Department. He would like to thank Sebastian Barnes, Boris Cournède, Luiz de Mello, Alain de Serres, Hermes Morgavi, Mauro Pisu, David Turner and participants to the October 2019 Working Party 1 meeting of the OECD Economic Policy Committee for comments and suggestions on earlier drafts of the paper; as well as Veronica Humi for preparing the document for publication.

[2] Because of the paucity of fiscal information in the WEO for Colombia and Costa Rica, they remain the only two countries in the model without a public finance block.

- General government current receipts
- General government current disbursements
- Net capital outlays of the government
- Government fixed capital formation

For some, but not all, of the countries, the WEO database also provides a series for general government net financial liabilities. When it is available, gross financial assets are computed by identity (for other countries, gross financial assets are assumed to be zero). Likewise, the variables listed above allow the computation by identity of a number of other variables (gross interest receipts, etc.).

3. Because long-run scenarios are built around potential output projections, fiscal analyses typically focus on 'underlying' fiscal variables. For instance, fiscal consolidation needs are measured as the necessary increase in the underlying primary balance as a percentage of potential GDP. Underlying variables are obtained by cyclically-adjusting raw variables using a cyclical indicator (usually the output gap) and removing the influence of one-off fiscal operations, the latter being recorded in the EO database in a special 'net one-offs' variable. Unfortunately, the WEO database does not contain information about one-off fiscal operations. Thus, underlying fiscal variables cannot be computed and the public finance block for the new countries instead relies on cyclically-adjusted variables wherever underlying variables are normally used.

4. WEO-based variables for current receipts and current primary disbursements are cyclically adjusted using the latest OECD output gap estimates as cyclical indicators. In the absence of country-specific estimates for the relevant elasticities, however, the OECD averages reported in Price, Dang and Botev (2015[2]) are applied. Specifically, the semi-elasticity of government revenue to the output gap is assumed to be 1.05, while that of primary government expenditure is assumed to be -0.14.

5. Apart from the exceptions just mentioned, as well as the projections of public pension and health care expenditure described in the next two sections, the new public finance block for the 11 countries follows the approach for other countries set out below and in Guillemette and Turner (2017[3]).

3. Public pension expenditure projections

3.1. Motivation and caveats

6. Public pension expenditure is an important component to account for explicitly in a government expenditure projection because of its strong dependence on population ageing. Previously, as described in Guillemette and Turner (2017[3]), public pension expenditure projections entered the model exogenously. The projections for EU countries were sourced from the most recent *Ageing Report* of the European Commission (2018[4]) and those of other countries from Standard & Poor's (2016[5]). One immediately apparent issue is that the two sets of projections are not consistent in methodologies and assumptions. Another issue is that using exogenous series rules out the possibility of changing some underlying assumptions, as well as the possibility of simulating the influence of policy reforms on pension expenditure, such as changes to statutory retirement ages.

7. The revision presented below takes steps to make the projection methodology more consistent across countries and to open up channels for policy settings to influence future pension expenditure. Given wide variation across countries in public pension systems and policies, making accurate projections of future expenditure requires a large amount of information that is beyond the scope of this exercise to collect. Therefore, the exercise remains highly stylised and a few countries continue to be treated differently, although to a lesser extent than before. Future work will seek to improve the accuracy of baseline projections, harmonise methodologies across countries and increase the number of available policy channels.

3.2. Definition and historical data

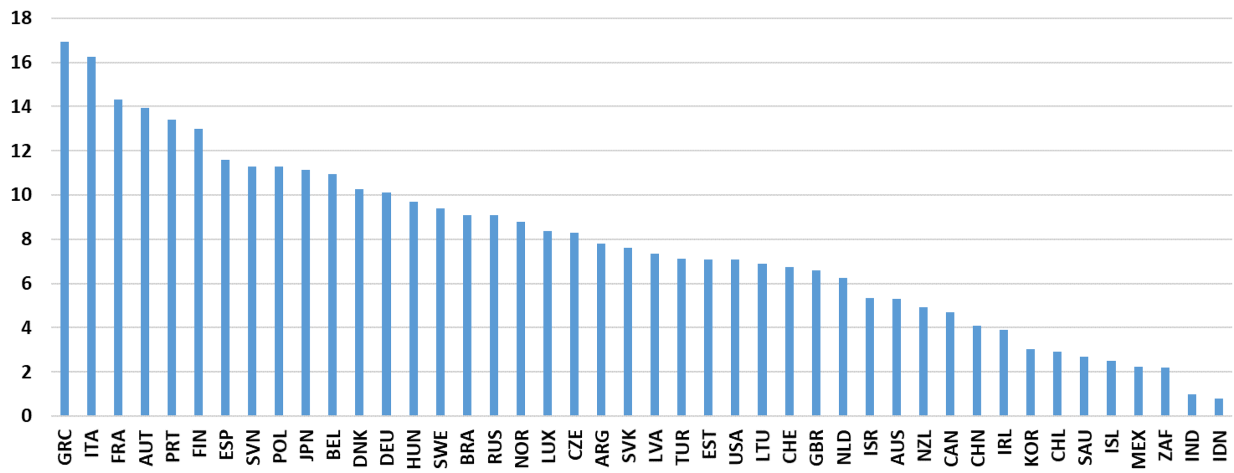
8. Historical data on public pension expenditure come from the OECD Social Expenditure Database (SOCX). The definition used essentially conforms to that of the European Commission and includes four categories of cash benefits from the aforementioned database:

- Old-age pensions
- Old-age early retirement pensions
- Survivors pensions
- Disability pensions

For countries with no historical data in the SOCX database (ARG, BRA, CHN, IDN, IND, RUS, SAU and ZAF), the starting point for the projections is public pension expenditure as a percentage of GDP in 2015 as reported by Standard & Poor's (2016[5]). In 2015, public pension expenditure among the countries in the model averaged 8% of GDP, ranging from 1% in Indonesia to nearly 18% in Greece (Figure 1).

Figure 1. Public pension expenditure, 2015

Percentage points of GDP



Source: OECD Social Expenditure database and Standard and Poor's (2016[5]).

3.3. Projections

9. The approach to projecting future public pension gross expenditure (PPE) starts from the following identity, with time subscript omitted:

$$\frac{PPE}{GDP} \equiv \frac{PENSIONERS}{ETPT} \cdot \frac{AVG\_PENSION}{AVG\_WAGE} \cdot \frac{LAB\_INCOME}{GDP} \quad [1]$$

where PPE is the total of the four categories of expenditure mentioned previously, GDP is nominal gross domestic product, $PENSIONERS$ is the number of people receiving a pension, $ETPT$ is potential employment, $AVG\_PENSION$ is the average pension benefit, AVG_WAGE is the average wage among workers and LAB_INCOME is total labour income. The identity holds because $LAB\_INCOME = AVG\_WAGE \cdot ETPT$ while $PPE = PENSIONERS \cdot AVG\_PENSION$. Taking logs and differentiating [1] yields an expression for the growth rate of public pension expenditure as a share of GDP:

$$\Delta log\left(\frac{PPE}{GDP}\right) \equiv \Delta log\left(\frac{PENSIONERS}{ETPT}\right) + \Delta log\left(\frac{AVG\_PENSION}{AVG\_WAGE}\right) + \Delta log\left(\frac{LAB\_INCOME}{GDP}\right) \quad [2]$$

10. The first term of this expression is the rate of change in the ratio of pensioners to workers. The number of pensioners is not available *per se* in the long-term model, but for projection purposes it is approximated by the following expression:

$$\Delta log\left(\frac{PENSIONERS}{ETPT}\right) \cong \Delta log\left(\frac{(1-ER_{5574}) \cdot POP_{5574} + POP_{75+}}{ETPT}\right) \quad [3]$$

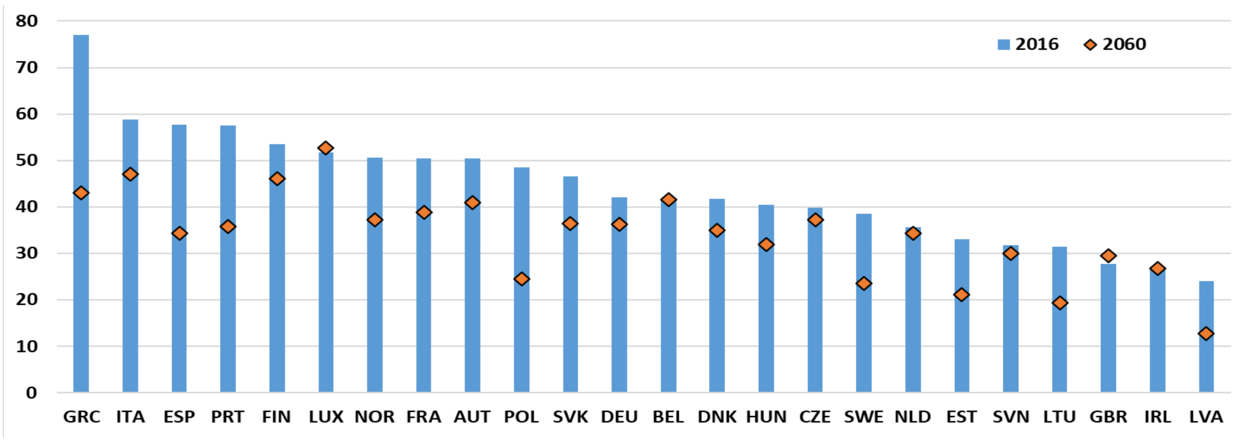
where ER_{5574} is the employment rate for 55-to-74 year-olds (in decimals), POP_{5574} is the population in this age range and POP_{75+} is the population aged 75 and up. This expression appears to imply that unemployed people between the ages of 55 and 74 and all those aged 75 and above are pensioners, but it is only the log *change* in the right-hand side expression that matters for the projections. The idea is that the evolution of the right-hand side ratio is a good proxy for the evolution of the true ratio of pensioners to workers. Variables on the right-hand side of [3] are already present in the long-term model. Detailed population projections are sourced from either Eurostat (for European countries) or the United Nations Population Division (for other countries). Age and sex-specific employment rates are from the OECD Labour Force Statistics database and are projected using a cohort model, taking into account the impact of assumed labour market policy reforms, as described in Guillemette and Cavalleri (2017[6]). Potential employment is the result of aggregating age and sex-specific employment rate projections using population weights.

11. The second term in equation [2] is the rate of change in the ratio of the average pension to the average wage, also called the average benefit ratio (not to be confused with the replacement rate, which usually refers to a new retiree's initial pension as a percentage of her last salary). Its numerator, the average pension, aggregates over all retirees and all types of pensions at a given time. As such, its future evolution depends on many factors, including eligibility rules for new pension benefits, the method used to uprate past earnings in the benefit formulae of defined-benefit plans, the rate of indexation of benefits, the age structure of the population of benefit recipients, rates of return on plan assets, etc. Projecting the future evolution of benefit ratios thus requires a large amount of information, not just on current rules, but also on how they will evolve given the many reforms that have already been legislated in many countries.

12. For the 24 EU countries included in the long-term model, the bi-annual *Ageing Report* of the European Commission (EC) provides projections of average benefit ratios covering the projection horizon of the long-term model (Figure 2). These projections are prepared in collaboration with national authorities and, in principle, account for all the factors mentioned above. There are, however, two issues with using these external projections in the long-term model.

Figure 2. Public pension benefit ratios in European Commission projections

Average public pension benefit, per cent of average wage

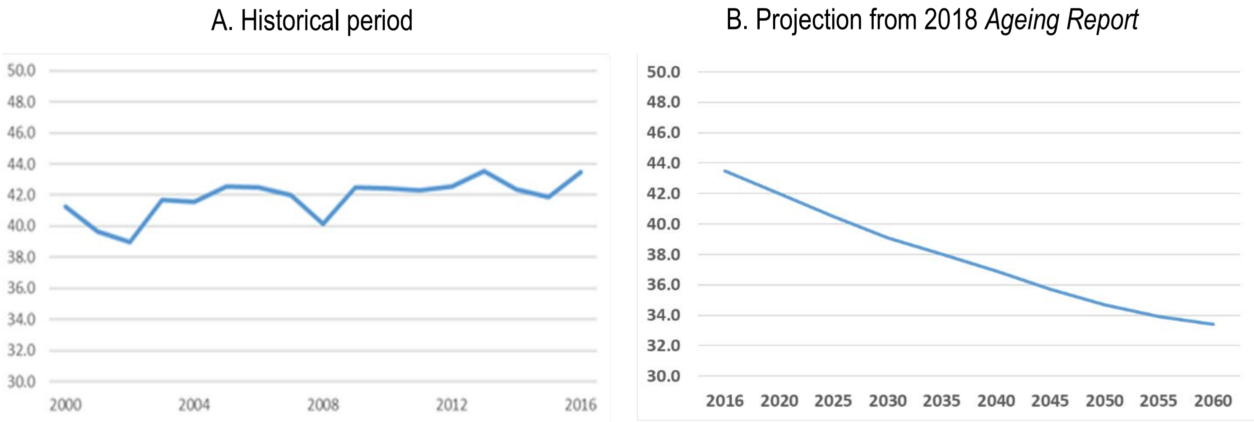


Source: Table III.1.81 in European Commission (2018[4]).

13. The first issue is that comparable average benefit ratio projections are not available for non-EU countries, so an alternative, necessarily simpler, projection approach would have to be devised for these countries, with the obvious drawback that public pension expenditure projections would not be comparable across the two sets of countries.

14. The second issue is that the EC projects substantial declines in average benefit ratios in many countries, a projection at odds with recent experience. From 2000 to 2016, the average pension benefit ratio stayed broadly constant at the aggregate EU level (Figure 3, Panel A). However, the EC projects that this ratio will decline by 10 percentage points of the average wage between 2016 and 2060 (Figure 3, Panel B). In principle, the EC projection reflects current pension system parameters and already-legislated reforms and otherwise assumes unchanged policies. It is difficult to believe, however, that society would accept a continuous decline in the average benefit ratio, especially considering the rising salience of inequality and old-age poverty as political issues. It seems likelier that public pension parameters will be adjusted in future to prevent average benefit ratios from falling.

Figure 3. Average public pension benefit ratio for the European Union



Source: Table III.1.81 in European Commission (2018[4]).

15. An alternative projection paradigm is to treat recent experience as 'revealed policy preferences' and assume that such preferences will hold in future as well. Such a paradigm seems likelier to yield realistic pension expenditure projections and provide a better basis for a fiscal sustainability exercise. Therefore, the approach chosen here is to assume constant average benefit ratios in the baseline projection, which means that projected changes in pension expenditure will stem essentially from demographic change. Alternative policy choices regarding the generosity of public pension systems can then be illustrated in alternative scenarios. This approach is simple to implement for both EU and non-EU countries.

16. Under the simplifying assumption that the indexation rule for existing benefits alone drives the evolution of the benefit ratio over time, its future evolution can be connected to the projected trend labour productivity growth rate. In countries where public pension benefits are indexed to the consumer price index, the average benefit ratio would decline each year by the wedge between nominal wage growth and consumer price inflation (i.e. real wage growth). In the long-term model, real wage growth is equal to labour productivity growth by construction, so under price indexation, the average benefit ratio falls at the rate of labour productivity growth. In countries where public pension benefits are indexed to wages, the average benefit ratio would be constant, so the second term in [2] would always be zero. Some countries use a formula, or a series of discrete adjustments, to maintain the indexation of public pension benefits somewhere between price indexation and full wage indexation. To be able to reflect a range of assumptions in the long-term model, the following expression is adopted to project the second term in [2]:

$$\Delta log\left(\frac{AVG\_PENSION}{AVG\_WAGE}\right) = -(1-\varphi)\cdot\Delta\log\left(\frac{GDPVTR}{ETPT}\right) \quad [4]$$

where φ is a coefficient reflecting the degree to which public pensions are indexed to wages and $\frac{GDPVTR}{ETPT}$ is trend labour productivity. Setting $\varphi = 0$ implies price indexation (minimum generosity), while $\varphi = 1$ implies full wage indexation (maximum generosity). Partial wage indexation can be simulated with a coefficient between zero and one. More work will hopefully be done in future to refine the methodology, taking into account eligibility and benefit calculation rules, indexation rules, demographics, etc. Some of the necessary information has already been collected, at least for OECD countries.[3]

17. This approach easily accommodates the baseline assumption of constant average benefit ratios by setting φ equal to one (even if in reality the simplifying assumptions do not hold and public pension benefits are not fully indexed to wages). In alternative scenarios, lowering φ can simulate the impact of reducing benefit generosity. Exceptions to the assumption of stable benefit ratios are made for Greece, Spain, Portugal and Brazil. The first three carried out extensive pension system reforms after the euro area sovereign debt crisis and, as a result, the EC projects that their average pension benefit ratios, which are currently well above the EU average, will fall more rapidly than the EU average through 2060 (Figure 2). Similarly, the government in Brazil just approved a substantial reform of public pensions, which should lower the average benefit ratio over time. In the case of Greece, Spain and Portugal, the parameter φ is calibrated to imply a fall in average benefit ratios to the current EU average (around 43%) by 2060, which also implies projections much closer to those of the EC for 2060 (see Figure 2). In the case of Brazil, no comparable average benefit ratio is available, but φ is set to zero, implying a fairly rapid decline in benefit generosity.

18. Finally, the third term in equation [2] is the rate of change in the labour share of income. In the long-term model, the labour share of income is assumed constant, so this term is zero.[4]

3.4. Preliminary baseline results

19. Keeping the stylised nature of the approach in mind, projected changes in public pension gross expenditure between 2016 and 2060 range from zero to 11 percentage points of GDP (Figure 4). Differences across countries are due to the following factors:

- *Population ageing*. A rising ratio of people aged 55 and above, and especially 75 and above, to the working-age population (15-74) raises pension expenditure as a percentage of GDP, all else equal.
- *Employment rates*. A rising aggregate employment rate lowers pension expenditure as a percentage of GDP, all else equal. The projected employment rate of 55-to-74 year-olds is especially important as it affects both the numerator and denominator of equation [3]. Employment rates for 55-to-74 year-olds are generally projected to increase on account of past increases in female entry rates into the labour force. Policy reforms can also affect projected employment rates. In the baseline scenario, only already-legislated changes to statutory retirement ages are incorporated. Projected increases in pension expenditure tend to be lower in countries that have legislated such increases, particularly countries that have tied future increases in statutory retirement ages to life expectancy (e.g. Denmark and the United Kingdom).

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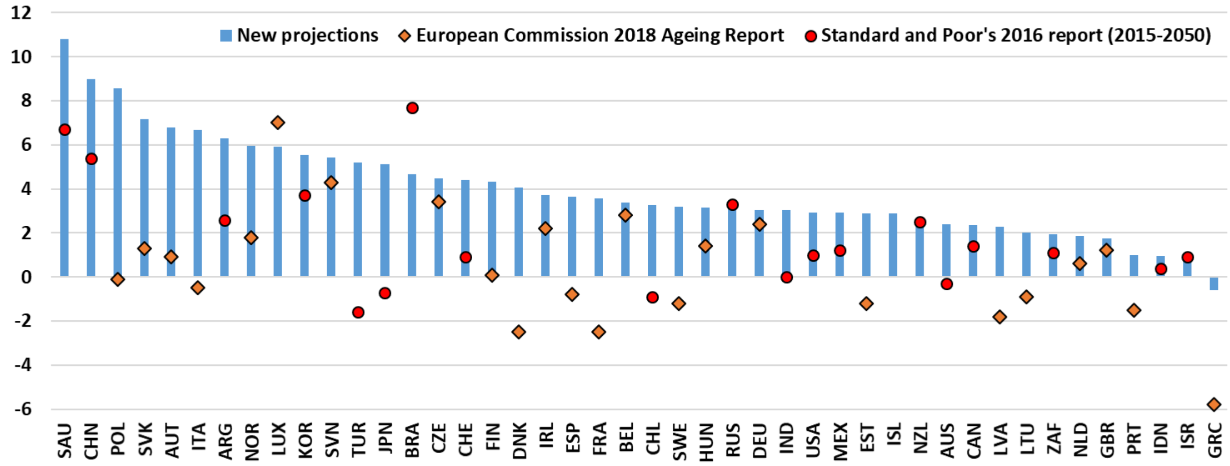
[3] For instance, see indicator 3.6 in Chapter 3 of OECD (2017[20]) for a summary of indexation rules applying to mandatory earnings-related pensions. See also OECD (2019[23]) for information on the evolution of average gross replacement rates for full-career private-sector workers across different cohorts.

[4] In view of the decline of labour income shares in some countries in recent years (Schwellnus et al., 2018[18]), as well as evidence of policy influences behind this trend (Pak and Schwellnus, 2019[19]), the assumption of a fixed labour share of income may be revisited in future model developments.

- *Labour productivity growth.* In countries for which an exception is made and $\varphi < 1$, a higher rate of labour productivity growth lowers pension spending as a percentage of GDP over time. In the baseline scenario, real labour productivity growth converges toward the assumed exogenous rate of technical progress, which is set at 1% per annum. This convergence happens at a slow speed, however, so countries that start with higher labour productivity growth rates, such as emerging-market economies, benefit from more downward pressure on public pension spending as a percentage of GDP, all else equal.

Figure 4. Change in public pension gross expenditure between 2016 and 2060

Percentage points of GDP



Source: Table III.1.66 in European Commission (2018[4]), Table 4 in Standard and Poor's (2016[5]) and authors' calculations. The Standard and Poor's numbers are projected changes from 2015 to 2050, instead of 2016 to 2060.

20. From a public finance perspective, the resulting pension expenditure projections are generally more pessimistic than those of the EC (for EU countries) and Standard and Poor's (S&P, for other countries). In the case of differences with EC projections, the main reason is straightforward: the projections here assume stable average benefit ratios through 2060, save for the aforementioned exceptions, whereas EC projections generally build in falling ratios. In the few cases where the EC projects roughly stable benefit ratios, such as Belgium, Luxembourg, Netherlands, Slovenia, the United Kingdom and Ireland, the two sets of projections are much closer, any difference stemming essentially from differences in the projected evolution of pensioners-to-workers ratios.

21. On the other hand, there is a 6 percentage-point discrepancy between the EC and this paper's projections of the change in public pension expenditure through 2060. This discrepancy cannot be attributed to differences in average benefit ratios, because in both cases this ratio falls to approximately 43% by 2060. The discrepancy is therefore due to differences in projected ratios of pensioners to workers, and more particularly to underlying participation rates for older workers. In the EC projection, the participation rate of 55-to-64 year-olds increases by about 30 percentage points between 2016 and 2060, whereas in this paper the (implicit) participation rate of 55-to-74 year-olds increases by much less. Given that underlying population projections are the same for EU countries, differences in projected ratios of pensioners to workers may be due to a more optimistic view by the EC of the effect of raising statutory retirement ages on participation rates for people nearing retirement. The EC assumption on this score is less transparent as it appears to rely on country-specific calculations.

22. The substantial increases in public pension expenditure projected for Saudi Arabia and China are largely due to unfavourable demographics – i.e. substantial increases in the share of 55+ in the population

15+. In Saudi Arabia, the progression of female employment rates has been limited when compared to OECD countries. Differences with S&P projections are difficult to explain, however, because the S&P methodology and assumptions are not detailed in the public report used as source.

4. Public health expenditure projections

23. Like public pension expenditure, public health expenditure is sensitive to population ageing and is projected separately from other primary expenditure in the fiscal block of the long-term model. In the last set of long-run scenarios, the public health spending projection was based on a reduced form equation similar to that estimated by the Employment, Labour and Social Affairs (ELS) directorate (Lorenzoni et al., 2018[7]).[5] Projected growth in real per capita expenditure on health care was a function of real GDP per capita growth, changes in the share of the population aged 65 and up and a time trend. The time trend was meant to capture the excess of wage inflation over productivity growth in the health sector (Baumol's cost-pressure effect) as well as upward cost pressures due to technological progress. This work has recently been updated by ELS (Lorenzoni et al., 2019[8]). The approach taken here is to retain this basic specification, but replace some of the coefficients with calibrated values based on a study with a wider country coverage more similar to that of the long-term model.

4.1. Definition and source of health expenditure data

24. Historical data on public health expenditure are sourced from the Health Expenditure and Financing database of the OECD. The concept used is per capita health spending financed by government for all functions (including long-term care) and by all providers, in current local currency. The objective being to assess fiscal pressure on governments, all private expenditure are excluded, including expenditure on compulsory health schemes (so-called health mandates, such as the Affordable Care Act in the United States), which are included in public expenditure in Lorenzoni et al. (2019[8]). The OECD database lacks data for Argentina and Saudi Arabia, so historical starting points for these countries are the 2015 estimates reported in Standard and Poor's (2016[5]).

4.2. Projection equation and calibration

25. The annual growth rate of nominal public health expenditure per capita in country *i* and year *t* ($HEPC_{i,t}$), is posited to be a function of growth in real GDP per capita ($GDPV\_CAP_{i,t}$), the share of total population aged 65 or above ($SHARE65_{i,t}$), growth in the GDP deflator ($PGDP_{i,t}$) and a variable, to be explained below, representing the excess of health care price inflation over general inflation ($\theta_{i,t}$):

$$\Delta \log\left(HEPC_{i,t}\right) = \beta_1 \Delta \log\left(GDPV\_CAP_{i,t}\right) + \beta_2 \Delta\log\left(SHARE65_{i,t}\right) + \Delta\log\left(PGDP_{i,t}\right) + \theta_{i,t} \quad [5]$$

The first two terms of the equation can be thought of as determining the evolution of the volume of health care services provided, and the last two terms as determining the evolution of health care prices. Both real GDP per capita and the GDP deflator are endogenous variables in the long-term model, while the share of total population aged 65 and above is an already-present exogenous variable.

[5] The health expenditure projection is described as exogenous in Guillemette and Turner (2017[3]) because it was at the time. By the time the last set of long-term scenarios were published, the projection had been endogenised, as described in Box 3 of Guillemette and Turner (2018[1]).

4.2.1. Income elasticity of health spending

26. The income elasticity of public health expenditure (β_1) is estimated in Lorenzoni et al. (2018[7]; 2019[8]) at 0.8, in line with many recent studies indicating that health care is a normal good. However, Lorenzoni et al. (2018[7]; 2019[8]) use a panel of OECD countries and as a result consider almost exclusively high-income countries. As they note, some studies find that the income elasticity of health spending is higher in middle-income countries. When considering a larger panel of 173 countries, Farag et al. (2012[9]) obtain an income elasticity of 0.6 for high-income countries and 0.9 for middle-income countries, following the World Bank income groups. The latter study considers total health expenditure as opposed to just public expenditure, but in Lorenzoni et al. (2019[8]) the two concepts yield similar elasticities.

27. Given that the long-term model includes a number of middle-income countries, distinguishing the income elasticity for middle-income countries is appealing. It implies a faster progression of health spending per capita as long as a country remains below the middle-income threshold, which is consistent with middle-income countries expanding social safety nets as they get richer. Therefore, β_1 is assumed to take the value of 0.9 for middle-income countries and 0.7 for high-income countries, the latter being the mid-point between preferred estimates for high-income countries in the studies cited previously. The income threshold for moving into the high-income group is set at USD 22 500 at 2015 Purchasing Power Parities, approximately matching the current World Bank's threshold, which is set in terms of gross national income and adjusted periodically.[6] If a country passes this threshold over the projection period, the lower elasticity applies henceforth.

4.2.2. Impact of population ageing on health spending

28. The coefficient β_2 captures the effect of population ageing on public health expenditure. A 1% increase in the share of the population aged 65 or more is assumed to raise real public health expenditure per capita by 0.4%. The calibration is based on the preferred specification of Lorenzoni et al. (2019[8]). Farag et al. (2012[9]) also estimate a positive association between the population aged 65 and above and total health expenditure per capita. The possibility of so-called 'healthy ageing' helping to lower health expenditure in the future is not taken into account in the projection equation.[7] In any case, as health care costs are typically concentrated at the end of life, healthy ageing may not reduce, so much as delay, costs and may well imply higher expenditure on long-term care, which are included in the definition used here.

4.2.3. Other factors

29. Rising income per capita, demographic change and GDP inflation are typically not sufficient to explain the historical increase in nominal public health spending per capita. In other words, when subtracting the influences of these three factors from the historical increase in health spending, a positive residual generally remains (Figure 5). In some countries, this residual accounts for as much as a third of the increase in health spending over the 1990-to-2017 period. For modelling purposes, this residual is assumed to capture factors that raise health care price inflation above GDP inflation and is represented by the variable $\theta_{i,t}$ in equation [5]. In reality, it could also capture volume effects, but few countries calculate price indices specific to the health care sector, allowing volume effects to be disentangled from price effects. There is little doubt in any case that health care prices have historically risen faster than broader output prices. In the United States, for example, the personal health care overall price index calculated by

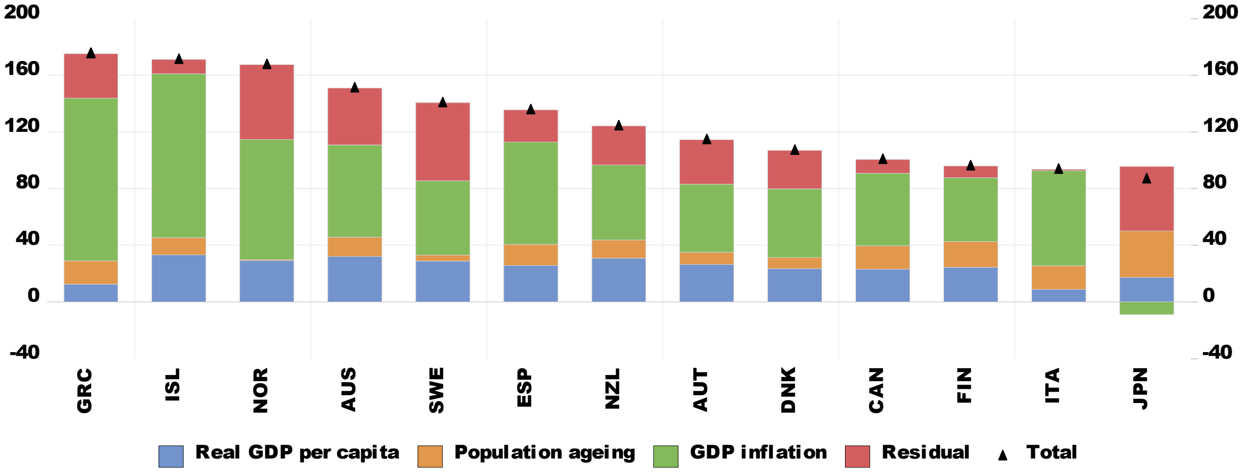
[6] This places Argentina, China, India, Indonesia, Mexico and South Africa in the middle-income group, among countries with a fiscal block in the model.

[7] When added to simple reduced-form equations such as the ones on which the calibration is based, life expectancy typically has a positive influence on health spending. This counterintuitive result is likely due to collinearity between life expectancy and omitted explanatory variables.

the Centers for Medicare and Medicaid Services has risen by 0.5 percentage points faster annually than the GDP deflator since 1996. Other price indices show a similar trend, probably reflecting two main influences.

Figure 5. Decomposition of change in public health expenditure from 1990 to 2017

Per cent increase in nominal public health expenditure per capita in selected countries



Note: The decomposition is done in logs following equation [5] above with coefficients calibrated as explained in the text. Only countries with health expenditure data going back to at least 1990 are shown.

30. The first influence is Baumol's cost disease. This cost-pressure effect occurs in sectors, notably labour-intensive ones, where the technology is such that labour productivity grows more slowly than in the rest of the economy. Because these sectors must compete for labour with other sectors, wage growth must remain in line with total-economy wage growth, itself in line with total-economy productivity growth. Thus, unit costs tend to rise over time. The second factor is the impact of technological change on health care costs. Unlike in many other sectors, new technologies in the health sector appear not to raise productivity so much as quality and costs, a case in point being effective but expensive new pharmaceuticals.

31. Incorporating these influences in a projection is not straightforward. One approach would be to assume that country-specific residuals (in red in Figure 5) persist over the projection horizon. There are three main problems with this approach, however. The first is that series on health spending have only short histories for many countries – hence the restricted selection of countries in Figure 5. A second concern is that while it makes sense to incorporate Baumol's cost-disease effect in some fashion, because it seems likely that health care will remain a labour-intensive sector subject to lower productivity growth than the general economy, it might be pessimistic to assume that technology is forever going to push costs up. Thirdly, since the Baumol effect is due to the wedge between total-economy productivity growth and health-sector productivity growth, it would make sense to endogenise the size of this effect to the projected rate of productivity growth in the overall economy. In particular, with labour productivity growth rates slowing across most economies, the cost-disease may be less severe in the future than in the past. At the same time, with such a setup, reforms that increase total-economy productivity growth would tend to worsen the cost disease (by boosting wages).

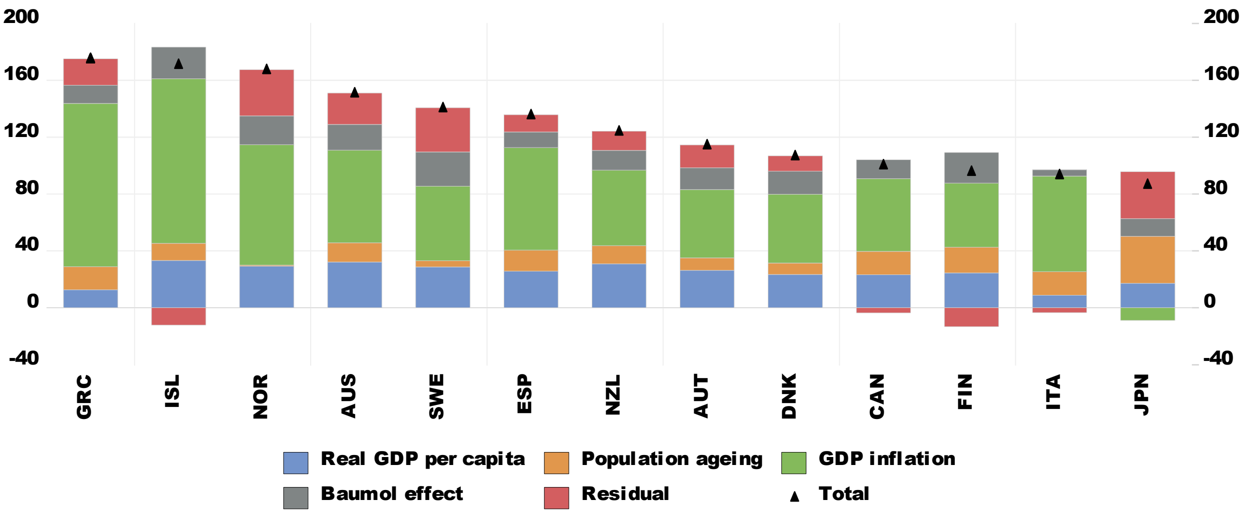
32. The chosen modelling approach is to make the excess of health care inflation over general inflation equal to one-half the rate of aggregate labour productivity growth. So the final health care expenditure projection equation becomes:

$$\Delta \log(HEPC_{i,t}) = \beta_1 \Delta \log(GDPV\_CAP_{i,t}) + 0.4\, \Delta\log(SHARE65_{i,t}) + \Delta \log(PGDP_{i,t}) + 0.5\, \Delta\log(PDTY_{i,t}) \quad [6]$$

where $PDTY_{i,t}$ is trend labour productivity and β_1 is 0.7 for high-income countries and 0.9 for middle-income countries. The coefficient of one-half is arbitrary, but reflects the assumption that productivity growth in the health sector is somewhere between zero and the total-economy rate. Applying this approach to the historical decomposition shown previously, in most countries the additional factor absorbs some, but not all, of the unexplained residual (Figure 6). This means that even with the assumed Baumol effect, the equation often under-predicts increases in public health expenditure per capita between 1990 and 2017. At the same time, the equation over-predicts the change in expenditure over this period for a few countries (Iceland, Canada, Finland and Italy). The assumed 0.5 coefficient therefore appears broadly reasonable. Residuals could be further reduced by making the assumed coefficient on labour productivity country specific, but again the lack of long time series for many countries make this approach impractical.

Figure 6. Decomposition of change in public health expenditure from 1990 to 2017

Per cent change in nominal public health expenditure per capita in selected countries



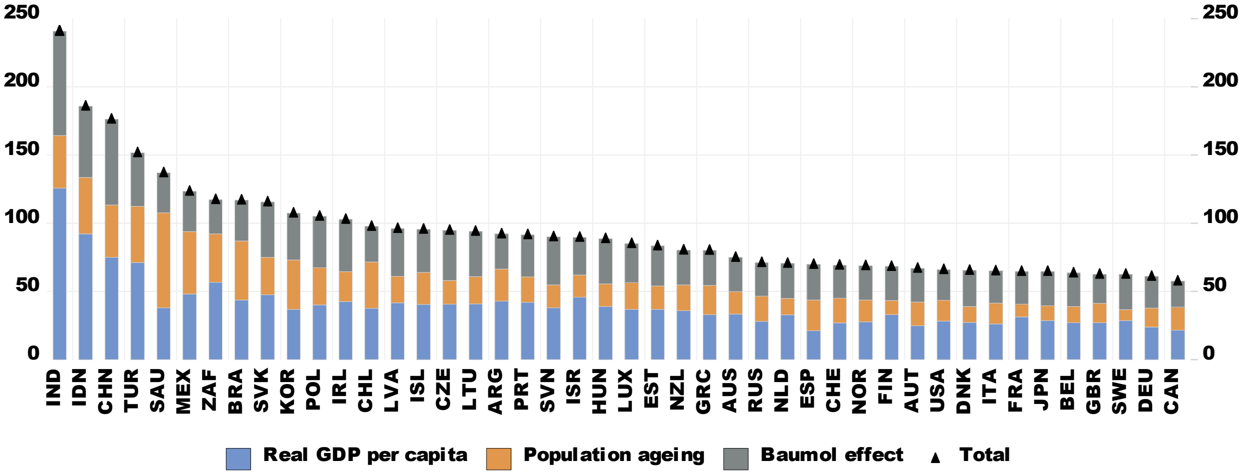
Note: The decomposition is done in logs following equation [6] with coefficients calibrated as explained in the text. Only countries with health expenditure data going back to at least 1990 are shown.

4.3. Preliminary baseline projections

33. To generate projections, equation [6] is applied as of the last historical data point for public health expenditure per capita, using in turn historical and projected values for the explanatory variables. Between 2019 and 2060, public health expenditure per capita in real terms (i.e. relative to the GDP deflator) are expected to increase by 85% in the median country, with most of the increase driven by income growth, about a third due to the assumed Baumol effect and about a quarter due to population ageing (Figure 7). The projected increases in health spending are strongest in middle-income countries at the start of the projection period given their faster income growth and higher income elasticity. Because of their higher labour productivity growth rates, the projected Baumol effects are also highest in emerging-market economies. More than 40 percentage points of increase in real health spending is attributable to population ageing in Brazil, Mexico, Turkey and Indonesia, a direct result of the projected change in the population share aged 65 and above.

Figure 7. Projected change in per capita public health expenditure from 2019 to 2060

Per cent change in real* per capita public heath expenditure

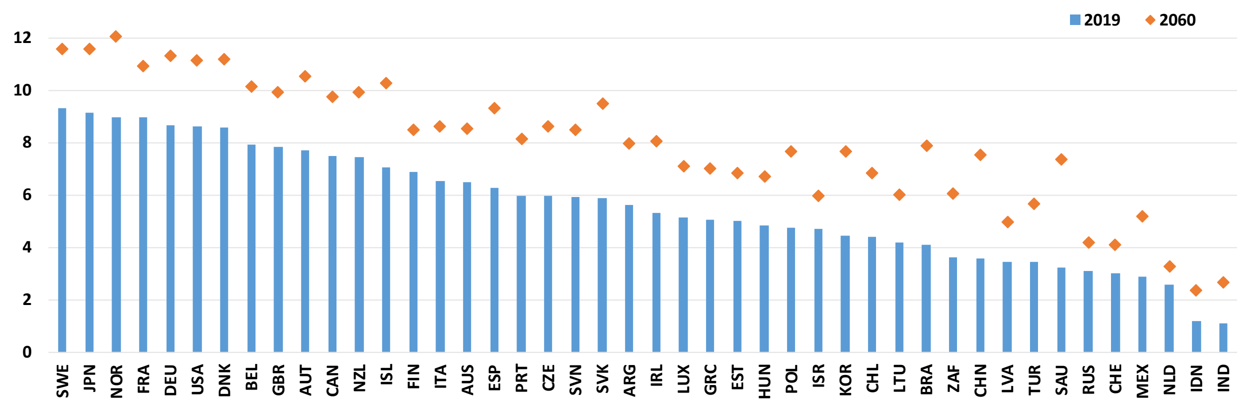


Note: *Real health expenditure is relative to the GDP deflator, not to a health care-specific price index.

34. It is more customary to present the projected increase in health expenditure in percentage-points-of-GDP terms. In the median country, public health expenditure increases by 2.3 percentage points of GDP from 2019 to 2060, ranging from 0.7 in the Netherlands to 3.8 in Brazil (Figure 8). Again, increases are strongest in countries classified as middle-income at the start of the projection period. Among other countries, differences stem mainly from the relative importance of ageing as opposed to income growth in driving higher per capita health expenditure. The greater the relative contribution of income growth, the lower the projected increase in health expenditure in percentage points of GDP terms given the offsetting effect of the denominator. For instance, while real per capita public health expenditure increases by about 70% in both Spain and Switzerland by 2060, the increase in percentage points of GDP is more pronounced in the case of Spain (3.1 vs 1.1 percentage points of GDP) because the relative contribution of population ageing is larger in Spain. Moreover, for a given income gain, health spending as a share of GDP increases more if the income gain stems from labour productivity gains as opposed to a higher employment rate, all else equal. This occurs because higher productivity worsens the Baumol effect, while higher employment does not.

Figure 8. Projected public health expenditure

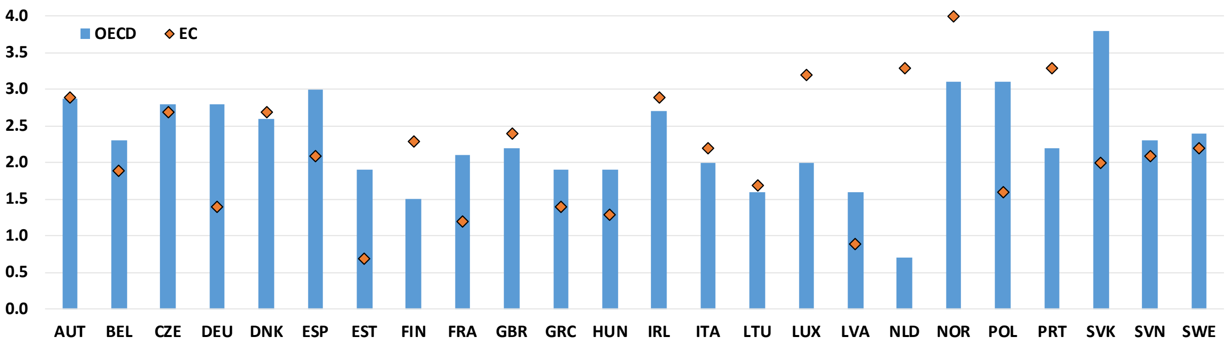
Per cent of GDP



35. Among the 24 European countries for which coverage overlaps, projected increases in health spending as a percentage of GDP using the methodology just set out can be compared with the reference scenario of the European Commission (EC) (2018[4]). The projected increases in health spending are similar (within 0.6 percentage points of GDP) for half of the countries (Figure 9). Not so for the other half, but the many methodological differences make it difficult to pinpoint reasons for the discrepancies. The EC projects long-term care expenditure separately from the rest of public health care expenditure and it projects that these will rise particularly strongly (by more than 2 percentage points of GDP) in Luxembourg, the Netherlands and Norway, three of the countries for which the EC projects substantially stronger increases in overall health expenditure than this study. Other differences probably stem mostly from the more country-specific approach used by the EC, including country-specific age/sex expenditure profiles, leading to more cross-country variability in the projections. The reduced-form approach outlined in this section may well be less detailed but, as for pension expenditure projections, the loss of accuracy is the trade-off for the benefits of endogenising the projection to other long-term model outcomes, in both baseline and alternative scenarios, as well as ensuring consistency of treatment across countries.

Figure 9. Change in public health care expenditure between 2016 and 2060 in EU countries

Percentage points of GDP



Note: The EC numbers add up health care and long-term care expenditure, which are projected separately, while the combined expenditure aggregate is modelled in the OECD approach.
Source: Tables III.1.104 and III.1.116 in European Commission (2018[4]) and author's calculations.

5. A new equation to project long-term interest rates

36. The interest rate definitions used in the long-term model are the same as in the *OECD Economic Outlook* short-run projections, which serve as starting point for the long-run scenarios. The short-term rate corresponds to the three-month interbank offer rate attaching to loans given and taken amongst banks for any excess or shortage of liquidity over several months, or the rate associated with Treasury bills, Certificates of Deposit or comparable instruments of three-month maturity. It often stands in for the policy rate, even though there can be slight differences between the official policy rate and the three-month interbank rate. The long-term interest rate corresponds to the yield on a benchmark ten-year government bond.

5.1. Previous approach and motivations for revision

37. The previous approach to projecting long-term interest rates had essentially not changed from that set out in Appendix 10 of Johansson et al. (2013[10]). The long-term interest rate of country *i* in year *t* ($IRL_{i,t}$) is calculated as a forward convolution of short-term interest rates ($IRS_{i,t}$), to which is added a term premium ($TERMPREM_{i,t}$) and a fiscal risk premium ($FISCALRISK_{i,t}$):

$$IRL_{i,t} = TERMPREM_{i,t} + \sum_{n=0}^{9} \frac{IRS_{i,t+n}}{10} + FISCALRISK_{i,t} \quad [7]$$

As described in Johansson et al. (2013[10]), short-term interest rates are projected in two steps. First, there is a neutral short-term interest rate, which depends on a country's real potential growth rate and its inflation target. Neutral interest rates also used to include a premium, common to all countries, related to the global saving/investment balance, but this approach proved impractical and was abandoned some time ago. Second, the actual short-term interest rate is assumed to converge toward the neutral rate following an error-correction process. The neutral short-term interest rate thus serves as anchor for both short-term and long-term interest rates. However, given great uncertainty as to current neutral interest rates across countries, and even greater uncertainty as to their future evolution, future long-term fiscal sustainability analyses will rely on multiple scenarios for the evolution of neutral interest rates.

38. Because equation [7] sets the level of the long-term interest rate (as opposed to its first difference), it does not fit perfectly with historical data at the jump-off point between the historical and projection periods. The term premium serves as an adjustment mechanism to transition smoothly to the equation's prediction. The implicit historical term premium according to equation [7] converges gradually to an assumed equilibrium value.

39. The fiscal risk premium is intended to capture country-specific lending risk associated with a country's fiscal position. It is set to 2 basis points for each point of gross government debt in excess of 75% of GDP, and an additional 2 basis points for each point of gross government debt in excess of 125% of GDP. There are several issues with this approach, however. For one, premia are determined irrespectively of broader economic conditions and particular country characteristics. For instance, Japan's very high gross government debt ratio does not appear to be reflected in its long-term interest rate. As a result, Japan is treated differently, with half of the usual risk premium applied, but this exception is not satisfactory since Japanese government bond yields do not appear to incorporate any fiscal risk premium. Moreover, there is no consensus in the literature, much of it post-financial crisis, on specific debt thresholds for the emergence of risk premia, or for a negative effect on growth.[8] Research has also found differences in the way interest rates of countries belonging to a currency union, such as the euro area, respond to fiscal stress relative to countries that enjoy monetary autonomy. Finally, the reliance on gross, as opposed to net, government debt neglects the impact of government financial assets on fiscal sustainability. There are a number of OECD governments with substantial financial assets – including Australia, Canada, Japan, Sweden and Switzerland – where net debt positions differ substantially from gross ones.

40. In view of these concerns, the revision to the determination of the fiscal risk premium has several objectives:

- Replace gross government debt with net government debt and eliminate debt thresholds.
- Allow the fiscal risk premium to turn on or off depending on the occurrence of financial crises, which would also help simulate the fiscal implications of future crises.
- Differentiate countries which supply global safe assets, and whose interest rates tend to decline in periods of global financial stress following a flight-to-safety effect, from countries that are not providers of global safe assets and whose interest rates tend to spike in crisis periods.
- Differentiate between euro area and other countries on the basis that default risk is inherently higher when a country cannot issue its own currency.

[8] See Panizza and Presbitero (2013[21]) for a survey of the literature. See also Égert (2013[22]).

5.2. Estimation framework and results

41. The estimation setup relies on the conventional framework set out previously whereby the long-term interest rate of country *i* in year t ($IRL_{i,t}$) is based on (a proxy for) expected future short-term rates, a fixed term premium (θ_0) and a variable fiscal risk premium. Specifically, the following system of equations is estimated:

$$IRL_{i,t} = \theta_0 + \theta_1 IRS_{i,t} + \theta_2 GAP_{i,t} + \sum_l \beta_l Z_{l,i,t} + \mu_{i,t} \qquad \forall\, i \qquad [8]$$

The summation expression represents the fiscal risk premium, modelled as a function of l factors (Z_l), some of which are interaction terms that condition the size of the premium on certain country characteristics or episodes. $\mu_{i,t}$ is an error term. Forty countries are included in the estimation sample and the 40-equation system is estimated with Seemingly Unrelated Regression on annual data spanning the period 1978 to 2018 (Table 1). Only the preferred specification, retaining the most robust effects, is shown and discussed below.

Table 1. Regression results for long-term interest rates

Dependent variables are short and long-term interest rates in per cent in a system of equations

A. Main linear determinants of long-term interest rates

Explanatory variable	Coefficient estimate
Constant (term premium)	2.359***
Short-term interest rate, per cent	0.659***
Output gap, per cent	-0.097***
Government net lending < 0, per cent of GDP	-0.099***
Net government debt, per cent of GDP	See Panel B
Percentage of world GDP undergoing banking crisis	See Panel B

B. Non-linear state-dependent effects on long-term interest rates

Explanatory variable	Effect conditional on…			Coefficient estimate
	Euro area member	Year of banking crisis	Provider of safe assets	
Net government debt, per cent of GDP				0
Net government debt > 0, per cent of GDP	Yes	Yes	No	0.173***
Net government debt > 0, per cent of GDP	No	Yes	No	0.034***
Interaction between net government debt > 0 and rule of law	Yes	Yes	No	-0.144***
Interaction between net government debt > 0 and rule of law	No	Yes	No	-0.037***
Percentage of world GDP undergoing banking crisis			Yes	-0.012***

Note: The estimated system includes individual long-term interest rate equations for 40 countries. They are estimated simultaneously using Seemingly Unrelated Regression (SUR), which accounts for heteroskedasticity and contemporaneous correlation in the errors across equations. The estimation period depends on data availability but ranges from 1978 to 2018 at the most. The total number of observations is 1084. Asterisks (***) indicate that the coefficient estimate is statistically significant at the 1% level. See main text for variable sources and explanations.

42. The following explanatory variables are included:

- *Constant*. A constant stands in for the term premium, which is not only assumed to be fixed, but also common to all countries. These are simplifying assumptions for estimation that make it possible to ‘explain’ the evolution of interest rates and their differences across countries with other, more fundamental, factors. In practice, the previous approach outlined previously, of using the term premium as an implicit residual to transition smoothly from the historical period to the equation’s predicted values, will be kept. The equilibrium term premium may also be calibrated to a value lower than the 236 basis points estimated here given empirical evidence that term premiums have been declining over time (Cohen, Hördahl and Xia, 2018[11]).
- *The short-term interest rate and the output gap*. The variables are sourced from the OECD Economic Outlook No. 105 (henceforth EO) database. The two variables together are intended to proxy for expected future short-term interest rates. In practice, the model equation uses the 10-year forward convolution of projected short-term interest rates (see equation [7]) and the solver iterates over time until the long-term rate in a given year is consistent with projected short-term rates for the next 10 years. The estimated coefficients indicate that a 1-percentage point increase in the short-term interest rate is associated with a 66-basis point increase in the long-term interest rate, while a 1-percentage point increase in the output gap is associated with a 10-basis point decline in the long-term rate. The output gap effect presumably reflects expectations that the short-term rate will eventually decline when the output gap is positive.
- *Government net lending if negative*. This variable is from the EO database (for most countries) or the IMF World Economic Outlook (WEO) database (for some non-OECD G20 countries). When net lending is negative, meaning that the government sector runs a deficit, each percentage point of GDP in deficit is associated with a risk premium of 10 basis points. The effect is small, but is only one part of the overall fiscal risk premium.
- *Government net debt*. This variable is from the EO database (for most countries) or the WEO database (for some non-OECD G20 countries). When entering the equation unconditionally, government net debt is estimated to have no effect on long-term interest rates. However, net debt does impact risk premiums if a country is undergoing a systemic banking crisis, has positive net debt and is not a provider of safe assets (Table 1, Panel B):
    - *The country is undergoing a systemic banking crisis.* The classification relies on Laeven and Valencia (2018[12]), who identify 151 systemic banking crises episodes around the globe during the 1970-2017 period.
    - *Government net debt is positive*. In the opposite case, i.e. when a government holds more financial assets than liabilities, there is no premium, which makes intuitive sense.
    - *The country is not a provider of safe assets.* A country is classified as a provider of safe assets in a given year if its Standard and Poor’s sovereign debt rating is A+ or higher as reported in IMF (2012[13]) and updated for years since. A country’s classification can change over time: for instance, Spain is coded as a safe asset provider until 2011, but not after, which is consistent with the classification of Caballero, Farhi and Gourinchas (2017[14]).

  When these three conditions are simultaneously met, the size of the fiscal risk premium associated with government net debt depends on whether the country is part of the euro area or not and on the quality of its governance.

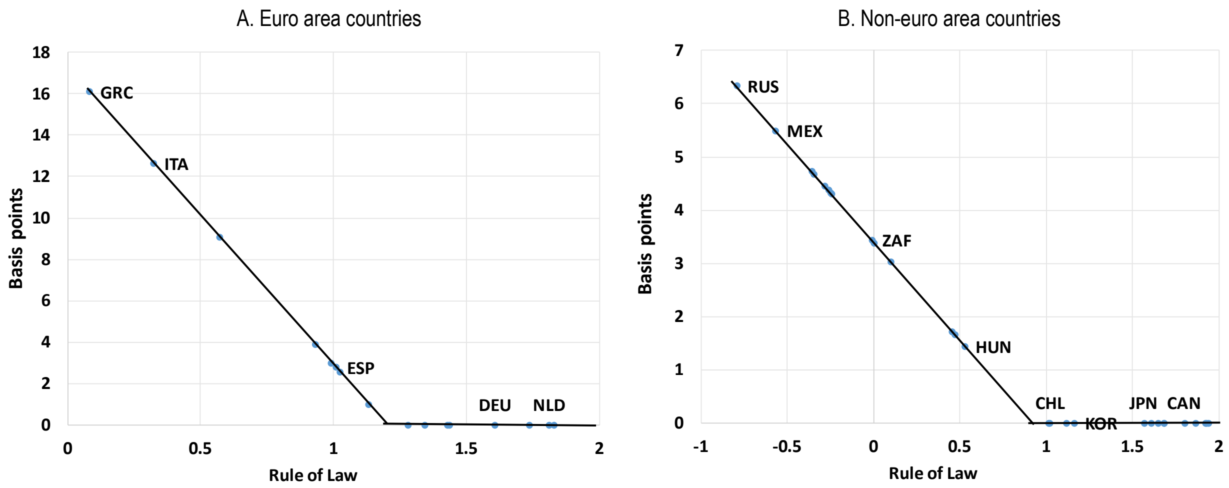
    - Countries are coded as part of the euro area from their year of entry into the currency union.
    - Governance quality is measured by the rule of law score, one of six governance indicators published by the World Bank (Kaufmann, Kraay and Mastruzzi, 2010[15]). It is a perceptions-based index intended to capture “…the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence”. Coverage only starts in

1996, however, so the first available value is assigned to previous years. The indicator varies between -3 (worst) and 3 (best) and averages zero across all countries covered by construction.

The estimation results determining the size of the fiscal risk premium are easiest to grasp by giving illustrative examples (Figure 10). Again, these apply only to countries that are not providers of safe assets during a systemic banking crisis:

- For a euro area country with average global governance, the fiscal risk premium is 17 basis points for each percentage point of GDP of positive net government debt, but all euro area countries included in the long-term model score better on governance than the global average. The highest premium is for Greece with 16 basis points. If rule of law is equal to 1 (about the level for Spain), then the premium is reduced to 2 basis points and it falls to zero when rule of law reaches 1.2.
- For non-euro area countries with average global governance (e.g. South Africa), the fiscal risk premium is 3 basis points for each percentage point of GDP of positive net government debt. If rule of law is equal to 0.9 (about the level for Chile), then the premium falls to zero. If governance is worse than average, the premium is larger: it goes up to 6 basis point for Russia.

Figure 10. Fiscal risk premium per percentage point of net government debt during systemic banking crisis



Note: The figure illustrates the fiscal risk premium associated with each percentage point of net government during a systemic banking crisis according to the empirical estimates in Table 1, Panel B. Selected countries are labelled.

The idea that government debt influences risk premiums only in crisis periods is borne out by the euro area experience. Even in euro area countries with significant fiscal challenges, long-term interest rates were similar to Germany's prior to the onset of the global financial crisis in 2008. The finding that government debt accumulation affects risk premia to a greater extent within the euro area than outside of it has intuitive appeal because the greater uncertainty around the role of the ECB as lender of last resort magnifies the perceived risk of default in a currency union (De Grauwe, 2012[16]; Krugman, 2014[17]). Finally, the idea that countries with better governance benefit from lower risk premia also has intuitive appeal because better governance ought to go hand in hand with lower risk of default.

- *Percentage of world GDP undergoing systemic banking crises*. This indicator is calculated from the database of banking crises mentioned previously and GDP in US dollars at market exchange rates from the World Bank's World Development Indicators database. It is defined as the sum of GDPs of countries undergoing a banking crisis as a percentage of world GDP. It is typically less than 5% but reached 15-20% during the 1998 Asian financial crisis and upwards of 50% in 2008/09 during the worst of the global financial crisis. The estimated coefficient on this variable captures the flight-to-safety phenomenon that occurs during financial panics allowing sovereigns with high government debt ratings to borrow more cheaply. It indicates that in countries that are providers of safe assets, long-term interest rates decline by 1 basis point for each percentage point of world GDP undergoing a banking crisis.

43. The new long-term rate equation improves the determination of fiscal risk premia considerably over the previous approach. For instance, despite its high gross government debt ratio, Japan is no longer predicted to have a large fiscal risk premium provided it remains recognized as a provider of safe assets. Instead, it can benefit from the flight-to-safety effect in periods of worldwide financial stress, which is what appears to occur in practice.

44. The determination of fiscal risk premia remains imperfect, however. One disadvantage is that implied risk premia are very sensitive to the coding of systemic banking crises. In reality, the increase in interest rates sometimes follows, rather than coincides with, banking crisis episodes. If a banking crisis ends with a sovereign bailout, for instance, it makes sense that fiscal risk would be highest following the bailout. In addition, the equation is unable to capture broader concerns about a possible exit from the common currency itself, which came to the fore during the Greek debt crisis, but affected risk spreads in other countries as well. These factors explain to some extent why the equation under-predicts euro area risk spreads post-2010 (Figure 11). While the equation performs well for Spain, it misses the impact of the euro area sovereign debt crisis on Italian bond spreads because Italy's systemic banking crisis (shaded area) preceded the broader euro area crisis. Portugal's systemic banking crisis extended into the sovereign debt crisis period, so the equation performs better, but still under predicts the size of the spread. Finally, the equation undershoots the very large increase in Greek spreads that occurred around 2012, but the underlying 'actual' yields are synthetic as there was essentially no market for Greek government debt during this period.

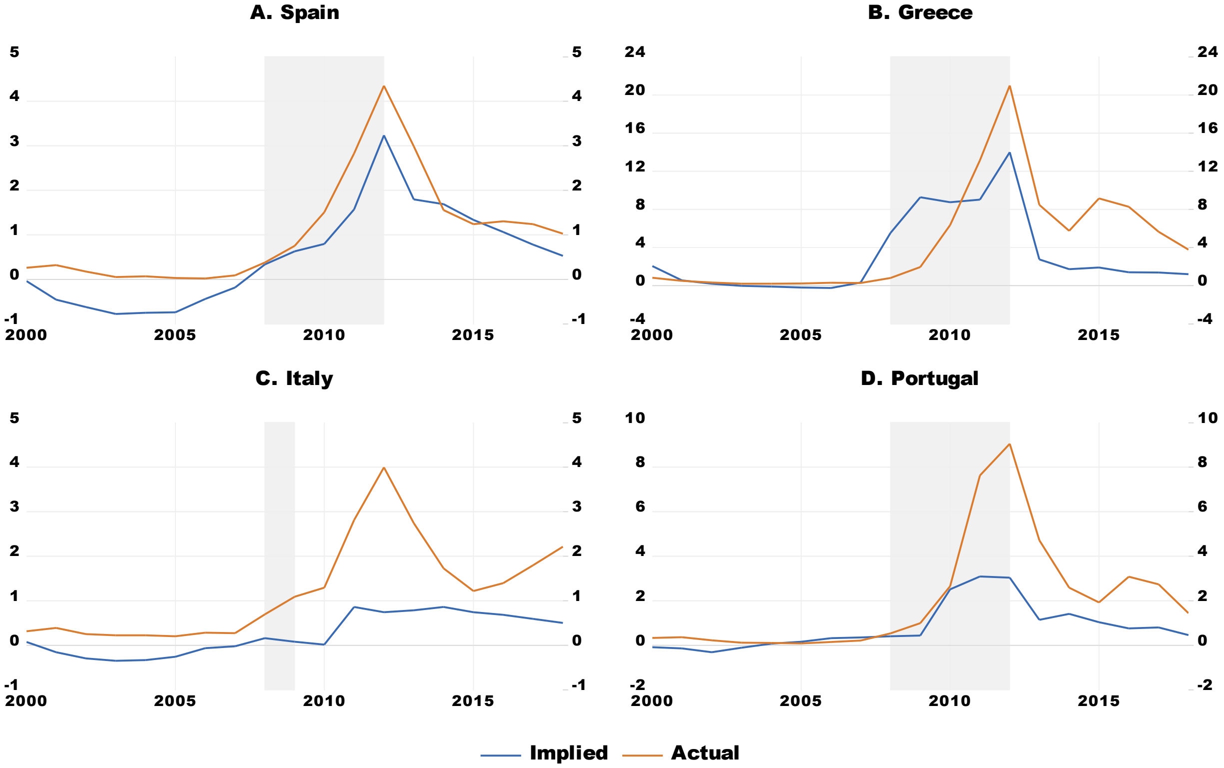
5.3. Implementation in the long-term model

45. The estimated coefficients relating to the fiscal risk premium (β_l in equation [7]) can be incorporated directly into the long-term model. However, as explained previously, the first two terms of equation [7] take a different form in the model equation. The term premium is used to transition smoothly from the long-term interest rate at the jump-off point to the equation's predicted value. Also, instead of the constant term premium estimated here of 236 basis points, which corresponds to an average over the sample period, the parameter is calibrated to a lower equilibrium value to more closely reflect current market conditions. And the second and third terms of [7] are replaced in the model equation with the actual forward convolution of projected short-term interest rates, so that short and long-term rates are time consistent.

46. Future baseline scenarios can be based on the assumption that no financial crisis occurs, but the implications of such crises on fiscal sustainability can be assessed in variant scenarios. Being anchored to projected short-term interest rates, long-term interest rates will be sensitive to projected neutral short-term interest rates. As explained previously, given wide uncertainties around these neutral rates, fiscal sustainability analyses will make use of several different scenarios.

Figure 11. Implied and actual spreads over Germany's long-term interest rate

Percentage points



Note: Shaded areas indicate the occurrence of a systemic banking crisis as per Laeven and Valencia (2018[12]).

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