

II. Special topics on the euro area economy

II.1. The effects of a slowdown in total factor productivity growth and ageing on GDP growth, inflation and interest rates

Demographic ageing and the slowdown of productivity growth are considered as two concerns for medium-term growth prospects affecting the euro area prior to the financial crisis, that have gathered further momentum since 2008. This section presents a model-based assessment of the effects of changes in total factor productivity (TFP) and the dependency ratio on the euro area economy. In particular it assesses their short- and medium-term impact on growth, inflation and interest rates. Interestingly, these underlying alleged causes of secular stagnation, which accelerated in 2008, produce distinct macroeconomic effects, particularly when assessed over different time horizons. Both shocks generate demand- and supply-side effects leading to a substantial decline in GDP growth, a sizeable fall in inflation, and a drop in interest rates. Following a temporary decline in TFP, the short-term fall in GDP growth is stronger than in the case of an ageing shock, but GDP, inflation and interest rates return to baseline in the medium-term. The shock to the dependency ratio causes the GDP deflator and the nominal interest rate to decline by more than the shock to TFP in the short run due to increases in savings and a fall in consumption. Its GDP effect, while much smaller in the short-term is also much more protracted and still visible in the medium term. The ageing shock also produces an increase in inflation in the medium-term following the projected reduction in labour supply. In the current economic juncture, an expected decline in productivity and a deterioration of demographic trends could leave Europe particularly vulnerable to stagnation following adverse shocks in the region. ⁽¹⁶⁾

Introduction

After the financial crisis, actual and potential GDP growth has been slowing in many industrialised countries and in the euro area, in particular. There is also a wider debate about secular stagnation

which, according to Larry Summers,⁽¹⁷⁾ began prior to the financial crisis and is characterised by demographic ageing and a slowdown in productivity growth (see, for example, Gordon (2014) ⁽¹⁸⁾).

This section presents the results of model simulations to assess the effects of a decline in productivity and ageing on the European economy in the short- and the medium-term. It complements previous contributions in this Report on the topic of secular stagnation,⁽¹⁹⁾ by assessing the duration and magnitude of the change in output, interest rates, inflation, labour productivity and employment caused by changes in TFP and the dependency ratio from 2008 to 2025.

In the current setting of low GDP growth, inflation and interest rates, all of which are legacies of the global financial crisis, a decline in productivity and a deterioration in demographic trends could weaken Europe's resilience in facing additional adverse shocks in the region. This is especially likely in the current environment of limited fiscal space and constraints on monetary policy. Looking ahead, it is therefore important to understand the consequences of such effects on aggregate economic activity and, in particular, on inflation and interest rates.

Cette, Fernald and Mojon⁽²⁰⁾ present evidence in support of the fact that productivity growth in Europe was slowing down prior to 2008, especially with respect to the US.⁽²¹⁾ Arguments put forward to explain these developments relate to the slow

⁽¹⁶⁾ This section was prepared by Romanos Priftis.

⁽¹⁷⁾ Summers, L., (2014), 'US economic prospects: secular stagnation, hysteresis and the zero lower bound', speech delivered at the Economic Policy Conference organised by the National Association for Business Economics, 24 February 2014.

⁽¹⁸⁾ Gordon, R., (2014), 'A new method of estimating potential real GDP growth: implications for the labour market and the debt/GDP ratio', *NBER Working Papers*, No 20423.

⁽¹⁹⁾ See: McMorro, K., and W. Roeger, (2013), 'The euro area's growth prospects over the coming decade', *Quarterly Report on the Euro Area*, Vol. 12, No 4, pp. 7-16.

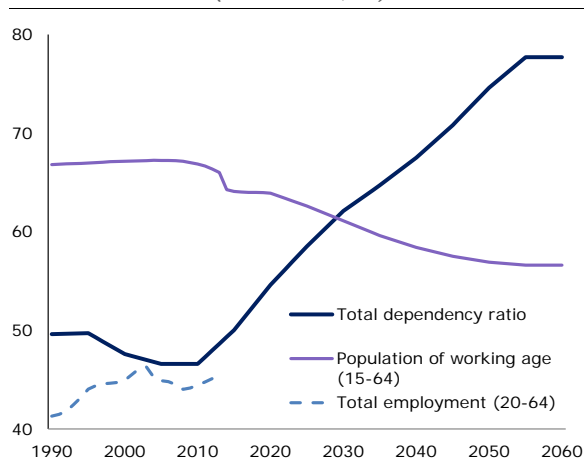
Roeger, W., (2013), 'ECFIN's medium term projections: the risk of 'secular stagnation'', *Quarterly Report on the Euro Area*, Vol. 13, No 4, pp. 23-29.

⁽²⁰⁾ Cete, G., J. Fernald, and B. Mojon, (2015), 'The pre-great recession slowdown in productivity', mimeo.

⁽²¹⁾ See also van Ark, B., O'Mahony, M., and Timmer, M. P., (2008), 'The productivity gap between Europe and the United States: trends and causes', *The Journal of Economic Perspectives*, Vol. 22, No 1, pp. 25-44.

ICT diffusion process in continental Europe ⁽²²⁾ and falling real interest rates in the periphery that were the result of a convergence process associated with the euro. ICT diffusion required flexible labour and product market institutions, which were not necessarily prevalent in the 2000s, inhibiting the development of the most efficient production techniques.

Graph II.1.1: Economic dependency ratio, working age population and total employment, euro area (1) (1990-2060, %)



(1) The economic dependency ratio is defined as the ratio between the total inactive population and employment. The population of working age and total employment are defined as a share of the total population.

Source: United Nations, OECD & AMECO.

On the other hand, low interest rates triggered capital inflows. However, these primarily boosted non-tradable output, such as the services and construction sectors ⁽²³⁾, in which productivity is usually lower than in the tradables and manufacturing sectors. ⁽²⁴⁾ In parallel, the collapse of interest rates led to a misallocation of capital, whereby firms with high potential were unable to

crowd out the least efficient firms. ⁽²⁵⁾ Moreover, DG ECFIN output gap calculations suggest the TFP contribution to potential growth was already falling from 0.9 in 2002 to 0.5 in 2008.

The dependency ratio, defined as a ratio of the number of inactive participants in the labour force, remained stable in the 1990s and only started sluggishly increasing from the end of the 2000s (Graph II.1.1). The onset of the global financial crisis in 2008 accelerated this development.

The output gap forecasting exercises by DG ECFIN suggest that in 2025 a gap of about 10 % will open up between pre-crisis and post-crisis productivity trends (see Graph II.1.2), while projected demographic developments suggest that, since the beginning of the crisis, both the working-age population and the number of employed people have begun falling faster (Graph II.1.1). Although migration flows and the participation rates of female and older workers are expected to increase, these will be offset by the ageing of the European population, which is expected to be progressing rapidly by 2025. The number of people in employment during the period 2025 to 2060 is expected to fall by approximately 13 million (Ageing Report 2015 ⁽²⁶⁾).

This section presents the results of analysis carried out to quantify these effects and assess the impact of changes in TFP and the dependency ratio on the European economy over the short- and medium-term. The section consists of two parts: the first presents the results of model simulations and assesses the duration and magnitude of the change in interest rates, inflation and output caused by changes in TFP and ageing between 2008 and 2025. A second section (Box II.1.1.) discusses the construction of the TFP and dependency ratio shocks used in the analysis and the way in which they are incorporated into the macroeconomic model designed for policy simulations.

⁽²²⁾ See also Dabla-Norris, E., Guo, S., Haksar, V., Kim, M., Kochhar, K., Wiseman, K., and Zdzienicka, A., (2015), 'The new normal: a sector-level perspective on productivity trends in advanced economies', *IMF Staff Discussion Note*, SDN/15/03.

⁽²³⁾ See Reis, R. (2013), 'The Portuguese slump and crash and the Euro crisis', *Brookings Papers on Economic Activity*, 46, pp. 143-193, Spring 2013.

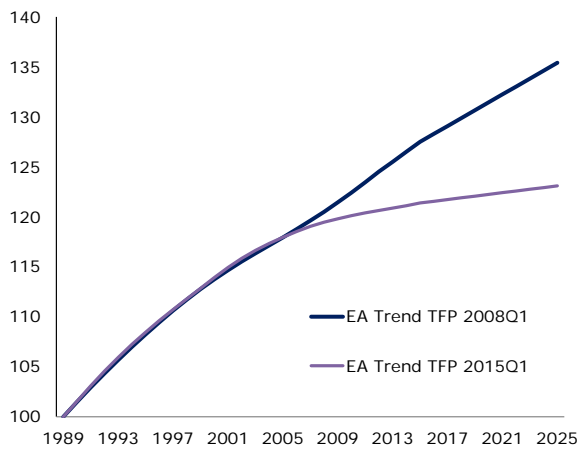
⁽²⁴⁾ See Kalantzis, Y. (2014), 'Financial fragility in small open economies: firm balance sheets and the sectoral structure', *Working papers*, 505, Banque de France, forthcoming in the *Review of Economic Studies*.

and Benigno, G., N. Converse, and L. Fornaro (2015), 'Large capital inflows, sectoral allocation, and economic performance', *Journal of International Money and Finance*, Elsevier, Vol. 55(C), pp. 60-87.

⁽²⁵⁾ See Gopinath, G., S. Kalemli-Ozcan, L. Karabarbounis, and C. Villegas-Sanchez (2015), 'Capital allocation and productivity in south Europe', *NBER Working Paper*, No 21453.

⁽²⁶⁾ European Commission (DG ECFIN) and Economic Policy Committee (Ageing Working Group) (2015), 'The 2015 ageing report: economic and budgetary projections for the 28 EU Member States (2013–2060)', *European Economy*, No 3.

Graph II.1.2: Euro area, trend TFP, (1989-2015, Index: 1989=100)



Source: DG ECFIN calculations of trend TFP using production function methodology.

Simulation Results

The simulations begin in 2009, at the start of the financial crisis. The model is placed as closely as possible within the context of the current economic environment, which is characterised by constraints on monetary policy. In this regard, it is important to point out that other major disturbances that have affected the European and the global economy since the start of the crisis, such as shocks to investment risk and private and public deleveraging pressures, have not been assessed. Therefore, the findings of the simulations reflect only the effects of shocks leading to a fall in TFP and ageing.

Information from DG ECFIN's medium-term projections of output gaps is used to construct the shock to TFP. A comparison of pre-crisis and post-crisis TFP projections suggests that by 2025 a gap of about 10 % will open up between the two projections. Information from the 2015 Ageing Report is used for the shock to the dependency ratio. This provides the expected changes in European demographics, with the dependency ratio projected to rise by 17 % by 2025. See Box II.1.1. for further information on the shock calibration and the set-up of the model.

Although both the TFP and demographic shocks are negative supply shocks, they will also produce demand-side effects that lead to deflation. The TFP shock affects the demand side due a reduction in expected per-capita income. The shock to the dependency ratio is also defined as a negative

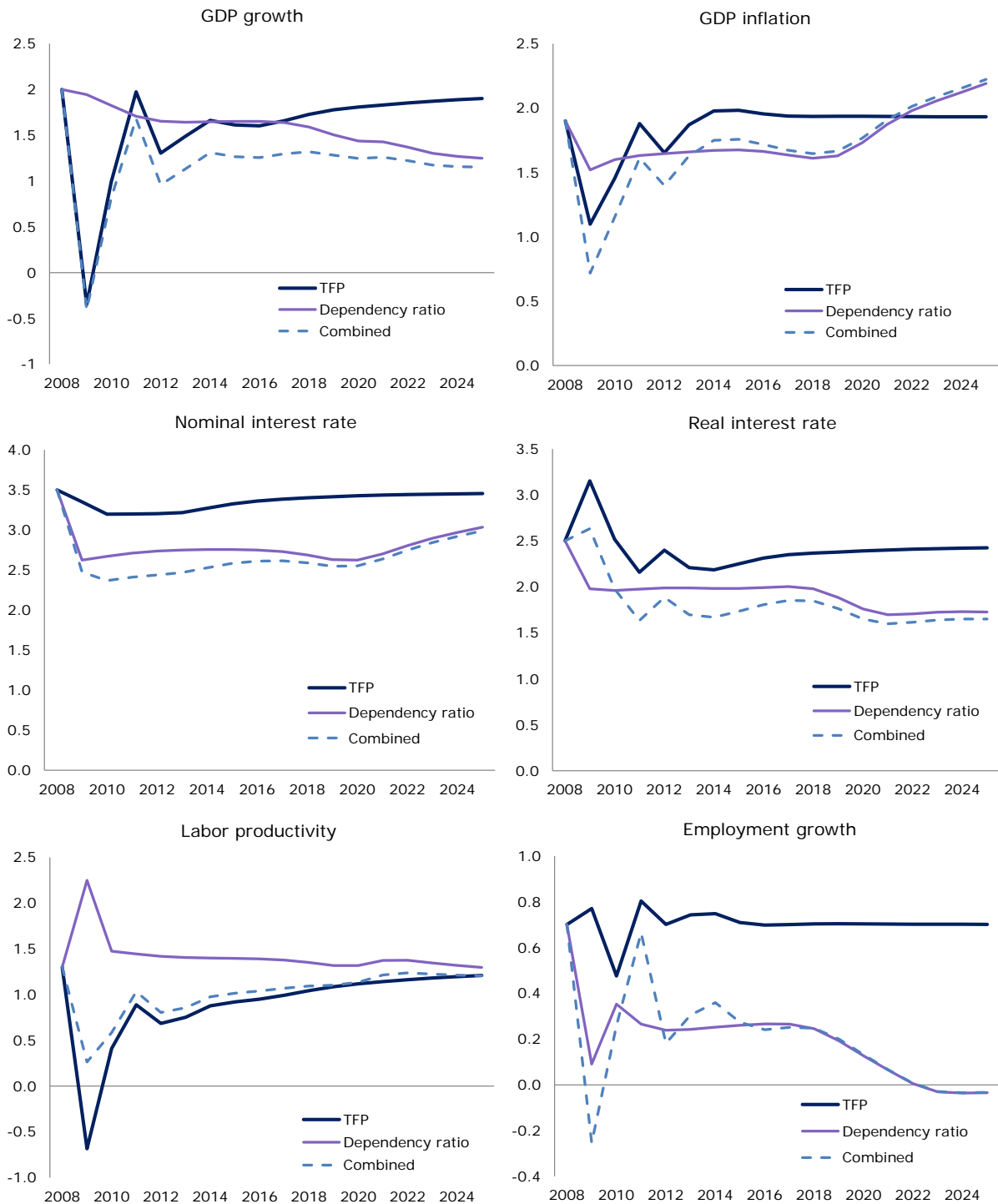
supply shock as it will ultimately lead to a reduction in the labour supply, through an increase in the labour market non-participants (e.g. pensioners). However, as agents in the economy also anticipate changes in demographic trends in the future, the increase in the dependency ratio will generate significant demand-side effects in the short and medium term. The expected fall in future income per capita will lead to an increase in household savings, and a fall in consumption and the real interest rate.

Graph II.1.3 shows model simulations of the analysis. Each subplot presents the effects of an individual TFP or dependency ratio shock, and the aggregate effect of both shocks combined.

Both shocks lead to a substantial decline in GDP growth by 2025 relative to a 2 % pre-crisis baseline trend. Quantitatively, the effects of the shock on the dependency ratio are larger and more long-lasting. This is due to the fact that, for TFP, it is assumed that the decline in the growth rate is only temporary and that it will return broadly to pre-crisis levels within 10 years. As a result, a TFP shock is associated with more front-loaded effects than a shock to the dependency ratio. Moreover, agents in the economy not only revise downwards their TFP growth expectations but also revise down the 2009 TFP level (by about 2 %, see calibration of TFP shock in Box II.1.1.) Consequently, this leads to a sizeable decline in GDP growth for 2009 – stronger than in the case of the shock to the dependency ratio. The ensuing recovery in GDP growth following the TFP shock is a consequence of the downward level shift of consumption and investment, which subsequently remain low over the medium-term. If agents only gradually learned about the future fall in TFP, then we could observe a more protracted decline in GDP growth.

It is important to emphasise that the contrasting results of the two shocks hinge on their constructed paths. For the dependency ratio, it is clear that ageing will be a long-lasting development and so the effects will be more durable. For TFP, it is assumed that the growth slowdown will fade away over time and that the gap between pre-crisis and post-crisis trends will not widen further after 2025 (see Graph II.1.2). Given the documented pre-crisis slowdown in TFP in Europe, our calibration of the TFP shock can be taken as a lower bound. However, the construction of the

Graph II.1.3: QUEST Simulations of an ageing shock and a TFP shock, euro area (2008-2025)



Source:

TFP shock is consistent with the much larger uncertainty regarding future technological progress.

A future acceleration in productivity growth cannot be ruled out (for example as a result of breakthroughs in ICT (e.g. robotics, artificial

intelligence). A recent optimistic growth scenario by Bartelsman⁽²⁷⁾ confirms this hypothesis. It is

⁽²⁷⁾ Bartelsman, E. J., (2013), 'ICT, reallocation and productivity', *European Economy, Economic Papers*, No 486.

also the reason why Gordon ⁽²⁸⁾ does not make a productivity prediction beyond 2025. Another argument why the TFP growth decline may not be a persistent phenomenon is that TFP itself is a consequence of worsening financing conditions for innovations. ⁽²⁹⁾

Both shocks lead to a significant and persistent decline in inflation. However, after 2015 the inflation rate slowly moves back towards the 2 % target. The shock to the dependency ratio causes the GDP deflator to decline by less on impact, but has a stronger effect in the short-term due to demand effects resulting from an increase in savings and a fall in consumption. In the medium-term the persistent effects of the shock leading to a reduction in labour supply will ultimately entail inflationary pressures that cause inflation to overshoot the 2 % target.

Both shocks lead to a sizeable and persistent decline in the nominal interest rate. Following a TFP shock, the nominal interest rate returns to baseline by 2025, whereas following a shock to the dependency ratio it remains persistently low.

The growth rate of labour productivity reacts differently to both shocks. Although labour productivity declines with a TFP shock it increases with an ageing shock. The latter response is due to the fact that higher savings allow for an increase in the capital-labour ratio, through an increase in the investment rate. This is because until the start of the crisis, agents project a constant dependency ratio, but from 2009, the increasing future path for the dependency ratio is incorporated into savings and investment decisions of the private sector.

Although both the shock to TFP and to the dependency ratio qualitatively contribute to the

patterns observed in actual data, neither shock alone, nor combined, can explain the aggregate quantitative behaviour. Arguably, the simulation would need to account for additional negative demand shocks, such as increases in investment risk premiums, or private and public deleveraging episodes, in order to fully capture these features. ⁽³⁰⁾

In summary, our results suggest that two underlying supposed causes of secular stagnation, which gained strength from the onset of the crisis, lead to quite different macroeconomic effects, especially when their medium-term outlook is taken into consideration.

On the policy front, structural reforms of labour markets could be appropriate policy responses for tackling the consequences of these supply-side disturbances. For example, pension reforms that extend the working age limit (as discussed in the 'Focus' section of this report) could slow the increasing trajectory of the dependency ratio. More generally, the current migration inflows that the euro area is experiencing could also prove beneficial in offsetting the effects of its ageing population in the longer term. Regarding the TFP slowdown, by fuelling investment into technological processes the productivity slowdown could be reversed. An increased supply of skilled labour inputs, as well as an increased demand for R&D, could lead to a creation of new technologies and intensify the speed of adoption of these.

Given the contribution of both these shocks in keeping interest rates low in the medium-term, and hence, limiting the ability of monetary policy to stimulate the economy, alternative measures for exiting episodes of secular stagnation should be pursued.

⁽²⁸⁾ Gordon, R. (2014), 'A new method of estimating potential real GDP growth: implications for the labour market and the debt/GDP Ratio', *NBER Working Papers*, No 20423.

⁽²⁹⁾ See Anzoategui, D., D. Comin, M. Gertler, and J. Martinez (2016), 'Endogenous technology adoption and R&D as sources of business cycle persistence', *NBER Working Papers*, No 22005.

⁽³⁰⁾ For such an analysis using an estimated model see:

Kollmann, R., B. Pataracchia, R. Raciborski, M. Ratto, W. Roeger, and L. Vogel (2015), 'The post-crisis slump in the Euro Area and the US: evidence from an estimated three-region DSGE model', DG ECFIN, mimeo.

For such an analysis using a calibrated model see:

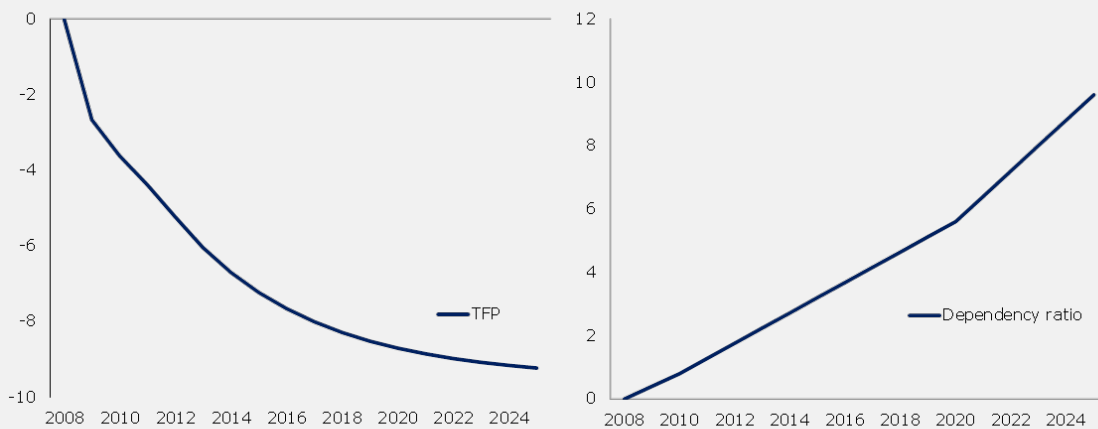
Priftis, R., W. Roeger, and J. in 't Veld (2015), 'The slow recovery in the Euro Area', DG ECFIN, mimeo.

Box II.1.1: Calibration of shocks and model set-up

In order to calibrate the shock to TFP we have used information from the European Commission's medium-term projections. With each forecasting exercise the Commission calculates output gaps using a production function approach. A crucial component of this exercise is the estimate of trend TFP together with a 5-10 year projection. By comparing various vintages of trend TFP we are able to trace the speed at which revisions to TFP have occurred.

A comparison of pre-crisis and post-crisis TFP projections suggests that, by 2025, a gap of about 10 % will open up between the two projections. However, it is assumed that the TFP growth slowdown will fade over time, so this gap will not widen further after 2025 (see graph below). Given the documented pre-crisis slowdown in TFP in Europe, our calibration of the TFP shock can be taken as a lower bound.

Graph : Euro area, shock Calibration, (2008-2025)



Source: DG ECFIN calculations.

For the shock to the dependency ratio, we used information from the European Commission's 2015 Ageing Report. This describes the expected changes in European demographics, and predicts that the dependency ratio will rise by 17 % by 2025. We constructed the shock by directly feeding into the model the projected path of the total dependency ratio. The latter is modelled as an increase in the population share of labour market non-participants (e.g. pensioners). The two calibrated shocks can be seen in the graph above.

The model used to conduct the simulations is a two-region dynamic general equilibrium set-up of the European economy and the rest of the world. Each region has two production sectors that produce tradable and non-tradable goods. There are two types of households: liquidity-constrained households and intertemporally optimising Ricardian households. All households consume and supply labour. Ricardian households also invest in domestic productive capital, domestic government bonds and foreign bonds, own firms, and obtain profits from firms. There is no cross-border mobility of labour. Since the TFP slowdown and projected ageing of the population is not purely a European phenomenon, we also assume that the rest-of-the-world section of the model will experience the same exogenous disturbances, although to a lesser extent. ⁽¹⁾

⁽¹⁾ A full description of the model can be found in: Priftis, R., W. Roeger, and J. in 't Veld (2015), 'The slow recovery in the Euro Area', DG ECFIN, mimeo.