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THE IMPACT OF POPULATION AGEING ON PUBLIC DEBT

A PANEL ANALYSIS FOR EIGHTEEN EUROPEAN COUNTRIES

BY

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THE IMPACT OF POPULATION AGEING ON PUBLIC DEBT

A PANEL DATA ANALYSIS FOR 18 EUROPEAN COUNTRIES

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Abstract

Population ageing is one of the major long-term challenges industrialized countries face. Forecasts predict that public debt is going to rise sharply for most countries due to population ageing. However, until now there has been little research on how population ageing already affects public debt. Based on a panel data analysis for 18 European countries it is shown that there is only little empirical evidence for an impact until 2015. This does certainly not mean that it will not have an effect on public debt in the future. Governments are well-advised to benefit from the breathing space the still moderate total dependency ratio offers to adapt their social security systems.

JEL Classification: **E62** Fiscal policy, **H63** Debt, debt management, sovereign debt, **J11** Demographic trends, macroeconomic effects, and forecasts

Keywords: Population ageing, public debt, social security systems, demographic dividend

1. Introduction

All industrialized countries are faced with population ageing, albeit to different degrees. This overthrow comes from two distinct mechanisms. The first is rising life-expectancy and the second the declining fertility rate with the latter being the major driving force for population ageing (Weil, 2006; Birg, 2015). Though, the industrialized countries are still benefitting from a breathing space due to a low total dependency ratio, composed of youth and old age dependency ratio (Figure 1, if not indicated otherwise all figures show data for the sample employed for the empirical testing). This "demographic dividend" is paying because the baby boomers are to a large extent still part of the working force and have still not fully retired. Since the end of the baby boom, population growth has sharply declined which has decreased the burden of the youth dependency ratio but not yet sharply increased the burden of the old-age dependency ratio (Weil, 1997).

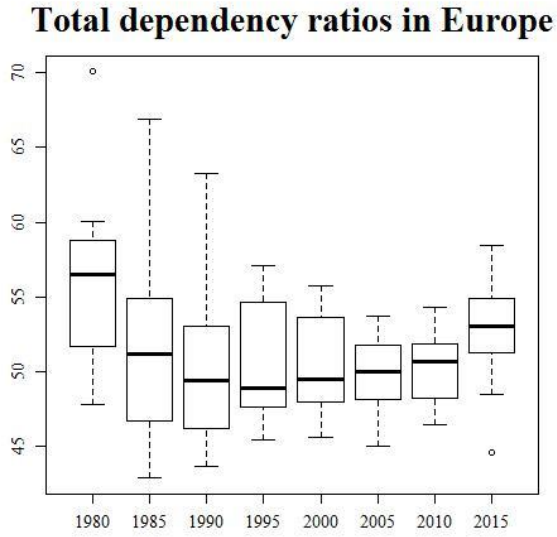

Figure 1

Once this breathing space is used up, the full effect of population ageing on public finances will occur. As most social security systems are designed as pay-as-you-go systems, no (sufficient) reserves have been accumulated to face this overthrow. Economists vastly agree that as a consequence public debt in most industrialized countries is going to rise because these additional expenditures can only be managed to a limited extent by additional revenues or reform measures.

Whereas research on how population ageing is going to affect public debt is extensive, little research has been done until now on whether and how it already affects public debt. Given the magnitude of demographic change it should expected that it can already be seen in the data. Based on a panel data analysis and using different indicators to capture population ageing, this article shows, however, that there is little evidence that it has already affected public debt. This does not mean that forecasts are wrong, but simply that until now the effects on debt cannot be detected. Examples show that population ageing might not affect public debt in the future as severely as predicted, especially not if adjustment and reform measures are undertaken in time before the voting power of the old age people can prevent such adaptions.

The rest of the article is organized as follows: The literature on the impact of population ageing on public debt is reviewed in chapter 2. In chapter 3, the empirical testing and its results are presented. Chapter 4 concludes the article.

2. Literature review

The literature on the impact of population ageing on public debt can be subdivided into two different groups with the one taking an ex-ante view, forecasting the impact of population ageing on debt in the future, and the other one taking an ex-post view, analysing how it has already affected public debt. Especially the literature of the first group is extensive.

To measure public debt, different methods can be used but generally they rely on debt as a ratio relative to economic output ($d_t = \frac{D_t}{Y_t}$). This view is in accordance with governments' view on public debt which takes only past payment flows into account. The following formula describes public debt in a given period t. In this equation $B_t = T_t - G_t - Z_t$ is the annual government balance, including interest payments ($Z_t = i_t * D_{t-1}$), and g_t the nominal GDP growth rate.

$$d_t = \sum_{t=0}^{T-1} \frac{-B_t}{(1+g)^{T-t}} + \frac{D_0}{(1+g)^T}$$

The danger of an increasing debt quota lies in the rising interest payments which result from the increasing debt. The increasing interest quota ($z_t = \frac{Z_t}{D_t}$) restricts government's scope and with it chances and possibilities of future generations. This is generally

considered to be unfair in an intergenerational manner (Schlesinger et al., 1993). That is why the debt quota must remain constant over time in order to meet the sustainability condition (Blanchard et al., 1990).

However, this indicator can be highly misleading when dealing with the impact of population on public debt (Velculescu, 2010; Auerbach, 2008; Gokhale, 2009; Cecchetti et al., 2010) as the debt quota reflects the borrowing history of a country, but does not take any future effects into account – not even those effects than can be expected to a high probability. Analyses of the future development of public debt take these effects into account by calculating today's sustainability gap (GAP) (Moog and Raffelhüschen, 2014) which reflects the sum of the already accumulated, explicit, debt (d_t) and the implicit debt which will be accumulated in the future. In this equation, s_t denotes the primary balance quota which excludes interest payments ($s_t = \frac{T_t - G_t + i_t * D_{t-1}}{Y_t}$) and $\pi_{t,i}$ the annual inflation rate.

$$GAP_t = d_t + \sum_{i=t+1}^{T} \left(\frac{1 + g_{t,i} - \pi_{t,i}}{1 + i - \pi_{t,i}}\right)^{i-t} * (-s_i)$$

These equations show that the size of the public debt quota depends on three factors: economic growth, interest rates government has to pay on the accumulated debt and primary balances. Any calculus of future debt must make assumptions on how these variables are going to develop. While demographic projections underlie uncertainty only to a narrow degree, projections on these three variables underlie uncertainty to a much higher degree.

Economists vastly agree that future public debt in industrialized countries is going to rise due to population ageing especially because public expenditures for pensions and even more for health care are going to rise sharply (e. g. Turner et al., 1998; Raffelhüschen, 2001; Lee and Edwards, 2002; Lee and Tuljapurkar, 2003; Hauner et al., 2007). Calculations of Moog and Raffelhüschen (2014) can be taken as example for the dimensions of the rise in public debt: They calculate a sustainability gap of 349% for the European Union adding an implicit debt of 262% to the explicit debt of 87% (2012). Yet, the variation within the European Union is enormous, ranging from a sustainability gap of 59% for Lithuania to 1267% for Ireland.

Because of the projected rise in public debt, economists detect substantial adjustment needs of public budgets advocating forward-looking strategies to lower the debt burden in a determined manner before the full effects of population ageing become effective

(Jensen and Nielsen, 1996; Balassone et al., 2008; Cecchetti et al., 2010). This suggestion is based on the consideration that with a growing share of old age people, reforms and consolidation measures are going to be difficult to implement due to their growing political power (Auerbach and Kotlikoff, 1990; Preston, 1984). However, these projections cannot be confirmed by all analyses.

Auerbach and Kotlikoff (1992) find that the higher share of old age people has already led to an increase in Social Security benefits in the US since the 1970s. With the share of old age people further rising, the probability of falling Social Security benefits is getting even lower because of their sheer voting power.

Razin et al. (2001) develop a theoretical model which solves the puzzle presented by their empirical analysis. It shows that a higher dependency ratio of retired people is surprisingly negatively correlated with labour tax rates and social transfers. Their model solves this contradiction: Pensioners' claims for higher transfers reduce the incentives to work for the working population because of the entailing higher taxes which in turn reduces their income. In the equilibrium labour tax rates thereby remain on a moderate level.

Finally, Chen (2004) argues that a growing share of old age people should not only lead to higher public expenditures due to higher expenditures for social security but also an increase in deficits because of lower per-capita income as a result of lower labour and capital inputs. Based on his empirical analysis of developing and developed countries, he can confirm this age structure hypothesis only for developing countries, not for developed ones. For developed countries he finds no hints for negative bequest motives as developed by Cukierman and Meltzer (1989). They had shown theoretically that public debt is higher, the lower the share of people for whom labour income is the principal source of income because they prefer to increase consumption at the expense of their descendants.

While the literature forecasting the impact of population ageing sees an increase in public debt resulting in redistributional struggles, the question whether these predictions will become reality remains open. After all, these forecasts underlie a non-negligible degree of uncertainty.

3. Empirical Testing

a. Data

For the empirical testing a panel including the EU15 countries, Norway, Switzerland and Iceland from 1981 to 2015 was used. Some observations were arbitrarily missing for some states which made it an unbalanced panel. The t-statistics presented in table 4 show that the unbalanced panel can be considered representative for the whole sample. An overview of the descriptive statistics of the variables employed as well as their origin is given in table 5.

To measure public debt, the public debt quota was employed. In earlier versions of this paper, debt per capita and debt relative to the annual public revenue were used as dependent variables, too, without showing different results than those for the debt quota.

Population ageing itself can be measured in different manners and the indicated degree of population ageing can vary a lot depending on which indicator is used:

- the median age of the population (Model 1). Figure 2 shows that there seems to be some positive correlation between the median age and public debt, though it is not very strong with an R^2 value of 0.11.

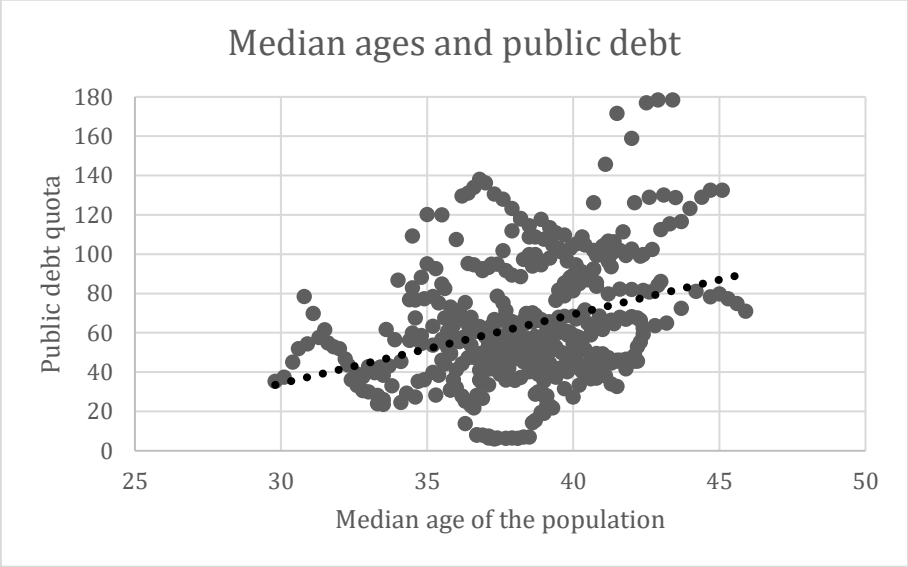

Figure 2

- the total dependency ratio measuring the share of the population depending on the transfers of the rest of the society, in this case the people younger than 15

and people older than 65 ($dep = \frac{Population_{age<15} + Population_{age\geq 65}}{Population_{15\leq age<65}}$) (Model 2). Both groups are probable not to work to a large degree, though there might be some imperfections because retirement can take place in earlier or also much later years, depending on individual circumstances. Figure 3 shows that it cannot be argued that there is a close correlation between debt and the total dependency ratio ($R^2 = 0.01$).

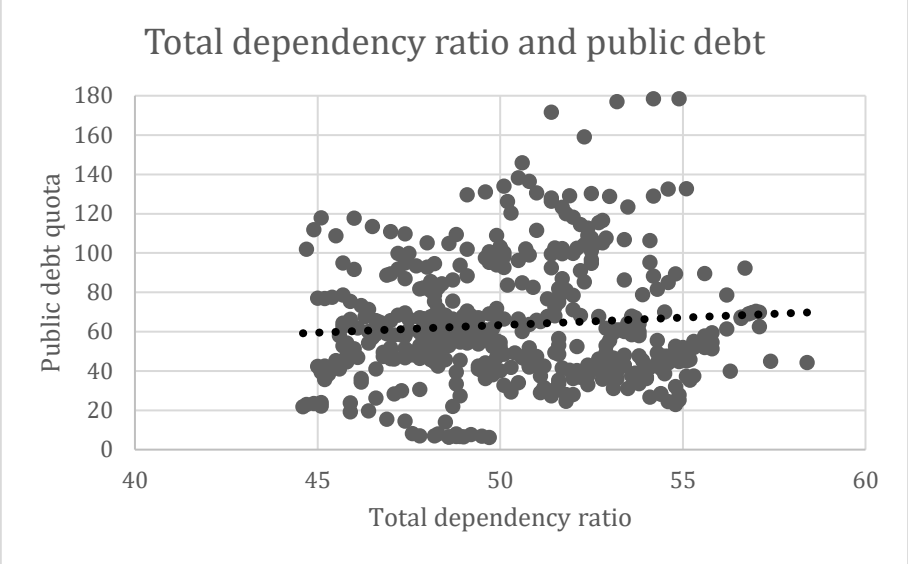

Figure 3

- the youth and old age people dependency ratio, both considered separately. The youth dependency ratio includes people younger than 15 ($y_{15\leq age} = \frac{Population_{age<15}}{Population_{15\leq age<65}}$) and the old age people dependency ratio people above age 65 ($e_{65\leq age} = \frac{Population_{age\geq 65}}{Population_{15\leq age<65}}$), both relative to the population at working age (Model 3). It is important to consider both groups separately because although both groups largely depend on the population at working age they cause costs to very different degrees (Weil, 1997): Cutler et al. (1990) calculate that people under 20 have 0.72 the consumption need of a working-age adult, people over 65 1.27 times those needs. Two identical total dependency ratios can thereby cause different costs depending on how they are composed. Figure 3 shows that contrary to the total dependency ratio there is a close correlation between the old age dependency ratio and public debt ($R^2 = 0.20$). At first sight, this supports the hypothesis that population ageing affects public debt. For the youth dependency ratio there is a very weak negative correlation ($R^2 = 0.02$).

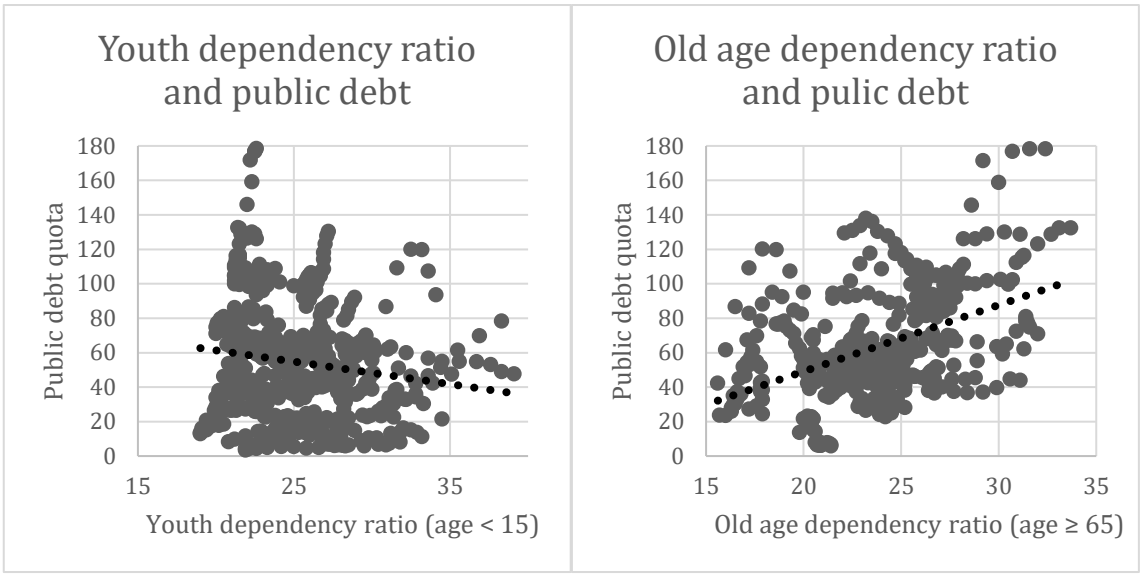

Figure 4

- two different old age people dependency ratios which divide the total old age dependency ratio at the age of 85 ($e_{65 \leq age < 85} = \frac{Population_{65 \leq age < 85}}{Population_{15 \leq age < 65}}$ and $e_{85 \leq age} = \frac{Population_{age \geq 85}}{Population_{15 \leq age < 65}}$) (Model 4). Costs rise disproportionally at higher ages because contrary to common assumptions, rising life expectancy does not prolong years in good health, but stretches life expectancy albeit sickness (Birg, 2015). Increasing life expectancy thereby causes high costs (if pension ages remain constant) because of higher pension payments and to a higher degree because of higher health care costs (Lee and Tuljapurkar, 2003). This problem will become even more severe as not only the share of older people will grow but also the share of very old age people within the group of old age people. Raffelhüschen (2001) describes this process as "double-ag(e)ing" process. Figure 5 shows that while the correlation between the old age dependency ratio and public debt is weaker for the younger group than for the total old age dependency ratio ($R^2 = 0.14$), it is even stronger for the group above age 85 ($R^2 = 0.26$).

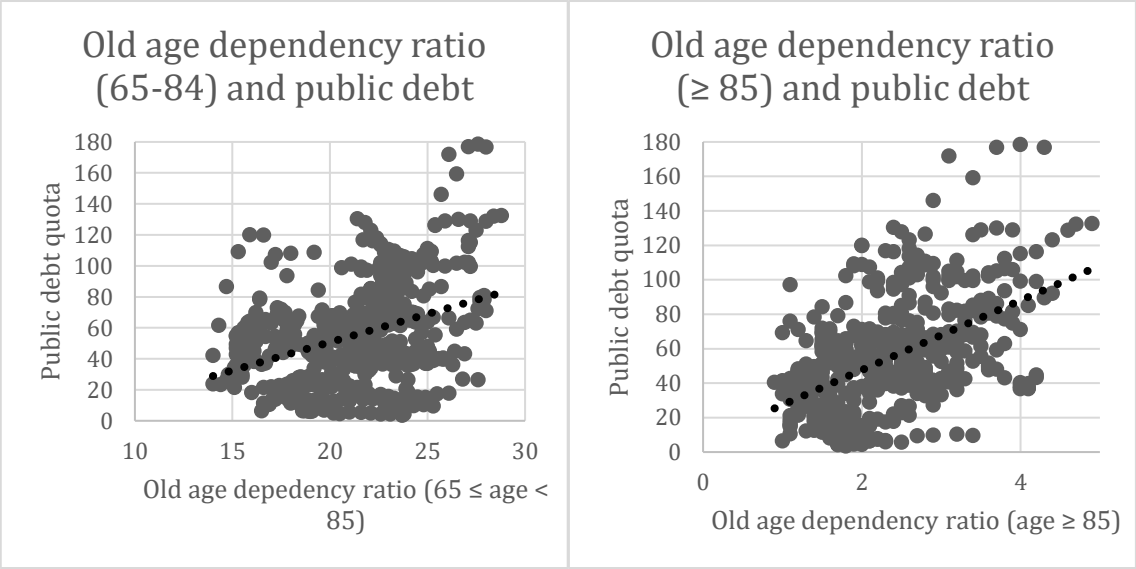

Figure 5

Besides these demographic variables, political and economic covariates were employed which are supposed or which have been shown to have an impact on public debt. First, four macroeconomic indicators: national GDP, income per head (in purchasing power parities), unemployment and the investment quota. The size of national GDP could have a debt-fostering effect because bond markets are bigger and thereby more efficient which would result in lower interest rates. This in turn would facilitate public borrowing according to the market discipline hypothesis. The income per head might have a debt-fostering effect because fertility rates are declining before all because of rising income (Birg, 2015) which would result in stronger increases in the old age dependency ratio which in turn would affect public debt. An economy's unemployment rate can be expected to have a clear negative impact on debt. Unemployment itself can have different reasons: rigidities, high minimum wages, high unemployment benefits and others. Yet, it is clear that a detrimental development on labour markets leads to a deterioration of public finances on the expenditure and revenue side. Finally, economic growth and the investment quota should have a debt lowering effect as economic growth has a positive impact on public budgets and also increases the denominator of the debt quota and economic growth itself is strengthened when investments are high.

Two indicators of the Freedom House index were included, too. The reasoning was that they should have both a debt lowering effect because of the positive effects of a higher degree of freedom and political participation on growth and public debt (Gwartney et al., 1999; De Haan and Sturm, 2000; Kiwiet and Szakaly, 1996; Feld, 1997).

b. Testing strategy

The dependent variable, the public debt quota, is difficult to explain statistically because it reflects the entire borrowing history of a country which can data back centuries. A country can have borrowed in the past for many different reasons: economic downturns, voters' preferences, banking crises, catastrophes, wars, revolutions, political ideology etc. Attempts to explain the size of public debt would have to take all these factors into account. Hence, it is much more common to focus on annual flow sizes like the budget or primary balance quota.

The drawback when focussing on budget or primary balances is that this approach does not consider all factors which have or might have an influence on the development of public debt due to population ageing. It has been shown above that the change of the debt quota depends on the interest rate government has to pay on its accumulated debt, the growth rate, the size of public debt and the state's primary balance. When focusing on budget balances at least two of these factors are left out from the consideration. However, population ageing might have an impact on all factors: interest (e. g. Turner et al., 1998; Baldacci and Kumar, 2010; Cecchetti et al., 2010) and growth rates (e. g. Auerbach and Kotlikoff 1987 and 1992; Bloom and Williamson, 1998; Turner et al., 1998; Fougère and Mérette, 1999; Miles, 1999) and budget balances (Hauner et al., 2007; Chen, 2004). Focusing directly on public debt instead of annual balances has one more advantage: It has been shown that governments can use methods of creative accounting to lower official deficits (which are given more attention to) by using stock-flow adjustments which can still be seen in the debt quota (Hagen and Wolff, 2006).

An empirical strategy which simply regresses the public debt quota on demographic variables could find a correlation as it has been shown above and yet, this could simply be due to the fact that both variables show a common upwards trend resulting in a spurious regression (Figure 6). When using the change in debt as a dependent variable instead of budget balances this problem can be addressed. If population ageing affects public debt negatively, a higher old age dependency ratio is positively correlated with a change in debt. This way, the general influence of population ageing is captured, though the channel through which population ageing affects public debt (higher public spending, lower public revenue, increase in interest rates or a decrease in growth rates) must be left to further research.

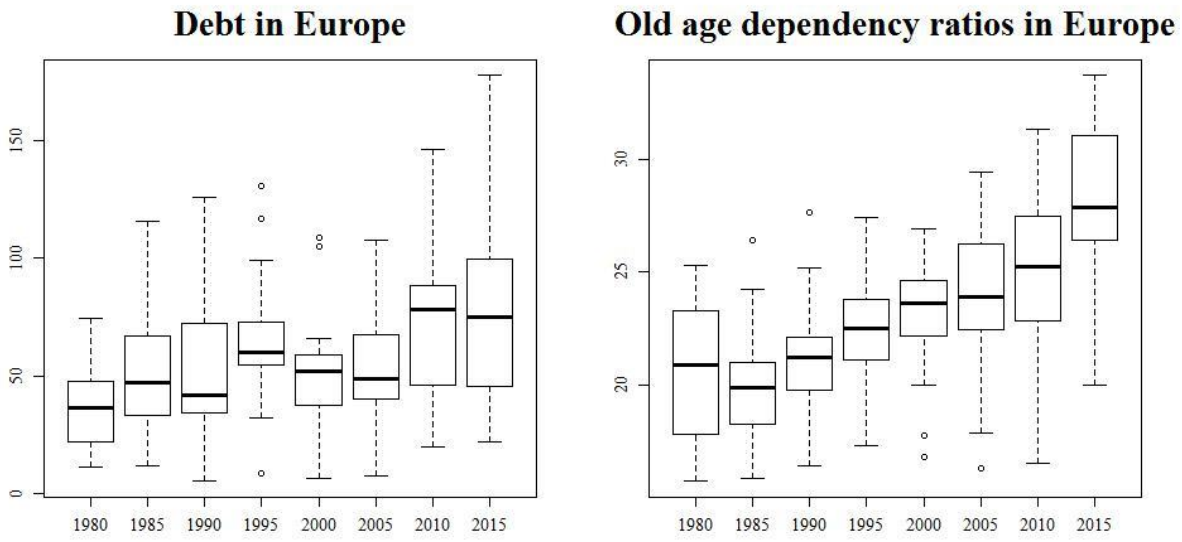

Figure 6

c. Model specification

For the empirical testing two different estimations are presented: a simple OLS regression and one including individual (country) and time (year) fixed effects (two-ways). The OLS regression is formulated as follows:

$$\Delta d_{i,\,t} = \beta_0 + \beta_1 d_{i,t-1} + \beta_2 X_{i,t} + \beta_3 e_{i,t} + \varepsilon_{i,\,t}$$

In the equation above, $\Delta d_{i,\,t}$ denotes the change in the dependent debt variable, $X_{i,t}$ is a vector containing the covariates, $e_{i,t}$ is a vector with the demographic variables and $\varepsilon_{i,\,t}$ is the error term.

The two-ways fixed effects regression then takes the individual (α_i) and time-specific (α_t) effects into account:

$$\Delta d_{i,\,t} = \beta_1 d_{i,t-1} + \beta_2 X_{i,t} + \beta_3 e_{i,t} + \alpha_i + \alpha_t + \varepsilon_{i,\,t}$$

All models contain a lag of the debt variable itself ($d_{i,t-1}$). As explained above, the change of the debt quota in a period t depends on the size of the debt quota in the previous period $t-1$ because past debt accumulation entails interest payments which influence changes in debt in following periods.

d. Empirical results

The regression results are presented in table 1. In all regressions lagged debt shows a very strong correlation. Lagged public debt contributes indeed substantially to explain

the change of public debt in period t. The negative algebraic sign leads to the conclusion that a higher size in public debt entails lower increases in future periods. This can be interpreted as a reaction of governments being afraid to lose confidence of investors after stronger increases of debt in the past and hence trying to limit their borrowing.

The macroeconomic variables show different results. The size of GDP is significantly negatively correlated with the change in debt in the pooled regressions. When controlling for time and individual fixed effects the algebraic sign becomes positive. It is thereby not robust to the testing method, although it is significant. The hypothesis presented above that countries with bigger bond markets might face less disciplining of markets may thereby still be true. The GDP per head, though, is always significantly negatively correlated with the change in debt. Richer countries thereby seem to limit their borrowing, contrary to the hypothesis formulated above. This can however be explained with the fact that the full effects of population ageing have not yet fully set in as it will be shown. For unemployment, growth and investment quota, the results are as expected: Unemployment has a significant debt-fostering, higher growth rates and investment quotas a significant debt-lowering effect which is in line with the hypotheses presented above.

The institutional variables included have, except for one case (pooled regression for model 1), the expected negative algebraic sign. Thus, a higher degree of political and economic freedom seems indeed to have some debt lowering effect, yet only the variable for the civil liberties is significant in some cases. The missing significance for the political rights variable can be explained with the small variance and the homogeneity of the countries included in the panel.

Concerning the demographic variables, the results are as follows:

- The median age shows a debt-fostering, yet not significant, effect when controlling for time and individual fixed effects.
- A higher total dependency ratio shows a significant debt-lowering effect.
- The same is true for the old age dependency ratio when estimating the pooled model. But significance disappears when controlling for time and individual fixed effects. The algebraic sign switches then, too.

	DeltaPubDebt							
	Pooled (1)	**Twoways fixed effects (1)**	**Pooled (2)**	**Twoways fixed effects (2)**	**Pooled (3)**	**Twoways fixed effects (3)**	**Pooled (4)**	**Twoways fixed effects (4)**
Intercept	22.46 (5.43)***		35.47 (6.62)***		33.24 (6.84)***		38.65 (9.69)***	
Lag (-1) PubDebt	-0.03 (0.01)***	-0.09 (0.01)***	-0.03 (0.01)***	-0.09 (0.01)***	-0.03 (0.01)***	-0.11 (0.02)***	-0.03 (0.01)***	-0.11 (-7.43)***
GDP (log)	-0.44 (0.15)**	18.43 (6.65)**	-0.35 (0.15)*	12.65 (6.39)*	-0.28 (0.16).	20.30 (7.28)**	-0.35 (0.18)*	29.41 (7.87)***
GDPHead (log, PPP)	-0.85 (0.56)	-15.85 (8.62).	-1.57 (0.44)***	-12.82 (8.12)	-1.32 (0.48)**	-21.19 (8.97)*	-1.74 (0.72)*	-29.58 (9.35)**
Unemploy	0.20 (0.05)***	0.42 (0.10)***	0.21 (0.05)***	0.46 (0.10)***	0.21 (0.05)***	0.46 (0.10)***	0.21 (0.05)***	0.43 (0.10)
Growth	-1.16 (0.08)***	-0.69 (0.10)***	-1.12 (0.07)***	-0.70 (0.10)***	-1.15 (0.08)***	-0.70 (0.10)***	-1.14 (0.08)***	-0.64 (0.10)***
Invest	-0.11 (0.06).	-0.35 (0.09)***	-0.15 (0.06)*	-0.35 (0.09)*	-0.14 (0.06)*	-0.35 (0.09)***	-0.14 (0.06)*	-0.42 (0.09)***
CivLib	0.07 (0.43)	-1.14 (0.57)*	-0.20 (0.43)	-1.26 (0.55)*	-0.16 (0.43)	-1.26 (0.55)*	-0.17 (0.43)	-1.03 (0.55).
PolRight	-1.80 (1.11)	-1.28 (1.11)	-1.56 (1.11)	-1.45 (1.10)	-1.51 (1.11)	-1.45 (1.10)	-1.61 (1.12)	-1.22 (1.10)
MedianAge	-0.07 (0.08)	0.17 (0.25)						
TotDepRatio			-0.16 (0.05)**	-0.23 (0.09)**				
OldAgeRatio (≥ 65)					-0.23 (0.08)**	0.04 (0.15)		
OldAgeRatio (64 < age < 85)							-0.29 (0.11)	-0.04 (0.15)
OldAgeRatio (≥ 85)							0.24 (0.59)	2.70 (0.93)**
YouthRatio (< 15)					-0.14 (0.05)**	-0.29 (0.08)***	-0.15 (0.06)**	-0.28 (0.08)***
N	613	613	612	612	612	612	612	612
R^2	0.35	0.22	0.35	0.23	0.36	0.24	0.36	0.24

Standard errors in parentheses; '.': 10% significance level, '*': 5%, '**': 1%, '***': 0.1%

Table 1

- When splitting the old age dependency ratio into two groups (old age dependency ratios 65 ≤ age < 85 and 85 ≤ age), the algebraic sign for the younger group is again negative but not significant. For the older group the algebraic sign is negative in both cases and significant when controlling for time and individual fixed effects.
- A higher youth ratio always has a significant debt-lowering effect.

e. Model diagnostics

For the model analysis the pooled models were compared to models with fixed effects. The F-tests clearly reject the null in all cases. The individual-specific heterogeneity should thereby be taken into account.

F-test for individual fixed effects	
Model 1	F = 2.65 p = 0.00
Model 2	F = 2.66 p = 0.00
Model 3	F = 2.63 p = 0.00
Model 4	F = 2.64 p = 0.00

Table 2

F-tests comparing the models with individual fixed effects with models with individual and time fixed effects also clearly reject the null for all four models. Time fixed effects should thereby also be taken into account.

F test for twoways fixed effects	
Model 1	F = 4.18 p = 0.00
Model 2	F = 4.24 p = 0.00
Model 3	F = 4.50 p = 0.00
Model 4	F = 5.00 p = 0.00

Table 3

f. Discussion of the empirical results

The empirical results presented above do not show clear evidence for an impact of population ageing on public debt until 2015 for the included countries. Some evidence can be found for the influence of the old age dependency ratio for people above age 85 but otherwise it is difficult to argue that population ageing has already affected public debt. Governments seem to have been able to manage the rising old age dependency ratios without relying on an increase of public debt. The results are in line with the findings of Razin et al. (2001) and Chen (2004). It should be noticed, however, that these results do certainly not imply that population ageing *will* not have an effect on debt, they only show that until 2015 it does not seem *to have had* an effect.

These results are less surprising than they first might look. Raffelhüschen (2001) predicts that the breathing space resulting from the low total dependency ratio (Figure 1) would last until 2015. He then expects a strongly rising old age dependency ratio putting pressure on public finances. It can thereby be argued that the demographic dividend is still paying but it is far from certain that this will still be valid in the years to come.

However, one fact should not be forgotten: Liabilities to future pensioners are political promises which can be adapted at any time. Several countries have addressed reforms of their social security systems by raising pensioning ages or cutting transfers (at least in nominal terms), thereby lowering real effects of future liabilities. Two countries shall be considered here more precisely: Italy and Germany. Both countries are among the fastest ageing in the world. Italy had an old age dependency ratio of 33.7% in 2015 and Germany of 32.0%. The European Union as a whole will reach a comparable dependency ratio only after 2020. Some countries, like Ireland, Cyprus, Luxemburg or Norway are forecasted to exceed these values only after 2030. Despite the fast ageing of their societies, both countries show very low implicit debt in comparison to the other European countries. In addition, Germany shows a moderate and declining debt quota. The high primary surpluses albeit already high pension payments in both countries contribute substantially to their low sustainability gaps (Moog and Raffelhüschen, 2014). Furthermore, their low implicit debt is a result of reforms in the past. Both countries have raised their pensioning ages, Germany has adapted its pensioning system by introducing a demographic factor which links pension payments to the old age dependency ratio and it has created incentives for more private provision. Due to the rising political power of the old age

population in the upcoming decades (Figure 7) it was important to undertake these reforms in time.

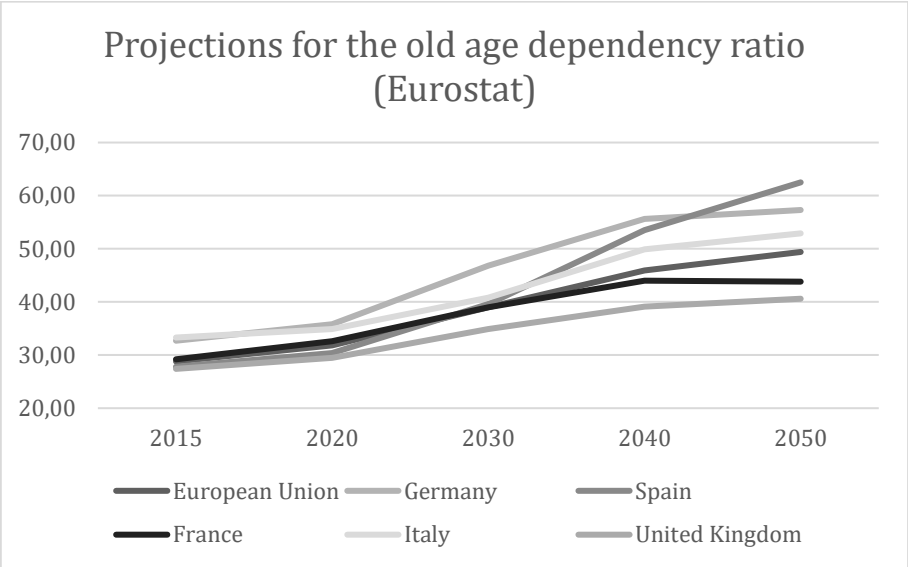

Figure 7

4. Conclusions

The empirical analysis of this article has shown that there is only limited evidence that population ageing has already affected public budgets to such an extent that it results in higher public debt. This result is in line with the literature taking an ex-post view on the subject. However, this analysis still points out need for further research. First, the question remains open whether population ageing affects only public primary balances or if it also affects interest and growth rates. Second, it covers the Western European economies but the Non-European economies and the Eastern European economies which lay behind the iron curtain until 1990 are not taken into consideration. Further analyses should extend their scope to these countries.

What policy implications can be drawn from these results? The results do not put the consensus into question that population ageing is going to affect public debt in the future. The need for solutions for this problem remains. However, enforced immigration can not be seen as a solution. The German example illustrates this: To keep the share of people above age 65 constant, 188 million additional people would have to migrate to Germany until 2050. This would lead to a rise of the total population from 82 to 299 million. Enforced immigration would thereby very probably lead to other severe problems, e. g. concerning integration (Birg, 2015). Governments should instead benefit from the

opportunity that the breathing space offers them and adapt their social security systems in time before the voting power of the old age people becomes fully effective. Possible measures are increases in the pensioning age, an adaption of pension payments, accompanied by the creation of incentives for private capital accumulation.

5. Annex

Two sample t-test	
Variables	**t-test**
PubDebt	t = 0.05 p = 0.96
GDP	t = 0.05 p = 0.85
IncHead	t = -0.34 p = 0.74
Unemploy	t = -0.38 p =0.71
Growth	t = -0.06 p =0.96
Inv	t = 0.45 p =0.65
CivilLib	t = -0.22 p = 0.83
PolRight	t = -0.09 p = 0.93
MedianAge	t = -0.83 p = 0.41
TotDepRatio	t = 0.67 p = 0.50
OldAgeRatio (age ≥ 65)	t = -0.53 p = 0.60
OldAgeRatio (65 ≤ age < 84)	t = -0.52 p =0.60
OldAgeRatio (age ≥ 85)	t = -0.45 p =0.65
YouthRatio (age < 15)	t = 0.96 p = 0.34

Table 4

Descriptive statistics							
Variable	**Source**	**Description**	**Obs.**	**Min.**	**Med.**	**Mean**	**Max.**
Public debt quota	IMF, Eurostat	PubDebt	642	4.7	54.7	59.9	179.7
GDP	IMF	GDP	648	11.3	615.5	951.3	4078.6
GDP per head (PPP)	IMF, own calculations	IncHead	648	6764.0	26516.0	29408.0	98987.0
Unemployment	IMF	Unemploy	644	0.2	7.0	7.4	27.5
Investment quota	IMF	Inv	648	9.8	22.6	22.8	38.3
Civil liberties	Freedom House	CivLib	648	1.0	1.0	1.3	3.0
Political rights	Freedom House	PolRight	648	1.0	1.0	1.0	2.0
Median age	Eurostat	MedianAge	646	26.5	37.3	37.1	45.9
Total dependency ratio	Eurostat	TotDepRatio	645	42.7	50.3	50.8	69.7
Old age dependency ratio (age ≥ 65)	Eurostat	OldAgeRatio	645	15.6	22.7	22.9	33.7
Old age dependency ratio (65 ≤ age < 85)	Eurostat, own calculations	OldAgeRatio	645	15.6	20.3	20.5	28.8
Old age dependency ratio (age ≥ 85)	Eurostat, own calculations	OldAgeRatio	645	0.9	2.3	2.4	4.9
Youth dependency ratio (age < 15)	Eurostat	YouthRatio	646	20.0	27.2	28.0	51.5

Table 5

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