Long-Lasting Consequences of the European Crisis*

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Abstract

The Great Recession and the subsequent European crisis may have long-lasting effects on aggregate demand, aggregate supply, and, hence, on macroeconomic performance over the medium and long-run. Besides the fact that financial crisis last longer and are succeeded by slower recoveries, and apart from the hysteresis effects that may operate after episodes of long-term unemployment, the combination of high (public and private) debt and low population and productivity growth may create important constraints for monetary and fiscal policies. In this paper I develop an OLG model, already used by Eggertsson and Mehrotra (2014) to rationalize the "secular stagnation hypothesis", to show how high debt, and low population and productivity growth may condition the macroeconomic performance of some European countries over the medium and long-run.

JEL Codes: E20, E43, E52, E66

Keywords: natural rate of interest, zero lower bound, population and productivity growth, intergenerational transfers, secular stagnation.

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The swift stream of events in the last quarter century offers, however, overwhelming testimony in support of the thesis that the economic order of the western world is undergoing in this generation a structural change no less basic and profound in character than that transformation of economic life and institutions which we are wont to designate loosely by the phrase "the Industrial Revolution". ...We are moving swiftly out of the order in which those of our generation were brought up, into no one knows what. (A. Hansen, "Economic Progress and Declining Population Growth", *American Economic Review,* vol. 29, 1939)

Indeed, I think it is fair to say that today, the amplitude of fluctuations appears large, not small...there is room for doubt about whether the cycle actually cycles (L. Summers, "U.S. Economic Prospects: Secular Stagnation, Hysteresis, and the Zero Lower Bound", *Business Economics*, vol. 49,2, 2014)

1 Introduction

The Great Recession was more intense and protracted than the typical recession.[1] And, in some European countries, it was followed by a debt crisis that have pushed them into a double/triple-dip recession. Currently, seven years after the financial turmoil that signalled the start of the recent economic crisis, GDP and employment are yet below their pre-crisis levels. Slow and jobless recoveries, if recoveries at all, are being observed in many European countries.

A signal that the Great Recession and the European crisis had some special features is the high number of research papers on its long-run impacts on many socioeconomic variables such as consumption, investment, productivity, the labor market, fertility,... [2] On broader terms, the economic literature approaches the causes of the slow recoveries after this episode under three different routes.[3] First, one line of research tries to link the causes of the slow recovery to the financial origin of the crisis, appealing to some characteristics of the financial sector that make the original factors leading to the Great Recession (bursting

[1] The term "Great Recession" usually applies to both the U.S. recession – officially lasting from December 2007 to June 2009 – and the ensuing global recession in 2009. Since this paper focuses mostly on the European situation, the term "Great Recession" is used to refer to the sequence of events starting with the financial crisis in late 2007, and continuing with global recession in 2009 and the European debt crisis that followed in early 2010.

[2] See, for instance, Crawford, Jin and Simpson (2013) on investment, Fernald (2014) on produtivity, and Goldstein, Kreyenfled, Jasilioniene, and Orsal (2013) on fertility. As for the labour market, there are three reasons why the effects may last longer than usual: i) slower labour reallocation under a credit crunch (see Foster, Grim, and Haltiwanger 2013), ii) a higher increase of long-term unemployment (see Casado, Fernandez and Jimeno, 2014), and iii) a higher incidence of unemployment on youth high-skilled workers (see Bell and Blanchflower, 2011, and Casado, Fernández and Jimeno, 2014)

[3] For a survey of alternative viewpoints on the causes of sluggish growth after the recent financial crisis, see Lo and Rogoff (2014).

of housing bubbles, prolonged deleveraging, and banking crises) long-lasting.[4] Secondly, there are other papers that emphasize transmission mechanisms by which temporary negative shocks may have long-lasting effects, such as, for instance, unemployment hysteresis or changes in expectations giving raise to long-lasting non-fundamental shocks.[5] Thirdly, there is the revival of the "secular stagnation hypothesis", which Eggertsson and Mehrotra (2014) have formalized in a model that illustrates the possibility that a temporary deleveraging shock yields a permanent liquidity trap under which demand is permanently too low and real interest rates negative enough for monetary policy to be permanently constrained by the Zero Lower Bound on policy interest rates.[6] While the financial nature of the crisis and the existence of hysteresis mechanisms may be relevant to understand the transmission and persistence of shocks, they do not explain: i) why demand and growth prospects remain subdued even after the financial sector has been repaired in many countries, and ii) why long-lasting effects are now more of a concern than in previous recessions. Hence, the medium and long-run effects of the European crisis seem to be more related to structural trends that severely constrain macroeconomic policies and economic growth.

Indeed, the legacy of the Great Recession is oppressive: i) high debt (private and public), ii) high unemployment and depressed earnings (decline of the middle class), iii) a significant fraction of capital stock that will not very be easy to reallocate, and iv) a financial sector with increasing cost of credit and, hence, less profitable investment projects to fund. These difficulties will have to be addressed in a scenario marked by low growth, due to population ageing, and diminished expectations of productivity growth. Moreover, demographic prospects may have significant economic consequences, affecting to patterns of consumption and potential growth (through employment and TFP growth). Additionally, in the EMU, competitiveness imbalances, built-up during the pre-crisis period, have to be corrected through changes in nominal wages, precisely at the time where nominal rigidities and the zero lower bound bind and, thus, wage cuts are most costly.

The main goal of this paper is to show how the interaction of the legacy of the crisis with log-run trends in the world economy prevailing in the pre-crisis period (mostly the decline of population and of productivity growth rates) gives raise to a long-lasting period of subdued growth and high unemployment To do so, I develop a simple OLG model, a version of Eggertsson and Mehrotra's (2014) model extended to include public debt and exogenous technical progress. In this model a deleveraging shock has long-lasting effects through the savings decision of households. As households accumulate less debt, savings increase and the natural interest rate falls, plausibly below zero. If then monetary policy is either unwilling or unable to accommodate a negative real interest rate by increasing inflation, then the zero lower bound on policy interest rates binds and

[4] See Reinhart and Rogoff (2010), Queraltó (2013).

[5] On hysteresis effects during the Great Recession, see Ball (2014). On other long-lasting effects to the US economy, see Hall (2014a). On the response to non-fundamental shocks, see Scmith-Grohe and Uribe (2012).

[6] See also Summers (2014).

unemployment raises. Moreover, if household anticipate lower population and productivity growth, savings increase further, increasing the pressure on real interest rate to fall. Hence lower population and productivity growth interact with deleveraging to push downwards the natural interest rate, and for a given inflation rate and nominal and real wage rigidities, for unemployment to increase and persist at high levels. In some sense, this interaction connects the literature on the effects of demographic changes on interest rates and on inflation (see Kara and von Thadden, 2014, and Carvalho and Ferrero, 2014) with papers looking at the effects of deleveraging shocks (Guerrieri and Lorenzoni, 2012, Eggertsson and Krugman, 2012, and Huo and Rios-Rull, 2013).

The structure of the paper is as follows. First (in Section 2) I present the model, and identify the main factors that may cause a protracted recession similar to the one currently being observed in many European countries. In contrast to Eggertsson and Mehrotra (2014) I neglect steady state analysis and focus on the main factors that may lead the economy to fall into a liquidity trap and that make that situation long-lasting. The second part of the paper (Section 3) documents how some European countries fare with these factors (population ageing, low productivity growth, high debt) that may give raise to long-lasting effects of the crisis, and, hence, it provides a first step towards the quantitative assessment of the persistence mechanisms and structural trends that appear very relevant for future macroeconomic performance in Europe. Finally, Section 4 concludes with some conjectures and policy implications of this analysis.

2 The Model

I consider a version of Eggertsson and Mehrotra's (2014) three period OLG model, extended to include: i) exogenous technical progress and ii) a public sector accumulating debt in order to implement some income transfers across generations. The focus is mainly on how savings decisions and demand for credit determine the natural interest rate, and to that end, both productivity growth and inter-generational transfers by fiscal policy are important factors to take on board.

2.1 Households

At each moment, three generations (young, y, middle, m, and old, o) coexist. The size of the young generation at t is denoted by N_t^y, and exogenously grows at rate n_t. Hence, $N_t^y = (1+n_t)N_{t-1}^y = (1+n_t)N_t^m = (1+n_t)(1+n_{t-1})N_t^o$.

The young generation is credit constrained, does not produce, and receives no income. Therefore, to consume they borrow from the middle generation, up to a limit D_t^y (inclusive of interest payments).

The middle generation provides labor (inelastically), receives all income (labor earnings and capital income, Y), and saves: i) to pay for debt accumulated while young, ii) to buy capital (at price p^k), iii) to lend to the young generation (B_t^m), and iv) to hold public bonds (B_t^g). Capital depreciates at rate δ.

There is a public sector that tax income at rate τ_t and spends $N_t^m G_t$, to be financed by tax revenues, $\tau_t Y_t$, and (one-period) bonds held by the middle generation, $N_t^m B_t^g$. Public expenditures are assumed to be spent in providing income to the old generation (as in a Pay-As-You-Go pension system).

The old generation consumes all of its savings (plus interest receipts) and government transfers.[7]

Thus, the household's problem is:

$$
\begin{aligned}
& \max_{\{c_t^y, c_{t+1}^m, c_{t+2}^o\}} E_t[\log c_t^y + \beta \log c_{t+1}^m + \beta^2 \log c_{t+2}^o] \\
s.t. \quad c_t^y &\leq B_t^y; \qquad (1+r_t)B_t^y \leq D_t \\
c_{t+1}^m + p_{t+1}^k \frac{K_{t+1}}{N_{t+1}^m} + (1+r_t)B_t^y &= (1-\tau_{t+1})\frac{Y_{t+1}}{N_{t+1}^m} - (B_{t+1}^g + B_{t+1}^m) \\
c_{t+2}^o &= p_{t+2}^k(1-\delta)\frac{K_{t+1}}{N_{t+1}^m} + (1+r_{t+1})(B_{t+1}^g + B_{t+1}^m) + \frac{N_{t+2}^m}{N_{t+2}^o} G_{t+2}
\end{aligned}
$$

The Euler equation for consumption is:

$$
\frac{1}{c_t^m} = \beta \frac{1+r_t}{c_{t+1}^o}
$$

while consumption of the young and old generations are determined by the corresponding budget constraints:

$$
\begin{aligned}
c_t^y &= \frac{D_t}{1+r_t} \\
c_t^o &= p_t^k k_{t-1}(1-\delta) + (1+r_{t-1})(B_{t-1}^g + B_{t-1}^m) + \frac{N_t^m}{N_t^o} G_t
\end{aligned}
$$

where $k_{t-1} = \frac{K_{t-1}}{N_{t-1}^m}$. Thus, savings (per member of the middle generation, excluding capital investment) at time t are given by:

$$
-(B_t^m + B_t^g) = \frac{\beta}{1+\beta}\left[(1-\tau_t)y_t - D_{t-1} - p_t^k k_t\right] - \frac{1}{1+\beta}\frac{1+n_t}{1+r_t}G_{t+1} - \frac{1}{1+\beta}\frac{(1-\delta)p_{t+1}^k k_t}{1+r_t}
$$

while the demand of loans is the sum of the (private) debt constraint for the young generation and the supply of (public) bonds:

$$
\frac{N_t^y D_t}{1+r_t} + N_t^m B_t^g
$$

[7] For simplicity and without loss of generality, I leave aside mortality risk and changes in retirement age that affect to the relative size of the old cohort. When discussing population projections in Section 3, I consider to what extent changes in retirement age would alter the size of intergenerational transfers from the working to the retired population.

2.2 Public debt dynamics

The accumulation of public debt is straightforward: The supply of public bonds is the sum of the bonds issued at the previous period, interest payments, and the primary deficit to be financed at each period:

$$\begin{aligned} N_t^m B_t^g &= N_{t-1}^m B_{t-1}^g (1 + r_{t-1}) + N_t^m G_t - \tau_t Y_t \\ B_t^g &= \frac{1 + r_{t-1}}{1 + n_{t-1}} B_{t-1}^g + G_t - \tau_t \frac{Y_t}{N_t^m} \end{aligned}$$

Hence, the debt-to-GDP ratio ($b = N^m B^g / Y$) is given by

$$b_t^g = \frac{1 + r_{t-1}}{1 + n_{t-1}} \frac{y_{t-1}}{y_t} b_{t-1}^g + g_t - \tau_t$$

where $y = Y/N^m$ and $g = G/y$.

2.3 Supply side

The production function is Cobb-Douglas, there is exogenous technical progress (indexed by A_t, growing at the exogenous rate a_t). Labor supply is inelastic, so that eemployment is given by proportion of the middle generation who is working:

$$Y_t = A_t K_t^{1-\alpha} L_t^{\alpha}; \qquad L_t = (1 - u_t) N_t^m$$

where u_t is the unemployment rate. Normalized by the size of the middle generation, N_t^m, the production function can be written as follows

$$y_t = A_t k_t^{1-\alpha} (1 - u_t)^{\alpha}$$

Labor and capital demand conditions are given by:

$$w_t = \frac{\alpha y_t}{1 - u_t} \tag{1}$$

$$r_t^k = \frac{(1 - \alpha) y_t}{k_t} \tag{2}$$

As for capital, the corresponding Euler equation is:

$$\frac{p_t^k - r_t^k}{c_t^m} = \frac{\beta [p_{t+1}^k (1 - \delta_t)]}{c_{t+1}^o}$$

Hence, the arbitrage condition linking the rental rate of capital and the real interest rate is:

$$r_t^k = p_t^k - \frac{(1 - \delta) p_{t+1}^k}{1 + r_t} \geq 0 \tag{3}$$

For given current and future price of capital and depreciation rate, this equation give the impact of the real interest rate on capital accumulation, assuming away financial distortions that could introduce and additional wedge between the real interest rate and the rental rate of capital. Combining equations (1) to (3) with the production function yields the following relationship:

$$\frac{1}{1+r_t} = \frac{p_t^k - \widetilde{A}_t w_t^{\frac{\alpha}{\alpha-1}}}{(1-\delta)p_{t+1}^k} \tag{4}$$

where $\widetilde{A} = (1-\alpha)\alpha^{\frac{\alpha}{1-\alpha}} A^{\frac{1}{1-\alpha}}$.

2.4 Wage and price determination

Eggertsson and Mehrotra (2014) consider downwards nominal wage rigidity, so that wages are given by:

$$\begin{aligned} W_t &= \max\left\{\overline{W_t}, P_t F_L(K_t, N_t^m)\right\} \\ \overline{W_t} &= \gamma W_{t-1} + (1-\gamma) P_t F_L(K_t, N_t^m) \end{aligned}$$

Alternatively, I also consider the possibility of wages being constrained by real rigidities.[8] In this case, I assume that the real wage cannot decrease below a certain level, $\overline{w_t}$, because of the existence of wage norms or imperfections in the labor market, and, hence, the prevailing wage is given by

$$w_t = \max\left\{\overline{w_t}, F_L(K_t, N_t^m)\right\}$$

2.5 Monetary policy

Monetary policy is determined by a Taylor rule with a Zero Lower Bound (henceforth, ZLB) on the policy nominal interest rate, while the Fisher equation relates nominal and real interest rates, so that, respectively:

$$1 + i_t = \max\left\{1, (1+i^*)\left(\frac{\Pi_t}{\Pi^*}\right)^{\phi_\pi}\right\}$$

$$1 + r_t = \frac{1+i_t}{\Pi_{t+1}}; \qquad \Pi_{t+1} = \frac{P_{t+1}}{P_t}$$

where i^*, Π^* and ϕ^π are policy parameters.

2.6 Full employment equilibrium

Consider first the case in which neither wage rigidities nor the ZLB are binding. In this case, the economy is at full employment, and the real interest rate, r_t^f, is determined by the condition equating supply and demands for loans, that is:

[8] See Shimer (2012) on the relevance of real wage rigidities to generate jobless recoveries.

$$1+r_t^f = \frac{1+i^*}{\Pi^*} = \frac{(1+\beta)[(1+n_t)d_t + (1-\delta)p_{t+1}^k \frac{kt}{yt}] + (\tau_{t+1} + b_{t+1}^g)(1+n_t)\frac{y_{t+1}}{y_t}}{\beta[\alpha - \tau_t - d_{t-1}\frac{y_{t-1}}{y_t} - b_t^g]} \tag{5}$$

where $d = D/y$.

The previous equation provide several insights on the channels by which the different factors enter into the determination of the natural real interest rate. These factors, some already highlighted by Eggertsson and Mehrotra (2014), others somehow neglected in their analysis, are:

- The population growth rate: as population growth falls (n_t), the natural interest rate falls, since there are less young people demanding credit. Notice however that there is another effect of population growth on the natural interest rate. First, as population growth falls, expected transfers to the old generation also fall, since the size relative of the middle generation to finance those transfers will be smaller. This implies lower future income for the old generation and, thus, an increase in savings that pushes down the natural interest rate even further.

- (Current and next period) productivity growth rates. Higher current productivity growth rate, a_t, increases savings since allows to the middle generation to pay for its debt accumulated while young using a lower fraction of its income, and hence, disposable income available for savings is higher, and the natural rate is lower. Higher next period productivity growth, a_{t+1}, decreases savings since expected transfers to the old generation are higher, for given tax rates and deb ratios, and, thus, the natural interest rate is higher.

- The future value of capital: A decrease in the price of capital or a higher depreciation rate decrease the equilibrium real interest rate, since future expected income by the middle generation is lower, and, hence, its savings are higher.

- Private debt. The lower the demand of credit by the young generation, d_t, is, the lower the equilibrium real interest rate is. Also, the lower the private debt accumulated by the middle generation while young, the higher savings are, and, thus, the lower the natural rate is.

- (Current and next period) Tax rates and public debt ratios. A higher current tax rate crowds out savings by lowering disposable income, and, hence, increases the natural rate. A higher next period tax rate also crowds out savings by increasing expected future income, also pushing the natural rate up. As for the debt ratios, the current one increases the demand for loans, while the future one, increases expected transfers to the old generation, so that high debt ratios push the natural rate up.[9]

Finally, notice that with full depreciation ($\delta = 1$) and constant price of capital, y^f grows at the same rate as technical progress, and thus

$$1+r_t^f = \frac{(1+n_t)(1+a_t)[(1+\beta)d_t + (\tau_{t+1} + b_{t+1}^g)(1+a_{t+1})]}{\beta[(\alpha - \tau_t - b_t^g)(1+a_t) - d_{t-1}]} \tag{6}$$

Therefore, under stationary fiscal policy (constant b^g and, τ) and constant population and productivity growth, the change in the natural rate after a permanent deleveraging shock is

$$r_{t+1}^f - r_t^f \approx \frac{(d_t - d_{t-1})/d_t}{(\alpha - \tau - b^g)(1+a)/d_t - 1}$$

Thus, a negative permanent deleveraging shocks ($d_t < d_{t-1}$) reduce the real interest rate by more, the lower disposable income of the medium generation is (that is disposable income after repaying debt and buying public bonds) With decreasing population and productivity growth, the impact of the deleveraging shock on the natural rate is even higher, as savings would increase by even more, since expected future income falls. Notice also, that the impact of the (private deleveraging shock) on the natural rate is higher, the higher the public debt ratio is. Assuming some plausible parameter values, just for illustrative purposes, the factor in the relationship between the variation in the natural rate and the proportional change in the ratio of debt-to-income ratio is of the order of 0.2.[10] Thus, for a reduction in the initial debt-to-income ratio of the middle generation of 10%, the natural rate would fall by 2 percentage points. Figure 1 gives the (annual) natural interest rate implied by equation (6) for alternative population and productivity growth rates and debt-to-income ratios, under plausible values for the rest of the parameters (time discount rate 2% annual, inter-generational transfers of 8% of GDP and a labor share of 2/3). It shows that for low productivity growth (1% annual) and low accumulation of private debt (d=5%), the natural rate can reach significant negative values even at not so low population growth rates.

In any case, if accommodated by monetary policy through a fall in the nominal rate, the fall of the natural interest rate has no unemployment consequences. As the real rate is lower, capital accumulation is higher, and output is at its full employment level, inflation is at its target, and nominal wages adjust for real wages to reached the level compatible with full employment.

[9] Under a specification of the utility function giving raise to precautionary savings, there will be an additional negative effect on savings from increasing uncertainty on future productivity growth, price of capital, taxes and public debt ratios.

[10] Taking $\alpha = 2/3$, Intergenerational transfers, $\tau + b = 8\%$, $a = 2\%$, and $d = 0.1$. Notice that the debt to income ratio is the debt to be paid by the middle generation over a long-period of time (say 30 years) relative to GDP per member of that cohort.

2.7 The constrained regime

I now consider the effects of a deleveraging shock when the ZLB and wage rigidities are binding, and population and productivity growth are declining. First suppose that monetary policy is either unable to accommodate a fall in the real interest rate into negative territory, because nominal rates cannot fall below zero, or unwilling to pursue unconventional measures to raise inflation. As for wage rigidities I will consider two cases: i) downwards nominal wage rigidity, and ii) downwards real wage rigidity.

Downwards nominal wage rigidity. Suppose now that both the ZLB and nominal wages are rigid downwards, so that

$$W_t = \gamma W_{t-1} + (1-\gamma)\alpha P_t A_t \left(k_t^f\right)^{1-\alpha}, \text{ with } W_{t-1} > \alpha P_t A_t \left(k_t^f\right)^{1-\alpha}$$

In this case, the real interest rate is above the natural rate, and output and employment are below the full employment levels.

$$\begin{aligned} w_t &= \gamma \Pi_t^{-1} w_{t-1} + (1-\gamma) w_t^f, \text{ being } \Pi_t^{-1} w_{t-1} > w_t^f \\ \Pi_{t+1} &= \frac{p_t^k - \widetilde{A_t}\left[\gamma \Pi_t^{-1} w_{t-1} + (1-\gamma) w_t^f\right]^{\frac{\alpha}{\alpha-1}}}{(1-\delta) p_{t+1}^k} = \\ &= \frac{\beta[\alpha - \tau_t - d_{t-1}\frac{y_{t-1}}{y_t} - b_t^g]}{(1+\beta)[(1+n_t)d_t + (1-\delta)p_{t+1}^k \frac{kt}{yt}] + (\tau_{t+1} + b_{t+1}^g)(1+n_t)\frac{y_{t+1}}{y_t}} \end{aligned}$$

Downwards real wage rigidity. Let us now suppose that real wages are downwards rigid, because of some wage norms or some imperfection in the labor market creating a constant mark-up of wages over prices. Alternatively, unemployment hysteresis, due to insider effects on wage setting or to depreciation of long-term unemployed skills, may raise structural unemployment putting a floor on real wages. In these cases,

$$\begin{aligned} w_t &= \overline{w}_t > \alpha A_t \left(k_t^f\right)^{1-\alpha} \\ \Pi_{t+1} &= \frac{p_t^k - \widetilde{A_t}\overline{w}_t^{\frac{\alpha}{\alpha-1}}}{(1-\delta) p_{t+1}^k} \\ &= \frac{\beta[\alpha - \tau_t - d_{t-1}\frac{y_{t-1}}{y_t} - b_t^g]}{(1+\beta)[(1+n_t)d_t + (1-\delta)p_{t+1}^k \frac{kt}{yt}] + (\tau_{t+1} + b_{t+1}^g)(1+n_t)\frac{y_{t+1}}{y_t}} \end{aligned}$$

As before, the real interest rate is above the natural rate, and output and employment are below the full employment levels. The significant difference with respect to the previous case is that now inflation does not affect to real wages, and, hence, aggregate supply does not vary with current inflation. In any of the two cases (under nominal or real rigidities). This equation determines y_t given predetermined y_{t-1} and expected y_{t+1}. Thus, for instance, lower population growth and lower productivity growth (lower expected y_{t+1}) yields lower y_t. Also a deleveraging shock (a reduction in d_t) implies lower y_t. Finally, a higher real wage, increases inflation, aggregate demand, and, hence, y_t Thus, under the constrained regime there is no trade-off between unemployment and inflation.

Alternatively, output can also be determined by adding up consumption of the three generations and capital investment, which yields the following aggregate demand relationship:

$$\begin{aligned} Y_t \quad = \quad & N_t D_t \Pi_{t+1} + \\ & + N_{t-1}\left[\frac{(1-\tau_t)y_t + \beta D_{t-1} + p_t^k k_t}{1+\beta} + (1+n_t)\Pi_{t+1}G_{t+1}] + \frac{\Pi_{t+1}(1-\delta)p_{t+1}^k k_t}{1+\beta}\right] + \\ & + N_{t-2}[p_t^k(1-\delta)k_{t-1} + \Pi_t B_t^g + D_{t-1} + (1+n_{t-1})G_t] + \\ & + N_{t-1}p_t^k\left[k_t - \frac{(1-\delta)k_{t-1}}{1+n_{t-1}}\right] \end{aligned}$$

that in per-capita terms (per member of the middle generation) is:

$$\begin{aligned} y_t \quad = \quad & \left(\frac{1+\beta}{\beta+\tau_t}\right)\left[(1+n_t)D_t\Pi_{t+1} + \frac{\beta D_{t-1} + p_t^k k_t}{1+\beta} + (1+n_t)\Pi_{t+1}G_{t+1} + \frac{\Pi_{t+1}(1-\delta)p_{t+1}^k k_t}{1+\beta}\right] + \\ & + \left(\frac{1+\beta}{\beta+\tau_t}\right)\left[\frac{1-\delta}{1+n_{t-1}}p_t^k k_{t-1} + B_t^g + \frac{D_{t-1}}{1+n_{t-1}} + (1+n_{t-1})\tau_t y_t\right] + \\ & + \left(\frac{1+\beta}{\beta+\tau_t}\right)p_t^k\left[k_t - \frac{(1-\delta)k_{t-1}}{1+n_{t-1}}\right] \end{aligned}$$

3 Potential Growth, (Private and Public) Debt, and Inter-generational Transfers in Europe

3.1 Population growth

Figure 2 plots the forecasts of the (gross) rate of growth of population ($1+n_t$, over five year periods) of three population cohorts (20-44, 45-69 and over 70 years of age) that may resemble the three overlapping generations considered in the model in Section 2. I consider four different areas (World, Europe, More developed regions, and Less developed regions) and take the data from *Population Division of the United Nations (World Population Prospects: The 2012 Revision)*[11] As can be seen, the world is going through a long period of declining population growth. The 5-year gross rate for the population aged 20-44 would fall from 1,09 to approximately 1 at the end of the Century, a moment in time

[11] Data are from the Population Division of the United Nations (World Population Prospects: The 2012 Revision), under the medium fertility assumption.

when the 5-year growth rates of the population cohorts aged 45-69 and over 70 would also being around unity.

In the case of Europe, population growth is going to be much lower and, in fact, it is already negative for the population cohort aged 20-44. Looking ahead, population aged 45-69 would start decreasing around 2025, when the 5-year gross growth rate of the younger cohort would be 0.95. This represents a significant decrease relative to the last decades of the XXth Century, when (gross) growth rate of the younger population was around 1.05. With gross population growth rate around 0.95, productivity growth would have to be around 1% (annual) for the product of $(1 + n)$ and $(1 + a)$ to be close to 1.

Figure 3 shows that the decrease of the size of younger population cohorts is shared to a great extent by all countries across Europe (only in Northern Europe total population growth is expected to be positive throughout the next Century). As a result, the ratio of population over 65 years of age to the working age population (20-64) would rise to surpass 40% in all European areas, reaching almost 70% in Southern Europe. This would further decreases the natural interest rate through the fall in inter-generational transfers that, absent more accumulation of public debt, such a drastic change of the relative size of the retired population would imply (more on this below in Subsection 3.3).

3.2 Productivity growth and capital accumulation

Taking the model in Section 2 literally, productivity growth and capital accumulation affect to the natural interest rate mostly by their positive impact on future expected income. An additional effect of productivity growth is to increase disposable income to pay for the accumulated private debt of the young generation. Recent developments show that Total Factor Productivity has slowed down, while capital-ouput ratios are growing at lower rates. Even though Galí, Smets and Wouters (2012) do not find any significant change of the output-employment relationship in the aftermath of the Great Recession in the US, there is some evidence (Fernald, 2014) that TFP started to slow down before the Great Recession to return to normal growth (by historical standards) after the exceptional period of higher growth fueled by industries producing and using IT. How TFP growth will evolve in the medium/long-run is a controversial issue.[12] Were TFP growth to remain low, deleveraging would be take longer and savings would increase in anticipation of lower future expected income.

As for Europe, Figure 4 and Table 1 display the main facts. In most European countries, during the IT Revolution TFP did not increase as much as in the US (only in Sweden and Finland it reached growth rates similar to those of he US). And during and after the Great Recession, TFP growth and capital deepening seem to have almost vanished. Admittedly, there are cyclical effects that makes it difficult the correct measurement of capital services and there are additional measurement problems regarding the quality of output and inputs (intangibles, human capital). Hence, it may be too early to assess to what

[12] For two alternative view, see Gordon (2014) -on the negative side- and Brynjolfsson and McAffee (2014) and Bartelsman (2013) -on the positive camp-..

extent the slowdown of TFP in Europe is a permanent phenomenon. Nevertheless, if, as Bartelsman (2013) argues, the future potential gains from TFP growth would require some reallocation of resources, so far this reallocation is not taking place at the rate that was observed in previous recessions.[13] The lower growth of the capital-output ratio does not necessarily imply that less capital deepening is putting a brake on productivity growth, as capital services from the current stock of capital, if there is no massive misallocation, can increase by means of higher utilization rates. However, higher utilization rate of capital hints at lower investment demand, which put further downwards pressure on the natural rate.

3.3 The scope for inter-generational transfers in Europe

An important motivation for savings is to supplement retirement income. Public pension schemes implement inter-generational transfers that, with some variation across countries, amount to around 8% of GDP (as an average for OECD countries). As shown in the first panel of Figure 5, public pension expenditures are higher in Continental Europe, where they typically are close to 10% of GDP, than in Anglo-Saxon countries, where pension schemes tend to follow an (Beveridgean) assistance approach, rather than the (Bismarckian) contributory approach prevalent in Continental European countries.

A very simple decomposition allows to identify what are the factors that determined pension expenditures (also displayed in Figure 5) and to what extent there are further scope for increasing transfers to the old population, which would reduce savings, and, hence, increase the natural rate of interest.[14] [15] In 2009, for the countries presented in the Figure, the average ratio of pensioners to working-age population was 24,3%, the average employment rate was 70% and the average ratio of pension benefit per pensioner to labour productivity was 21.5%, which corresponds to average pensions expenditures as % of GDP of around 7.7%.

[13] See Foster et al (2013) and Casado et al. (2014).

[14] The decomposition, similar to the one used by Boldrin et al. (1999), is as follows:
$\frac{P}{Y} = \frac{B \cdot R}{N \cdot (Y/N)} = \frac{POP\_RET}{POP\_TOT} \frac{POP\_TOT}{N} \frac{B}{Y/N}$
where
P: Pension Expenditures
Y: GDP
N : Employment
Y/N: Average Labour Productivity
POP_TOT: Working-Age Population
POP_RET: Population receiving pensions
B: Average pension benefit
so that pension expenditures as % of GDP is the product of the ration of Pensioners to working-age population and the ratio of average pension benefit to average labour productivity divided by the employment rate (the ratio of employment to the working-age population

[15] Pension expenditures are a major component of transfers to the old population, but they are not the only ones. Health expenditures are also significant and go mostly to the old population. Hence, to the extent that health expenditures may increase in the future, focusing only old-age pensions is likely to deliver an upper bound for the future scope for intergeneraational transfers to the old population.

Starting from the three main determinants of pension expenditures, it is straightforward to compute, given population forecasts and assuming a given value for the employment rate, how much replacement ratios (old-age pension benefits per pensioner/average labour productivity) would be for any given level of pension expenditures (as % of GDP). Thus, for illustrative purposes, Figure 6 displays the change in replacement ratios between 2009 and 2050 for three different scenarios:

- Countries will have the same pension expenditures (in %GDP) and the same employment rates in 2050 than in 2009 (M1)
- Countries will converge to and employment rate of 65% and keep the same pension expenditures (in %GDP) of 2009 (M2).
- Countries will converge both in employment rates (65%) and in pension expenditures (10% of GDP) (M3).

and considering two alternative definitions of the working -age population: between 16 and 64 years (left panel) and between 16 and 69 years (right panel).

As seen in Figure 6, the reductions in replacement ratios are sizeable under the first two scenarios, amounting to around 10 pp, when the working-population is considered to be between 16 and 64 years of age, and 6%, when working-population is that between 16 and 69 years of age Obviously, when pension expenditures converge to 10% of GDP, Anglo-Saxon countries can even experiment an increase of the replacement ratio, which could reach more than 5pp if at the same time retirement age is increased to 70 years. But even under these conditions, some European countries (Italy, France, Austria, Portugal) would have to reduce replacement ratios by almost 10 pp.

Of course, for individual savings decisions what matters is the ratio of income during working age to income during old age, and this ratio may not decrease even after sizeable reduction is the replacement ratios defined above, if labour productivity grows at a significant rate. This is another channel by which lower productivity growth would increase savings and, hence, decrease the natural rate of interest.

3.4 Household Debt

The credit expansion during the pre-crisis period and the bursting of housing bubbles in several European countries have left some European households highly indebted.[16] Figure 7 displays the proportion of indebted households, (median) debt-to-income ratios, and (median) net wealth by age groups (which to some extent resemble the age cohort classification in the model presented in Section 2) in the European countries for which microeconomic data are available.[17]

[16] See Bover, et al. (2014) for the incidence of household debt across European countries and to what extent demographics and institutional factors explain its cross-country variation.

[17] The data are from the Household Finance and Consumption Survey: https://www.ecb.europa.eu/home/html/researcher_hfcn.en.htm

Since middle-age household also present high debt-to-income ratios and low net wealth in several countries, it can be expected that there is a need for further deleveraging in the forthcoming years, which would push savings up and real interest rates further down. For instance, Carroll, Slacalek, and Sommer (2012) interpret the recent (2008-2011) increase in U.S. saving rate using a buffer-stock model of optimal consumption with labor income uncertainty, under which saving is determined by the gap between target and actual wealth, to conclude that it is very unlikely that the U.S. personal saving rate could return to its low pre-crisis period level. Moreover, for Europe and in some contrast with the US, household debt deleveraging during the crisis has been small, what suggests that more deleveraging shock is still to come.[18]

4 Concluding remarks

The Great Recession and the subsequent European crisis have left the European economy in a dismal situation. The legacy of these events (high public and private debt, high unemployment, competitiveness misalignments) will have to be addressed in a context of lower population ageing and uncertain productivity growth. The combination of the legacy and future demographic and economic prospects suggest that it is very plausible that the natural interest rate has fallen significantly, maybe to a level that monetary policy is unable to accommodate, and may remain at that level for a long period In this constrained regime, there is a permanent shortfall of demand that pushes the economy in a high unemployment trap.

In this paper I have used a simple OLG model, in which the natural interest is determined by the balance between savings and investment, to show that the combination of high debt and low population and productivity growth pushes monetary policy into the Zero Lower Bound and may lead the economy to a long-lasting period of high unemployment. Among all the factors determining the natural interest rate, only a revival of productivity growth seem within the scope of policy to revert this situation. Maybe, this is why "structural reforms " are back at the top of proposals for policy agendas in Europe. But even with structural reforms yielding higher productivity growth, it seems that, as L. Summers put it, the economy is entering into a period in which the cyclical fluctuations would be minor relative to more permanent trends, or more drastically, as Alvin Hansen put it, this time indeed *"the western world is undergoing in this generation a structural change no less basic and profound in character than that transformation of economic life and institutions which we are wont to designate loosely by the phrase "the Industrial Revolution"*'.

[18] See also Buttiglione et al. (2014)

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Figure 1. Natural interest rate under alternative sets of parameter values

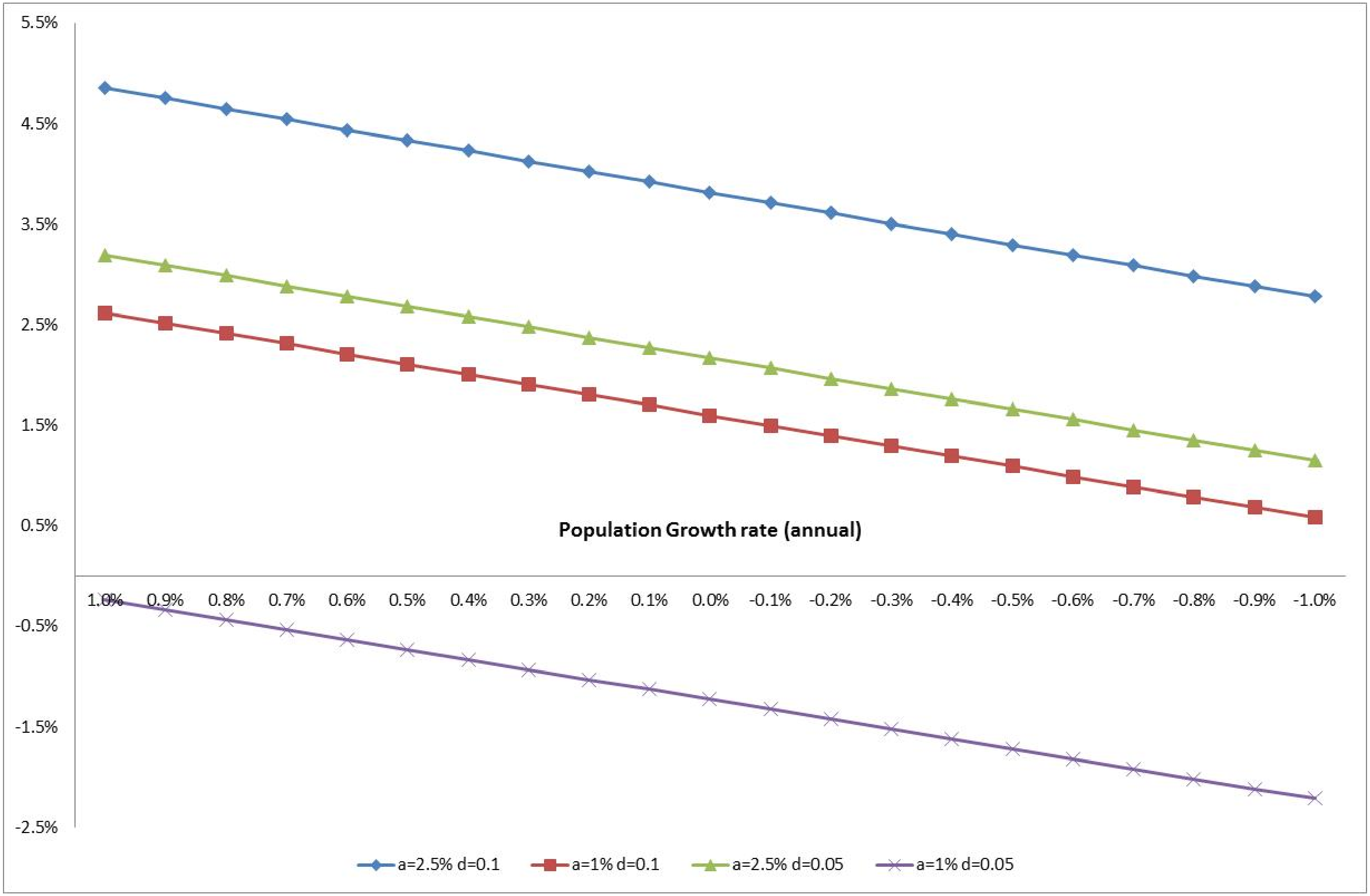


Figure 2. World Population Growth, by areas and age groups (5-years gross growth rates)

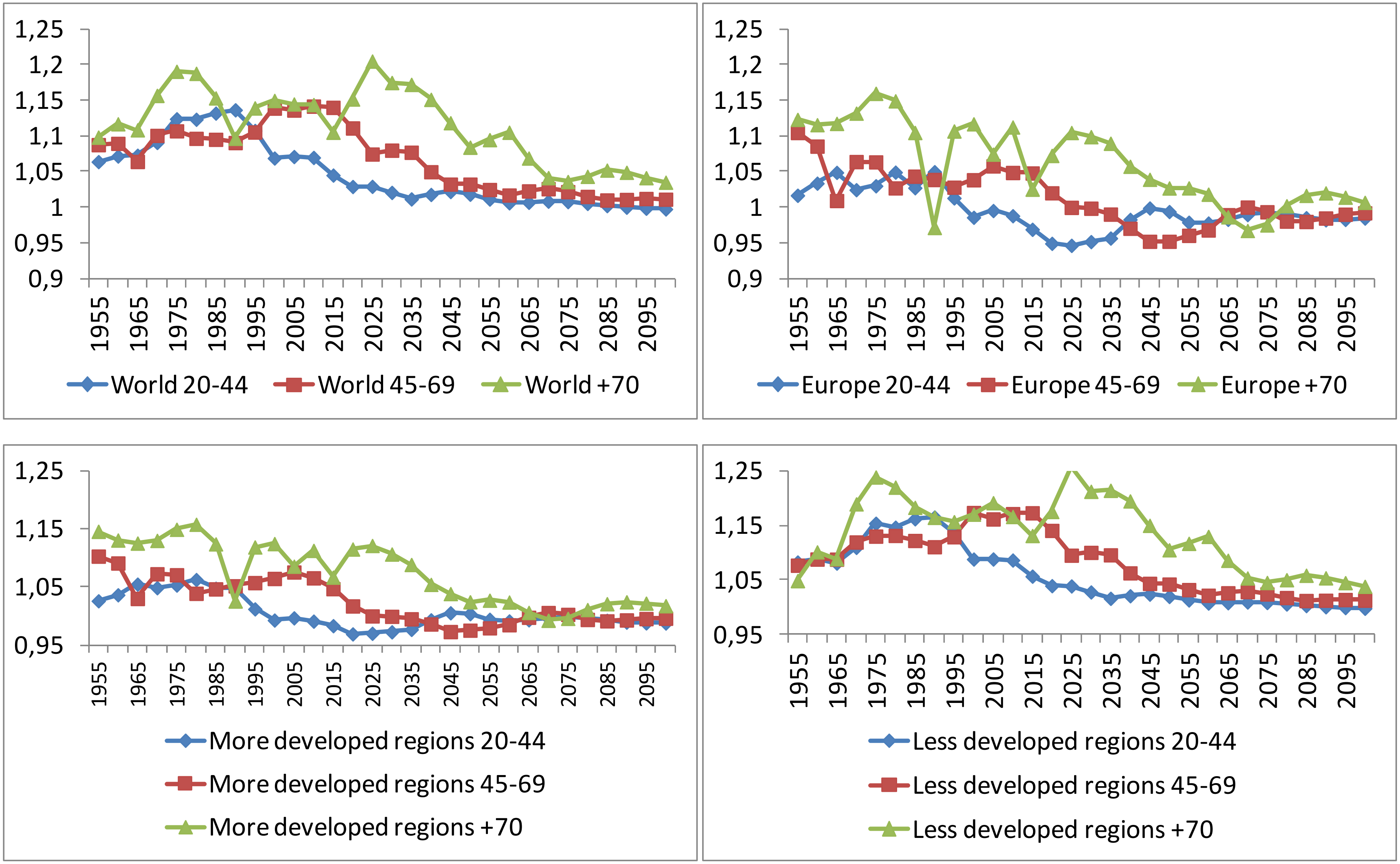
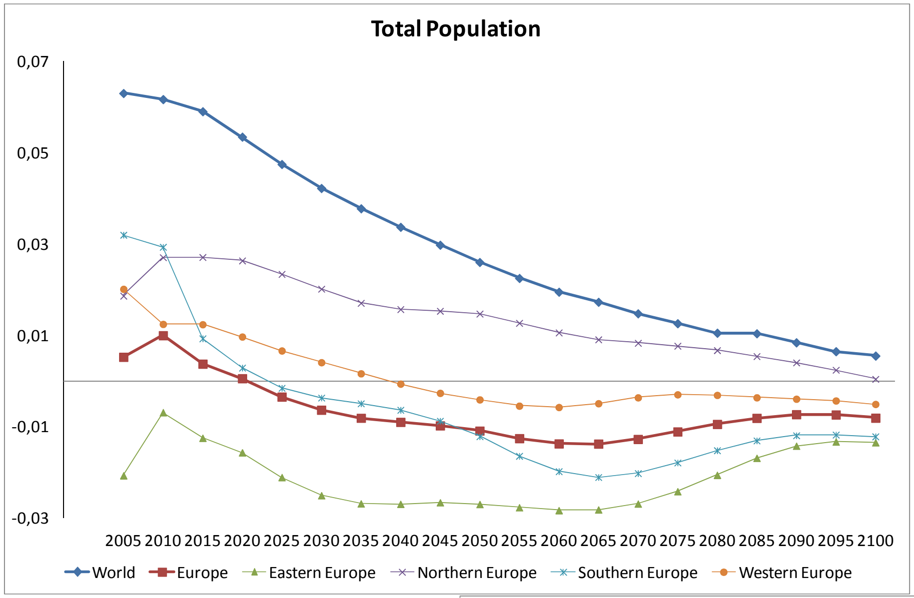
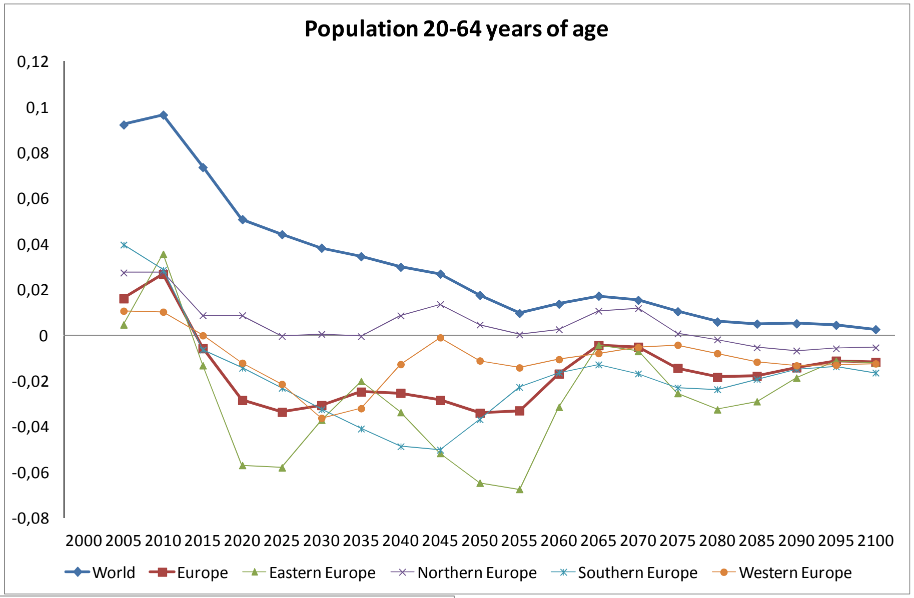


Figure 3. Population Growth in Europe (growth rates over 5 year periods)





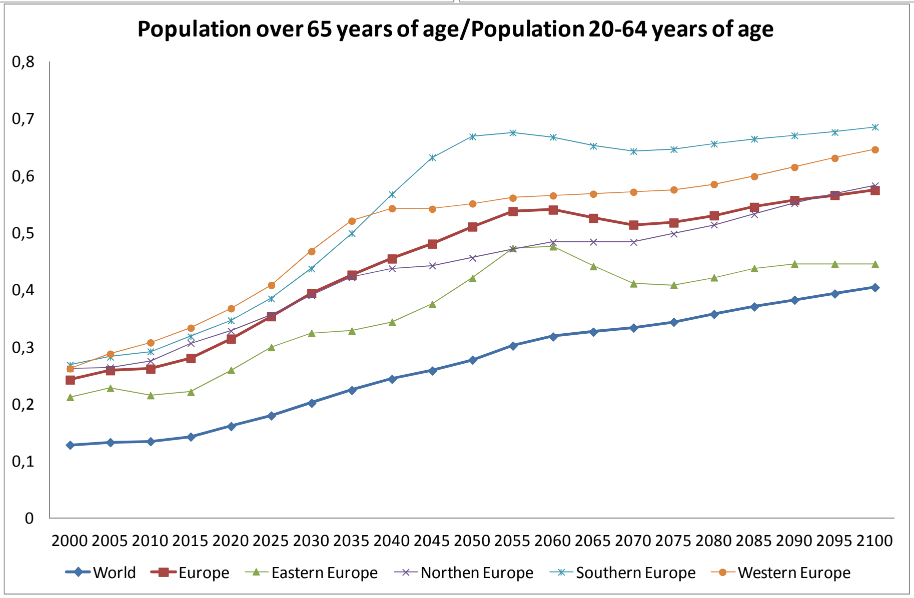
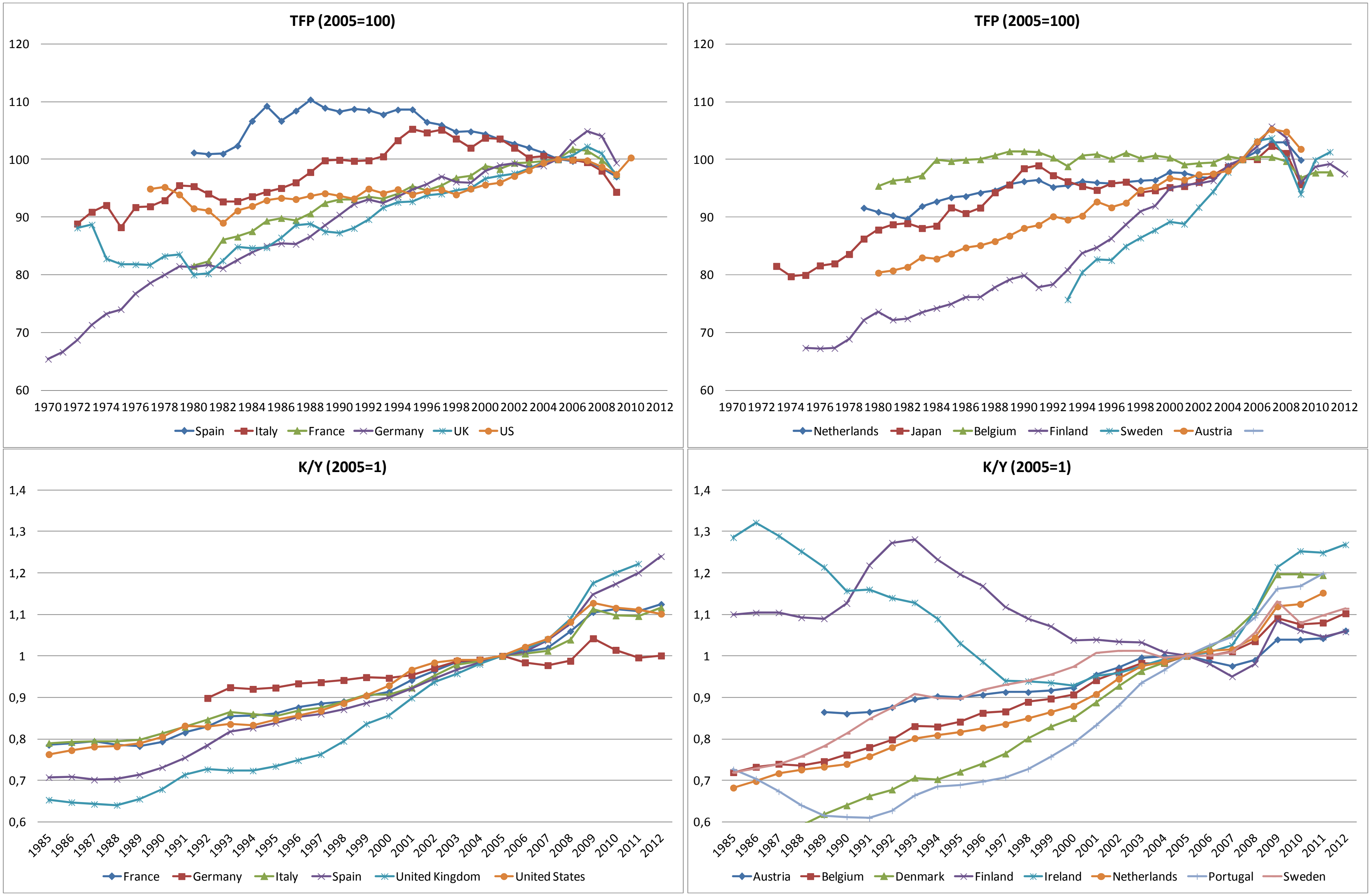
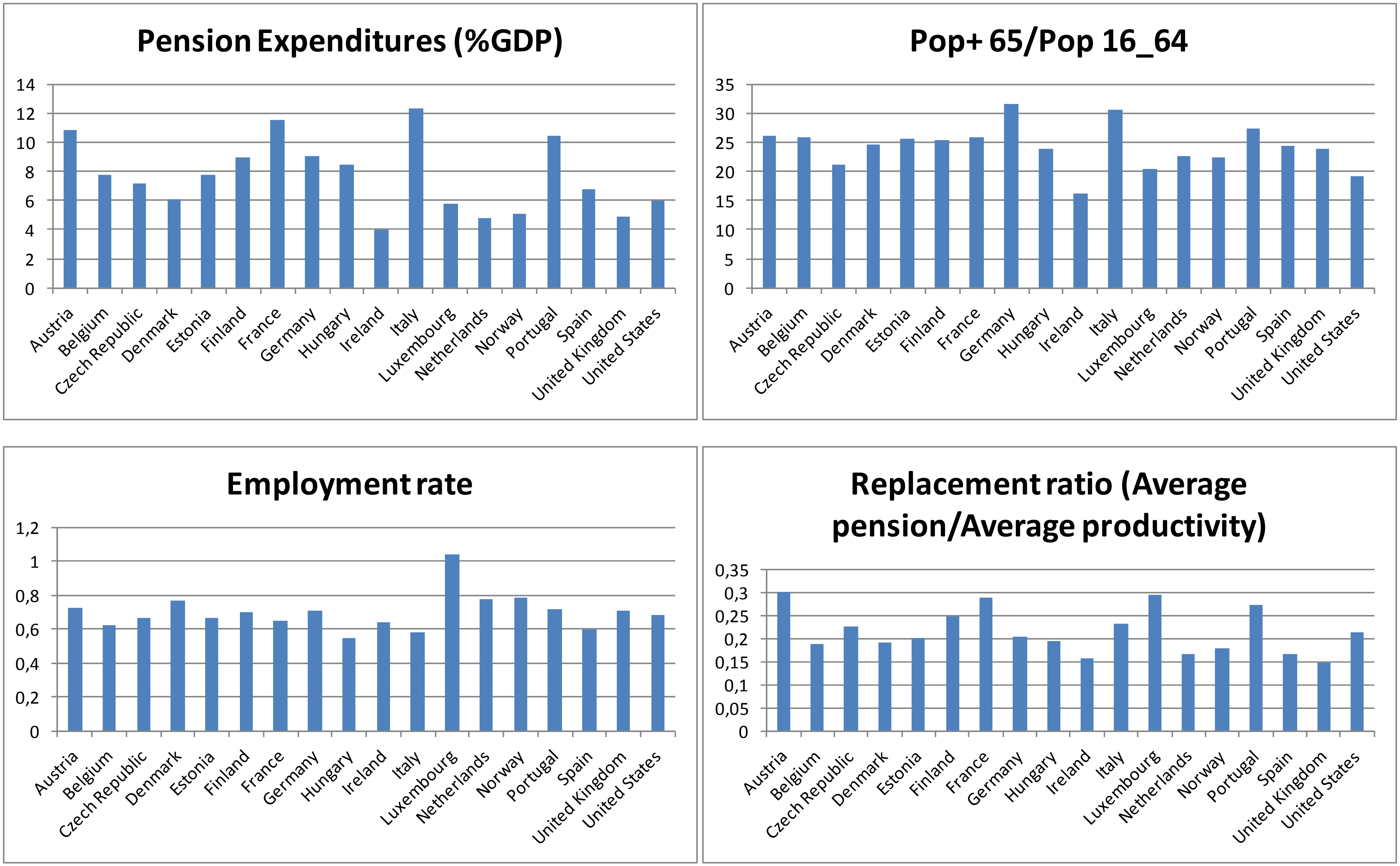


Figure 4. TFP and Capital-Output Ratios



Source: EUKLEMS and OECD

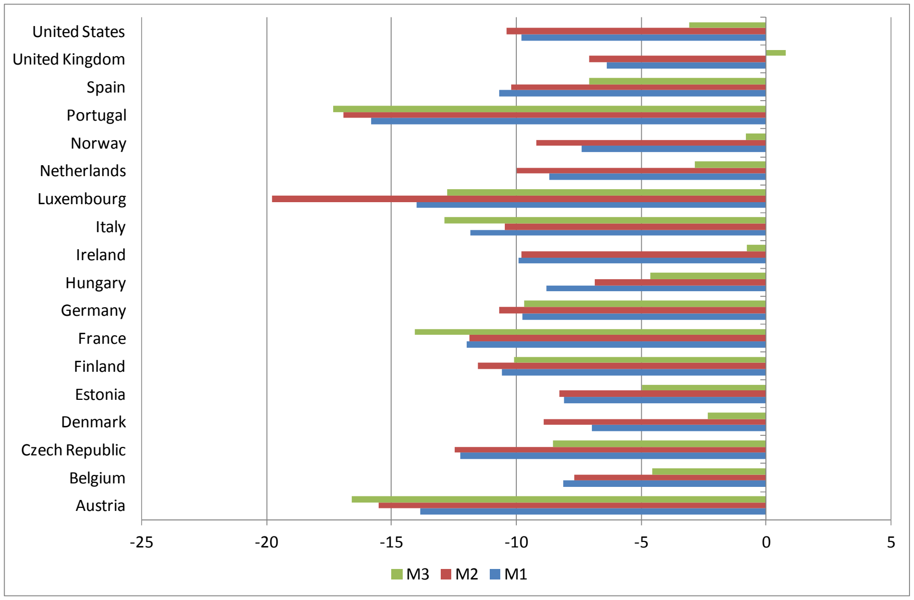
Figure 5. Public Pension Expenditures and its determinants



Source: OECD (first three panels). Last panel computed as a residual from the equation in footnote 12.

Figure 6. Variations (pp) in pension replacement ratios under alternative scenarios (2009-2050)

a) Retirement age: 65 years



b) Retirement age: 70 years

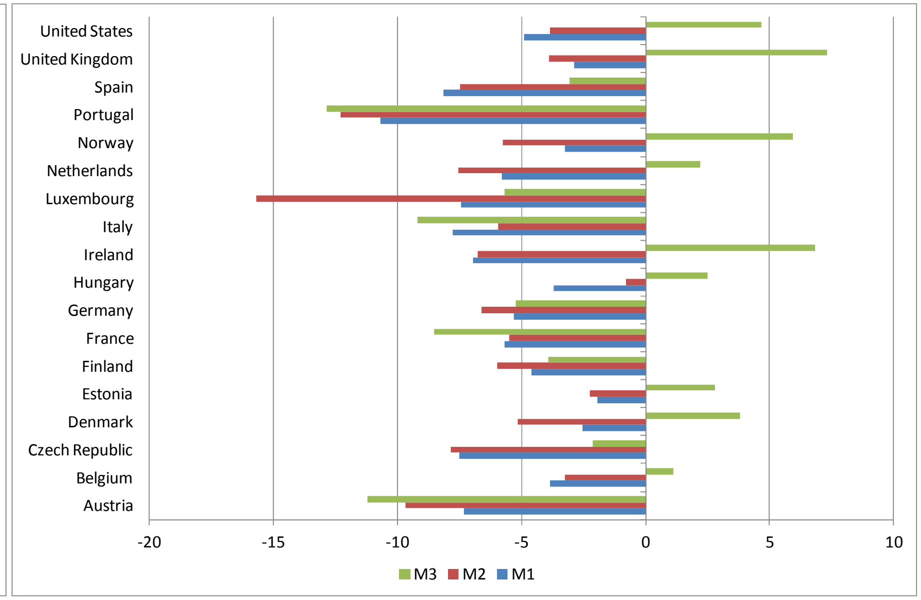
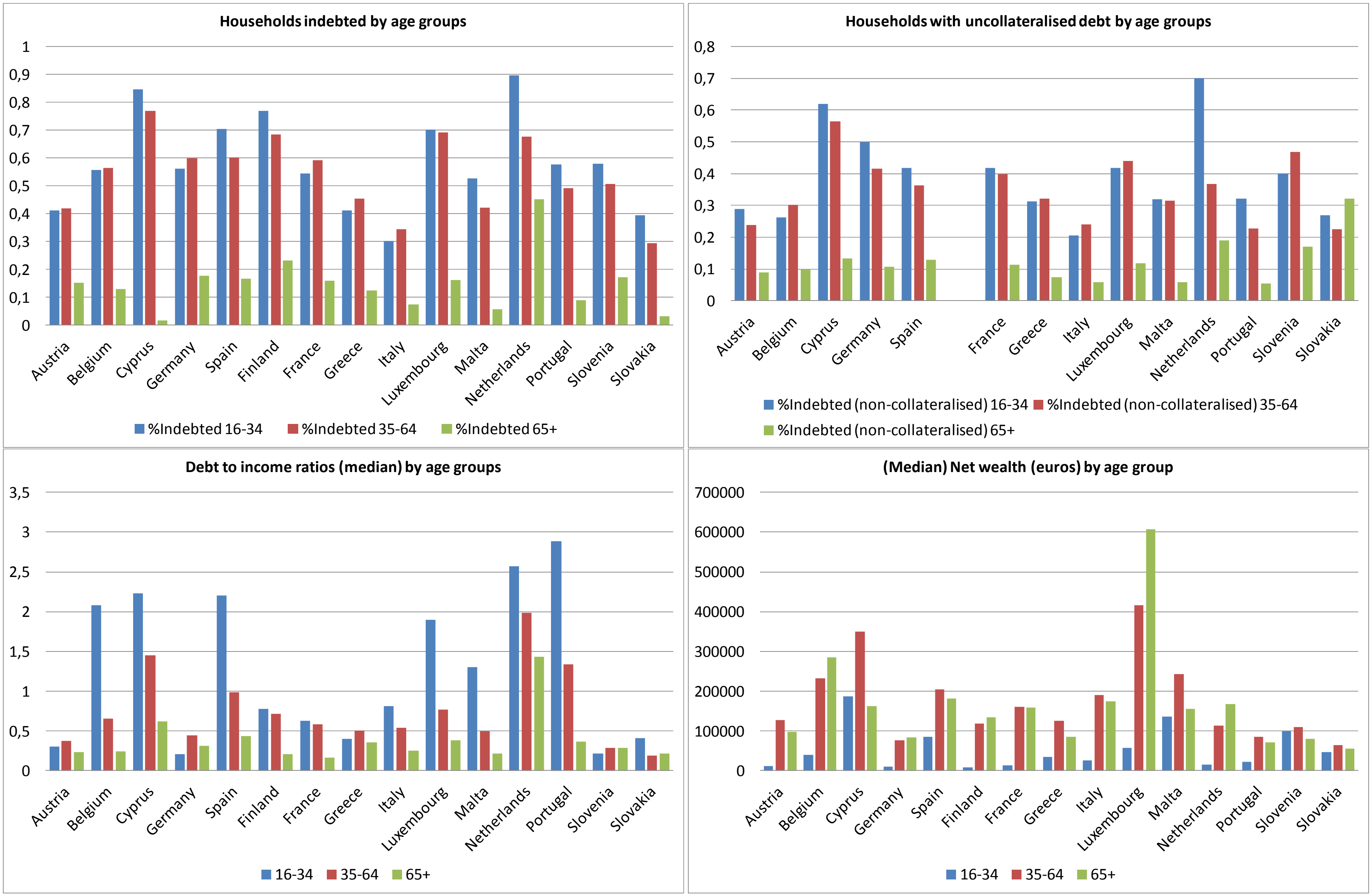


Figure 7. Household debt and net wealth by age groups



Source: HFCS

Table 1. TFP Growth by periods

	Average annual growth/change, selected periods, in %				
	1995-2011	2007-2011	1995-2012	2001-2007	2007-2012
Australia	0,8	-0,1	0,8	0,2	0,1
Austria	0,9	0,1	0,9	1,4	0,1
Belgium	0,3	-0,6	0,2	0,8	-0,6
Canada	0,6	0,2	0,6	0,4	0,1
Denmark	-0,2	-0,8	..	0,4	..
Finland	1,6	-0,9	1,4	2,3	-1
France	0,7	-0,3	0,6	0,9	-0,3
Germany	0,9	0	0,8	1,1	0,1
Ireland	2,3	0,5	2,2	1,3	0,4
Italy	-0,1	-0,6	-0,2	-0,3	-0,8
Japan	0,6	0,2	0,7	1	0,4
Korea	3,3	3,3	2,9	3,4	2,1
Netherlands	0,4	-0,7	..	0,9	..
New Zealand	0,6	0,2	0,6	0,4	0,2
Portugal	0,2	0	..	-0,1	..
Spain	0	0,1	0,1	0,2	0,4
Sweden	1,2	-0,4	1,2	2,2	-0,2
United Kingdom	0,9	-1,1	..	1,7	..
United States	1,3	1	1,3	1,4	0,9

Source: OECD