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DEMOGRAPHICS AND THE SECULAR STAGNATION HYPOTHESIS IN EUROPE[†]

Abstract

Demographic trends in Europe do not support empirically the secular stagnation hypothesis. Our evidence shows that the age structure of population generates less long-term growth but positive real rates. Policies for growth become very important. We assess the relevance of the demographic structure for the choice between macro adjustements and structural reforms. We show that middle aged and elderly individuals have a more negative view of reforms, competitiveness and globalization than young. Our results suggest that older countries -- in terms of share of elderly people -- should lean more towards macroeconomic adjustments, whereas younger nations will be more supportive of structural reforms.

JEL Classification: J11 and J14
Keywords: Europe, growth, real interest rates and stochastic mortality

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1 Introduction

Do demographic trends support the secular stagnation hypothesis for the euro area? The issue of secular stagnation was first raised in 1938 by Alvin Hansen (1939) in his presidential address "Economic progress and declining population growth", delivered nine years after the onset of the Great Depression, when he worried that low population growth would produce a situation of persistently inadequate output growth. The wording has been recently revamped by Larry Summers (see Teulings and Baldwin, 2014) who argued that negative real interest rates are currently needed to equate saving and investment with full employment. With low inflation and zero lower bound on policy interest rates it may be impossible for an economy to achieve full employment, satisfactory growth and financial stability (as low real rates increase the probability of bubbles). The rate of growth of population has traditionally been the main concern of economists, and Alvin Hansen made no exception. Demographers (see, for example, Bloom, Canning and Sevilla, 2003) take a different view and insist on the importance of the age structure of the population (that is, the way in which the population is distributed across different age groups) for growth and real rates. In this paper, we assess the importance of the age structure of population for the secular stagnation hypothesis by deriving a mortality trend from a standard model of mortality, the Lee-Carter model, and combining it with the projected age structure of population to generate long-term projections for the trend in output per capita and real interest rates for euro area economies. Our evidence shows that demographic-based projections deliver for the next twenty years a lower long-run potential growth rate but a reversion of real interest rates to their historical mean. The increase in life expectancy with lower

fertility increases the supply of loanable funds savings, but ageing and a higher share of old age population more than compensate this effect to deliver projected higher real rates. Evidence on real rates is that they moved from 5% in the 1980s to 2% in the 1990s to an average of -1% after the Lehman collapse; the demographics based projected rates are back in the positive range for the next ten years with a between country variability that reflects the heterogeneity in the age structure of population.

On the basis of this evidence, we proceed to assess the role of age structure on productivity and labour markets, to understand to what extent the evidence on the empirical relationship between age structure and long-term growth could be related to the impact of age structure on reforms in labour and product market. First, we exploit OECD labor and product market indicators to show that a large share of middle aged and elderly individuals in the population is associated with a lower reform effort. Second, using Eurobarometer data, we show that middle aged and elderly individuals have a more negative view of reforms, competitiveness and globalization than young. We conclude by evaluating the importance of our results for the debate on the best strategy to promote growth in the current macroeconomic conditions. In particular we discuss the importance of our evidence for the two different views that are currently debated: the structural reforms view versus the macroeconomic adjustment view. The first one underlines the relevance of structural policies to promote growth in potential output after the crisis while the macro adjustment view suggests that structural reforms may prove detrimental if more flexibility in the labour market cannot be accommodated by the central bank with expansionary policy that cannot in any case deliver the negative real rates necessary to restore equilibrium. Our results suggest that the real interest

rates projected by taking into account the age structure of the population will be positive and moderately raising over the next decade. However, the implementation of product and labour market reforms will not be facilitated by the same age structure of population.

2 The Demographic Scenario for Europe

Demographic dynamics is seldom empirically modelled in economics, we shall make an exception here and base our analysis of the demographic scenario on an explicit dynamic model of mortality. We consider the Lee-Carter (1992) mortality model to derive a mortality trend that we will combine with the age structure of population in Europe[1] to generate demographic-driven trends for real output and real interest rates. We analyze fifteen European countries (Austria, Belgium, Denmark, Spain, Finland, France, Great Britain, Germany, Ireland, Italy, The Netherlands, Norway, Portugal, Switzerland and Sweden) to generate a sample of 10 euro area countries and 5 non euro area countries. Data on mortality for the sample 1956-2009 are taken from the Berkeley Human Mortality Database website.[2] The data are annual observations of central mortality rates. $m_{x,t}$ denotes the mortality for individuals of age x in year t, where mortality is the probability that a person aged x and alive at the beginning of the year dies within the end of the year. $s(x,t)$ is instead the survivor probability for individuals of age x in year t, which is the probability that an individual will be alive at age x given that he has survived up to age $x-1$. Given mortality rates, survivor probabilities are derived recursively for individuals aged T and over: If $x = T$ then $s(x,t) = 1-m_{x,t}$, if $x > T$ then $s(x,t) = s(x-1,t)[1-m_{x,t}]$.

[1] We thererefore model the demographic dynamics only partially as we do not explicitly combine our mortality model with a migration model and a natality model.

[2] www.mortality.org

Frequencies of death for individuals of age x at time t are determined as first differences of survival probabilities: $fod(x,t) = s(x,t) - s(x+1,t)$. Finally, life expectancy at age x in period t is defined as follows $E_{x,t} = \sum_{j=1}^{\infty} s(x+j, t+j)$.

The Lee-Carter (1992) model consists of a system of equations for logarithms of mortality rates for age cohort x at time t, $\ln[m_{x,t}]$, and a time-series equation for an unobservable time-varying mortality index k_t:

$$\begin{aligned} \ln(m_{x,t}) &= a_x + b_x k_t + \epsilon_{x,t} \\ k_t &= c_0 + c_1 k_{t-1} + e_t \\ \epsilon_{x,t} &\sim NID\left(0, \sigma_\epsilon^2\right) \\ e_t &\sim \text{MeanZero - Stationary Process} \end{aligned} \tag{1}$$

where a_x and b_x are age-specific constants. The error term $\epsilon_{x,t}$ captures cross-sectional errors in the model based prediction for mortality of different cohorts, while the error term e_t captures random fluctuations in the time series of the common factor k_t driving mortality at all ages. This common factor, usually known as the unobservable mortality index, evolves over time as an autoregressive process and the favorite Lee-Carter specification makes it a unit-root process by setting $c_1 = 1$. The model allows to identify the unobservable stochastic mortality trend, common to all cohorts, and to construct empirical counterparts for survivor probabilities, frequencies of death and life expectancy at every age.[3]

The model fits well the data for all countries considered in our sample and the results form estimation and model projection are very helpful in describing the

[3]Identification and estimation of the Lee-Carter model are discussed in Appendix B.

demographic scenario for Europe. Figure 2.1 reports historical data and projections (with associated 95 per cent confidence intervals) for expected residual lifetime at 65 years. The typical scenario of an increase of expected lifetime of "six hours a day" is confirmed for all countries and also projected to continue in the future with a considerable longevity risk surrounding the point estimates. Figure 2.2 reports the frequency of death from 65 onwards in 1980 and 2009, which shows how the increasing concentration of death around the mode of the curve of deaths ("compression of morbidity", see, for example, Robine et al., 2008) has made the profile of frequencies of death for ages above the mode closer and closer to a straight vertical line on the left of the range.

Insert Figures 2.1-2.2-2.3 here

Figure 2.3 complements the picture by reporting the observed and projected age distribution of population based on the databases of the UN Population Division and of the US Census Bureau; we consider four age groups: 0-19, 20-39, 40-59 and over 60. The trend of share of total population in each group shows a clear upward movement in the over 60, a downward movement in the 0-19 group, and humps shaped patterns in the 20-39 and 40-59 groups, who have already both peaked respectively at the beginning of the eighties and at the beginning of the new millenium. Ageing and the increased expected lifetime are the two major demographic forces at work. These two major forces might have heterogenous economic consequences. Consider, for example, the impact on savings and real interest rates: on the one hand the increase in expected lifetime at middle-age has an expansionary effect on the supply of savings and pushes downward the equilibrium real rates, on the other hand the increase in longevity and the higher

share of population in retirement age decreases the supply of saving and pushes the equilibrium real rates upward. Quantifying these effects is crucial to understand the impact of demographic trends on equilibrium real rates. Similar arguments apply to the output effect of demographic trends. On the one hand, the increased expected lifetime might reflect technological progress that generates higher output per capita but, on the other hand, productivity decreases with age and the equilibrium output might be lowered by an ageing population.

In section 3 we shall try to quantify the effect of demographic forces on output and real rates by specifying demographically driven models for these variables.

3 Demographic-Based Projections for Output and Real Interest Rates

To derive demographically based trends for output and real interest rates we take annual data from the Penn World Table 8 database for Expenditure-side Real GDP at Chained PPP (Millions of 2005 US$) and Total Population (Millions) and data for Long-Term Nominal Interest Rates, and GDP deflator (OECD base year i.e. 2005) from the OECD statistics.

We consider log of real per capita output at chained PPP, and we derive real long-term rates using dynamic forecasts for inflation from a country specific recursively estimated first order autoregressive model.

We then adopt a model for a panel regression in levels of the logarithm of per capita GDP at PPP US dollars, $y_{i,t}$, and the real long-term interest rate, $rr_{i,t}$, on the logarithms of age shares, $a_{j,i,t}$, and the Lee-Carter country-specific mortality trend $k_{i,t}$:

$$z_{i,t} = \beta_1 k_{i,t} + \sum_{j=0-19}^{60+} \beta_j a_{j,i,t} + \lambda_i + \chi_t + u_{i,t}$$
$$k_{i,t} = c_{0,i} + c_{1,i} k_{i,t-1} + e_{i,t} \tag{2}$$

where $j = 0-19, 20-39, 40-59, 60+,\ z_{i,t} = y_{i,t}, rr_{i,t}$. The specification also includes a country fixed effect and time-dummies; the model is estimated by SURE to deal with cross-country correlations of residuals $u_{i,t}$. We use the model to project within sample and out-of-sample the variables of our interest, by taking the age shares as exogenous and using the US Census Bureau projections. The results from estimation (over the sample 1956-2009 for $y_{i,t}$ and over the sample 1971-2014 for $rr_{i,t}$) are reported in Table 2.1.

Insert Table 2.1 here

The estimation results show a positive impact of the longevity trend both on output and interest rates, the coefficients on age-shares show that the replacement of population aged 40-59 with population aged 60 and over has a negative impact on outptut and a positive impact on real rates. Impact on output trend is linearly related to the age structure with a uniformly decreasing impact of the coefficient of age-shares on the trend for individuals aged 20 and over, while the effect on real rates is U-shaped with a trough at the 40-59 age share, that is the phase in life in which most savings should be cumulated. To provide further model evaluation and further insight on the implications of the empirical estimates, we perform within-sample and out-of sample dynamic simulations for the two variables of our interest. Out-of-sample projections are based on the predicted shares of population

made available by the US Census Bureau and the out-of-sample predicted common stochastic trend generated by our estimated Lee-Carter model. The results are reported in Figures 2.4 and 2.5.

Insert Figures 2.4-2.5 here

Figure 2.4 shows that the estimated model is capable of fitting well the observed trend in output within the estimation sample and that it predicts a clear break in this trend for the out-of-sample simulation: the trend output consistent with the age structure of population has a clear different and flatter slope in the out-of-sample simulations. This flatter slope is driven by the progressive increased importance of the 60+ share over time in the out-of-sample period and by the significantly smaller coefficient of this age share in the estimated equation for output. The tipping point in the output trend is naturally related to baby boomers reaching retirement age, with the subsequent increase in the share of the population in retirement age and the decrease in the share of population in working age. This evidence is consistent with the results in Aksoy et al. (2015), who investigate the relation between demographic structure and macroeconomic trends in a Panel VAR framework that features a richer dynamic specification for the macroeconomic variables but a more parsimoniuos one for the demographic structure, limited to the inclusion of the age share with no mortality trend. Similar within sample evidence is observed for real rates but the implications for the out-of sample simulations are cleary in constrast with the "secular stagnation" hypothesis. The impact of the overall ageing population on real rates dominates that of longer expected lifetime of the savers. As a consequence real rates are predicted to increase out-of-sample. The overall demographic "new normal" is one with slower trend growth (if any)

and higher real interest rates.

3.1 Demographic Structure and Real Rates: Some Further Evidence

The evidence reported on demographics and real rates so far for all countries in our sample is based only on domestic demographic factors. However, domestic debt is also held by foreign investors and therefore our results can be affected by the omission of demographic trends that are relevant to determine the share of domestic debt held by foreigners.

We address this issue by considering an alternative construction of our shares. Given the availability of data on foreign holdings of sovereign debt in advanced economies (Ali Abbas et al., 2014, Arslanalp and Tsuda, 2012) we have reconstruced the population of debt holders for each country as the weighted average of domestic and world population with time-varying weigths determined by the share of domestic debt held abroad. Over the estimation sample we have adopted the sum of the population in Europe, US and Japan as the relevant world population, while in the out-of-sample simulation we have also included China to determine the relevant world population aggregate. We have therefore implictly assumed that demographic changes in China have been so far less relevant than demographic changes in individual EU countries in the determination of bond prices, but we have removed this assumption for future projections. Importantly, although the composition of the relevant population changes from the estimation period to the out-of-sample simulation period, the share of domestic debt held abroad out-of-sample is kept fixed at the last within sample observation.

Insert Table 2.2 here

Table 2.2 shows that the patterns of the coefficients of the shares and of the

stochastic mortality trends using the domestic population and the relevant world population are similar. Figure 2.6 illustrates that out-of-sample real rates projected using the shares in the relevant world population (including China) are not very different from our baseline projections based on the domestic population shares, although in general real rates are projected at a positive but lower level than those in the baseline simulation.

Insert Figure 2.6 here

4 Age Structure, Productivity and Labour Markets

During the last few decades, particularly in Europe, the quest for more economic growth has often been associated with the need of structural reforms (see Eggertsson et al., 2014, for a critical review of this argument). Deep institutional changes took place in the nineties, such as the creation of the European Single Market or the adoption of the Euro, which limited the role played by fiscal and monetary policy in accommodating national shocks. As a result, large emphasis has been attributed to more structural, microeconomic adjustments, needed to reduce the rigidities in the labor and product market and ultimately to foster competition on output and input markets, and to increase economic efficiency (Nicoletti and Scarpetta, 2003). Several contributions discussed how structural reforms would have been incentivized by the introduction of the Euro (see Bean, 1998, Obstfeld, 1997), while others were more critical (Saint-Paul and Bentolila, 2000).

In the last two decades, a growing literature has analyzed these structural reforms. Many contributions have highlighted the pattern of liberalization in product, labor and financial markets in different countries. As shown in Figure 2.7,

which displays the magnitude of the liberalization process between 1975 and 2013, product market regulations, as measured by the OECD index (see Conway and Nicoletti, 2006), have dropped, albeit to a different degree, in several countries. Besides the UK, which represented an early mover, most European countries began to liberalize their product market in the nineties following the introduction of the EU's internal market program and of the Euro (see Alesina et al., 2009). Liberalization of the labor market, as measured by the Employment Protection Legislation (EPL) index (OECD, 2006) has instead proved to be more difficult to achieve. As shown in Figure 2.8, which displays the degree of EPL in 1985 and in 2013 for regular workers, few countries have reduced labor market rigidities for regular workers, although some liberalizations have instead taken place for the temporary workers.

Insert Figures 2.7-2.8 here

Other contributions have focused on the economic and political determinants of the structural reforms.

Large emphasis has been given to the incentive provided by institutional changes, such as the entrance in the European Single Market or the adoption of the Euro. Alesina et al. (2009) found that the adoption of the Euro increased the deregulations in the product market, particularly in countries such as France and Italy, and sectors such as energy and communication, which featured higher initial levels of regulation. The adoption of the Euro was instead not associated with major reforms in the labor market.

Economic crises have been shown to lead to labor market reforms (IMF, 2004, Duval and Elmeskov, 2005, Høj et al., 2006), yet with opposite effects for labor

market insiders and outsiders. In particular, increases in the long-term unemployment rates are associated with lower employment protection for temporary workers and more generous unemployment benefits, but have no effect on EPL for regular workers. Countries with more rigid labor markets enjoyed more reform efforts. Economic crises are also associated to deregulation in the product markets (Hoj et al., 2006). Interestingly, also good fiscal positions have been shown to be beneficial for reforms in labor and product markets (Duval and Elmeskov, 2005, and IMF, 2004), perhaps as they provide the fiscal capabilities to compensate the losers from the reforms.

Unsurprisingly, politics is crucial to reform. Ideology seems to matter, as right-wing governments are more active in reforming the labor market (IMF, 2004), adopt more liberalizations in the product market and reduce generous unemployment benefits (Høj et al., 2006). However, during economic crisis, right-wing parties refrain from promoting privatizations, while center and left wing governments are more keen on liberalizing and privatizing (Galasso, 2014). Finally, Buti et al. (2008) find no empirical support for the idea that reforming governments pay an electoral cost.

Little emphasis has instead been given to the role played by demographic variables, besides perhaps controlling for the share of the elderly in the empirical studies. In this paper, we instead give a closer look at how demographic elements may affect structural reforms. We augment the standard panel regressions used in this literature (IMF, 2004, Høj et al., 2006) with two different types of demographic indicators. First, we include a trend to capture the aging process. In one set of regressions, we consider a simple linear time trend; in another set of regression, we instead use the mortality trend estimated in section 2. While this

latter trend is perhaps more accurate, it has the drawback of reducing the number of observations for the empirical analysis, as three countries are dropped from the sample. Second, we include a set of dummy variables to capture the age structure of the population. We consider the relative share of the population in four age groups: 0-19, 20-39, 40-59 and 60+, as displayed at Figure 2.3.

On a theoretical ground, there are at least two channels through which the age composition of the population may affect the structural reforms. An economic channel will consist of the impact that changes in the age composition may have on the (economic) costs and benefits of the status quo or of the reforms. A political channel will instead be given by how changes in the age composition affect the political representation, and thereby the political support for the status quo or the reforms. To see this, consider the PAYG pension systems. Population aging induces an increase in the share of the elderly, and a contemporaneous drop in the share of the young workers. The economic channel would thus suggest pension generosity to be reduced, in order to secure the financial sustainability of a PAYG pension scheme. Yet, in the political arena, a larger share of elderly increases the political support for generous pension schemes. In this case, aging thus has opposite economic and political effects (see Galasso, 2006).

4.1 Data Description

In our empirical analysis, we examine the structural reforms in product and labor markets, and in the welfare state. We restrict the analysis to 18 European countries, more specifically to Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portu-

gal, Spain, Sweden, Switzerland, and United Kingdom.[4]

For the product market, reforms are measured as changes in the OECD indicators of sectoral product market regulation. These indicators were constructed by Conway and Nicoletti (2006) and later updated. We consider indicators for energy, communications and transports from 1975 to 2013. These product market regulation indicators summarize information about entry regulation, public ownership, market structure, vertical integration and price controls with reference to these three sectors, which are composed of seven industries: (i) energy (electricity, gas); (ii) communications (telecoms, post), and (iii) transport (rail, air transport and road). A score, on a scale from 0 to 6, is attributed to each regulatory aspect, where the lowest possible score stands for the maximum deregulation. As in Høj et al. (2006), an overall regulation indicator that excludes public ownership index is used.

For labor market reforms, we use OECD indicators of strictness of employment protection. These indicators are intended to measure the legally envisaged constraints that employers face in hiring or firing workers. Data are available for the 1985-2013 period. On a scale from 0 to 6, they quantify three specific aspects of labor market regulation: (i) procedural inconveniences; (ii) notice and severance payments requirements; and (iii) difficulty of dismissal, such as litigations costs, restrictions on firing, due compensation for unfair dismissal. These indicators refer to permanent workers (EPLR), to temporary workers (EPLT), i.e., those workers hired on fixed-term or temporary work agency contracts, and to an average of the two (EPL). The OECD provides data also on union density, from 1975 to 2013, which we use in our regressions.

[4] Greece, Iceland and Luxembourg are dropped when we use the mortality trend.

Unfortunately, OECD statistics do not provide long-series data on other labor market policies. We thus rely on the Comparative Welfare Entitlements Dataset assembled by Scruggs et al. (2014) to obtain comparable data upon national welfare programs for our sample of countries over 1970-2011. In particular, we have data on three social insurance programs: Unemployment Insurance, Sick Pay Insurance and Public Pension. Unemployment insurance consists only of national insurance provisions, and pensions include only mandatory public programs. For the sick pay insurance, which consists of the benefits paid in case of temporary non-occupational illness or injury, we consider both public provisions and provisions for mandatory private benefits. For each of these three social insurance programs, information on benefit replacement rates, qualifying condition, and coverage are collected and aggregated into benefit generosity scores.

For product and labor markets, variations in the respective indicators denote structural reforms. A negative variation in indicator for product and labor market regulation represents deregulation. Our welfare state indicators denote instead generosity.

Consistently with previous empirical studies on structural reforms, we consider several control variables. We include in our regressions, economic crisis, measured as one standard deviation reduction in output gap, a dummy variable respectively for the adoption of the European Single Market (singlemkt) and of the Euro (emu), a measure of the country openness, the logarithm of the real per-capita GDP, and a dummy variable for a right-wing government in power. Table 2.3 provides the summary statistics relative to our measures of labor and product market regulation, welfare state generosity, and to these control variables.

Insert Table 2.3 here

4.2 Results

Table 2.4 shows the results of our panel regression for the product market using year and country fixed effects, and respectively the linear and the mortality trend. The age composition of the population turns out to be an important determinant of reforms in the product market. In particular, a larger share of individuals in working age – namely aged 20-39 and even more 40-59 – is associated with a strong reduction in the overall product market regulator indicator. These results are robust to using linear or mortality trend.

Insert Table 2.4 here

Why would a larger share of the working population be associated with more product market reforms? Different interpretations can be provided. A first, static explanation hinges on the observation that the sectors measured in the OECD product market regulation index are all non-manufacturing sectors. Hence, the rents associated with the dominant positions in sectors such as energy or transportation translate into higher costs for other manufacturing industries, and perhaps to lower employment opportunities. Thus, a larger share of the working population, who is to some extent negatively affected by these higher costs, may put pressure for liberalizing the non-manufacturing sectors. A second, more dynamic explanation relies on the idea that microeconomic adjustments induce long-term growth, although they have current costs for those employers and employees who benefit from the rents associated with the dominant market position. In this case, a larger share of workers – particularly the younger ones – may tilt the aggregate preferences more towards future growth perspectives.

Insert Table 2.5 here

The age composition of the population seems to matter also for the labor market reforms, as shown in Table 2.5. The overall employment protection drops as the share of the young individuals – aged 20 to 39 – increases (columns 1 and 5). Unsurprisingly, this effect is mostly driven by the deregulation for the temporary contracts (columns 2 and 6). This evidence thus suggests that an increase in the share of young individuals, who represent potential entrants into the labor market, puts pressure on designing reforms that may indeed facilitate their entry. It is also interesting to notice that the degree of union density (columns 4 and 8) is increasing in the share of the elderly – aged 60+, most of whom are indeed retired – and thereby out of the labor force. This evidence is however consistent with the drop in union density among the current young workers, and may indeed be driven by a cohort effect, with past generation of workers being more heavily unionized. As before, these results are robust to using a linear or mortality trend.

Insert Table 2.6 here

Table 2.6 presents our evidence on the generosity of three social insurance programs, namely unemployment insurance, sick pay insurance and public pensions. An increase in the share of the "older" working population, aged 40-59, is associated with more generous unemployment benefits. Indeed, even a larger share of the elderly – aged 60 years old or more – is correlated with more unemployment benefits. This is however not very surprisingly, as many elderly workers have used unemployment insurance as an early pathway out of the labor market. All these individuals, albeit to different degrees, thus seem to support more generous unemployment insurance system. The support for more generous sick pay insurance

is instead stronger among the elderly. Perhaps surprisingly, the generosity of the pension system – a program clearly targeted to the elderly – is not affected by the age composition. This may well be due to the opposite economic and political effects of aging. In other words, while the elderly would support a more generous pension scheme, the aging process makes it financially impossible to sustain such a system.

5 The Political Economy of the Age Structure of Population

Two different schools of thought have receintly emerged on how to exit from the current economic crisis and on the determinants of growth. Several scholars and institutions – including the Governor of the European Central Bank, Mario Draghi, have emphasized the crucial role of the structural reforms in fostering competition in the product and labor markets. These microeconomic adjustments are deemed to be necessary to increase economic efficiency (Nicoletti and Scarpetta, 2003). This is particularly the case in the southern European countries strongly hit by the crisis, in which larger price adjustments are needed. Other scholars have instead argued that the current crisis needs to be addressed with macroeconomic adjustments. Eggertsson et al. (2014) go even further to suggest that structural reforms may indeed prove detrimental in the short run, if decreases in wages lead to deflationary policies that cannot be accomodated by the central bank with a reduction in the interest rate. Gali and Monacelli (2014) have remarked that structural reforms, when asymmetric across countries, require asymmetric monetary policy to accompany them. Such policies cannot be implemented in a common currency area.

Regardless of the relative merits of these two arguments, however, section 4 suggests that there may be political economy motivations to support one school of thought or the other. And these motivations are likely to differ mainly across generations.

To address this intergenerational issue, we use data from the Eurobarometer – a survey run by the European Commission, to learn the opinions of the citizens in the EU countries on several issues. We exploit the 2014 Eurobarometer survey for the seventeen countries examined in the analysis at section 4 (we have no data for Switzerland) on three broad issues: reforms, competition and globalization. The questions asked in the Eurobarometer allow us to obtain information on the individual perceptions about the relevance of reforms, competition and globalization for economic growth, as well as on their preferences for reforms, free trade, liberalization and competition. We regress the individual responses to these questions on several individual characteristics, such as gender, marital status, employment status, self-declared social status and political orientation, and of course on an age indicator. In particular, in all regressions, we identify the individuals younger than 40 year old as our reference group, and include middle aged (40-59) and old (60+) among the regressors. We always use country fixed effects to exploit only within country variation.

Insert Table 2.7 here

Table 2.7 presents the results of our empirical analysis on the reforms. In column (1), we consider as dependent variable the individual responsed to a question in which individuals assign a value between 1 (totally agree) and 4 (totally disagree) to the following statement "Our country needs reforms to face the future".

Awarness about the need of reforming is higher among males, self-employed and among middle and upper class individuals, while no difference emerges across age groups. Columns (2), (3) and (4) show instead the results related to individual preferences for reforms, liberalization and flexibility. For these questions, individuals assign a value between 1 (very positive) and 4 (very negative) to the following statement: "Could you please tell me whether the following term – respectively *reforms* for column (2), *liberalization* for column (3) and *flexibility* for column (4) – brings to mind something very positive, fairly positive, fairly negative or very negative?". In all three cases, males, managers, self-employed and middle and upper class individuals tend to have a more positive view. Preferences strongly differ by age groups. For middle age individuals, reforms, liberalization and flexibility are considered strongly more negatively than for the young. And the same holds true for the old, except for the case of reforms.variation.

Insert Table 2.8 here

At Table 2.8, we show the results for our empirical analysis on competition. Column (1) reports the results related to the question in which individuals assign a value between 1 (not at all important) and 10 (very important) to the following statement "Please tell me how important or not you think in order for the EU to exit the present financial and economic crisis and prepare for the next decade is to help the EU's industrial base to be more competitive by promoting entrepreneurship and developing new skills". Unsurprisingly, self-employed, middle and upper class individuals endorse the relevance of competition to exit the crisis. Individuals with right-wing political views also believe competition to be important, while left-wing individuals do not. A, perhaps surprising, difference emerges also across

age groups: middle age, and even more elderly individuals deem competition to be relevant more than young individuals do. This awarness by the elderly, however, does not translate into more preference for competition. Column (2) shows the results related to individual responses to the following statement: "Could you please tell me whether *competition* brings to mind something very positive, fairly positive, fairly negative or very negative?", where 1 indicates very positive and 4 very negative. Consistently with the answer to the previous question (column 1), self-employed, right-wing and middle and upper class individuals tend to have a more positive view of competition. Middle aged and elderly individuals instead have a more negative view of competition than the young, despite the fact that they seem to be aware of its relevance for economic growth.

Insert Table 2.9 here

Finally, at Table 2.9, we concentrate on our empirical analysis on glabalization. Column (1) reports the results related to the Eurobarometer question in which individuals assign a value between 1 (totally agree) and 4 (totally disagree) to the following statement "Globalisation is an opportunity for economic growth". Males, managers and middle and upper class individuals are more likely to agree with this statement; left-wing and singles to disagree. A strong difference about the merit of globalization emerges also by age group, as middle aged and elderly individuals strongly disagree with the above statement. Columns (2) and (3) report the results of the individual responses to the following statement: "Could you please tell me whether *globalization* (column 2) or *free trade* (column 3) bring to mind something very positive, fairly positive, fairly negative or very negative?", where 1 indicates very positive and 4 very negative. Consistently with the previous answers, middle

aged and elderly individuals view globalization and free trade more negatively than the young.

In a nutshell, our analysis with Eurobarometer data suggests that, regardless of their awarness on the relevance of reforms, competitiveness and globalization for economic growth, middle aged and elderly individuals have much stronger views against reforms, liberalization, flexibility, competitiveness, globalization and free trade than the young may have. These findings are consistent with the idea that structural reforms in the labor and product markets, as well as the retrenchment of the welfare state, have clear redistributive consequences. Labor market liberalizations may increase hiring, but they reduce the degree of production of the insiders. Analogously, less generous unemployment benefits reduce the degree of insurance for those workers who were initially protected. As a clear age cleavage emerges among labor market insiders and outsiders, these labor market policies may benefit the younger generation but they tend to impose a cost on the elderly workers. Our empirical results on both aggregate outcome and individual perceptions are in line with this interpretation. Product market deregulations instead reduce the economic rents enjoyed in these protected markets. Economic theory suggests that these rents are shared between employees and employers active in the protected sectors. Also product market liberalizations thus have redistributive consequences. To the extent that elderly workers in these protected sectors are able to extract more rents, again an age cleavage may emerge. The same age divide would emerge in the preferences for welfare state retrenchment, since in most countries – particularly in Southern Europe – current social spending is massively targeted to the elderly. Finally, to the extent that structural reforms are able to spur future growth, the main beneficiaries of this economic growth would still be

the young generations. As a result, structural reforms may obtain the political support of the young generations, but they most likely get the opposition of the elderly (insiders).

Neo-Keneysian macroeconomic adjustments, on the other hand, may be less divisive, to the extent that all generations are allowed to benefit from more public spending and easier access to credit. However, given the large influence that elderly and insiders have on the political process that allocates public resources, these macroeconomic adjustments would most likely benefit the older generations, rather than the younger ones. Moreover, our evidence on real rates and demographic structure does not support the concern of the existence of a negative equilibrium for real rates that cannot be achieved in the presence of a zero lower bound on policy rates.

6 Conclusions

The main tenet of secular stagnation is that negative real interest rates are needed to equate saving and investment with full employment. Demographics is often referred to as one of the potential causes of secular stagnation. In this paper we have addressed the relationship between the age structure of population and long-term growth and real rates. We have estimated a standard model of mortality, the Lee-Carter model, to generate a mortality trend for fifteeen European countries and combine it with the projected age structure of population to generate long-term projections for the trend in output per capita and real interest rates for euro area economies. Our evidence shows that demographic-based projections deliver for the next twenty years a lower long-run potential growth rate but a reversion of real interest rates to their historical mean. Within this framework, polices

for growth become of crucial importance and we therefore address the debate on structural reforms versus macroeconomic adjustment.

On the basis of this evidence, we have assessed the role of the age structure in promoting or hindering reforms in labour and product markets, which have been advocated to increase long-term growth. Our results suggest that the implementation of such reforms will not be facilitated by the age structure of population. In a world of ageing population, structural reforms should obtain the political support of the young generations, but they will most likely get the opposition of the elderly.

Our evidence on the feasibility of Neo-Keynesian macroeconomic adjustment given projected positive real rates paired with the projection for an increasing share of the old age bracket leads us to conclude that, given the large influence that elderly and insiders have on the political process that allocates public resources, these macroeconomic adjustments would most likely benefit the older generations, rather than the younger ones. Different policy recipes may have different intellectual and academic backgrounds, but they also seem to have different redistributive consequences. It should thus not be surprising if the older countries – in terms of share of elderly people – lean more towards macroeconomic adjustments, whereas younger nations – again in terms of population share, are more supportive of structural reforms.

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Figures and Tables

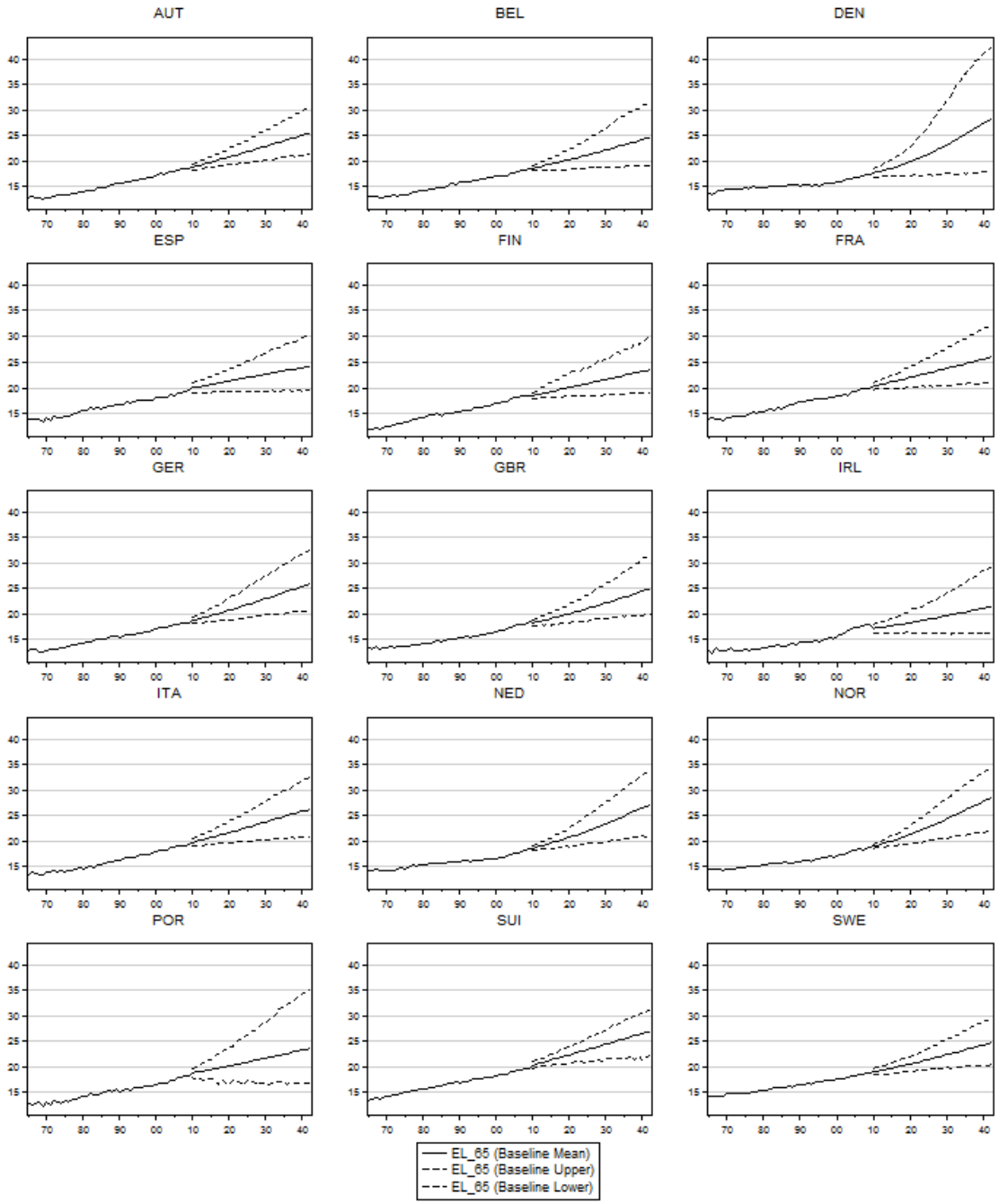

Figure 2.1: Expected residual life at 65

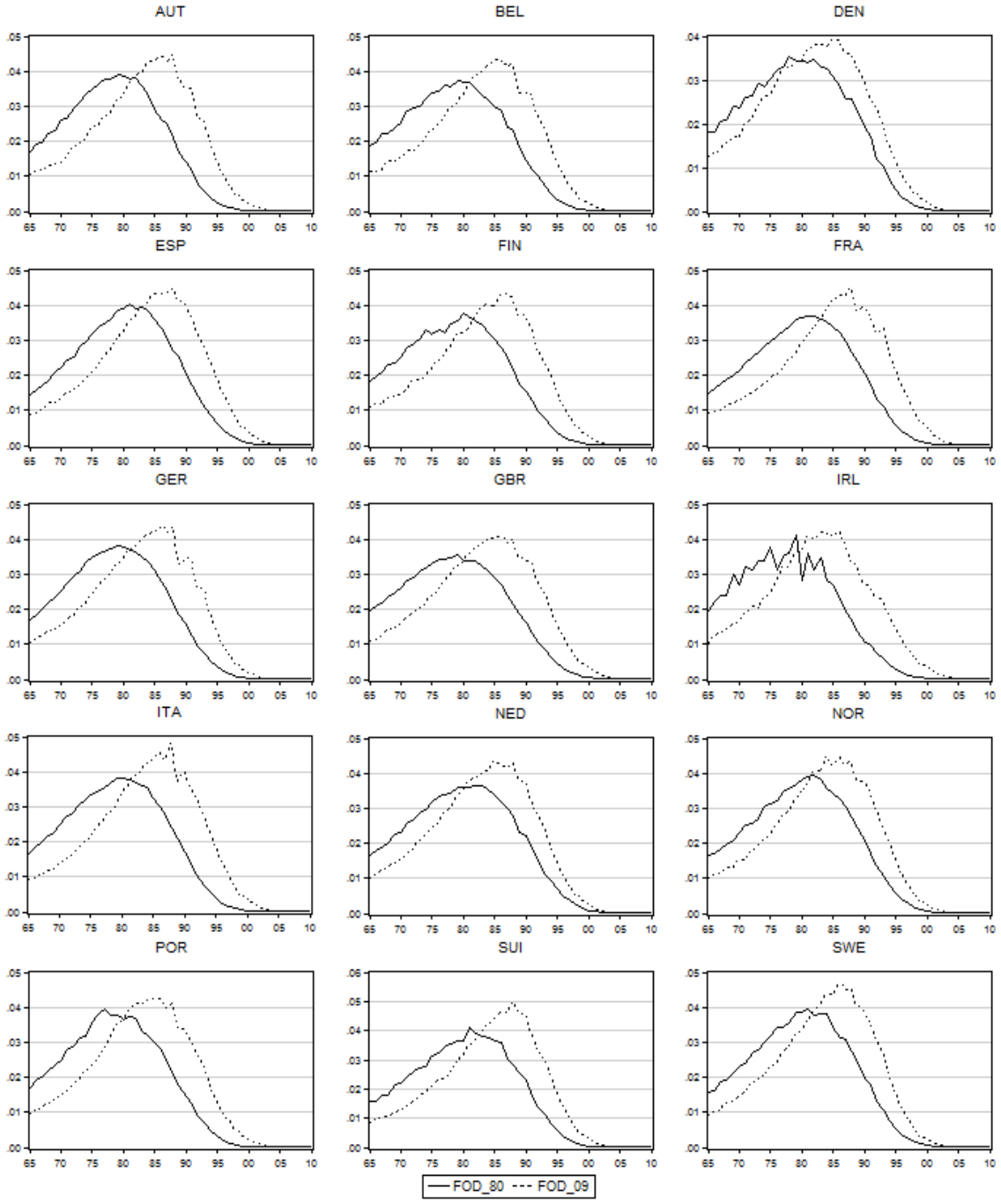

Figure 2.2: Frequencies of death from 65 onwards

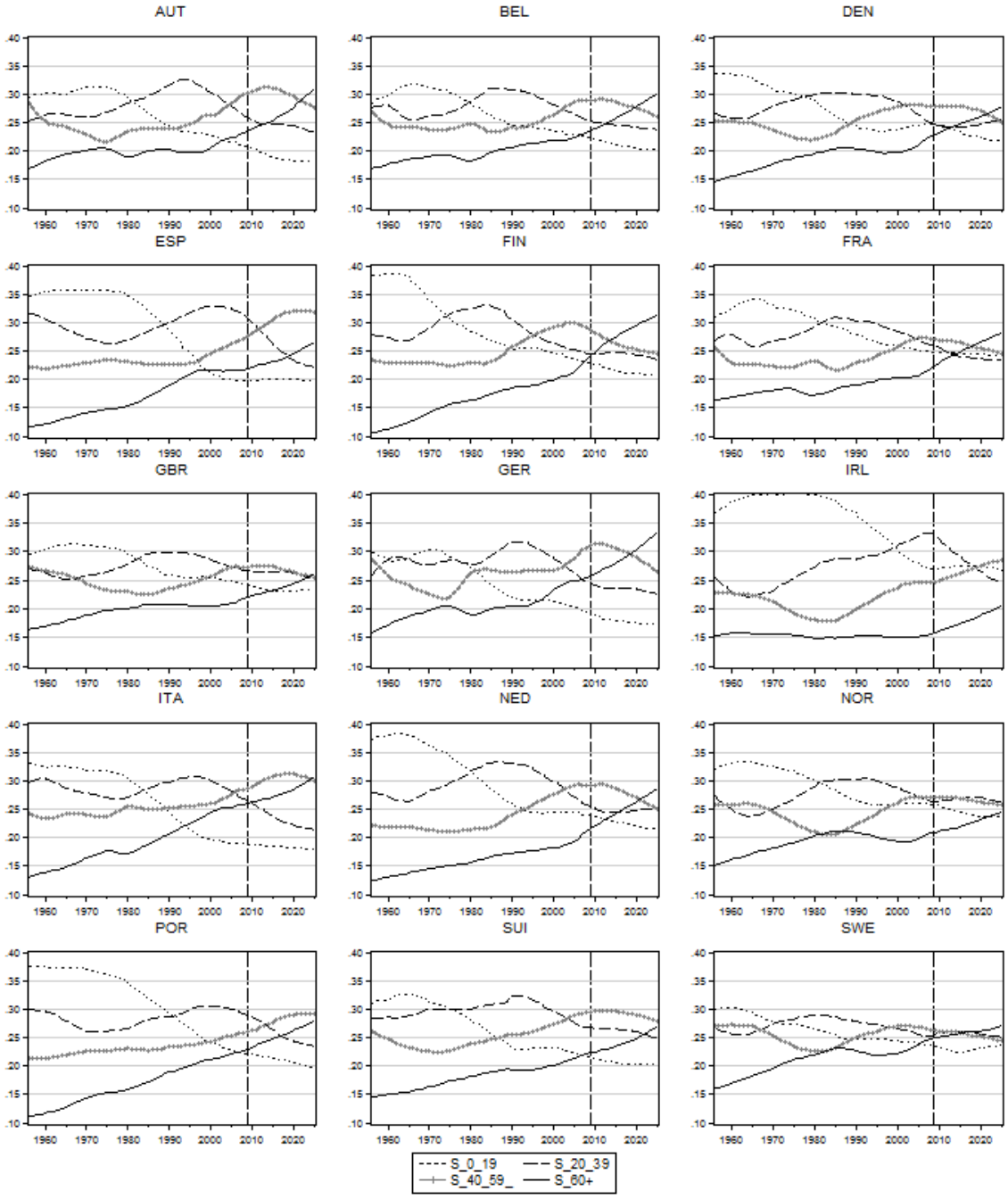

Figure 2.3: Shares of total population for age group

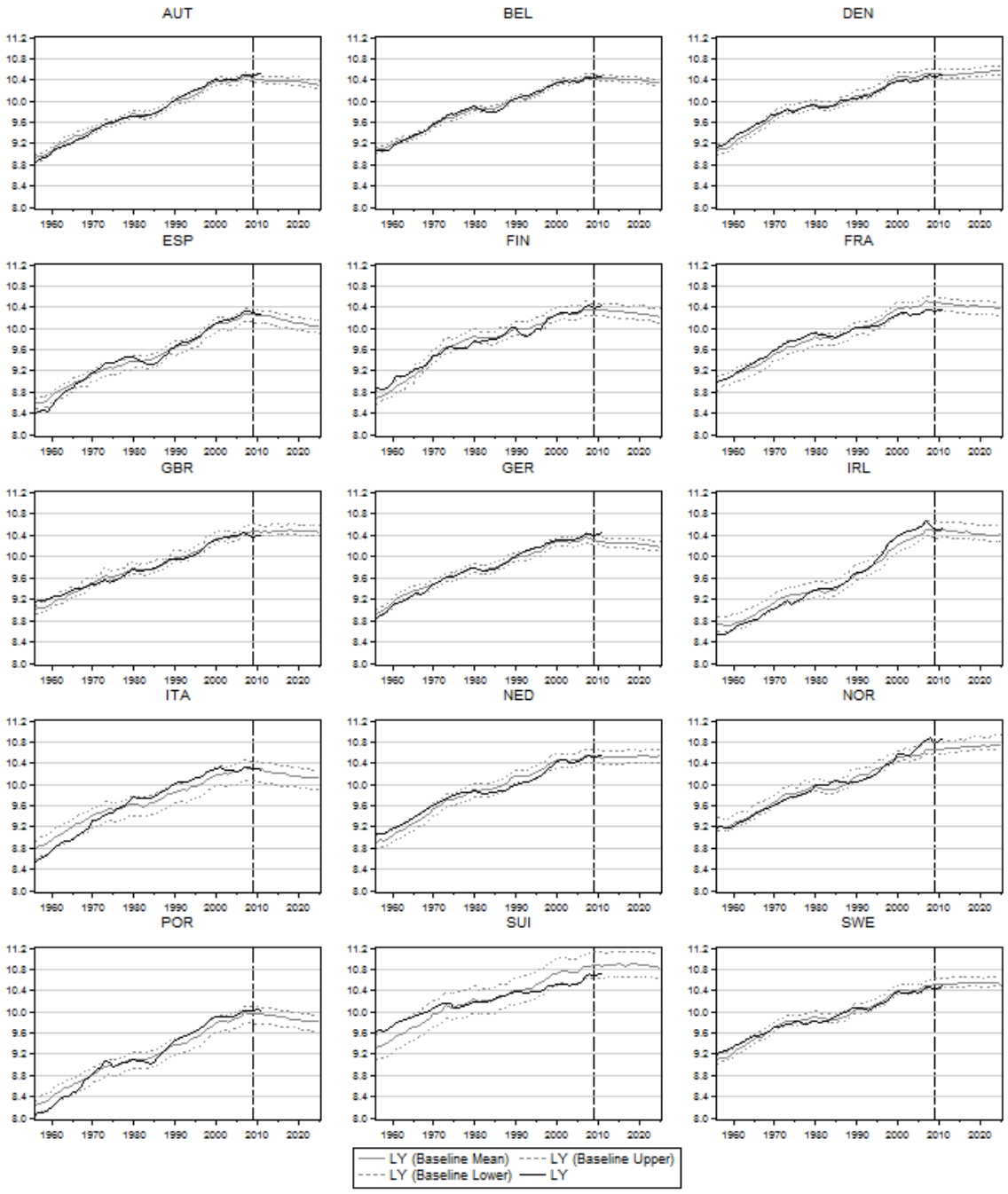

Figure 2.4: Demographic-based projections for log per capita output

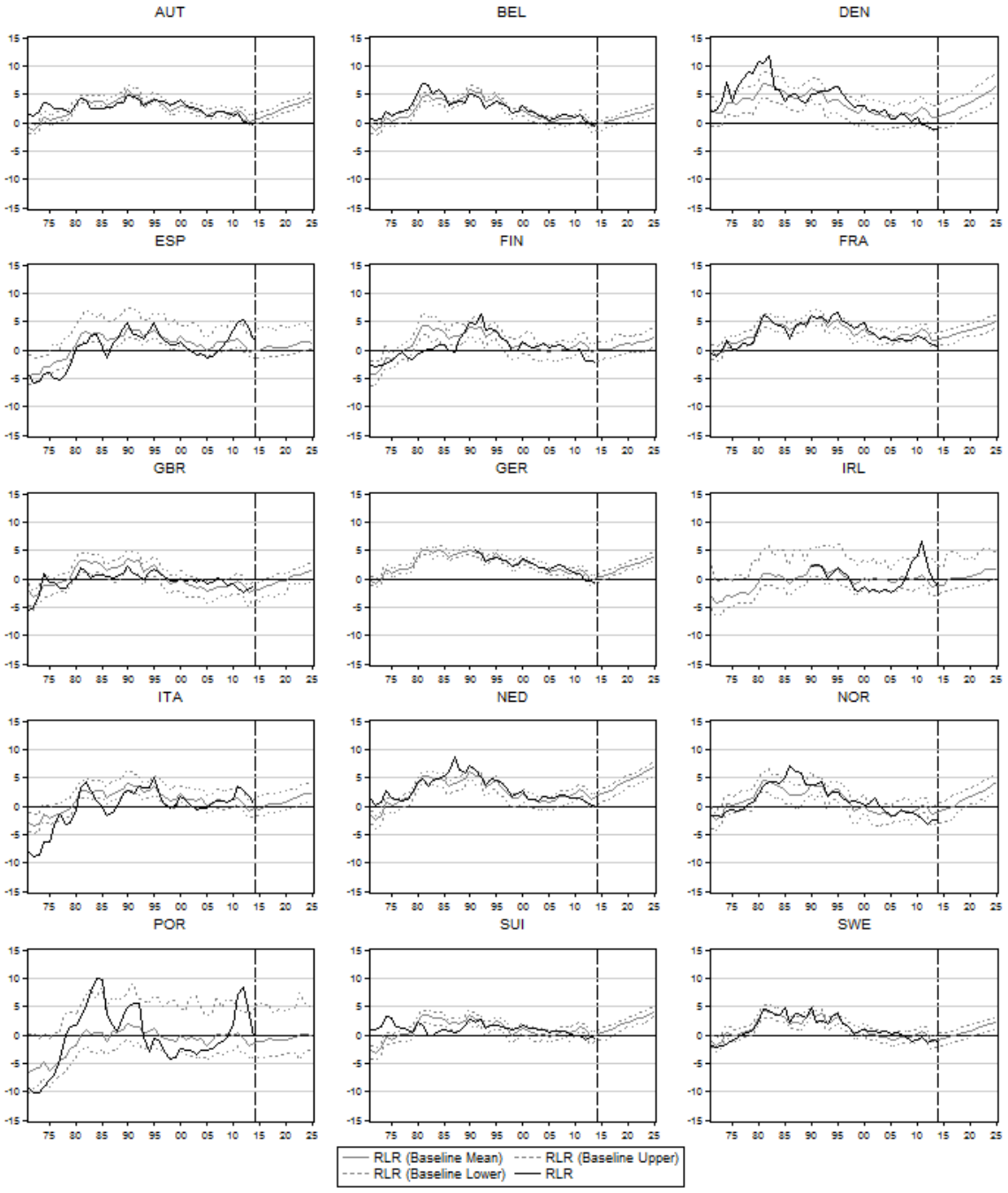

Figure 2.5: Demographic-based projections for real long-term (10 year) rates

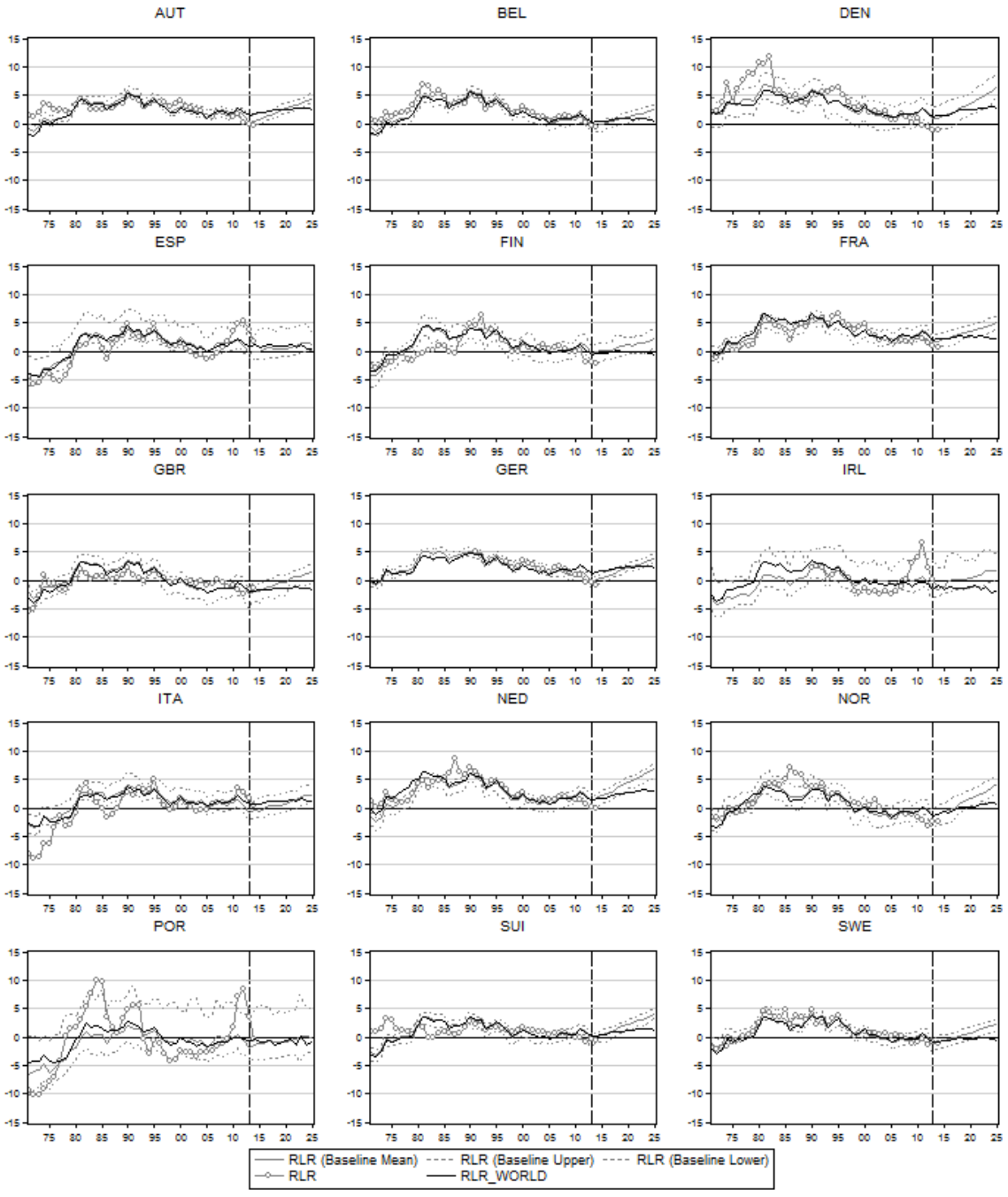

Figure 2.6: Demographic-based projections for real long-term (10 year) rates based on world (US, Europe, Japan and China) shares

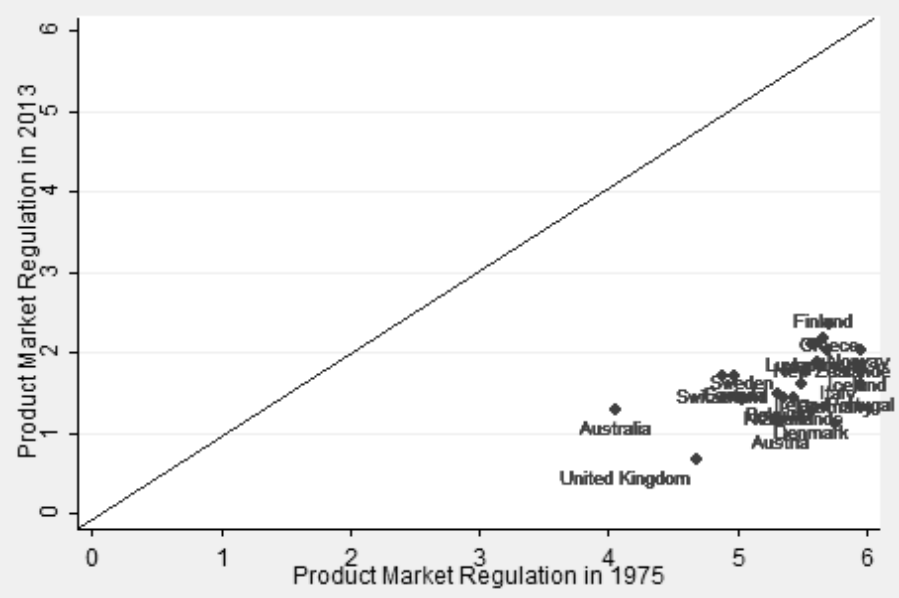

Figure 2.7: Convergence in product market regulation

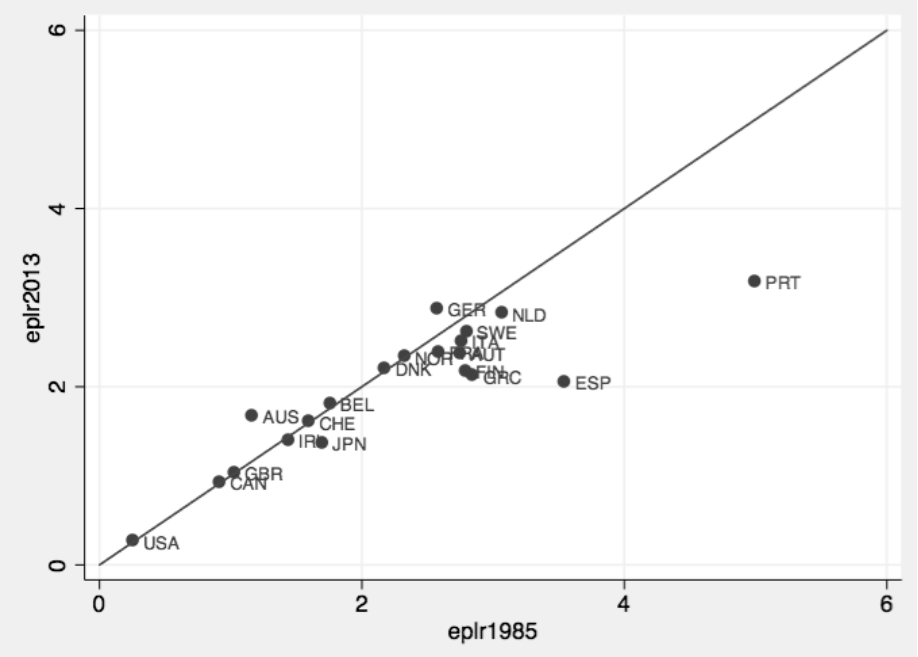

Figure 2.8: Labor market reforms

Table 2.1: Demographic-based projections for output and real interest rates

Log(GDP/capita), Seemingly Unrelated Regression (SURE), 1956-2009

	Coefficient	Std. Error	t-Statistic	Prob.
a_{0-19}	1.238014	0.049163	25.18180	0.0000
a_{20-39}	2.139490	0.047767	44.79056	0.0000
a_{40-59}	1.540705	0.040224	38.30345	0.0000
a_{60+}	0.931189	0.030463	30.56808	0.0000
k_t	-0.003238	0.000218	-14.84704	0.0000

Real Interest Rate, Seemingly Unrelated Regression (SURE), 1971-2014

	Coefficient	Std. Error	t-Statistic	Prob.
a_{0-19}	19.05117	1.873710	10.16762	0.0000
a_{20-39}	24.50064	1.975536	12.40202	0.0000
a_{40-59}	17.96599	2.017357	8.905707	0.0000
a_{60+}	21.73423	1.525143	14.25062	0.0000
k_t	-0.139914	0.007949	-17.60123	0.0000

Table 2.2: Demographic-based projections for real interest rates

Real Interest Rate, Seemingly Unrelated Regression (SURE), 1971-2014

	Coefficient	Std. Error	t-Statistic	Prob.
a_{0-19}	19.05117	1.873710	10.16762	0.0000
a_{20-39}	24.50064	1.975536	12.40202	0.0000
a_{40-59}	17.96599	2.017357	8.905707	0.0000
a_{60+}	21.73423	1.525143	14.25062	0.0000
k_t	-0.139914	0.007949	-17.60123	0.0000

Real Interest Rate, Seemingly Unrelated Regression (SURE), 1971-2013

	Coefficient	Std. Error	t-Statistic	Prob.
a^w_{0-19}	44.71629	12.59162	3.551273	0.0004
a^w_{20-39}	64.88732	12.14674	5.341952	0.0000
a^w_{40-59}	24.03895	9.293653	2.586598	0.0100
a^w_{60+}	32.71870	7.426528	4.405652	0.0000
k_t	-0.116852	0.007655	-15.26486	0.0000

Table 2.3: Summary Statistics

Variables	Num Obs	Mean	St. Deviation	Min	Max
pmr	702	3.929957	1.619784	0.68	5.96
transport	612	3.55492	1.708931	0.6111111	6
communication	702	3.770726	1.802306	0.7	6
energy	344	3.576885	1.688385	0.7816667	6
epl	476	2.320998	0.9092663	0.64	4.19
eplt	476	2.223592	1.358306	0.25	5.25
eplr	476	2.418403	0.7766565	1.03	5
tradeun	679	43.94204	21.85163	7.55	99.07
uegen	577	10.24385	2.699466	2.6	14.5
skgen	576	11.74167	3.091419	5.3	18.2
pgen	540	12.17907	1.857389	7.2	17.1
finreform	465	14.65108	5.378197	1	21
privatization	465	1.647312	1.11239	0	3
crisisgap	614	0.0993485	0.2993733	0	1
emu	702	0.6666667	0.4717406	0	1
single market	700	0.4414286	0.4969126	0	1
openess	651	0.9070469	0.6702533	0.146074	4.43126
GDP log	651	26.38578	1.47732	22.13217	28.8467
right	646	0.3931889	0.4888367	0	1
linear trend	702	20	11.26265	1	39
mortality trend	585	-13.01138	16.73193	-54.13894	16.16084
share 20-39	648	0.2913678	0.0197512	0.2424523	0.3325609
share 40-59	648	0.2479392	0.0255655	0.1781538	0.3108268
share 60+	648	0.1954618	0.0266706	0.1271392	0.2650315

Table 2.4: Product Market Regulation

VARIABLES	(1) pmr	(2) transport	(3) communication	(4) energy	(5) pmr	(6) transport	(7) communication	(8) energy
lagged dependent	0.793***	0.765***	0.832***	0.849***	0.799***	0.756***	0.827***	0.860***
	(0.0383)	(0.0502)	(0.0340)	(0.0387)	(0.0383)	(0.0524)	(0.0374)	(0.0393)
L.crisisgap	-0.0512	-0.00766	-0.0804*	-0.0128	-0.0649**	0.000217	-0.0961*	0.00287
	(0.0333)	(0.0467)	(0.0470)	(0.0696)	(0.0320)	(0.0468)	(0.0495)	(0.0690)
emu	1.079***	1.399**	0.474	2.202	1.084***	1.582***	0.293	2.618*
	(0.277)	(0.542)	(0.365)	(1.403)	(0.291)	(0.546)	(0.388)	(1.555)
single market	-0.0874**	-0.169**	0.0304	4.398	-0.129***	-0.176**	0.0520	-0.475
	(0.0427)	(0.0821)	(0.0579)	(3.549)	(0.0487)	(0.0834)	(0.0639)	(1.025)
L.openness	-0.0407	0.257**	-0.272**	-0.828***	-0.163**	0.173	-0.311**	-0.816***
	(0.0844)	(0.123)	(0.126)	(0.247)	(0.0827)	(0.125)	(0.130)	(0.265)
L.gdplog	0.452***	0.623**	0.184	0.737	0.435***	0.685***	0.0734	0.955
	(0.137)	(0.258)	(0.184)	(0.749)	(0.142)	(0.261)	(0.194)	(0.855)
L.right	-0.0229	-0.0148	-0.00961	0.0312	-0.00256	0.00900	-0.000974	0.0160
	(0.0165)	(0.0284)	(0.0241)	(0.0434)	(0.0165)	(0.0275)	(0.0277)	(0.0389)
linear trend	-0.0202***	-0.0294***	-0.00941*	-0.141				
	(0.00508)	(0.00820)	(0.00570)	(0.107)				
mortality trend					0.00444*	0.00508	0.00606	0.00198
					(0.00241)	(0.00410)	(0.00400)	(0.00788)
share 20-39	-3.302***	-4.070***	-0.914	-13.36***	-3.109***	-4.089***	-0.465	-14.44***
	(0.650)	(1.244)	(0.813)	(4.722)	(0.646)	(1.229)	(0.856)	(5.124)
share 40-59	-7.710***	-8.778***	-5.436***	-10.23***	-6.502***	-8.675***	-5.051***	-10.30***
	(1.615)	(2.521)	(1.961)	(3.349)	(1.442)	(2.541)	(1.916)	(3.551)
share 60+	-0.623	0.817	-2.199**	-3.485	-0.295	1.008	-2.317**	-3.260
	(0.672)	(1.192)	(1.106)	(4.301)	(0.687)	(1.220)	(1.137)	(4.301)
constant	-8.773**	-13.34**	-2.295	-12.75	-8.783**	-15.18**	0.526	-18.84
	(3.429)	(6.468)	(4.792)	(20.63)	(3.647)	(6.583)	(5.112)	(23.91)
number of countries	18	18	18	18	15	15	15	15
country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
observations	509	445	509	235	453	430	453	220
R-squared	0.990	0.979	0.983	0.987	0.991	0.980	0.983	0.989

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.5: Labor Market Regulation

VARIABLES	(1) epl	(2) eplt	(3) eplr	(4) tradeun	(5) epl	(6) eplt	(7) eplr	(8) tradeun
lagged dependent	0.891***	0.909***	0.851***	0.923***	0.886***	0.903***	0.848***	0.942***
	(0.0389)	(0.0366)	(0.0986)	(0.0166)	(0.0431)	(0.0409)	(0.0992)	(0.0114)
L.crisisgap	0.0101	-0.00183	0.0207	-0.0321	0.00936	-0.00388	0.0207	0.0839
	(0.0225)	(0.0414)	(0.0142)	(0.154)	(0.0226)	(0.0411)	(0.0144)	(0.148)
emu	0.526*	0.669	0.251	-2.735	0.900**	1.416**	0.191	-2.066
	(0.274)	(0.486)	(0.218)	(2.719)	(0.394)	(0.709)	(0.255)	(2.142)
single market	0.00930	0.0323	-0.00683	-0.0281	0.00850	0.0312	-0.00791	-0.259
	(0.0319)	(0.0610)	(0.0116)	(0.322)	(0.0321)	(0.0614)	(0.0120)	(0.195)
L.openness	-0.0103	0.0240	-0.0204	-0.00858	-0.0758	-0.103	-0.0101	-0.326
	(0.0523)	(0.0892)	(0.0356)	(0.813)	(0.0614)	(0.101)	(0.0386)	(0.549)
L.gdplog	0.201*	0.300	0.0106	-1.456	0.392**	0.689**	-0.0237	-1.016
	(0.122)	(0.229)	(0.0916)	(1.361)	(0.183)	(0.348)	(0.103)	(1.090)
L.right	0.00732	0.0197	-0.00353	-0.0322	0.00112	0.00561	-0.00373	-0.250**
	(0.0152)	(0.0285)	(0.00908)	(0.147)	(0.0140)	(0.0254)	(0.00892)	(0.109)
linear trend	-0.00666**	-0.0115*	0.00172	-0.0864**				
	(0.00315)	(0.00594)	(0.00272)	(0.0341)				
mortality trend					-0.00381	-0.00830	0.000977	-0.00207
					(0.00330)	(0.00637)	(0.00147)	(0.0185)
share 20-39	-1.372**	-1.857	-0.830	6.170	-1.919**	-2.960*	-0.739	7.732
	(0.694)	(1.209)	(0.582)	(5.715)	(0.898)	(1.661)	(0.660)	(5.309)
share 40-59	-0.350	-0.110	-0.993	17.06	-0.900	-1.290	-0.921	20.08**
	(1.445)	(2.636)	(0.670)	(10.35)	(1.682)	(3.187)	(0.736)	(8.549)
share 60+	-1.467*	-1.992	-1.531	19.97***	-1.380*	-1.786	-1.548	23.08***
	(0.804)	(1.348)	(1.307)	(5.852)	(0.782)	(1.293)	(1.344)	(5.276)
constant	-4.628	-7.174	0.659	35.44	-9.734**	-17.55**	1.598	20.77
	(3.020)	(5.746)	(2.474)	(36.47)	(4.587)	(8.753)	(2.715)	(28.63)
number of countries	18	18	18	18	15	15	15	15
country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
observations	360	360	360	507	343	343	343	452
R-squared	0.985	0.975	0.993	0.998	0.987	0.978	0.993	0.999

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.6: Welfare State

VARIABLES	(1) uegen	(2) skgen	(3) pgen	(4) uegen	(5) skgen	(6) pgen
lagged dependent	0.838***	0.860***	0.931***	0.837***	0.856***	0.933***
	(0.0319)	(0.0475)	(0.0211)	(0.0318)	(0.0482)	(0.0212)
L.crisisgap	0.210**	0.0431	0.0136	0.205**	0.0412	0.00985
	(0.0911)	(0.0606)	(0.0626)	(0.0890)	(0.0609)	(0.0629)
emu	0.886	1.206*	0.693	1.161	1.536*	0.656
	(0.957)	(0.722)	(0.861)	(1.064)	(0.800)	(0.786)
single market	-0.318***	-0.107	-0.166*	-0.312***	-0.104	-0.165*
	(0.106)	(0.0718)	(0.0849)	(0.105)	(0.0721)	(0.0849)
L.openness	-0.198	-0.0913	-0.0908	-0.184	-0.0976	-0.116
	(0.277)	(0.261)	(0.195)	(0.278)	(0.264)	(0.198)
L.gdplog	0.343	0.515	0.279	0.502	0.695	0.254
	(0.489)	(0.390)	(0.435)	(0.559)	(0.441)	(0.393)
L.right	-0.00762	0.0517	-0.0951**	-0.00956	0.0522	-0.0895**
	(0.0518)	(0.0502)	(0.0380)	(0.0545)	(0.0524)	(0.0391)
linear trend	-0.0264*	-0.0226**	0.00219			
	(0.0142)	(0.0111)	(0.00933)			
mortality trend				-0.00808	-0.00643	0.00244
				(0.00772)	(0.00617)	(0.00676)
share 20-39	2.419	0.992	0.105	1.738	0.393	0.228
	(1.884)	(2.151)	(2.039)	(1.912)	(2.073)	(1.941)
share 40-59	10.20***	2.475	-1.288	10.20***	2.522	-0.996
	(3.886)	(2.911)	(3.688)	(3.870)	(2.879)	(3.751)
share 60+	10.47***	5.695**	0.159	10.29***	5.684**	0.135
	(2.398)	(2.520)	(2.164)	(2.368)	(2.490)	(2.145)
constant	-12.91	-14.86	-6.638	-17.03	-19.61	-6.065
	(12.99)	(10.50)	(11.17)	(14.90)	(11.92)	(10.12)
number of countries	18	18	18	15	15	15
country fixed effects	yes	yes	yes	yes	yes	yes
year fixed effects	yes	yes	yes	yes	yes	yes
observations	464	463	450	449	448	435
R-squared	0.981	0.989	0.960	0.980	0.988	0.958

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2.7: Reforms

VARIABLES	(1) need of reforms	(2) preference for reform	(3) preference for liberalization	(4) preference for flexibility
male	-0.0506***	-0.0286**	-0.167***	-0.0579***
	(0.0116)	(0.0128)	(0.0185)	(0.0167)
single	0.0177	0.0125	0.0605***	0.0510***
	(0.0120)	(0.0133)	(0.0194)	(0.0176)
manager	0.000458	-0.0834***	-0.0954***	-0.133***
	(0.0203)	(0.0216)	(0.0301)	(0.0268)
employed	0.0229	-0.0244	-0.0750***	-0.0889***
	(0.0153)	(0.0172)	(0.0247)	(0.0224)
self-employed	-0.0516**	-0.0981***	-0.101***	-0.152***
	(0.0245)	(0.0265)	(0.0356)	(0.0326)
middle age	-0.0141	0.0420**	0.102***	0.119***
	(0.0149)	(0.0168)	(0.0238)	(0.0214)
old	-0.0145	-0.0146	0.196***	0.232***
	(0.0163)	(0.0180)	(0.0266)	(0.0241)
left	-0.0273*	0.0113	0.0367	0.0382*
	(0.0153)	(0.0171)	(0.0242)	(0.0223)
right	-0.0126	0.0459**	-0.162***	0.00767
	(0.0196)	(0.0208)	(0.0285)	(0.0265)
middle class	-0.0905***	-0.152***	-0.278***	-0.200***
	(0.0133)	(0.0146)	(0.0209)	(0.0188)
upper class	-0.148**	-0.391***	-0.372***	-0.339***
	(0.0718)	(0.0716)	(0.104)	(0.0900)
constant	1.861***	2.367***	2.834***	2.250***
	(0.0380)	(0.0455)	(0.0744)	(0.0488)
number of countries	17	17	17	17
country FE	yes	yes	yes	yes
observations	14927	14691	16105	15605
R-squared	0.093	0.078	0.054	0.112

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.8: Competition

VARIABLES	(1) industrial competition	(2) preference for competition
male	0.0266	-0.163***
	(0.0295)	(0.0153)
single	-0.143***	0.0534***
	(0.0308)	(0.0161)
manager	-0.0212	-0.0656***
	(0.0521)	(0.0244)
employed	0.0615	-0.0760***
	(0.0392)	(0.0207)
self-employed	0.190***	-0.119***
	(0.0628)	(0.0298)
middle age	0.168***	0.0595***
	(0.0388)	(0.0196)
old	0.298***	0.109***
	(0.0414)	(0.0223)
left	-0.121***	0.0968***
	(0.0418)	(0.0203)
right	0.155***	-0.110***
	(0.0492)	(0.0237)
middle class	0.279***	-0.187***
	(0.0334)	(0.0173)
upper class	0.535***	-0.306***
	(0.148)	(0.0859)
constant	7.272***	2.289***
	(0.0969)	(0.0643)
number of countries	17	17
country FE	yes	yes
observations	14912	16105
R-squared	0.054	0.066

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.9: Globalization

VARIABLES	(1) globalization	(2) preference for globalization	(3) preference for free trade
male	-0.0564***	-0.154***	-0.233***
	(0.0135)	(0.0176)	(0.0173)
single	0.0502***	0.0844***	0.0757***
	(0.0141)	(0.0185)	(0.0182)
manager	-0.0716***	-0.132***	-0.0607**
	(0.0225)	(0.0287)	(0.0287)
employed	-0.00276	-0.0571**	-0.0437*
	(0.0181)	(0.0236)	(0.0232)
self-employed	-0.0125	-0.0983***	-0.0775**
	(0.0284)	(0.0343)	(0.0332)
middle age	0.177***	0.226***	0.0971***
	(0.0174)	(0.0228)	(0.0223)
old	0.170***	0.332***	0.185***
	(0.0189)	(0.0252)	(0.0250)
left	0.0836***	0.00705	0.0464**
	(0.0185)	(0.0229)	(0.0228)
right	-0.0312	-0.0492*	-0.156***
	(0.0224)	(0.0284)	(0.0274)
middle class	-0.194***	-0.286***	-0.233***
	(0.0156)	(0.0200)	(0.0197)
upper class	-0.220**	-0.509***	-0.366***
	(0.0953)	(0.109)	(0.106)
constant	2.216***	2.965***	2.558***
	(0.0527)	(0.0540)	(0.0522)
number of countries	17	17	17
country FE	yes	yes	yes
observations	14,110	15,605	15,605
R-squared	0.145	0.091	0.064

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix A: Data Sources

Series for Expenditure-side Real GDP at Chained PPP (Millions of 2005 US$) and Total Population (Millions) were downloaded from the Penn World Table 8 database; . Data for Long-Term Nominal Interest Rates, Nominal and Real GDP (OECD base year i.e. 2005) in national currencies were downloaded from the databases in OECD Statistics. Data on GDP from OECD were used to compute the GDP deflator. Series for population's age structure were obtained by combining databases from the UN Population Division and the US Census Bureau. Data on mortality were downloaded from The Human Mortality Database.

Appendix B: Identification and Estimation of the Lee-Carter Model

The Lee-Carter (1992) model consists of a system of equations for logarithms of mortality rates for age cohort x at time t, $\ln[m_{x,t}]$, and a time-series equation for an unobservable time-varying mortality index k_t:

$$\begin{aligned} \ln(m_{x,t}) &= a_x + b_x k_t + \epsilon_{x,t} \\ k_t &= c_0 + c_1 k_{t-1} + e_t \\ \epsilon_{x,t} &\sim NID\left(0, \sigma_\epsilon^2\right) \\ e_t &\sim \text{MeanZero - Stationary Process} \end{aligned} \tag{3}$$

where a_x and b_x are age-specific constants. The error term $\epsilon_{x,t}$ captures cross-sectional errors in the model based prediction for mortality of different cohorts, while the error term e_t captures random fluctuations in the time series of the common factor k_t driving mortality at all ages. Identification of the parameters of interest is achieved by imposing the restrictions $\sum_t k_t = 0$ and $\sum_x b_x = 1$, so that the unobserved mortality index k_t is estimated through Singular Value Decomposition (SVD). SVD is a technique based on a theorem of linear algebra stating that a $(m \times n)$ rectangular matrix M can be broken down into the product of three matrices - an $(m \times m)$ orthogonal matrix U, a diagonal $(m \times n)$ matrix S, and the transpose of an orthogonal $(n \times n)$ matrix V. The SVD of the matrix M will be therefore be given by $M = USV'$ where $U'U = I$ and $V'V = I$. The columns of U are orthonormal eigenvectors of AA' , the columns of V are

orthonormal eigenvectors of $A'A$, and S is a diagonal matrix whose elements are the square roots of eigenvalues from U or V in descending order. The restriction $\sum_t k_t = 0$ implies that a_x is the average across time of $\ln(m_{x,t})$, and Equation 3 can be rewritten in terms of the mean-centered log-mortality rate as

$$m_{x,t} - \overline{m}_{x,t} \equiv \tilde{m}_{x,t} = b_x k_t + \epsilon_{x,t}. \tag{4}$$

Grouping all the $\tilde{m}_{x,t}$ in a unique $(X \times T)$ matrix $\tilde{m}$ (where the columns are mortality rates at time-t ordered by age groups and the rows are mortality rates through time for a specific age-group x), leads naturally to use SVD to obtain estimates of b_x and k_t. In particular, if $\tilde{m}$ can be decomposed as $\tilde{m} = USV'$, $b = [b_0, b_1, \ldots, b_X]$ is represented by the normalized first column of U, $u_1 = [u_{0,1}, u_{1,1}, \ldots, u_{X,1}]$, so that

$$b = \frac{u_1}{\sum_{x=0}^{X} u_{x,1}}.$$

On the other hand the mortality index vector $k = [k_1, k_2, \ldots, k_T]$ is given by

$$k = \lambda_1 (\sum_{x=0}^{X} u_{x,1}) \nu_1$$

where $\nu_1 = [\nu_{1,1}, \nu_{1,2}, \ldots, \nu_{1,T}]'$ is the first column of the V matrix and λ_1 is the highest eigenvalue of the matrix S (see Girosi and King, 2007, Giacometti et al., 2010) where $\nu_1 = [\nu_{1,1}, \nu_{1,2}, \ldots, \nu_{1,T}]'$ is the first column of the V matrix and λ_1 is the highest eigenvalue of the matrix S.