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Demographic Change and the Labour Share of Income

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Torsten Schmidt and Simeon Vosen[1]

Demographic Change and the Labour Share of Income

Abstract

Despite similar levels of per capita income, education, and technology the development of labour shares in OECD countries has displayed different patterns since 1960. The paper examines the role of demography in this regard. Employing an overlapping generations model we first examine the mechanisms through which demographic change can affect labour shares. Model simulations show that demographic effects on the labour share are larger in open than in closed economies. Empirical estimates, conducted using panel cointegration techniques for a panel of 18 OECD countries, provide strong support for demographic effects on the labour share. In line with the simulation results, we also find evidence that openness increases this impact.

JEL Classification: E25, J10, D91, C23

Keywords: Labour share; demographic change; panel cointegration

February 2010

1 Both RWI. – We thank Christoph M. Schmidt, Christina B. Wilke, Bernhard Mahlberg, and Jan Hogrefe for helpful comments. – All correspondence to Simeon Vosen, RWI, Hohenzollernstr. 1–3, 45128 Essen, Germany, e-mail: simeon.vosen@rwi-essen.de.

1 Introduction

After rising substantially in the 1960s and early 1970s, labour shares have been steadily declining ever since in most OECD countries. In a few countries however, despite similar levels of per capita income, education and technology, labour shares have remained relatively stable (Figure 1 for selected countries). There has been extensive research on factors that might have caused this phenomenon. It is widely argued in literature that the interplay of institutional labour market reforms and high real wage growth on the one hand and a slowdown in productivity growth caused by supply shocks on the other hand, lead to the rise in most European labour shares in the 1960s and 1970s (Bertoli and Farina, 2007). The following recovery of profit shares in the 1980s is by many authors interpreted as a result of the reaction of firms who increased profit shares by reducing labour demand and through a shift to more capital-intensive production techniques (Blanchard, 1997).

However, the question remains why in several countries labour shares have kept on falling since the 1980s when they returned to their initial levels of the 1960s. Given that the countries with declining labour shares are mostly continental European, labour market institutions are a natural candidate. However, labour share declines have taken place both in countries which reduced unemployment and others in which unemployment rates remained high. Likewise correlations between real wage growth and changes in labour shares have been quite small (Bentolila and Saint-Paul, 2003). This indicates that a potential common factor explaining the decline in labour shares should be consistent with differing labour market outcomes. Some other potential determinants that have been analysed in the recent empirical literature include sectoral composition effects (De Serres et al., 2001), labour saving technological change (Guscina, 2006), and the globalisation of trade and capital flows (Guscina, 2006; Jayadev, 2007).

This paper examines the role of demography as a further potential explanation for the differences in labour share developments across OECD countries. The extent to which these countries are affected by demographic change differs considerably. While some countries have seen steady population growth others experienced a substantial slowdown (Figure 2). Moreover, growing life expectancy has led to substantial increases in expected retirement durations if pension ages were not adjusted accordingly. As a result of both factors, old-age dependency ratios are projected to display largely differing developments until 2050 (Figure 3). This paper seeks to examine *whether* differences in demographic developments can explain some of the differences in labour share developments and also *how* demography affects labour shares. Our approach is therefore to conduct both model simulations and empirical estimations. By simulating demographic shocks in a neoclassical overlapping generations (OLG) framework we seek to identify the mechanisms and determinants of demographic change on labour shares. Based on these insights we then estimate the demographic impact on labour shares empirically using a panel of 18 OECD countries for the period from 1960 to 2008.

To our knowledge, theoretical analysis of labour shares has so far only been conducted for closed economy frameworks and missed the potentially important impact of international capital mobility. Though closed economy models might be somewhat appropriate for large countries, open economy models are certainly more realistic for smaller countries. To provide for both cases, we conduct model simulations for closed as well as small open economy frameworks. To examine the role of pension systems, we also distinguish between economies with pay-as-you-go (PAYGO) or fully funded pension systems. We treat the model simulations as a preparatory exercise to identify possible mechanisms through which demography can affect labour shares, which are subsequently tested in empirical estimations. We therefore keep the OLG model very simple, assuming a 2-period life-cycle and simulating only steady state effects for different combinations of pension systems, openness and elasticities of substitution between capital and labour.

The simulation results suggest that in closed economies a drop in labour force growth and higher expected retirement duration can affect labour shares by altering the capital intensity of production. Shifts in the capital intensity affect the labour share either positively or negatively depending on the production function's elasticity of substitution between capital and labour. In a small open economy (SOE) framework with perfect capital mobility, however, interest rates are exogenous and the domestic capital intensity remains thus unaffected. Both, higher expected retirement duration and falling labour force growth rates can nevertheless decrease labour shares by creating a gap between domestic savings and domestic investments.[1] Since the domestic capital-intensity is constant, excess savings are invested abroad. This improves the country's net foreign asset position and generates higher foreign asset income by which the labour share is reduced independently of the elasticity of substitution between capital and labour. Moreover, demographic effects are slightly stronger in countries with PAYGO system as households adjust their saving behaviour to lower expected public pensions during retirement.

Based on the simulation results, we then test the relationship between demographic change and the labour share empirically. Unit root tests show labour shares to be non-stationary, a fact that has been widely neglected in the previous empirical literature on the labour share. Pedroni tests indicate cointegrating relationships between the labour share and several demographic variables. This allows us to employ a panel error correction model to detect the long-run effects of demographic change on the labour share. Referring to the simulation results, we also interact the demographic variables with openness and a pension system indicator to test whether these variables influence demographic effects on labour shares. The estimation results mostly confirm those of our model simulations. We find significant long-run relationships between all demographic variables and labour shares. These effects tend to be larger in open economies. The size of the PAYGO-financed component of the pension system, however, appears not to play a significant role.

[1] The effect of demographic change on saving and investment behaviour as well as international capital flows has been subject to a number of theoretical and empirical studies (see Domeij and Flodén (2006) for an overview). Almost all of these suggest that differences in demographic trends have been an important determinant of international capital flows since WWII.

The remainder of this paper is structured as follows: Section 2 develops the OLG model used to simulate demographic effects on labour shares. Section 3 contains the calibration and simulation results. Section 4 presents the data and empirical methodology, section 5 the estimation results. Section 6 concludes.

2 The model

This section develops a 2-period OLG model in several variants that differ with regard to pension system and openness. Pension systems are either PAYGO or fully funded and economies are modelled either as closed or small open economies. The PAYGO and SOE variants of the OLG model are based on Pemberton (2000).

2.1 The closed economy variant

In a closed economy, all savings are invested domestically. Changes in saving rates can affect the labour share by altering the capital intensity of production unless the elasticity of substitution between capital and labour is equal to one. We show that the capital intensity depends on the representative household's expected duration of retirement and the country's labour force growth rate. General equilibrium is constructed via the production sector where, given labour and capital inputs, output and factor prices are determined by a CES production function.

The labour share is defined as the ratio of labour income to total income. It therefore depends on factor prices (wage and profit rates) as well as endowments of labour and capital – in other words on the capital intensity of production. In a closed economy framework total income equals total production. The labour share, defined in real terms, is therefore

$$ls_t^{closed} = \frac{w_t L_t}{w_t L_t + r_t K_t} = \frac{w_t L_t}{Y_t}, \quad (1)$$

where w is the wage rate, r is the interest rate, L is the labour force, K is the domestic capital stock, and Y is total production.

Given factor inputs of capital and labour, output and factor prices are determined by a representative firm that uses a standard CES production function in units of labour given by

$$y_t = A(\alpha k_t^{-\varepsilon} + (1-\alpha))^{-\frac{1}{\varepsilon}}\ ,\ \varepsilon = \frac{1-\sigma}{\sigma}\ , \tag{2}$$

where k = K/L is the capital intensity, the term A represents total factor productivity, σ the elasticity of substitution and α is a factor share parameter that allows the relative importance of capital and labour in production to vary. For simplicity we assume that A is constant and not affected by demographic change. Labour inputs grow at rate n per period:

$$L_t = (1+n)^t L_0\ . \tag{3}$$

We further assume 100% capital depreciation per period and static profit maximisation of firms. Both production factors are paid their marginal product:

$$w_t = (1-\alpha)A\left[\alpha k_t^{-\varepsilon} + 1 - \alpha\right]^{-\left(1+\frac{1}{\varepsilon}\right)} \tag{4}$$

$$r_t = \alpha A\left[\left(\alpha + k_t^{\varepsilon}(1-\alpha)\right)^{-\frac{1}{\varepsilon}}\right]^{1+\varepsilon} - 1\ . \tag{5}$$

The economy consists of overlapping generations of households with identical utility functions. Each household lives for a working period during which savings are accumulated, and with probability π, 0<π<1, for a second, retired, period, in which the household lives on its accumulated annuities. In a PAYGO system economy, retired households additionally receive public pensions which are financed by working households. For simplicity, we assume no bequest. Households thus save only to provide for their own income during retirement.

By choosing an optimal consumption path, households maximise their inter-temporal utility. As usual in life-cycle models, the trade-off between consumption in young or old age is determined by the ratio of interest rate and time preference rate, and by the degree of relative risk aversion. Preferences are additive and separable over time. For a representative household who is young at time t the objective function is

$$u_t^Y = \frac{(c_t^Y)^{1-\theta}}{1-\theta} + \frac{\pi}{1+\rho}\frac{(c_{t+1}^O)^{1-\theta}}{1-\theta}, \tag{6}$$

where c_t^Y and c_t^O are the consumption levels of a young and old household at time t. ρ denotes the time preference rate and θ the coefficient of relative risk aversion. Households can borrow and lend freely at r_t. Since the average survival rate of each generation is π, gross return on annuities is $(1+r)/\pi$. Maximisation of lifetime consumption is subject to budget constraints which for an economy with PAYGO pension system are given by

$$c_t^Y = (1-\tau)w_t - s_t \tag{7}$$

$$c_t^O = \frac{1+r_t}{\pi}s_{t-1} + \frac{1+n}{\pi}\tau w_t, \tag{8}$$

where τ is a constant wage tax rate paid by the young households. Old households live on the annuities which their generation saved during working age and which are distributed to all pensioners still alive. Assuming that the government runs a balanced PAYGO budget each period, every old household receives additionally a public pension that depends on the current young generation's wages and the old-age dependency ratio $\pi/1+n$, which equals the ratio of the country's survival rate and labour force growth. The old-age dependency ratio is therefore determined by both demographic factors – the survival probability and labour force growth. In a funded pension system economy τ is zero and old households live only on their accumulated annuities.

Since we assume no bequest motives, all savings are spent during retirement. The accumulation equation is

$$k_{t+1} = \frac{s_t}{1+n}. \tag{9}$$

Higher individual savings increase the capital intensity. A drop in the labour force growth rate will also increase capital intensity as labour supply becomes scarce relative to capital. For an economy with a PAYGO pension system the young household's saving function derived from inter-temporal utility maximisation is

$$s_t = \frac{\left(\frac{1+r_{t+1}}{1+\rho}\right)^{\frac{1}{\theta}} - \tau\left[\left(\frac{1+r_{t+1}}{1+\rho}\right)^{\frac{1}{\theta}} + \frac{1+n}{\pi}\right]}{\frac{1+r_{t+1}}{\pi} + \left(\frac{1+r_{t+1}}{1+\rho}\right)^{\frac{1}{\theta}}} w_t. \tag{10}$$

An increase in π has a positive effect on savings of young households who provide for a higher probability of living through a second retired period. Since in a funded pension system economy τ is zero, saving rates are c.p. higher.

2.2 The small open economy variant

Next, we assume a small open economy and constant world interest rates which the economy takes as given. Capital is perfectly mobile but labour immobile. The domestic capital intensity and wage rate are thus constant as well and no longer depend on the domestic saving rate. A decrease in a country's labour supply leads to lower demand for domestic investments because less capital is needed. In an open economy however domestic savings and investments no longer need to be equal. Additional capital for domestic production can be acquired from abroad and domestic excess capital invested abroad. Assuming immobility of labour, the only income from abroad is capital income.

All other characteristics of the model remain unchanged. The accumulation equation is now

$$f_{t+1} + k = \frac{s_t}{1+n}, \tag{11}$$

where f denotes net foreign assets per domestic worker. Since the capital intensity is constant, changes in the labour force growth rate only affect the net foreign asset position. Countries experiencing a slowdown of labour force growth relative to the rest of the world should therefore see an improvement of their net foreign asset position.

For the open economy framework we have to alter our definition of the labour share since now total income includes not only domestic income, but also net international factor payments. The labour share is now

$$ls_t^{open} = \frac{wL_t}{wL_t + r(K_t + F_t)} = \frac{wL_t}{Y_t + rF_t}. \tag{12}$$

From (12) it is obvious that higher capital returns from abroad reduce the labour share. Demographic change can therefore affect labour shares not only by altering the capital intensity of production (which is constant in a SOE) but also by increasing the share of capital invested abroad. Exogenous shifts in relative supply of labour and capital are no longer balanced by adjustments in factor prices. Changes in labour shares are therefore possible even if Cobb-Douglas production functions are used.

3 Model calibration and simulation results

We analyse the steady state effects of a rise in the expected retirement duration, a decrease in the labour force growth rate as well as the combined effects of both demographic factors. A rise in the expected retirement duration is modelled as an increase in the survival parameter π, a decrease in labour force growth rate as a drop in the labour force growth rate n. We conduct separate simulations for either closed or small open economies, either PAYGO or funded pension system economies, and economies with elasticity of substitution either lower or greater than one.[2] This gives us a total of 24 variants to be simulated.

The parameter values used in the calibration of our model are set as follows: We interpret each period in the OLG model as lasting for 30 years. We set the survival parameter for the initial steady state $\pi = 0.7$ and the labour force growth rate to 1% per year implying $n = 0.35$ per period. Elasticities of substitution are either $\sigma = 0.9$ in which case capital and labour are complements or $\sigma = 1.1$ in which they are substitutes. Other parameter values are taken from the literature. The coefficient on capital $\alpha = 0.5$ is taken from de la Croix and Michel (2002), the coefficient of relative risk aversion $\theta = 2$ from Heer and Maussner (2005) and the total factor productivity $A = 100$ from Fanti and Gori (2007). The private subjective discount rate $\beta = 1/(1+\rho)$ in OLG models ranges from 0.3 (de la Croix and Michel 2002) to 0.75 (Ambler, 2000). We therefore set the time preference rate to $\rho = 1$ (implying $\beta = 0.5$). The wage tax rate for the variants with PAYGO pension system $\tau = 0.18$ from Pemberton (2000).

Table 2 summarises the results of our simulations of demographic shocks for economies with varying combinations of pension systems, openness and elasticities of substitution between capital and labour. It firstly reports the initial steady state capital intensities and the resulting labour shares. Saving rates and capital intensities are higher in economies with fully funded pension system relative to economies with PAYGO system. The labour share is higher in funded system economies if σ is 0.9 (lower than 1) and lower if σ is 1.1 (greater than 1). The table then shows the adjustments of capital intensities and labour shares when the survival parameter π is lifted from 0.7 to 0.9 and when labour force growth is reduced to zero ($n = 0$). Additionally the combined effects of both demographic shocks are presented.

[2] Since in closed economies labour shares are constant by definition if the elasticity equals one, this case is not simulated.

In the closed economy simulations all demographic shocks increase capital intensities. In line with the standard neo-classical growth model, a drop in labour force growth directly leads to higher capital intensity. A higher survival rate also increases the capital intensity by lifting saving rates of households who provide for a longer expected retirement period. This effect is to some extend muted by the lower interest rates resulting from increased capital supply.[3] The effect of higher capital intensity on labour shares is ambiguous and depends on whether the elasticity of substitution is greater or lower than one. Labour shares drop if $\sigma = 1.1$. For $\sigma = 0.9$, however, the demographic shocks lead to an increase of labour shares. The closed economy version of our model can therefore help to explain declining labour shares in countries only if σ exceeds unity.[4]

For the simulations of the demographic shocks in small open economies we take the interest rate from the initial steady states of the respective closed economy variants as exogenous and constant. Unlike in closed economies, however, demographic change no longer entails wage increases in open economies as capital intensities are constant. Labour share adjustments are thus only driven by changes in net foreign asset income. Demographically induced excess savings are invested abroad which improves the country's net foreign asset position and increases households' foreign investment income. As table 2 shows, by increasing the share of households' capital invested abroad, demographic shocks can thus lead to reductions in labour shares even if the production function's elasticity of substitution is lower than one. In case of $\sigma = 1.1$ reductions in labour shares caused by demographic shocks are also substantially larger in open economies compared to the respective closed economy variants.

The impact of the demographic shocks on labour shares is larger in economies with PAYGO pension system. This is because households increase their saving rates to

[3] Demographic effects on interest rates are discussed in the literature evolving around the so-called asset meltdown hypothesis (e.g. Abel, 2001, 2003; Poterba, 2001; Brooks, 2002).

[4] Empirical estimates of σ display mixed results. Rowthorn (1996) estimates σ to be substantially lower than one in all OECD countries. Blanchard (1997) estimates σ to be slightly greater than one in Continental European Countries and slightly lower than one in Anglo-Saxon Countries. Berthold et al. (2002) estimate σ to be substantially greater than one in Germany and France and a Cobb-Douglas-like production structure in the US.

compensate for the expected loss of income from PAYGO-financed public pensions due to higher old-age dependency ratios. The effect is larger in open economies because the increase in saving is not mitigated by lower interest rates resulting from higher capital intensities.[5] A pension system reform that entails a switch from a PAYGO to a fully funded pension system should therefore also have an impact on labour shares. The effect's direction would, however, again depend on the elasticity of substitution.

The simulations suggest that diverging demographic developments may indeed have been a factor contributing to the differing developments of labour shares across regions. Increased expected retirement durations and dropping population growth rates can cause labour shares to decline, particularly in open economies.[6]

4 Data and empirical methodology

To examine the links between demography and the labour share empirically we use a panel of 18 OECD countries covering annual data from 1960 to 2008.[7] For such type of data-sets time-series-cross-section methods are most efficient in exploring the information of the data's time and cross section dimension.[8] To be consistent with the

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[5] Accordingly a possible "asset meltdown" problem is alleviated to the extent that capital is internationally mobile (Börsch-Supan et al., 2006).

[6] Another possible channel through which demographic change can influence labour shares is factor biased technological change. If a slowdown in labour force growth leads to an increasing scarcity of labour relative to capital, firms may react by either shifting production abroad or by using more labour-saving techniques. The latter allows firms to decrease the marginal product of labour at a given capital intensity (Blanchard, 1997). In our model an increase of the proportion of relatively capital-intensive methods of production would increase the coefficient on capital α and decrease the coefficient on labour (1-α) which also causes the labour share to drop. The resulting effect on the labour share can be shown by plugging (2) into (1). In this case, the labour share equals

$$ls_t = \frac{(1-\alpha) L_t^{-\varepsilon}}{\alpha K_t^{-\varepsilon} + (1-\alpha) L_t^{-\varepsilon}}$$

. It is obvious that $\partial ls / \partial \alpha < 0$. An increase in α reduces the labour share.

[7] We exclude a number of OECD countries from the sample which have been or still are at different levels of development. These are mostly Eastern European countries, such as Czech Republic, Estonia, Hungary, Poland, Slovak Republic, Slovenia, Turkey, and also Korea, Israel, Mexico and Russia. Switzerland and New Zealand are also excluded due to lack of comparable data on labour shares, Luxemburg and Iceland due to idiosyncratic economic structures. Canada was also excluded as it was identified as an extreme outlier in all estimations which is problematic, particularly in the conducted Mean Group estimations

[8] See Breitung and Peseran (2005) for an overview.

model simulations we use the expected retirement duration, population growth rates[9] and expected old-age dependency ratios as demographic variables and also include measures for openness and the weight of PAYGO elements in the national pension system. As described in section 2, the old-age dependency ratio variable presents a combination of both other demographic factors. Other variables, typically used in labour share models, are not included as a correlation with demography seems not plausible.

The labour share, unlike the wage share, also includes labour income of non-employees (i.e. self-employed or family workers). Since the latter is not provided in national accounts, we follow the widely adopted approach of Gollin (2002) to adjust for labour income of non-employees by assuming that other categories of workers earn the same average wage as employees:

$$ls_t = \frac{w_t / L_t}{GNI_t / N_t},$$

where w is compensation of employees, L is the number of employees, N is total employment and GNI is Gross National Income at current market prices. Data are taken from the European commission's *AMECO* database.

To obtain a measure for the expected retirement duration $E(RD)_t$ we use data on life expectancy at age 40 (LE_t^{40}) taken from *OECD Health Data* assuming that each year the average worker is 40 years old. Since these data are provided separately for males and females, we use each year's respective employment share of men and women as weights to compute the average life expectancy. The expected retirement duration for each year is then obtained after adding 40 years and subtracting the official national retirement age applying to people at age 40 (RA_t):[10]

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[9] We take population growth rates instead of labour force growth rates because national statistical agencies have used different methods in compiling labour force data which are thus not strictly comparable between countries. Moreover changes in estimation methods by statistical agencies have led to numerous structural breaks in the time series of several countries.

[10] In some countries the retirement age for men and women differs. In that case we use the employment shares of men and women as weights to compute the average retirement age. Computing the official retirement age of those at age 40 for each year, we also look at the year the retirement reforms were enacted. Changes in official retirement age applying to those cohorts of pre-reform periods are ignored since at age 40 they were not yet aware of the changes in their retirement age applying to them. For example the Australian Social Security Act of 1991 entailed changes in

$$E(RD)_t = LE_t^{40} + 40 - RA_t .$$

The expected old-age dependency ratio $E(ADR)_t$ is computed as the average old-age dependency ratio that a worker at age 40 faces during his expected retirement period:[11]

$$E(ADR)_t = \frac{1}{R}\sum_{r=t+RA_t-40}^{r+R} ADR_r \ , R = \lfloor E(RD)_t + 0.5 \rfloor .$$

Since real time data for life expectancy at age 40 and old-age dependency ratios are not available, we assume that earlier projections equalled the data of 2006 (old-age dependency ratios) and 2009 (life expectancy at age 40). Population growth rates are computed using data from the *OECD Factbook 2009*. The ratio of exports plus imports to GDP is used as the measure for openness.[12] Constructing a variable that characterises the countries' pension systems with regard to the importance of PAYGO financed elements in the national pension systems has proved to be difficult as national pension systems are often complex and differ substantially in numerous elements. Bloom et al. (2007) calculate for a large number of countries approximations of the PAYGO portion of the replacement rate for 3 years between 1961 and 2002. We linearly interpolate (and extrapolate for 1960 and 2002-2008) the missing values, aware that these time-series present only very rough estimates of the true weights of PAYGO elements in national pension policies.

Descriptive statistics of the variables are summarised in table 2. To get an impression of the properties of the data and to avoid spurious regressions we first perform panel unit root tests for all variables. To account for the possibility of cross-section dependence we use the CIPS statistic of Pesaran (2007). Following Pesaran we report test statistics based on CADF regressions with four different lag lengths. As shown in table 3, the null of a unit root can be rejected at the five percent level for the labour share only for the statistic with 1 or 2 lags and cannot be rejected in all other cases and

retirement age for women born after July 1935 thus applying to those cohorts of women at age 40 since 1975. However, we do not adjust the retirement age for women at age 40 before 1991 when the reform was enacted.

[11] Projected data on old-age dependency ratios until 2050 were taken from *OECD Social Indicators.*

[12] Data were also taken from the *AMECO* database.

for all other variables. Next, we test for cointegration between the labour shares and the above mentioned demographic variables as well as the openness variable, the PAYGO variable and the interaction terms. In tables 4 and 5 three cointegration tests of Pedroni (1999, 2004) are reported. We conduct the Panel-ADF and Group-ADF tests because Hlouskova and Wagner (2007) find in a simulation study that both tests perform better than other panel cointegration tests. In addition, we report the Group-Rho statistic because Pedroni (2004) shows that this test is the most conservative in small samples. Overall, these tests indicate a cointegrating relationship between the labour share and the explanatory variables included in the regressions.

These results allow us to estimate error correction models to detect long-run effects. To find the appropriate specification we proceed in the following steps. Firstly, the lag order of the explanatory variables is determined by the Hannan-Quinn information criterion. Secondly, a Hausmann test is used to analyse whether coefficients are homogeneous across cross sections. We start from the most restricted model which is a fully homogenous model. This is tested against a model with heterogeneous constants and a model with heterogeneous short-run coefficients. If one of the later is superior, it is tested against a fully heterogeneous model. The model with heterogeneous short-run coefficients is estimated using the Pooled Mean Group (PMG) estimator (Pesaran et al., 1999) and the fully heterogeneours model using the Mean Group (MG) estimator (Pesaran, Smith, 1995).[13] Finally, we use the Breusch-Pagan test to detect cross section correlation. In the case of cross section correlation we use the seemingly-unrelated (SUR) estimator and otherwise OLS. From our estimation results we compute the long-run elasticities and the corresponding standard errors.[14]

[13] The MG estimator is the only consistent estimator if long-run coefficients are heterogeneous. However, it requires balanced panels and is extremely vulnerable to outliers. Therefore, in some estimations we had to remove a few more countries from the sample (see footnotes in tables 4 and 5). In two cases, in which the PMG estimator was used, extreme outliers were also removed.

[14] De Boef and Keele (2005) show how the standard errors of the long-run elasticities can be computed.

5 Empirical results

Table 4 shows the estimated long-run elasticities with respect to labour shares. It turns out that in all specifications the fully homogenous model and the fixed effects model are rejected. Therefore, all models are estimated using either the PMG or the MG estimator. First we estimate the elasticities for all demographic variables individually (columns 1-3). The estimated long-run elasticities are highly significant and have the expected signs, which are negative for the expected retirement duration and the expected old-age dependency ratio and positive for the population growth rate.

Next, we add openness as a further explanatory variable. While the elasticities of the demographic variables are hardly affected, openness is only significant if population growth is included as the demographic variable. This indicates that the negative relationship between globalisation of trade and the labour share found in most studies (e.g. Guscina (2006) and Jayadev (2007)) may in fact not be attributable to Stolper-Samuelson effects on relative factor prices or higher elasticities of labour demand in wage bargaining models (e.g. Rodrik, 1997) but to demographically induced international capital flows. Column 6 shows that if the expected retirement duration and population growth are both included, population growth is no longer significant. This is also interesting as it implies that a retirement policy that links the retirement age to live expectancy can stabilise the labour share even if the population growth rates declines. To examine the role of the pension system we then include the PAYGO variable instead of openness (columns 8-10). The elasticities of the PAYGO variable are not significant which indicates that pension reforms alone do not affect labour shares.

We then re-estimate the models from columns 4-6 and 8-10, this time including interaction terms between the demographic variables and the openness and PAYGO variables. The long-run elasticities of the interaction terms are reported in table 5. The results of the model simulations in section 3 suggested that demographic impacts should be larger in open economies. The coefficients of the expected retirement duration and the expected old-age dependency ratio interacted with openness are indeed negative and significant which gives support to the simulation results. The interaction term of population growth and openness has the expected positive sign but is not significant. The elasticities of the interactions of the demographic variables with the PAYGO variable are again not significant which might indicate that the pension system is indeed not an important element in this regard. Given the very approximate construction of the PAYGO variable this result should, however, be treated with caution.

6 Conclusions

This paper demonstrates that the diverging patterns of labour share developments in OECD countries also reflect their demographic differences. Employing a stylized OLG model we show how demographic change leads to adjustments of households' saving and investment behaviour. This in turn can affect labour shares by either altering domestic capital intensities or the share of net income from foreign assets. Anticipating higher retirement durations or lower PAYGO-financed public pensions due to higher old-age dependency ratios, households increase their saving rates. As a result, domestic capital intensities are increased and interest rates reduced. Households adjust to the expected loss of capital returns by investing a growing share of their savings in countries which are less affected by ageing and can thus provide higher interests on capital. In return, higher net foreign assets income reduces the country's labour share. A decline in labour shares in ageing countries – in the public debate often regarded as a distributive problem – can thus also be attributed to provident behaviour of households.

In subsequent empirical estimations we find evidence for these causal relationships. Effects of demographic change on the labour share are indeed significant and tend to be larger in open countries. Our findings also suggest that a country with decreasing population growth rates can keep a stable labour share if the country's retirement age is adjusted continuously to its growing life expectations.

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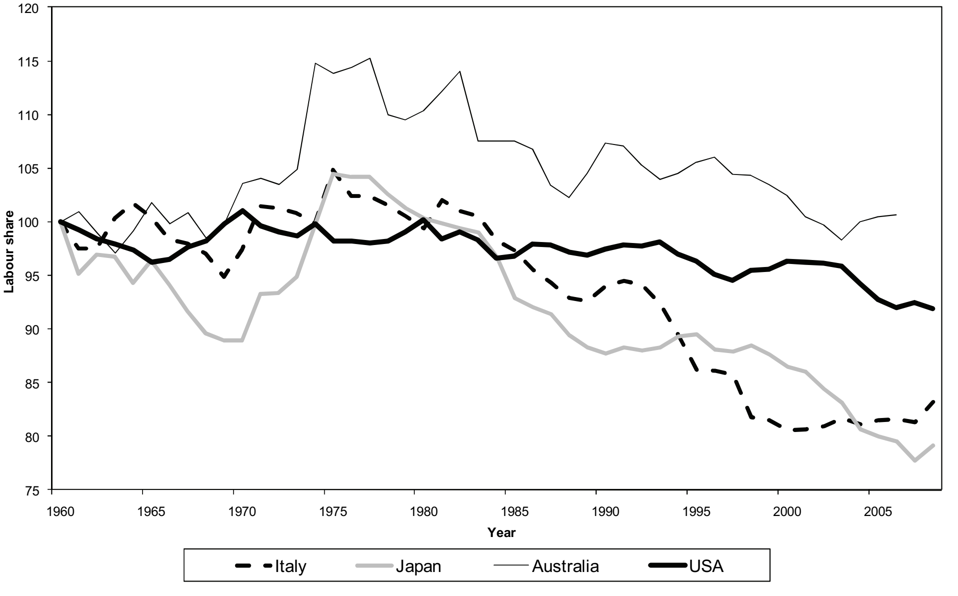
Appendix

Figure 1

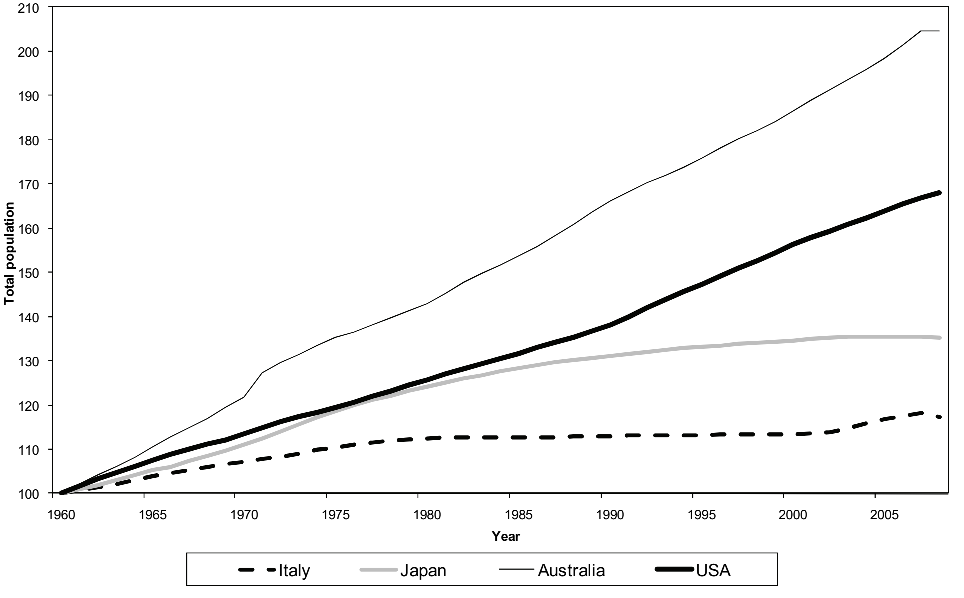
Labour shares in selected OECD countries (1960 = 100)



Source: AMECO Database

Figure 2

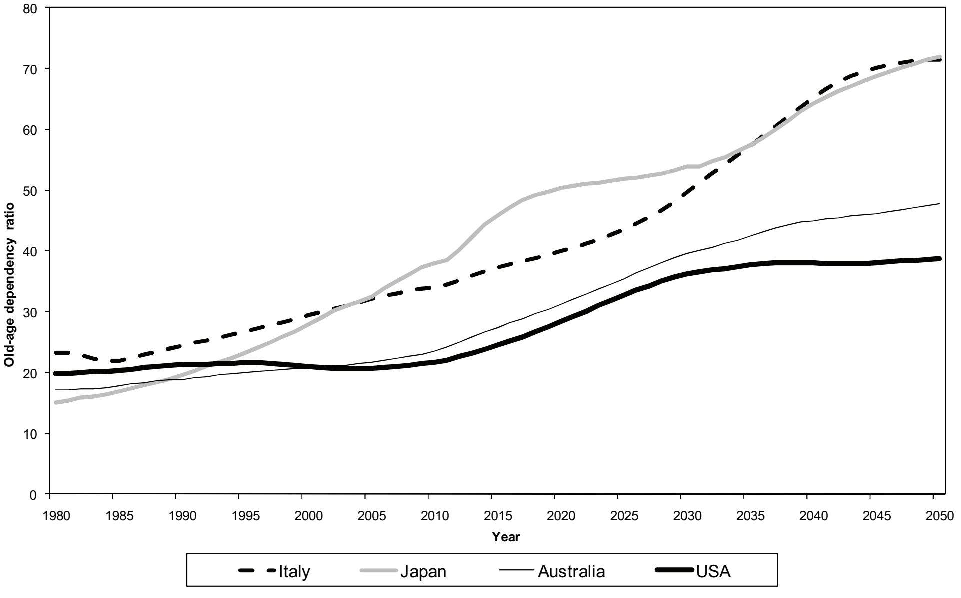
Population growth in selected OECD countries (1960 = 100)



Source: OECD Factbook 2009

Figure 3

Old-age dependency ratios in selected OECD countries



Source: OECD Social Indicators 2006

Table 1

Simulation results: Steady state capital intensities and labour shares before and after demographic shocks

Elasticity of substitution	$\sigma = 1.1$		$\sigma = 0.9$	
Pension System	**PAYGO**	**Funded**	**PAYGO**	**Funded**
Initial Steady State Capital Intensity				
($\pi = 0.7$, $n = 0.35$)	5.34	14.87	10.20	43.22
Initial Steady State Labour Share				
($\pi = 0.7$, $n = 0.35$)	0.46	0.43	0.56	0.59
Closed Economy				
Capital Intensity ($\pi = 0.9$)	11.11	29.69	23.11	82.98
Capital Intensity ($n = 0$)	14.21	38.89	31.21	117.19
Capital Intensity ($\pi = 0.9$, $n = 0$)	29.55	77.68	63.11	201.39
Labour Share ($\pi = 0.9$)	0.44	0.42	0.58	0.61
Labour Share ($n = 0$)	0.43	0.41	0.59	0.61
Labour Share ($\pi = 0.9$, $n = 0$)	0.42	0.39	0.60	0.62
Small Open Economy				
Labour Share ($\pi = 0.9$)	0.40	0.38	0.50	0.55
Labour Share ($n = 0$)	0.38	0.36	0.48	0.53
Labour Share ($\pi = 0.9$, $n = 0$)	0.32	0.31	0.42	0.49

Table 2

Descriptive Statistics of the Main Variables (1960-2008)

	Mean	Standard deviation	Maximum	Minimum	Observations
Labour share	62.41	5.02	85.79	44.08	880
Expected retirement duration	12.63	3.11	23.74	6.61	756
Expected old-age dependency ratio	0.34	0.09	0.64	0.19	756
Population growth	0.59	0.53	4.48	-2.05	864
Openness	0.59	0.33	1.84	0.09	882
PAYGO	0.57	0.29	1.43	0.00	861

Table 3

CIPS (Pesaran, 2007) Panel Unit Root Test Statistics

		Number of Lags					
		p=0	p=1	p=2	p=3	N	T
Labour Share	Intercept, Trend	-2.574	-2.845**	-2.766**	-2.525	18	43
Exp. retirement duration	Intercept, Trend	-2.424	-1.814	-1.974	-2.137	11	43
Population growth	Intercept	-1.724	-2.261	-1.657	-1.938	18	44
Exp. old-age dep. ratio	Intercept, Trend	-1.043	-1.486	-1.890	-1.937	12	43
Openness	Intercept, Trend	-1.933	-2.538	-2.161	-2.270	18	45
Exp. retirement duration × Openness	Intercept, Trend	-1.985	-2.115	-2.252	-2.158	11	43
Population growth × Openness	Intercept	-1.781	-2.330	-1.727	-1.977	18	44
Exp. old-age dep. Ratio × Openness	Intercept, Trend	-2.089	-2.433	-2.146	-2.174	12	43
Exp. retirement duration × PAYGO	Intercept, Trend	-1.302	-1.068	-1.305	-1.413	11	43
Population growth × PAYGO	Intercept	-1.563	-2.069	-1.479	-1.768	17	44
Exp. old-age dep. Ratio × PAYGO	Intercept, Trend	-1.302	-1.068	-1.305	-1.413	11	43

*, **, *** Null hypothesis of unit root rejected at the 10 %, 5 %, 1 % significance level respectively.

Table 4

Long-run elasticities with respect to the labour share

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exp. retirement duration	-0.302 (0.049)			-0.431 (0.011)			-0.280 (0.085)	-0.362 (0.099)		
Population growth		0.094 (0.028)			0.064 (0.001)		-0.006 (0.031)		-0.001 (0.021)	
Exp. old-age dep. ratio			-0.211 (0.065)			-0.219 (0.065)				-0.061 (0.004)
Openness				0.045 (0.080)	-0.157 (0.011)	-0.096 (0.067)	-0.068 (0.094)			
PAYGO								0.124 (0.088)	0.296 (0.369)	0.356 (0.420)
Observations	690	826	573[1]	690	826	573[1]	550[1]	546[2]	641[3]	484[2]
Order of ARDL	3,2	3,2	3,2	3,2,2	3,2,2	3,2,2	3,2,2	3,2,2	3,2,2	3,2,2
Model	PMG	PMG	MG	PMG	PMG	MG	MG	PMG	MG	MG
Estimation	SUR	SUR	LS	LS	SUR	LS	LS	LS	SUR	SUR
Cointegration										
Panel-ADF	4.08***	6.90***	7.93***	4.94***	6.38***	7.16***	4.68***	3.60***	7.42***	8.14***
Group-ADF	10.69***	14.22***	11.66***	10.90***	13.15***	9.96***	9.43***	7.84***	9.90***	8.71***
Group-Rho	2.85***	2.99***	1.02	4.40***	1.48	1.77*	3.89***	2.23***	1.47	0.31

*, **, *** indicate significance at the 10 %, 5 %, 1 % significance level respectively.

[1]Finland, Greece, Italy, Spain, UK were excluded

[2]Austria, Finland, Italy, Spain, UK were excluded

[3]Austria, Finland were excluded

Table 5

Long-run elasticities of interaction terms with respect to the labour share

	(11)	(12)	(13)	(14)	(15)	(16)
Exp. retirement duration × Openness	-0.157 (0.087)					
Population growth × Openness		0.048 (0.037)				
Exp. old-age dep. ratio × Openness			-0.443 (0.119)			
Exp. retirement duration × PAYGO				-0.177 (0.191)		
Population growth × PAYGO					0.068 (0.168)	
Exp. old-age dep. ratio × PAYGO						-0.001 (0.838)
Observations	690	826[2]	573	546[3]	641[1]	484[2]
Order of ARDL	3,2,2,2	3,2,2,2	3,2,2,2	3,2,2,2	3,2,2,2	3,2,2,2
Model	PMG	PMG	MG	PMG	MG	MG
Estimation	LS	SUR	LS	LS	SUR	LS
Cointegration						
Panel-ADF	4.53***	6.32***	5.72***	4.13***	6.68***	7.34***
Group-ADF	7.14***	10.88***	7.39***	9.27***	9.51***	9.56***
Group-Rho	4.32**	2.21**	1.52	3.45***	2.54**	1.84*

*, **, *** indicate significance at the 10 %, 5 %, 1 % significance level respectively.

[1]Finland, Greece, Italy, Spain, UK were excluded

[2]Austria, Finland, Italy, Spain, UK were excluded

[3]Austria, Finland were excluded