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Temi di Discussione

(Working Papers)

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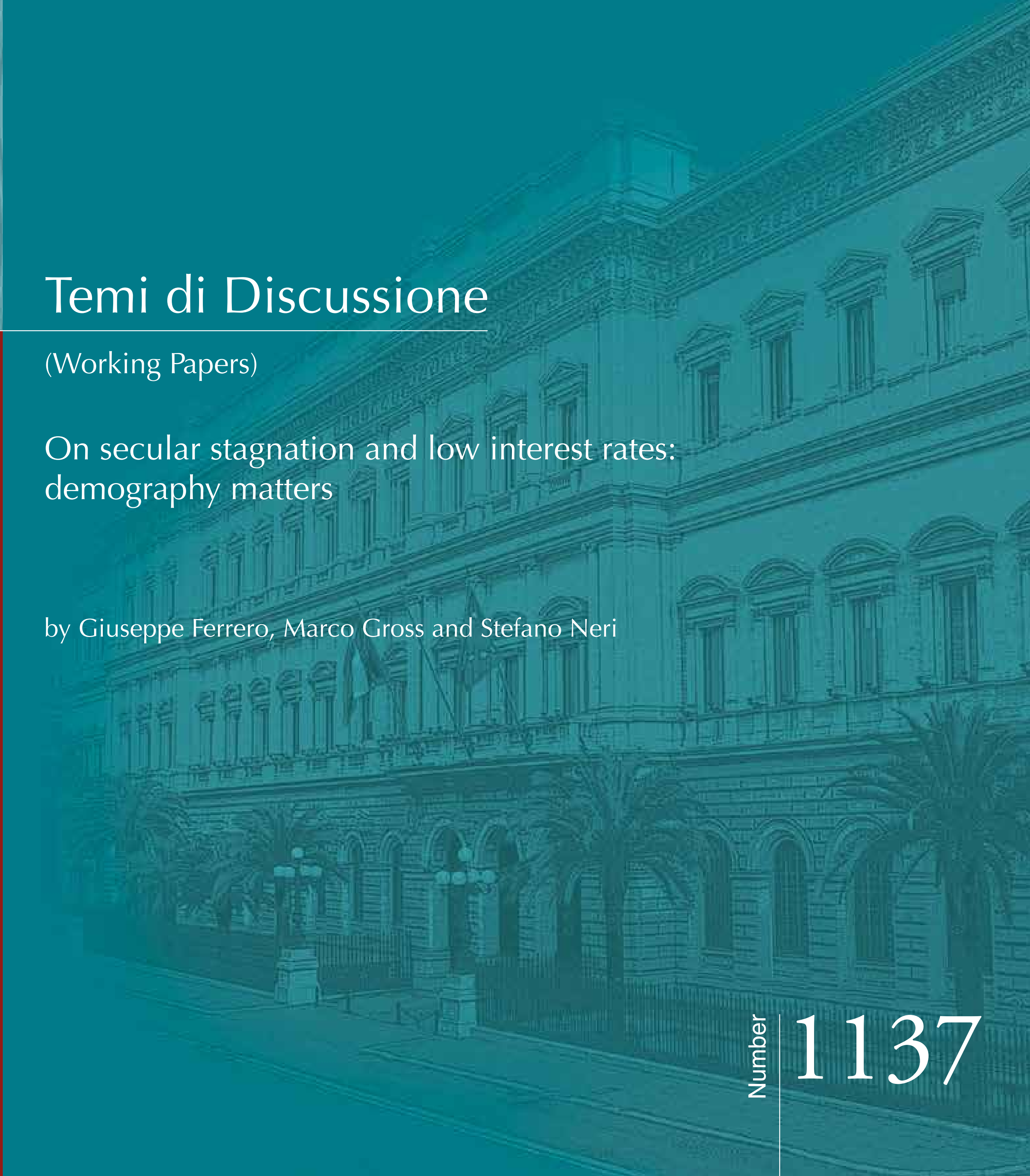
by Giuseppe Ferrero, Marco Gross and Stefano Neri



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ON SECULAR STAGNATION AND LOW INTEREST RATES: DEMOGRAPHY MATTERS

by Giuseppe Ferrero[§], Marco Gross[◊] and Stefano Neri[§]

Abstract

Nominal and real interest rates in advanced economies have been decreasing since the mid-1980s and reached historical lows in the aftermath of the global financial crisis. Understanding why interest rates have fallen is essential for both monetary policy and financial stability. This paper focuses on one of the factors put forward in the literature within the secular stagnation view: adverse demographic developments. The main conclusion that we draw from the empirical analysis is that these developments have exerted downward pressure on real short- and long-term interest rates in the euro area over the past decade. Moreover, building on the European Commission's projections for dependency ratios until 2025, we illustrate that the foreseen changes in the age structure of the population may dampen economic growth and continue exerting downward pressure on real interest rates in the future.

Keywords: secular stagnation, demographic developments, real interest rates, monetary policy.
JEL Classification: C32, E52, J11.

Contents

[§] Banca d'Italia, Economic Outlook and Monetary Policy Directorate.
[◊] European Central Bank, Directorate General Macroprudential Policy and Financial Stability.

"[…] *demographic shifts, in particular the increase in life expectancy, can go a long way in explaining the decline in real interest rate over the past couple of decades. This is quite likely to be the main explanation for the sharp increase in house prices over the past couple of decades. This trend endangers the possibility for monetary policy to achieve full employment* […].

Axel Gottfries and Coen Teulings, VoxEU, 30 January 2015

1. Introduction[1]

Nominal and real short- and long-term interest rates have been decreasing since the mid-1980s and reached historical low levels in the aftermath of the global financial crisis. Understanding why interest rates have fallen is essential for both monetary policy and financial stability. To the extent that nominal and real interest rates are low in normal times, monetary policy may be constrained by the presence of the effective lower bound (ELB) of policy rates, potentially limiting the ability of the central bank to preserve price stability in the aftermath of a recessionary shock (Kiley and Roberts, 2017). This is, indeed, one of the lessons of the last decade: the probability of hitting the ELB is higher than previously thought, as the real rate required for equating the supply and the demand for funds when output is at its potential, unemployment is at its natural level and inflation is on target has declined (Holston, Laubach and Williams, 2016, Curdia et al., 2015 and Christensen and Rudebusch, 2017). Low nominal and real interest rates may also pose risks to financial stability, reducing financial institutions' profitability and resilience, raising the likelihood of bubbles and potentially leading to excessive risk-taking by investors.

Two explanations for the persistent decline of interest rates have been put forward in the literature: one relying on financial-cyclical factors, the other on changes in the structure and the functioning of the economy (Ferrero and Neri, 2017).

According to Borio (2014) and Lo and Rogoff (2015) during the "Great Moderation", financial deregulation, excessively expansionary monetary policies and overly optimistic expectations about future returns have favored an excessive increase in the supply of funds, a compression of risk premia and low interest rates; the sharp correction in the financial cycle occurred with the outbreak of the financial crisis, followed by a persistent contraction in aggregate demand and an increase in the demand for safe assets, have led to a further reduction in interest rates. Looking forward, interest rates will remain low for an extensive period of time; however, as the deleveraging process ends and expansionary monetary policies are phased out, interest rates will increase from their current low levels.

[1] The authors wish to thank Luca Metelli for comments and suggestions. This paper, which is a revised version of the one published as the ECB Working Paper n. 2088, builds upon the work done by the authors within the ESRB/ECB Task Force on "Macroprudential policy issues arising from low interest rates and structural changes in the EU financial system"; see https://www.esrb.europa.eu/news/pr/date/2016/html/pr161128_1.en.html.
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Summers (2014), Eggertsson and Mehrotra (2014) and Gordon (2016) examine the role of structural economic changes that have led to a persistent imbalance between demand for investment and supply of savings, and to the consequent reduction in equilibrium real interest rates. A number of demand and supply factors, all characterized by a high degree of persistence, have been considered in the literature: adverse demographic developments, falling (relative) price of investment goods, lower pace of technological innovation, rise in savings rates and scarcity of safe assets, increasing wealth and income inequality. According to this view, the global financial crisis added further downward pressure on real interest rates. Looking forward, structural factors may continue to keep real interest rates low for a long time, even after the effects of the crisis fade away. While technological progress is difficult to predict, demographic developments are persistent and more predictable. Pagano and Sbracia (2014) argue that pessimistic predictions in the past turned out to be wrong because they underestimated the potential of existing technologies.

This paper does not aim at assessing the relevance of all the factors put forward in the literature, but rather at focusing only on demographic developments.[2] The high persistence of these factors makes them particularly relevant from a monetary policy and financial stability perspective, to the extent that they affect medium-term trends in nominal and real interest rates. However, only few papers have empirically assessed the role of demographic factors on real interest rates. Aksoy et al. (2016) examine the effects of changes in the demographic structure on macroeconomic trends using a panel VAR for OECD economies. Favero and Galasso (2016) also study the relation between the age structure of the population, on the one hand, and long-term growth and real interest rates, on the other. Favero et al. (2017) study the relation between the common persistent component of the US term structure of interest rates and the age composition of population. On the theoretical side, Carvalho et al. (2016) and Gagnon et al. (2016) develop and calibrate life-cycle models to assess the impact of demographic changes on the short-term real interest rate in developed economies.

The empirical literature on the role of demographic trends is very scant, as the above brief review suggests, and the issue of their impact on interest rates is far from being settled (section 3.1). The objective of this paper is to provide new evidence on the impact of demographics on real interest rates and other macroeconomic variables in the euro area, adopting both a backward and forward-looking perspective. In this sense, we complement the analysis by Aksoy et al. (2016) and Favero et al. (2017) by focusing on the euro area and providing an assessment of the impact of the ageing of the population on macroeconomic variables during the global financial and sovereign debt crises. The empirical analysis, which is based on a dynamic panel vector autoregressive model, shows that an increase in

[2] Mojon et al. (2017) use an overlapping generation model to assess the role of ageing, slower productivity, deleveraging and shortage of safe assets in explaining the downward trend in real interest rates since the seventies.

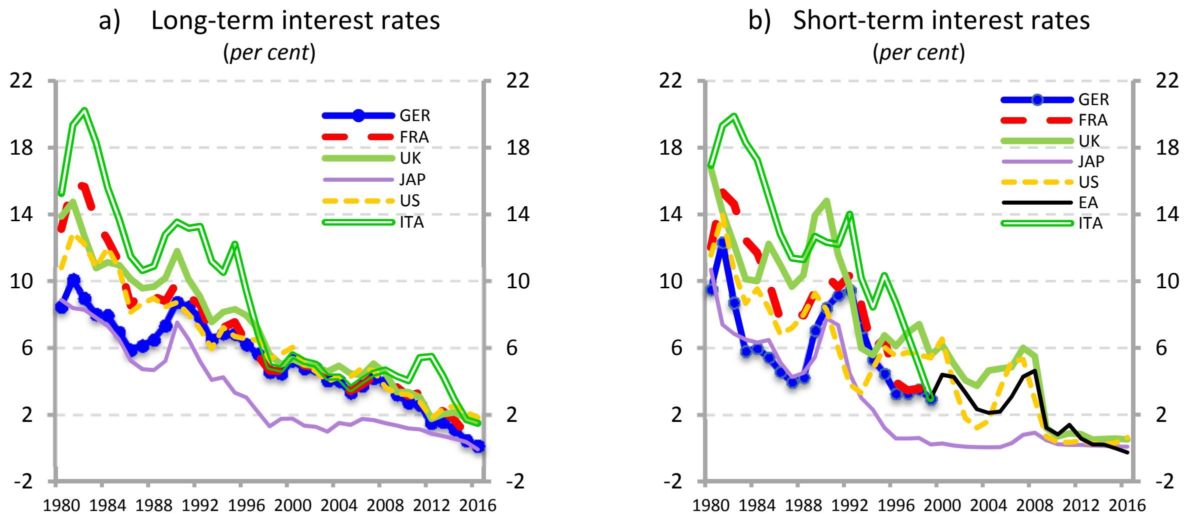
dependency ratios, which may result from the ageing of the population and a reduction in fertility, pushes nominal and real interest rates downward. The policy implication is that in advanced economies the ability of central banks to preserve price stability and keep output at its potential could be hampered by the decline in the natural rate of interest, over which slow-moving factors such as demographic ones may have a significant impact.

The paper is organized as follows. Section 2 discusses the long-term trends in nominal and real rates. Section 3 presents the explanations put forward in the literature. Section 4 presents the empirical model and the backward- and forward-looking counterfactual assessment. Section 5 concludes highlighting the implications for monetary policy.

2. Some stylized facts on nominal and real interest rates

The current macroeconomic environment is characterized by exceptionally low nominal rates in advanced economies. The decline of long- and short-term nominal rates started in the mid-80s (Figure 1, panels a and b), as part of a global phenomenon and coincided with a decline of real interest rates, a strong and persistent reduction of inflation and a period of low macroeconomic volatility (the so-called "Great Moderation").

Figure 1. Nominal interest rates in main advanced countries: 1980-2016



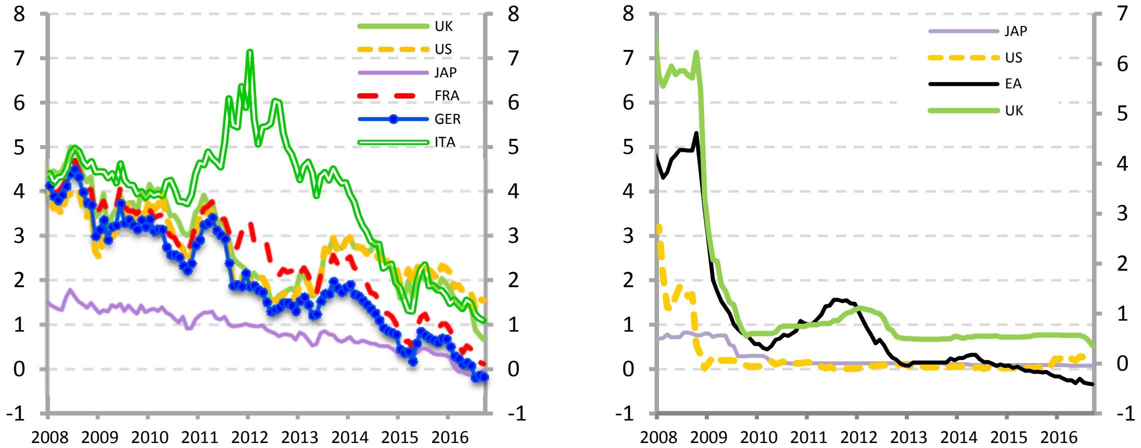
Source: European Commission; AMECO. Long-term interest rates are yields on 10-year government bonds (or on the closest maturity). Short-term interest rates are yields on 3-month deposits, or Treasury bills, depending on the period and country.

The decline accelerated with the outbreak of the global financial crisis. Since late 2008-early 2009, the slack in the economy and protracted low inflation rates contributed to further reducing nominal interest rates, as monetary policies turned very accommodative (Figure 2, panel a), also by means of unconventional measures. In some countries a strong compression of risk premia and flight-to-quality phenomena pushed nominal interest rates into negative territory even at long maturities (Figure 2, panel b).

Since mid-2013, long-term rates in the euro area declined at a faster pace than in the US due to the consequences of the sovereign debt crisis and the new measures adopted by the European Central Bank (ECB) to preserve the proper functioning of the monetary transmission mechanism and to provide further monetary accommodation when the policy rates reached their effective lower bound. The decline in short- and long-term interest rates brought about a decline in the financing costs of banks, non-financial corporations, households and governments, which reached historical minima (ESRB, 2016).

Figure 2. Nominal interest rates in main advanced countries: 2008-2016

a) Long-term interest rates (*per cent*)　　　b) Short-term interest rates (*per cent*)

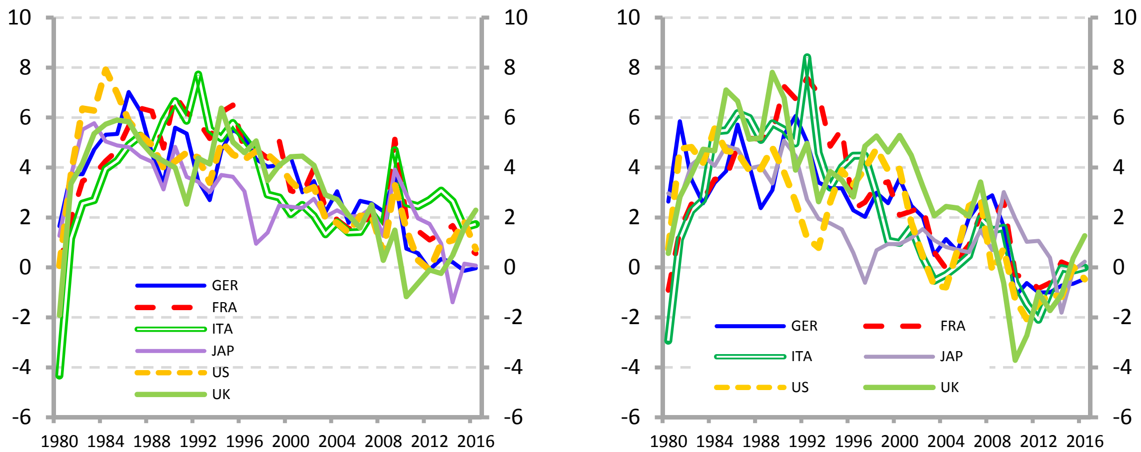


Source: Datastream. Long-term interest rates are yields on 10-year government bonds (or on the closest maturity). Short-term interest rates are yields on 3-month deposits, or Treasury bills, depending on the period and country.

Real interest rates have been decreasing since the second half of the 80s (Figure 3, panels a and b). This trend, too, accelerated with the outbreak of the global financial crisis, and in the euro area after the sovereign debt crisis.

Figure 3. Real interest rates in main advanced countries

(a) Long term interest rates (*per cent*)　　　(b) Short-term interest rates (*per cent*)



Source: European Commission; AMECO. Real rates are computed as nominal rates minus the inflation rate based on the private consumption deflator.

According to recent analyses (Curdia et al., 2015 and Holston et al., 2016), a similar trend has marked the evolution of the natural interest rate, which is defined as the real short-term interest rate that keeps output at its potential, unemployment at its natural rate and inflation at the central bank's target. Holston et al. (2016) show that the natural rate of interest decreased in recent years in the main advanced countries, from around 3% in the 1980s to close to zero in the US and to negative values in the euro area. Curdia et al. (2015) and Gerali and Neri (2017), using dynamic stochastic general equilibrium models, have shown that the natural rate in the US between 2008 and 2016 has remained well below zero; in the euro area, the natural rate has become negative in the aftermath of the sovereign debt crisis. Being an unobservable variable, however, there is no consensus neither on how to estimate nor on the specific estimates of the natural rate, in particular for the period after the global financial crisis.

The debate about the drivers of the dynamics of real interest rates over the past decades is open and lively especially at the policy-making level.[3] Two views have been put forward in the literature: the "real/structural" and the "cyclical/financial" views. Among the "real/structural" explanations, the "secular stagnation" one is probably the most famous (Summers, 2014). As for the "financial/cyclical" explanation, Borio (2014) and Lo and Rogoff (2015) are two key references. The two views are briefly reviewed in the next section.

The two views share some elements (Borio, 2017). First, they take a long-term perspective. Second, they question the presumption that the economy is always self-equilibrating. Third, they encourage academics and policy-makers to question the prevailing macroeconomic framework and to invest in developing models in which real and financial factors influence each other.

3. Low interest rates: the structural and financial-cyclical views

According to the structural view, advanced economies suffer from a persistent imbalance resulting from an increasing propensity to save and a decreasing propensity to invest; in this context, excessive savings act as a drag on growth and inflation, exerting a downward pressure on real interest rates. A number of demand and supply factors, all marked by a high degree of persistence, have been considered to account for this imbalance: adverse demographic developments, the falling relative price of investment goods, the decline in investment due to missing opportunities, the lower pace of technological innovation, the rise in savings rates in emerging economies, the scarcity of safe assets and the increase in

[3] See, among others, IMF (2014), Bean, Broda, Ito and Kroszner (2015), Council of Economic Affair (2015), Rachel and Smith (2015), Praet (2017) and Williams (2016).

wealth and income inequality.[4] According to this view the global financial crisis added a drag to these structural factors.

A second group of hypotheses underlines the role of financial/cyclical factors: deregulation of financial markets, expansionary monetary policies and investors' overly optimistic expectations encouraged, in the period of relative macroeconomic stability prior to the global financial crisis (the "Great Moderation"), a persistent increase in the supply of funds, a squeeze in risk premia and a decline in interest rates, which led to excessive borrowing.[5] Subsequently, the outbreak of the global financial crisis led to a sharp decline in nominal interest rates in all advanced economies.

While it is not easy to assess which of these views is more likely to be true, none of them can be dismissed a priori. Moreover, factors behind one explanation may affect the factors behind the other: for example, changes in the age composition of the population and in other demographic developments, usually considered structural factors within the secular stagnation view, may also influence the financial cycle.

The next sections provide a review of the literature on the relationship between demographic developments and interest rates and selected stylized facts on demographic trends.

3.1 Demographic factors and interest rates

Demographic trends affect both the demand and the supply side of the economy. Lower fertility and longer longevity, which lead to a higher old-age dependency ratio, require more savings for old age, unless these are offset by an increase in the retirement age, and may cause a decline in aggregate consumption as a share of income. Population trends also affect investment demand, as lower population growth implies that lower investment is required to maintain a given capital-to-labor ratio, reducing real interest rates. An increasing proportion of elderly people leads to a shrinking working-age population; given the capital stock, this lowers the real rate due to higher capital intensity. As time goes by, however, the elderly consume their own wealth and reduce their savings, potentially exerting upward pressure on real interest rates.

Several contributions (shortly referred to in the Introduction) on the role of demographic factors have recently appeared in the literature, with different results in terms of the impact on interest rates. Aksoy et al. (2016) employ a panel VAR for the OECD countries estimated over the period 1970-2007 to investigate the impact of changes in the demographic structure; the authors show that the ageing of the population leads to

[4] For a description of the mechanism through which these factors affect real rates, see Summers (2014) and De Long (2017).
[5] On the role of financial factors, see Borio (2014).

subdued output growth, higher savings and lower interest rates. Favero et al. (2016) show that the common persistent component of the term structure of interest rates is related to the ratio of middle-aged to young population. Projections based on the estimated model show that real interest rates would remain negative only for the next few years, and then would recover rather than continuing their secular decline. Favero and Galasso (2016) show that interest rates are depressed by increased savings by the middle-aged population, due to longer life expectancy. However, this effect is compensated by longevity, as the longer-living generations of retirees raise aggregate consumption and interest rates. All in all, a change in the age composition of the population measured by the replacement of population between 40 and 59 with the population aged 60 and over, has a negative impact on output and a positive effect on real interest rates.

Carvalho et al. (2016) develop and calibrate a life-cycle model to capture the salient demographic features in developed economies. Demographic trends between 1990 and 2014 reduced, ceteris paribus, the equilibrium interest rate by 1.5 p.p. Gagnon et al. (2016) develop an overlapping-generation model with a rich demographic structure to assess the impact of the demographic changes occurred in the US since the early 80s on real interest rates and real GDP growth. The model accounts for around one p.p. of the decline in both real GDP growth and the equilibrium real rate and suggests that they may remain low in a "new normal" economy. Ikeda and Saito (2014) construct a model for the Japanese economy and show that an exogenous decline in the ratio of workers to total population causes a reduction in the real interest rate. Backus et al. (2014) study the persistence of international capital flows (i.e. "global imbalances"), showing that demographic factors could be behind these developments. The authors show that among these factors, changes in life expectancy can explain much of the capital flows across countries. These changes are consistent, ceteris paribus, with the decline in interest rates over the past decades.

3.2 Stylized facts on demographic trends

Over the last 45 years there has been considerable increase in dependency ratios – the number of people of non-working age (0 to 14 and above 65) relative to the number of those in the working age (15 to 64) – a key statistic for measuring the degree of ageing of a society (Figure 4, panel a). Population growth has also declined in most economies, although with varying patterns (Figure 4, panel b). Lower population growth implies that the elderly cohorts increase in size relative to the younger ones. Declining fertility rates, which have fallen sharply after the introduction of the contraceptive pill in developed countries in the early sixties (Figure 5, panel a), and increased life expectancy have contributed to the ageing of the population.

The discovery of the contraceptive has led to a strong demographic imbalance in some countries. While in the US the size of cohorts has remained stable over time, the effects of the introduction of the pill on the population pyramid has been strong in countries such as Germany, where total fertility fell from 2.5 in 1967 to 1.4 in 1970 (Gottfries and Teulings, 2015 and Lu and Teulings, 2016).

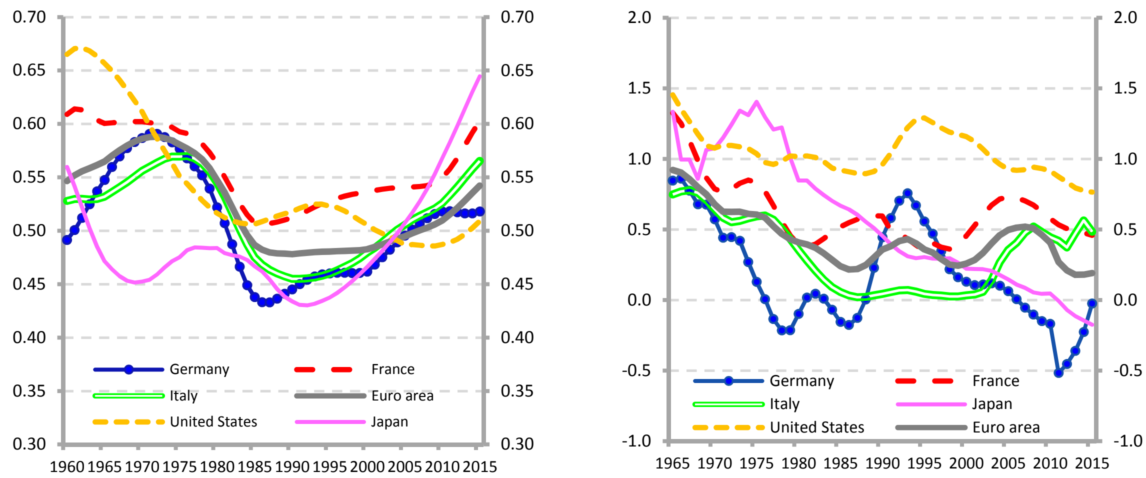
Figure 4. Dependency ratio and population growth

(a) Dependency ratio

(*percentage point*)

(b) Population growth

(*per cent*; *five year average*)



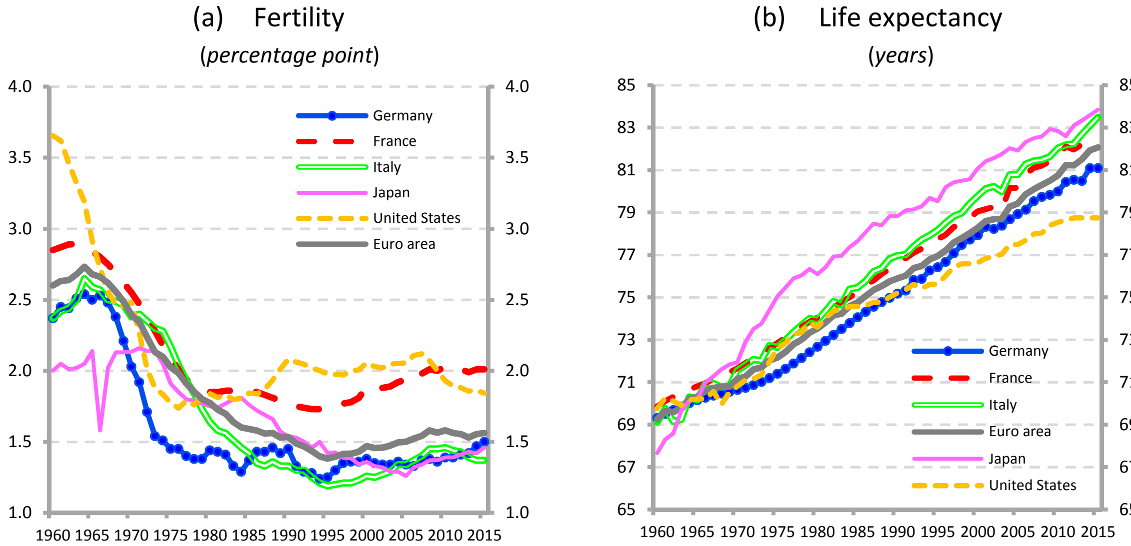
Source: World Bank Open Data, http://data.worldbank.org/.

The sharp and persistent decline in fertility rates can be seen as the end point of a global demographic transition that started with the decline in child mortality, which led to exceptionally large young age cohorts and an unprecedented growth in population. The decline in fertility, in addition to reflecting the introduction of the pill, could constitute a delayed response to the survival of many children, reinforced by rising income, increased education of women and higher labor force participation by women (Bussolo et al., 2015).

Other factors equal, these demographic trends have led to an increased supply of savings, as workers have to save more to finance their consumption during the retirement period (Lu and Teulings, 2016). For a given demand for investment, this excess saving may have contributed to driving interest rates down.

In several countries, the population is expected to decline in the next four decades (United Nations, 2015). Fertility in all European countries is now below the level required for full replacement of the population in the long run (around 2.1 children per woman, on average); in the majority of these countries, fertility has been below the replacement level for several decades. Fertility in Europe as a whole is projected to increase from 1.6 children per women in 2010-2015 to 1.8 in 2045-2050, but such an increase may not be sufficient to prevent a contraction of the population. Migration could potentially offset these trends.

Figure 5. Fertility and life expectancy



Source: World Bank Open Data, http://data.worldbank.org/.

As the figures above show, future age composition and growth of the population depend on fertility and longevity. As fertility declines and life expectancy rises, the proportion of elderly people increases. This population ageing is occurring throughout the world; at the global level, the population aged 60 or over is the most rapidly growing. Europe has the largest percentage of its population at ages 60 or older (24 per cent). In the short- to medium-term, the projected increase of the older population is very likely or even inevitable. These unprecedented developments in demographic trends raise the issue of assessing their impact on growth and real interest rates.

4. Empirical analysis

In this Section we present an empirical analysis to shed light on the impact of demographic developments on short- and long-term interest rates and other relevant macroeconomic variables, adopting both a backward and a forward looking perspective.

Section 4.1 provides details on the specification of the model and section 4.2 briefly discusses the results its estimation. In Sections 4.2 and 4.3, we carry out a counterfactual analysis to assess how the main macroeconomic variables would have evolved had demographic developments been more favorable between 2006 and 2015. Section 4.4 presents the results of this historical counterfactual assessment. In Section 4.5 we present a forward-looking counterfactual analysis, involving different assumptions for the evolution of dependency ratios between 2016 and 2025 in euro area countries. The baseline simulation is built upon the projections of demographic variables presented by the European Commission (EC) in its 2015 Ageing Report (European Commission, 2014).

4.1 Model specification

The empirical analysis is based on a dynamic panel vector autoregressive model with 11 endogenous and 2 exogenous variables, for the 19 euro-area countries and spanning the period from 1990 to 2015. The model has the following form:

$$Y_t^i = \alpha_i + A(L)Y_{t-1}^i + \gamma(L)D_t + \varepsilon_t^i$$

where *i* and *t* denote, respectively, the country and time dimensions, α_i is a vector of country/variable fixed effects, $A(L)$ are the coefficients of an autoregressive polynomial, D_t the vector of exogenous variables and ε_t^i the error term.

The endogenous variables are potential output growth, real GDP growth, total factor productivity (TFP) growth, investment growth, private consumption growth, GDP deflator inflation, investment deflator inflation, private consumption deflator inflation, unemployment rates (change) and real short-term and long-term interest rates. The two exogenous variables are population growth and the (change in the) total dependency ratio, defined as the share of the population under 15 and over 64 relative to the population aged 15-64. The data, whose frequency is annual, are taken from the AMECO database of the EC.

The choice of focusing on the dependency ratio is motivated by the fact that, under certain conditions, the change in the ratio is a summary statistic for the evolution of the composition of the population (Carvalho et al., 2016). Consider, for simplicity, workers (*w*) and retirees (*r*). Let ω_t be the probability of remaining in the labor force between time *t-1* and *t*, and let γ_t be the probability of surviving in the same period if retired. The aggregate labor force (equivalent to total population under our assumptions) evolves according to:

$$N_t^w = (1 - \omega_t + n_t)N_{t-1}^w + \omega_t N_{t-1}^w = (1 + n_t)N_{t-1}^w$$

where n_t is the growth of the labor force. The number of retirees evolves according to:

$$N_t^r = (1 - \omega_t)N_{t-1}^w + \gamma_t N_{t-1}^r \ .$$

Re-arranging the two equations yields the evolution of the dependency ratio $\Psi_t = \frac{N_t^r}{N_t^w}$

$$\Psi_t = \frac{(1 - \omega_t)}{1 + n_t} + \frac{\gamma_t}{1 + n_t}\Psi_{t-1}$$

which describes the evolution of the age composition of the population. An increase in life expectancy (higher γ_t), a decrease in fertility rates (lower n_t) raise the dependency ratio or a decrease in the probability of remaining in the labor force.[6] In this sense, the simulations

[6] An increase in the retirement age that would offset the increase in life expectancy or the decrease in the fertility rate can be simulated by increasing the probability of remaining in the labour force.

in which we condition on the evolution of the dependency ratio can be rationalized in terms of past developments in life expectancy and fertility rates. In principle, the whole age-composition of the population matters. Atksoy et al. (2016) show, indeed, that the dependent population (groups 0-9, 10-19 and 70+) has a negative impact on real output and real rates while the working age population (groups between 20 and 60) has a positive effect. Taking also this result into account, we use the dependency ratio as our preferred measure of the age-composition of the population.

We have employed an LSDVC estimator (Kiviet, 1995 and Bruno 2005) to estimate the model, to thereby properly account for the presence of the autoregressive lags in the equations which would — if not reflected in the estimation method — have the potential to bias the estimates.[7] All model variables were normalized by their historical standard deviations prior to the estimation. The rationale for using the normalization is to better account for cross-country differences in sensitivities in a model where these are assumed to be homogeneous across countries.[8] A panel model is better than a system of equations with country-specific coefficients to capture economic relationships with a short sample.

4.2 Estimation results

Table 1 shows the estimates of the parameters for selected equations. Table A.1 in the Annex shows the complete set of estimates.

Potential output growth depends positively on TFP growth and negatively on the change in the dependency ratio. These results confirm that the ageing of the population affects the economy long-run potential output growth: a smaller share of the younger cohorts may imply lower innovation and investment in R&D, which would reduce potential growth in the long run. This result is consistent with the empirical evidence and the theoretical model in Aksoy et al. (2016).

Real GDP, potential output, investment and consumption growth depend negatively on the change in the dependency ratio. Also inflation (based on the private consumption and GDP deflators), is negatively affected by changes in the dependency ratio, consistently with Bobeica et al. (2017). The real short-term interest rate depends negatively on the dependency ratio, consistently with Aksoy et al. (2016), Carvalho et al. (2016) and Gagnon et al. (2016).[9] Finally, an increase in the dependency ratio indirectly reduces long-term real rates through the effect that ageing exerts on potential output and short-term real rates.

[7] Standard errors and *p*-values were computed by means of a bootstrap procedure.

[8] The model in which the variables were not normalized was inferior in terms of in-sample predictive performance.

[9] Our results are also consistent with Eggertsson and Mehrotra (2014) who illustrate, based on an overlapping generation model, that a reduction in the demand for loans by the middle-aged population would lower real interest rates. Similar in spirit and also compatible with our results is the model by Krugman (1998).

Table 1. Panel VAR coefficients: selected equations

	Potential output growth	TFP growth	Real GDP growth	GDP deflator Inflation	Real long-term interest	Real short-term interest	Unemployment rate change	Investment growth	Private consumption growth	Private consumption deflator inflation
Potential output growth (-1)	**0.88 ****	0.13	**0.37 ****	-0.03	**0.39 ****	0.23	**0.18 ****			
TFP growth (-1)	**0.10 ****	-0.01	0.24	0.00	-0.08	-0.10		**0.40 ****	**0.18 ****	0.04
Real GDP growth (-1)			0.00	**0.10****	-0.27	0.18	**-0.39 ****			
GDP deflator inflation (-1)	-0.05		-0.20	**0.61 ****						
Change in unemploym. rate		**-0.25 ****								
Real long-term i-rate		**-0.09 ****					**0.22 ****			
Real long-term i-rate (-1)	**0.02 ***	**0.15 ****	**0.06 ****	0.01	**0.64 ****	-0.03	**-0.21 ****	0.04	0.01	0.01
Real short-term i-rate		**0.06 ***					**-0.13 ****			
Real short-term i-rate (-1)	-0.01	**-0.07 ****	**-0.07 ****	0.01	0.11	**0.74****	**0.17 ****	**-0.09 ****	-0.01	-0.00
Population growth	-0.00	-0.12	-0.01	**0.05 ****	**-0.25 ****	**-0.25 ****		-0.01	0.07	**0.04 ***
Change in dependency ratio	**-0.08 ****	-0.02	**-0.21 ****	**-0.04 ****	0.00	**-0.19 ***	**0.28 ****	**-0.22 ****	**-0.27 ****	**-0.07 ****
R^2	*0.94*	*0.40*	*0.40*	*0.81*	*0.63*	*0.69*	*0.49*	*0.29*	*0.46*	*0.63*
$Adj.\ R^2$	*0.93*	*0.35*	*0.36*	*0.79*	*0.61*	*0.67*	*0.45*	*0.24*	*0.42*	*0.60*
SE of regression	*0.35*	*0.74*	*0.80*	*0.33*	*2.45*	*2.30*	*0.89*	*0.87*	*0.69*	*0.44*
Durbin Watson	*1.53*	*1.84*	*1.91*	*2.09*	*1.93*	*2.02*	*1.89*	*1.83*	*1.96*	*2.15*
N. observations	*396*	*395*	*396*	*396*	*395*	*396*	*395*	*396*	*396*	*396*

Note: The model is estimated with cross-section (country) fixed effects on annual data spanning the 1990-2015 period. ** and * denote significance at least at the 5% and 10% levels, respectively.

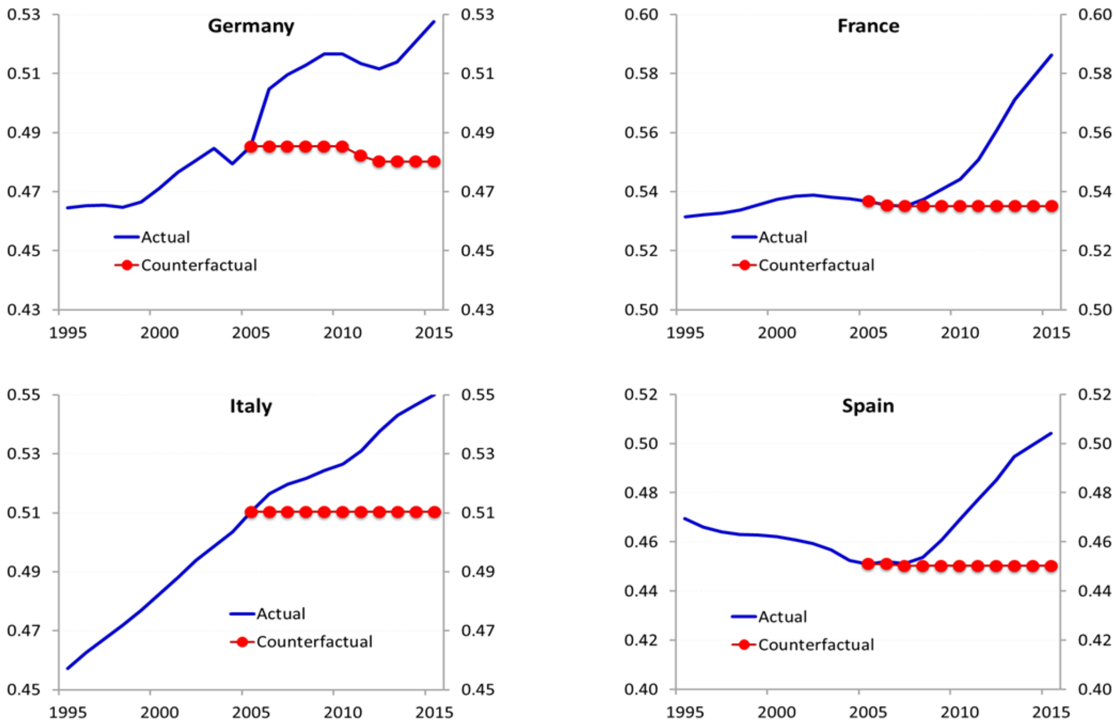
4.3 Historical counterfactual analysis: 2006-15

The historical counterfactual assessment is conducted by assuming that the dependency ratios did not increase between 2006 and 2015: in constructing this counterfactual evolution, we set to zero the annual changes in the years in which they are positive and leave unchanged the negative variations. We focus on this period for two reasons. First, for some countries (e.g. France and Spain), the depending ratio started increasing in mid-2000s. Second, we are interested in assessing how much of the decline in interest rates that followed the outbreak of the global financial crisis is due to the adverse evolution of demographic trends.

Figure 6 shows the resulting counterfactual paths, along with the observed ones for the largest euro-area countries. Table 2 shows the counterfactual and the observed average growth rates and interest rates for the period 2006-2015. The table reports nominal GDP-weighted aggregates for the euro area. The conditional forecasts are dynamic, meaning that the lags in the model are the previous period conditional forecasts and not the observed realizations. Figure 7 plots the actual values and the counterfactual projections for the euro area. The exercise confirms the non-negligible impact of the assumed more favourable demographic devolution.

Figure 6. Historical counterfactual assumptions for dependency ratios: selected countries

(*percentage point*)



Note: The chart shows the evolution of dependency ratios between 1995 and 2015, along with the assumed more favorable evolution between 2006 and 2015.

In the counterfactual scenario, the real short-term interest rate in the euro area would have been 0.5 p.p. higher on average than the actual value. Macroeconomic variables would have evolved more favorably, with real GDP growth averaging 1.3%, 0.5 p.p. above the realized value. Real investment growth would have been 1.0 p.p. above the actual per annum growth (-0.2%) and real consumption growth by 0.6 p.p. (1.1%, compared with 0.5). The average unemployment rate would have equaled 8.5%, against the actual 9.2. The differences in the paths of the real long-term rates are small.

Table 2. Historical counterfactual under more favorable dependency ratios, 2006-15 – euro area

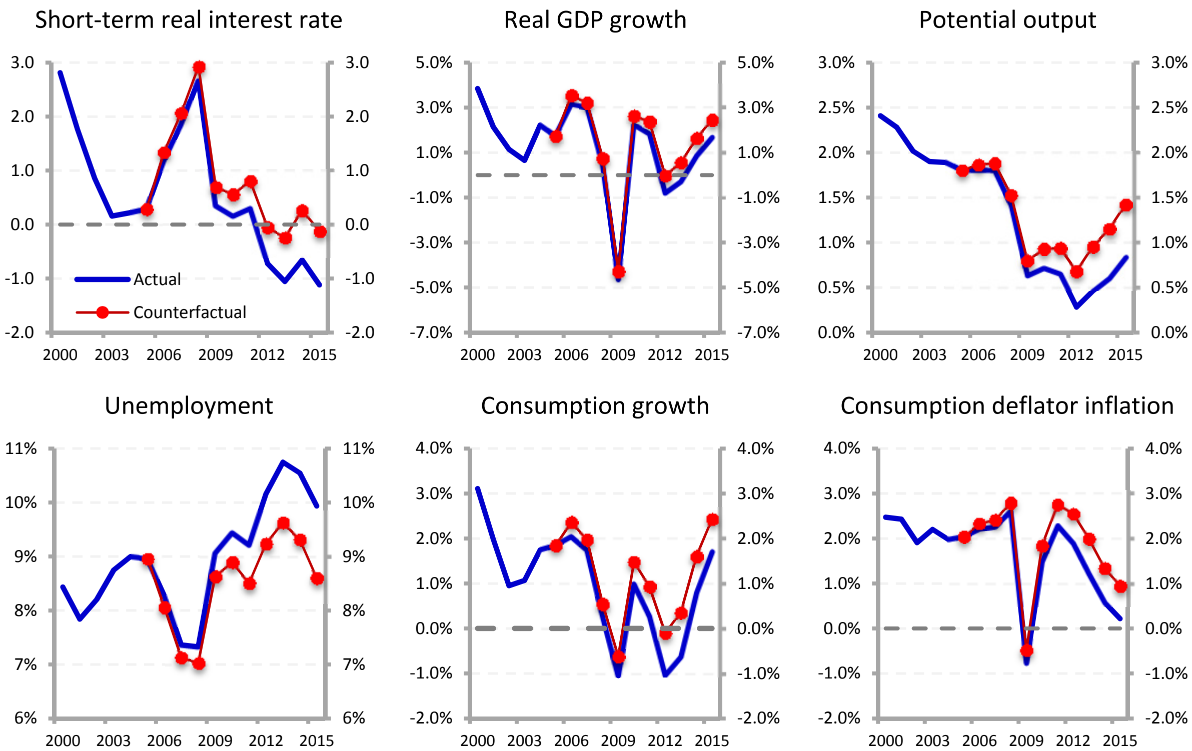
		Population growth	Dependency ratio	Real long-term interest rates	Real short-term interest rates	Nominal long-term interest rates	Nominal short-term interest rates	TFP	Potential output	Real GDP	Real investment	Real priv. consumption	GDP deflator	Priv. cons. deflator	Unemployment rates
2006-15	Obs.	0.35%	51.8%	2.0%	0.3%	3.3%	1.6%	0.1%	0.9%	0.7%	-0.2%	0.5%	1.4%	1.4%	9.2%
	Counterf.	0.35%	49.5%	2.1%	0.8%	3.8%	2.5%	0.3%	1.2%	1.3%	0.8%	1.1%	1.7%	1.8%	8.5%
	Diff. in p.p.	0.0	-2.3	0.1	0.5	0.5	0.9	0.2	0.3	0.5	1.0	0.6	0.4	0.4	-0.7

Note: Euro area aggregates based on data and estimates of the 19 euro-area countries. Averages over the period 2006-15. The nominal interest rate counterfactual paths are proxied by the sum of the real rates and the GDP deflator inflation averages per annum.

The significance of the estimates of the differences between the observed and the counterfactual paths are presented in Table A.2. The *p*-values were computed by positioning the observed variable paths in the counterfactual-conditional density forecasts, to measure the significance of the deviation between the observed and the counterfactual conditional mean on average along the projection horizon. The way the counterfactual-conditional density forecasts were generated reflects both the residuals and coefficient uncertainty.[10] For the euro area aggregate, the nominal GDP-weighted aggregates of the variable paths were first generated for all bootstrap replicates, to then compute the *p*-values. For the euro area as whole, the estimates suggest that for numerous variables the counterfactual path is statistically different from the observed trajectories at least at the 10% level. Against this threshold, the only exceptions are TFP growth and real long-term rates, which at 13% and 15% respectively may still be deemed as border-line significant, however. The relatively low *p*-values for the euro area are driven to a large extent by the low levels (and high GDP weight) for France, Spain, and the Netherlands.

Figure 7. Counterfactual projections – 2006-2015: euro area

(*percentage point*)



Note: The charts depict the historical evolution of the variables over the 2005-2015 period along with the counterfactual projections conditional on a more favorable evolution of demographics between 2006 and 2015.

[10] A nonparametric bootstrap on the residuals was combined with a parametric bootstrap for the estimated means and covariance matrix of the coefficients to generate 5,000 forward paths for the variables conditional on the counterfactual assumptions for the demographic factors.

In addition to the historical counterfactual analysis based on the 2006-2015 period, we have conducted the same exercise for the preceding 10-year window, spanning the 1996-2005 period. During this period, approximately half of the countries in the sample experienced an upward trend of their dependency ratios, while for the other half the ratios were trending downward. We do not report the results of this additional exercise; the counterfactual-observed gaps at the country aggregate level equal about one third of the size of the gaps based on the 2006-2015 period. The reason why in this case the gaps are significantly smaller is that dependency ratios did not trend upward significantly during this period, in particular for the euro area as a whole. All in all, while dependency ratios started trending upward in a subset of countries already in the second half of the 1990s, these trends intensified afterwards, implying a more sizable drag on macroeconomic developments in the last part of the sample.

4.4 Forward-looking counterfactual analysis: 2016-2025

Three scenarios are considered for the evolution of the dependency ratios for the forward-looking counterfactual assessment that we present now.

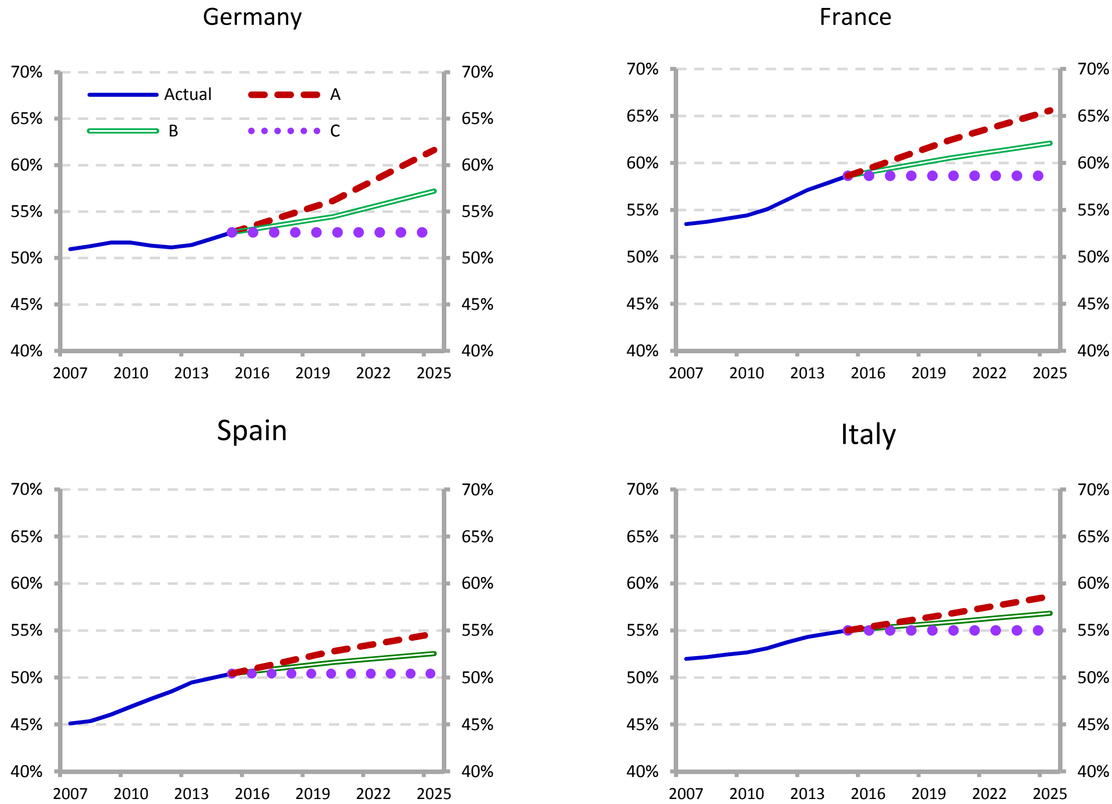
In scenario A, the ratios are aligned for all the countries with the projections by the EC. The implied ageing is the result of slowing dynamics of fertility, rising life expectancy and specific assumptions in terms of migration. The proportion of young people (aged 0-14) is projected to remain relatively constant in the euro area (around 15%), while those aged 15-64 are expected to constitute a substantially smaller share, declining from 66% to 57%. The share of those aged 65 and older is expected to increase substantially (to 29%, from 19%).

In scenario B, the dependency ratios are assumed to move half way in between the EC projections and a flat path with respect to 2015, thereby implying, to some extent, more favorable demographic developments, given that the EC paths imply a relatively steep upward trend compared to historical trends for all countries.

Scenario C assumes that dependency ratios remain flat at their 2015 values; it can be interpreted as an optimistic upside scenario (in economic terms) when judged against the projections of the EC.

The ratios are expected to rise in the four largest economies: in Germany, by 9 p.p. between 2016 and 2025, one of the largest increases after Lithuania, Malta and Slovenia. Ireland, Italy and Spain would experience the lowest increase (4 p.p.). Figure 8 shows the assumptions for the largest euro area countries.

Figure 8. Forward-looking scenarios for dependency ratios: selected countries



Note: For scenario A, the assumptions from the 2015 Ageing Report were adopted (red dashed line). In scenario B (green dashed line) the dependency ratios move half way in between the EC projections and a flat path. Under scenario C (purple dotted line), the ratios are assumed to remain flat at their 2015 levels.

The resulting counterfactual projections for the main euro-area variables for the 2016-2025 period are presented in Table 3.

The results confirm the important role that the dependency ratio plays in shaping macroeconomic outcomes. In scenario A, average TFP, real GDP, real investment and consumption growth would be lower than in scenarios B and C; TFP would be almost flat, growing by just 0.1% on average, and real GDP would grow by 0.6%. Compared with the more benign scenario C, TFP and real GDP growth would be lower by, respectively, 0.3 and 0.7 p.p. The increase in the dependency ratio would have a large impact on real investment, which would grow on average by 0.7% in adverse scenario A, compared with 1.9 in the more favorable scenario. The projections of real variables in scenario B would be in between those implied by scenarios A and C. Figure 9 shows the conditional projections for the short-term real rate, potential output and real GDP growth.

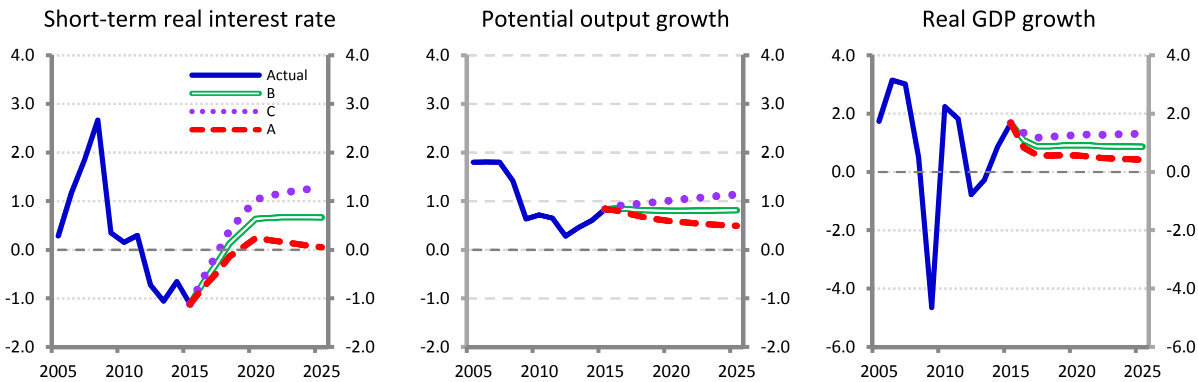
Table 3. Counterfactual scenario-conditional forecasts: euro area, 2016-2025

Scenario	Population growth	Dependency ratio (2025)	Real long-term interest rate (2025)	Real short-term interest rate (2025)	Nominal long-term interest rate (2025)	Nominal short-term interest rate (2025)	TFP	Potential output	Real GDP	GDP deflator	Real investment	Real private consumption	Private consumption deflator	Unem. rate (2025)
2000-06	0.46%	49.5%	2.3%	1.1%	4.4%	3.2%	0.6%	2.0%	2.1%	2.0%	2.3%	1.8%	2.2%	8.5%
2007-15	0.34%	52.0%	2.0%	0.2%	3.3%	1.5%	0.0%	0.8%	0.5%	1.3%	-0.8%	0.3%	1.3%	9.3%
2015	0.43%	54.1%	0.1%	-1.1%	1.2%	0.0%	0.8%	0.8%	1.6%	1.3%	2.8%	1.7%	0.2%	10.0%
2016-25 A	0.13%	60.7%	1.9%	0.1%	2.8%	1.0%	0.1%	0.6%	0.6%	1.0%	0.7%	1.0%	1.1%	9.9%
2016-25 B	0.13%	57.4%	2.1%	0.7%	3.3%	1.9%	0.3%	0.8%	0.9%	1.2%	1.3%	1.4%	1.4%	9.0%
2016-25 C	0.13%	54.1%	2.4%	1.3%	3.9%	2.8%	0.4%	1.0%	1.3%	1.4%	1.9%	1.8%	1.7%	8.3%

Note: euro area (nominal GDP-weighted) aggregates. In scenario A, dependency ratios are in line with the EC Ageing Report; in scenario B, they are assumed to evolve halfway between the EC projections and constant levels at 2015 values; in scenario C, they are constant at 2015 levels. The real interest rates were included in the model and projected conditional on the scenarios. The figures for nominal rate counterfactuals are proxied by the sum of the real rates and the GDP deflator inflation averages per annum.

Figure 9. Counterfactual scenario-conditional forecasts: euro area

(*per cent*)



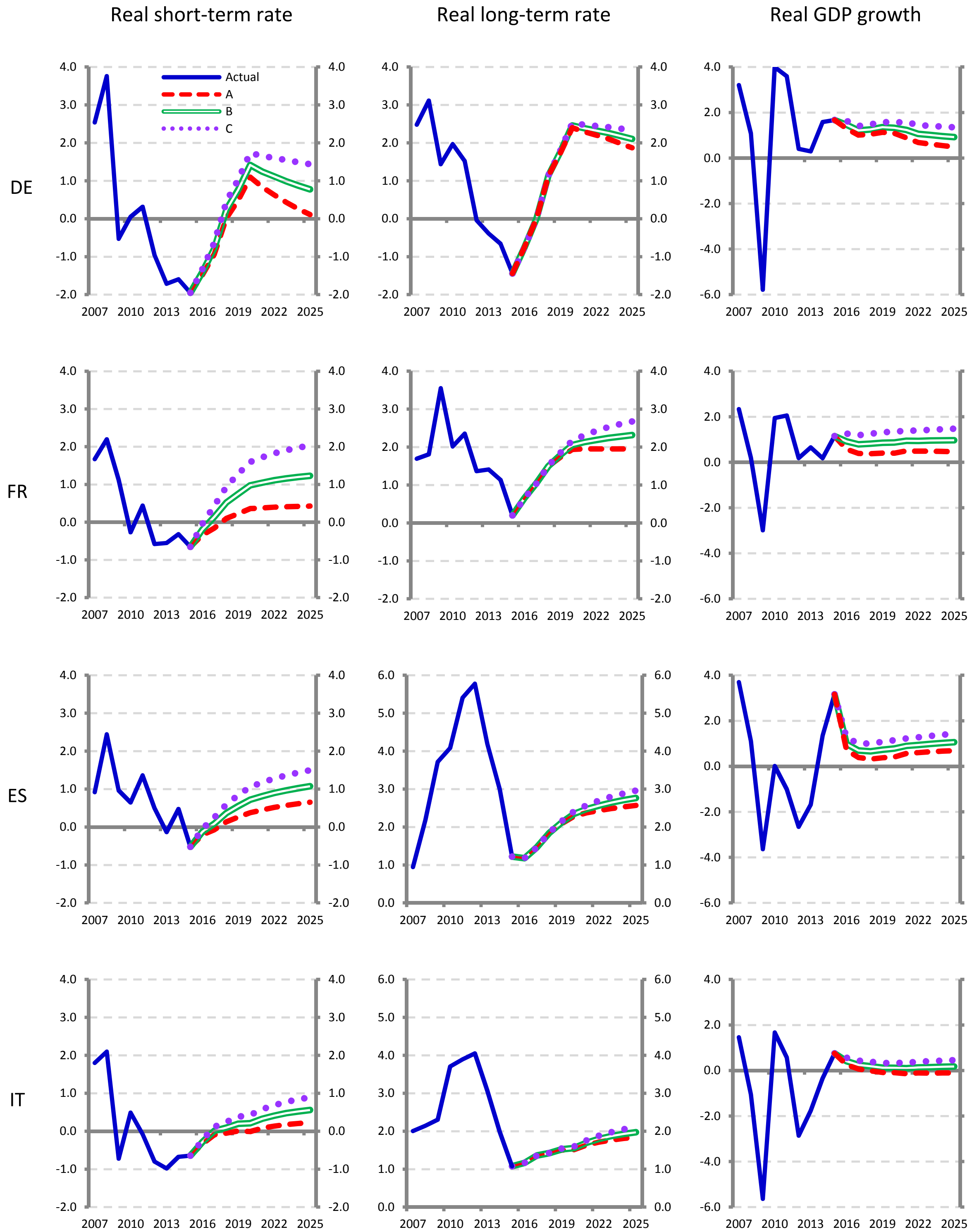
Note: The charts show the actual data and the conditional projections in the scenarios. For scenario A, the assumptions from the 2015 Ageing Report were adopted (red dashed line). In scenario B (green dashed line) the dependency ratios move half way in between EC projections and a flat path. In scenario C (purple dotted line), the ratios are assumed to remain flat at 2015 levels.

The conclusion we can draw from the forward-looking counterfactual assessment is that the evolution of the dependency ratios can be expected to play a key role in shaping macroeconomic developments in the future. In scenario A, the real short-term interest rate in the euro area would remain negative until 2019 and remain close to 0.0% in the 2020-2025 period (Figure 9), not far from the average between 2007 and 2015. In the most favorable scenario (C), instead, the real short-term rate would return to the levels observed in the 2000-2006 period (1.3% at the end of the horizon). In scenario A, potential output and real GDP growth would decrease significantly along the simulation horizon, moving from 0.8 and 1.7% respectively in 2015, to 0.5 and 0.4% in 2025.

Figure 10 shows the conditional forecasts for short- and long-term real interest rates and real GDP growth for the largest euro area countries. These projections confirm the important role that demographic developments may play over the next decade: to the extent that the ageing of the population continues, short and long-term real interest rates would remain below the pre-crisis levels.

Figure 10. Conditional projections: real interest rates and GDP growth, selected countries

(*percentage point*)



Note: see note to Figure 9.

Table A3 in the Annex presents the *p*-values of the differences between the simulations in scenarios B and C, respectively, and scenario A. Compared to the historical counterfactual significance estimates, the *p*-values comparing the forward-looking scenario C with scenario A are comparable in terms of their range with a view to the area aggregates, spanning from a sizable 2%-3% for potential output growth and unemployment rates, to the less significant 11%-14% for real long-term rates, real investment growth, and TFP growth. The euro area aggregate *p*-values are driven by the low *p*-values for France and the Netherlands.

4.5 Robustness

We have carried out several robustness checks of the results presented in this Section.

First, we have extended the sample back to 1980. The results that we presented both in terms of model estimates and historical and forward-looking counterfactuals change only marginally.

Second, we have used nominal short- and long-term interest rates instead of the real counterparts and the results in terms of projections for the implied real and nominal rates remain very close to those presented in this Section.

Third, we have excluded population growth from the model to judge whether there is a potential conflict with the dependency ratio. In this case too, the projections were only marginally affected.

Fourth, in terms of the estimation method, we have considered conventional GGM estimators as developed by Arellano and Bond (1991) instead of the LSDVC estimator. Although the Arellano-Bond estimator is known for its sub-optimal small-sample properties, our estimates and the resulting counterfactual projections do not change much and all the conclusions hold up to the alternative estimation method.

5. Conclusions and policy implications

Nominal and real interest rates have been decreasing since the mid-1980s and have reached historical low levels in the aftermath of the global financial crisis. Understanding why interest rates have fallen is essential for both the conduct of monetary policy and the assessment of the risks to financial stability. The ability of central banks to preserve price stability and keep output at its potential in the future will be conditioned by the level of the natural or equilibrium interest rate.

This paper has focused on one factor that has been put forward within the debate on the secular stagnation (Summers, 2014) as the source of the declining trend of interest rates: adverse demographic developments. The worrisome expected evolution of the demographic structure in Europe requires assessing the impact of demographic developments on real interest rates and potential output growth.

The empirical evidence presented in this paper suggests that over the next decade, adverse demographic developments in the euro area may continue exerting downward pressures on short- and long-term nominal and real interest rates, potentially limiting the ability of monetary policy to adjust its stance due to the presence of the lower bound to policy rates.

The pace at which real interest rates increase from current historically low levels may be influenced by structural, fiscal policies that encourage later retirement and promote innovation and investment in R&D. Such policies are also necessary to limit the negative impact of ageing on long-term growth prospects. They may, however, take quite a long time to exert their impact as time lags for policies to affect demographic structures are naturally relatively long, spanning up to several decades.

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Appendix

Table A.1. Panel VARX model estimates (1990-2015)

	Pot. output growth LN(PYER/PYER(-1))			TFP growth LN(TFP/TFP(-1))			Real GDP growth LN(YER/YER(-1))			GDP defl. infl. LN(YED/YED(-1))			Real l-term i-rate RLR		
	coef	se	p	coef	se	p	coef	se	p	coef	se	p	coef	se	p
Potential output growth (-1)	0.884	0.041	0.000	0.134	0.092	0.146	0.374	0.146	0.011	-0.026	0.025	0.292	0.392	0.172	0.023
TFP growth (-1)	0.103	0.033	0.002	-0.012	0.104	0.909	0.240	0.157	0.127	0.004	0.029	0.888	-0.081	0.244	0.741
Real GDP growth (-1)							0.004	0.205	0.986	0.096	0.040	0.016	-0.272	0.277	0.328
GDP defl. infl. (-1)	-0.046	0.049	0.347				-0.200	0.145	0.168	0.612	0.041	0.000			
Investment growth (-1)															
Investment defl. infl. (-1)															
Private cons. growth (-1)															
Private cons. deflator infl. (-1)															
Change in unemploym. rate				-0.250	0.054	0.000									
Change in unemploym. rate (-1)															
Real long-term i-rate				-0.088	0.033	0.007									
Real long-term i-rate (-1)	0.020	0.011	0.080	0.147	0.033	0.000	0.065	0.032	0.046	0.008	0.006	0.199	0.638	0.097	0.000
Real short-term i-rate				0.056	0.034	0.099									
Real short-term i-rate (-1)	-0.015	0.011	0.188	-0.075	0.032	0.020	-0.073	0.033	0.026	0.005	0.006	0.386	0.113	0.090	0.210
Population growth	-0.001	0.018	0.933	-0.122	0.090	0.178	-0.010	0.061	0.865	0.047	0.016	0.003	-0.255	0.106	0.017
Change in dependency ratio	-0.083	0.023	0.000	-0.017	0.069	0.801	-0.211	0.074	0.005	-0.037	0.017	0.028	0.001	0.129	0.995
Change in dependency ratio (-1)															
R2		0.94			0.40			0.40			0.81			0.63	
Adj. R2		0.93			0.35			0.36			0.79			0.61	
SE of regression		0.355			0.743			0.800			0.333			2.451	
DW		1.53			1.84			1.91			2.09			1.93	
Obs.		396			395			396			396			395	

	Real s-term i-rate RSR			D(unempl. rate) URX-URX(-1)			Inv. growth LN(ITR/ITR(-1))			Inv. defl. infl. LN(ITD/ITD(-1))			Priv. cons. growth LN(PCR/PCR(-1))			Priv. cons. Defl. infl. LN(PCD/PCD(-1))		
	coef	se	p	coef	se	p	coef	se	p	coef	se	p	coef	se	p	coef	se	p
Potential output growth (-1)	0.228	0.188	0.225	0.184	0.098	0.060												
TFP growth (-1)	-0.101	0.242	0.678				0.400	0.100	0.000	0.081	0.028	0.004	0.176	0.068	0.010	0.043	0.035	0.219
Real GDP growth (-1)	0.182	0.305	0.551	-0.391	0.120	0.001												
GDP defl. infl. (-1)																		
Investment growth (-1)							0.097	0.090	0.284	0.023	0.026	0.381						
Investment defl. infl. (-1)							-0.143	0.117	0.222	0.491	0.055	0.000						
Private cons. growth (-1)													0.367	0.079	0.000	0.063	0.041	0.126
Private cons. deflator infl. (-1)													-0.391	0.109	0.000	0.483	0.081	0.000
Change in unemploym. rate																		
Change in unemploym. rate (-1)				0.268	0.077	0.001												
Real long-term i-rate				0.219	0.042	0.000												
Real long-term i-rate (-1)	-0.028	0.072	0.697	-0.212	0.043	0.000	0.042	0.034	0.219	0.006	0.008	0.503	0.007	0.026	0.793	0.009	0.012	0.447
Real short-term i-rate				-0.135	0.048	0.005												
Real short-term i-rate (-1)	0.741	0.081	0.000	0.173	0.046	0.000	-0.087	0.035	0.014	-0.009	0.010	0.369	-0.009	0.027	0.732	0.000	0.013	0.977
Population growth	-0.255	0.112	0.023				-0.015	0.063	0.815	0.029	0.021	0.176	0.067	0.050	0.182	0.036	0.022	0.101
Change in dependency ratio	-0.191	0.110	0.084	0.282	0.086	0.001	-0.223	0.091	0.015	-0.082	0.023	0.000	-0.268	0.064	0.000	-0.069	0.028	0.013
Change in dependency ratio (-1)				-0.192	0.088	0.029												
R2		0.69			0.49			0.29			0.57			0.46			0.63	
Adj. R2		0.67			0.45			0.24			0.54			0.42			0.60	
SE of regression		2.305			0.886			0.866			0.431			0.690			0.436	
DW		2.02			1.89			1.83			2.16			1.96			2.15	
Obs.		396			395			396			396			396			396	

Note: The model has been estimated with cross-section (country) fixed effects on annual data spanning the 1990-2015 period. An LSDV estimation method has been employed for estimation. The model has been constrained to some extent, by excluding insignificant relationships resulting after a first, unconstrained estimation of the model. Intercept/fixed effects estimates are not presented here. Green and yellow cells are a visual support to finding coefficients whose *p*-values suggest significance at least at the 1% and 5% levels, respectively. See text for details.

Table A.2. Significance estimates (*p*-values): counterfactual versus actual, 2006-2015

	AT	BE	CY	DE	EE	ES	FI	FR	EL	IE	IT	LT	LU	LV	MT	NL	PT	SI	SK	EA
Potential output growth	16%	2%	14%	15%	3%	4%	3%	0%	6%	5%	7%	9%	23%	4%	4%	6%	7%	2%	10%	5%
TFP growth	20%	16%	17%	16%	12%	1%	12%	7%	11%	13%	15%	13%	22%	14%	13%	13%	4%	9%	15%	13%
Real long-term interest rates	24%	21%	25%	19%	20%	17%	20%	17%	22%	19%	19%	24%	25%	23%	14%	17%	20%	15%	23%	15%
Real short-term interest rates	19%	11%	10%	14%	9%	9%	9%	6%	12%	12%	14%	18%	23%	17%	3%	7%	11%	0%	17%	7%
Real GDP growth	17%	9%	12%	8%	5%	6%	5%	2%	6%	7%	11%	8%	22%	7%	6%	8%	1%	3%	10%	8%
GDP deflator inflation	19%	9%	19%	20%	14%	8%	2%	0%	14%	8%	12%	18%	23%	15%	15%	7%	8%	12%	18%	6%
Real investment growth	17%	11%	12%	8%	8%	10%	6%	6%	9%	9%	15%	9%	21%	10%	9%	9%	1%	5%	11%	10%
Investment deflator inflation	17%	7%	17%	18%	11%	6%	3%	1%	8%	9%	5%	14%	21%	13%	12%	4%	1%	9%	15%	5%
Real private consumption growth	12%	3%	8%	5%	3%	4%	2%	0%	5%	4%	8%	5%	20%	5%	4%	4%	0%	1%	6%	4%
Private consumption deflator inflation	17%	7%	17%	18%	11%	3%	1%	0%	11%	3%	9%	15%	21%	13%	12%	5%	3%	9%	15%	6%
Unemployment rate	26%	6%	12%	13%	1%	1%	0%	0%	2%	15%	9%	14%	41%	0%	0%	1%	4%	0%	7%	5%

Note: Lower levels imply larger significance in the difference between the observed and the counterfactual average values along the 2006-2015 simulation period. Green, orange and light grey colors are a visual support to seeing *p*-values less than 1%, between 1%-5%, and between 5%-10%.

Table A.3. Significance estimates (*p*-values): counterfactual scenario A, 2016-2025

versus scenario B

	AT	BE	CY	DE	EE	ES	FI	FR	EL	IE	IT	LT	LU	LV	MT	NL	PT	SI	SK	EA
Potential output growth	11%	5%	13%	14%	12%	16%	11%	2%	18%	18%	15%	3%	20%	10%	8%	10%	16%	7%	12%	10%
TFP growth	20%	20%	21%	20%	18%	14%	19%	17%	21%	22%	22%	14%	23%	19%	18%	19%	19%	16%	20%	19%
Real long-term interest rates	21%	19%	20%	20%	21%	22%	20%	18%	24%	23%	22%	21%	24%	23%	10%	19%	22%	13%	17%	17%
Real short-term interest rates	16%	14%	10%	12%	17%	19%	17%	14%	21%	21%	20%	14%	21%	20%	7%	11%	18%	4%	19%	12%
Real GDP growth	17%	15%	17%	17%	14%	19%	15%	12%	20%	19%	19%	7%	21%	14%	13%	14%	17%	11%	16%	16%
GDP deflator inflation	17%	15%	21%	21%	19%	20%	10%	7%	22%	20%	19%	23%	22%	20%	19%	12%	18%	18%	21%	12%
Real investment growth	18%	17%	18%	19%	15%	20%	16%	16%	21%	20%	22%	11%	22%	16%	15%	17%	19%	12%	17%	18%
Investment deflator inflation	16%	15%	20%	20%	18%	19%	11%	9%	21%	20%	17%	14%	20%	19%	18%	10%	14%	16%	19%	13%
Real private consumption growth	13%	11%	15%	16%	11%	17%	11%	9%	20%	18%	19%	6%	21%	13%	12%	12%	17%	8%	14%	14%
Private consumption deflator inflation	16%	14%	20%	20%	17%	17%	8%	8%	22%	17%	18%	13%	20%	19%	18%	11%	16%	16%	19%	14%
Unemployment rate	17%	11%	10%	12%	8%	22%	7%	7%	24%	26%	27%	0%	32%	4%	2%	4%	19%	1%	10%	13%

versus scenario C

	AT	BE	CY	DE	EE	ES	FI	FR	EL	IE	IT	LT	LU	LV	MT	NL	PT	SI	SK	EA
Potential output growth	3%	0%	5%	6%	4%	9%	3%	0%	11%	13%	8%	0%	15%	2%	1%	2%	8%	1%	4%	3%
TFP growth	15%	15%	16%	16%	12%	6%	13%	10%	18%	18%	18%	6%	21%	14%	12%	13%	13%	9%	15%	14%
Real long-term interest rates	17%	14%	15%	16%	16%	18%	15%	12%	23%	21%	20%	17%	23%	21%	2%	13%	20%	5%	10%	11%
Real short-term interest rates	8%	6%	2%	4%	10%	13%	10%	6%	17%	18%	15%	6%	18%	15%	1%	3%	12%	0%	13%	5%
Real GDP growth	10%	7%	10%	10%	6%	13%	7%	4%	15%	14%	14%	1%	18%	6%	4%	6%	10%	3%	9%	9%
GDP deflator inflation	10%	7%	17%	17%	14%	14%	3%	1%	20%	15%	14%	20%	19%	15%	13%	4%	12%	11%	16%	6%
Real investment growth	12%	10%	12%	14%	7%	16%	8%	9%	17%	15%	19%	3%	20%	9%	8%	11%	14%	4%	10%	13%
Investment deflator inflation	9%	7%	16%	16%	11%	13%	3%	2%	17%	16%	10%	6%	16%	13%	12%	3%	6%	8%	14%	6%
Real private consumption growth	5%	3%	8%	9%	3%	11%	3%	1%	14%	12%	13%	0%	18%	5%	4%	4%	10%	1%	6%	7%
Private consumption deflator inflation	9%	7%	16%	15%	11%	10%	1%	1%	18%	10%	13%	5%	16%	13%	12%	3%	9%	8%	14%	7%
Unemployment rate	3%	1%	0%	2%	0%	6%	0%	0%	8%	10%	11%	0%	18%	0%	2%	0%	4%	0%	1%	2%

Note: Lower levels imply larger significance in the difference between the observed and the counterfactual average values. Green, orange and light grey colors are a visual support to seeing *p*-values less than 1%, between 1%-5%, and between 5%-10%.

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