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Economic growth and funded pension systems

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Abstract

Growing pension savings lead to deeper capital markets. This can have a positive effect on economic growth by allowing firms that are more dependent on external finance to grow faster. We study this effect using data on 69 industrial sectors in 34 OECD countries for the period 2001-2010 through a difference-in-differences approach that interacts financial development with industry dependence on external finance. We take into account unobserved heterogeneity by including country-time, industry-time and industry-country fixed effects. We find a significant impact of higher level of pension savings on growth in sectors that are more dependent on external financing. The financial crisis does not significantly affect this relation.

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Keywords: Pension reform, pension funding, financial structure, economic growth.

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1. Introduction

The role of pension funds and life-insurance companies in the economy has increased with ageing populations and government policies promoting private pension savings (Coletta and Zinni, 2013). Growing pension savings lead to deeper capital markets, and therefore may have a positive effect on economic growth. Also the financial landscape might change, with institutional investors taking over some of the financial intermediation activities from banks. This may lead to a shift away from the traditional continental model of relationship banking to a more Anglo-American system with a larger role for capital markets in corporate funding (Davis and Steil, 2001). The European Commission welcomes a larger role of institutional investors; their longer time horizons enable them "to behave in a patient, counter-cyclical manner, restraining 'short-termism' and reducing the need for maturity transformation" (European Commission, 2013). This is expected to foster long-term investment, helping to put Europe back on the path of sustainable growth. The role of pension funds and life-insurance companies seems especially relevant after the banking crisis, as banks are restrained in credit to firms and households during the difficult process of deleveraging.

In this paper we present new empirical evidence for such an alleged positive impact of pension savings on economic growth. We study the effect of pension assets on economic growth in OECD countries for the period 2001-2011. Unlike the standard cross-country growth regressions, we focus on one specific transmission mechanism for the impact of pension savings on economic growth, namely the access of firms to external finance to fund their investments. The hypothesis is as follows: If capital markets are more developed, one would expect firms that rely more strongly on external finance to benefit disproportionally from more efficient financial markets compared to firms that depend less on external finance. To test this hypothesis, we apply a difference-in-difference approach by regressing industry growth on the interaction of an industry's dependence on external finance with the level of pension savings. Significance of this interaction term then indicates that financial frictions are lower in countries with higher levels of pension savings. Thus, we are able to focus on a key mechanism that could explain the positive effect on economic growth of a larger pension savings through pension funds and life-insurance companies. This idea goes back to Rajan and Zingales (1998) in the context of financial markets and growth. The difference in difference approach helps us to mitigate the endogeneity problem in standard growth regressions (e.g. Davis and Hu (2008), Zandberg and Spierdijk (2013)). In line with our hypothesis, we find supporting empirical evidence that growth of funded pension systems has a positive effect on economic growth in OECD countries.

Our paper relates to a small literature on the effect of different types of pension systems on economic growth. In a recent paper, Zandberg and Spierdijk (2013) find no significant effects of the growth in funded pension systems on economic growth in the 2001-2010 period for 54 OECD and non-OECD countries. The authors control for pension investment returns to capture the switch in funded pensions. Only when using a 5-year period growth model with rolling windows, which is non-standard in empirical growth literature, do they find a weak significantly positive effect of pension savings on economic growth. These positive findings, however, are not robust to exclusion of individual countries. In appendix 2, we find that a cross-country regression for OECD countries only does give significant positive effects of pension assets on economic growth, also without applying rolling windows. In an older paper Davis and Hu (2008) find that an increasing pension assets-to-GDP ratio positively affects

output using both OLS estimation and dynamic heterogeneous panel estimation. The authors find a positive influence of funded pension systems on economic growth for both OECD countries and Emerging Market Economies in the period 1960-2002. For example for Chile they find that a 1% increase in pension assets can contribute to economic growth by 0.14%. Other papers focus on the impact of pension reforms on aggregate savings. Samwick (2000) shows that PAYG countries tend to have lower aggregate saving rates than countries with funded pensions. Similar results were found by Bailliu and Reisen (1997), who find evidence that funded pensions in OECD and developing countries are correlated with higher savings.

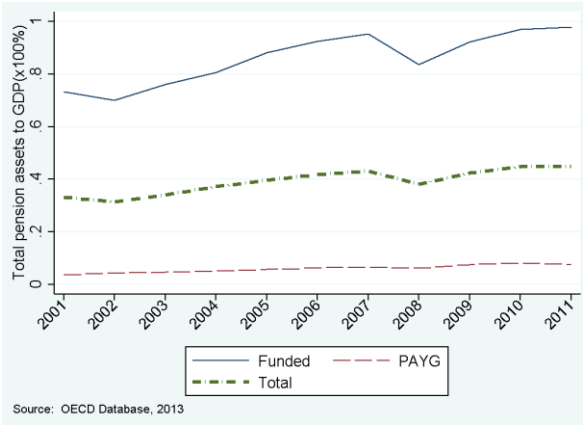
Our paper is structured as follows. Section 2 provides some background on the increasing role of pension savings, and discusses the potential impact on the financial landscape and economic growth. Section 3 presents the econometric methodology and describes the data. Section 4 presents our empirical results applying the Rajan and Zingales (1998) methodology in a cross-industry, cross-country comparison. Section 5 concludes.

2. Funded pensions, financial intermediation and economic growth

The role of private pensions in the provision of retirement income has grown significantly in the past two decades, reflecting efforts by many countries to relieve pressure on unsustainable pay-as-you-go (PAYG) benefits. The growing importance of pension savings is illustrated in figure 1. Despite the considerable losses due to the financial crises in 2002 and 2008, total pension assets relative to GDP rose 13 percentage points in OECD countries from approximately 33% on average in 2001 to 45% in 2011[4]. Most of the increase is driven by OECD countries with already larger funded pension systems. Total pension assets to GDP for this group increased with nearly 25 percentage points from 73.2% to 97.8%. However, also for the average PAYG country the ratio more than doubled from 3.7% to 7.6%. Despite this common trend for pension savings to increase, great diversity remains across individual countries, both in level and in evolution over time (for a detailed description, see Appendix 1). Pension policies are typically determined at the national level, and are subject to specific historical and political circumstances, and are sometimes erratic. The recent incidents in Poland and Hungary where private pensions where re-nationalized - mainly for budgetary reasons - fall outside the scope of our observation period.

Figure 1: Total pension assets-to-GDP for 'funded' countries and 'PAYG' countries, 2001-2011. Unweighted average of pension assets-to-GDP for all 34 OECD countries. The funded group is identified as having at least 25% of total pension assets-to-GDP in 2002.

[4] Unweighted average for all 34 OECD countries (Source: OECD - total pension assets to GDP statistics)



There are several potential mechanisms that can explain a positive relation between the size of funded pensions and economic growth. First, increased pension savings may imply higher aggregate savings providing more funds available for investment in general. Second, higher pension savings will lead to a larger inflow for pension funds and life-insurance companies, who will invest these funds into capital markets. As pension funds' liabilities have a long maturity, they can afford to make long-term investments, for example through long-term equity stakes. Even if these savings substitute savings through banks, this may have a net positive effect on economic growth, if banks have a more short-term focus. Third, pension funds are better able to diversify risks across younger and older generations, and - if properly regulated - across countries as well. Optimal international and intergenerational risk sharing reduces the costs of risk, and thus helps to promote economic growth. According to Obstfeld (1994) halving the variance of macroeconomic risks through better risk sharing could increase growth, leading to substantial welfare gains. Private saving in pension funds may also contribute to stability of markets for government debt, as it reduces citizens' exposure to the credit risk of their governments. With funded private pensions credit risks can be diversified by holding explicit claims (for example bonds) on different governments rather than an implicit claim on the national government (Bovenberg and Van Ewijk, 2011). Finally, the presence of big institutional investors may lead to better governance of firms by reducing free-riding incentives, which in turn improves these firms' efficiency and hence may lead to higher growth.

In contrast to these positive effects, there are also concerns that higher pension savings could have adverse effects. This could happen if the diversion of household savings to pension funds and life-insurance companies weakens the position of banks by reducing their base of stable household deposits. This could be aggravated if better prospects on pension income induces households to lengthen their balance sheets by taking on more mortgage and other debt (Cecchetti, King and Yetman, 2011). The second factor seems to be more important in practice than the first. The larger funding gap of bank in countries with strong funded pensions implies that banks are more dependent on wholesale financing through money markets. This does not have to be a problem in normal times - as institutional investors buy bank bonds and thus fill the financing gap, but it may increase liquidity risks in bad states of the world. Cecchetti et al. (2011) show that higher loan-to-deposit ratios and larger funding gaps are associated with worse performance during the banking crisis.

3. Method and data

We analyse the effect of pension assets on economic growth in OECD countries for the period 2001-2011 using a cross-industry, cross-country difference-in-difference regression. We focus on the difference in dependence on external finance across different industries. Following Rajan and Zingales (1998) we define an index of the dependence of firms on external finance as the fraction of investment not financed through retained earnings. Specifically, it is the gap between capital expenditures on fixed assets and cash flow from operations. The index is constructed using data on US firms; the literature proposes that this country provides the preferred measure of dependence on external finance as it has the best developed financial markets. A central assumption is that the ordering of industries according to their dependence on external finance is the same for different countries, and is determined by some fundamental characteristics of these sectors. This methodology has been used in several papers such as Dell'ariccia (2008), to identify the impact of banking crises on the real economy, and Laeven and Valencia (2013) to identify the effect of financial sector intervention on the real economy. The latter paper also checks robustness of the original Rajan Zingales index by recalculating it with more recent data.

Our hypothesis is that domestic industries with high dependence on external finance (ED_i) should disproportionately benefit from an increase in the size of pension assets as this is associated with more efficient financial markets. Equation 1 shows the model with cross-industry, cross-country fixed effects. Also, we include a crisis dummy to see whether the relation changed during the crisis, or even might have changed sign, as suggested by authors concerned with the funding gap of banks (Cecchetti et al (2011)).

$$y_{c,i,t} = \mu_{c,i,t} + \beta_1 IndustrySize_{c,i,t-1} + \beta_2 PA_{c,t-1} * ED_i + \varepsilon_{c,i,t} \quad (1)$$

Here, the dependent variable $y_{c,i,t}$ is the value added growth for sector *i* in country *c* and year *t.* $\mu_{c,i,t}$ include country-industry, country-time and industry-time fixed effects. This large number of dummy variables controls for a large number of time specific, country specific, and industry specific shocks that may affect firm performance. $IndustrySize_{c,i,t-1}$ is the size of sector *i* in country *c* relative to total manufacturing of that particular country[5]; this accounts for the possibility that larger, more saturated industries experience slower growth. We interact the level of total pension assets per country with dependence on external finance per industry $PA_{c,t-1} * ED_i$. Here the *PA*-to-*GDP* ratio ($PA_{c,t-1}$) is taken as a lagged variable as it takes time for additional pension savings to lead to higher investment and growth. The external dependence variable is included as a time-invariant characteristic per industry. The United States is excluded from the regression because it is the benchmark for external dependence per industry.

To examine whether the relation of pension assets and economic growth might have changed during the crisis, we also include a crisis dummy interacted with the difference-in-difference term $PA_{c,t-1} * ED_i * crisis$. We expect the coefficient on this term to be negative if the crisis has hit countries with large funded pensions more strongly and firms with large external financing suffer from impaired bank

[5] $\frac{IndustrySize_{c,i,t-1}}{\sum_{i=1}^{n} IndustrySize_{c,i,t-1}}$ where the sum of total value added is given as a variable on INDSTAT.

lending in particular. Following Laeven and Valencia (2013) we define the crisis period dummy to be one from 2008 to 2010 for the following countries in our sample: Austria, Belgium, Czech, Denmark, Estonia, France, Germany, Greece, Hungary, Iceland, Ireland, Luxembourg, Netherlands, Portugal, Slovakia, Spain, Sweden and the United Kingdom.

Our panel includes all 34 OECD countries and 69 industry sectors. The OECD provides annual data on total pension assets relative to its country's nominal GDP (current prices, local currency) for all OECD countries in the 2001-11 period.[6] Missing pension asset data for Japan is complemented by total PA-to-GDP ratio from the Bank of Japan.[7] Limited availability of industry data (INDSTAT) restricts our regressions to the period 2001-2010, where for the year 2010 data are available only for Australia, Canada, Estonia, Japan, Mexico and Slovenia. Taken together we have 13,682 available observations for 1,862 unique country and sector combinations. The panel is not perfectly balanced; there are some missing years for specific countries or industries.

Table 1: description of the data.

Variable	2001-2010	Mean	Std. Dev.	Min	Max	Obs
$Output\ growth$	Overall	0.013	0.282	-5.508	3.229	N= 13,682
	Between		0.143	-0.919	3.229	n= 1,862
	Within		0.263	-4.939	2.976	T= 7.3
$Industry\ share$	Overall	0.013	0.022	0.000	0.566	N= 13,682
	Between		0.021	0.000	0.356	n= 1,862
	Within		0.007	-0.240	0.332	T= 7.3
$External\ dependence$	Overall	0.210	0.402	-1.530	1.470	N= 13,682
	Between		0.412	-1.530	1.470	n= 1,862
	Within		0.000	0.210	0.210	T= 7.3
$PA\ to\ GDP\ ratio$	Overall	0.330	0.402	0.000	1.654	N= 13,682
	Between		0.397	0.000	1.456	n= 1,862
	Within		0.067	-0.048	0.764	T= 7.3

Table 1 provides some descriptives of the data. We use annual value added growth per manufacturing sector which is the net output per sector after adding up all outputs and subtracting intermediate inputs (source: World Bank). This output indicator is given in local currency and current prices; as we focus on differences across sectors it is fair to use nominal growth rates; a country's inflation is captured in country-time fixed effects.[8] Annual nominal growth on average is positive at 1.3%, but quite volatile. Average industry share per sector relative to total manufacturing output equals 1.3%. The highest industry share of over 50% is due to the *non-ferrous metal basic industry* in Chile. Total PA-to-GDP averages 33%, but varies widely over time and across countries (see Appendix 1 Table A for country data).

[6] Total pension assets comprise pension fund assets, pension insurance contracts, funds managed as part of financial institutions and the value of funds book reserve systems, (http://www.oecd.org/finance/private-pensions/globalpensionstatistics.htm)

[7] Total pension assets, Flow of Funds, Bank of Japan (BOJ) codes: FOF_FFAS800A100 till FOF_FFAS800A900. There is a difference between total pension asset data of Japan as reported by the OECD and the BOJ. We use BOJ data due to their larger and more detailed time series data on total pension assets.

[8] Further details about data adjustments for the value added data is elaborated in Appendix 1.

The index for external dependence per manufacturing sector (ED_i) has previously been constructed by Rajan and Zingales (1998), and enlarged by Raddatz (2006). Rajan and Zingales distinguish 36 sectors which has been extended to 70 sectors by Raddatz. External dependence at the company level is defined as the gap between capital expenditures on fixed assets and cash flow from operations:

$$External\ Dependence = \frac{Capital\ expenditures\ on\ fixed\ assets - Cash\ flows\ from\ operations}{Capital\ expenditures\ on\ fixed\ assets} \quad (2)$$

The authors take the median of the (time-averaged) external dependence of all firms per sector in the 1980-89 period to compute the aggregate external dependence ratio which is time-invariant but differs between sectors. Note that the external dependence index is not constrained to be positive. Sectors range from the leather industry, with the lowest external dependence (-1.53), to manufacturing of drugs and medicines, with the highest external financial needs (1.47).[9] Rajan and Zingales argue that these measures are very persistent and technologically determined, and therefore typical for an industry over time and across countries. Indeed, a number of papers have checked robustness by constructing the measure with more recent data (Beck, Chen, Lin, and Song, 2012 and Laeven and Valencia, 2013).

4. Empirical results

In this section we estimate the model in Equation 1. The results are summarised in Table 2 both for the standard model, and for the model that includes a crisis dummy to account for the potential impact of the crisis. To account for country and sector trends, as well as for omitted variables, each regression includes country-industry, country-year and industry-year fixed effects with standard errors clustered by country-industry. In order to eliminate noise we only use output data with at least 5 consecutive growth data points (see also Ciccone and Papaioannou , 2010). Furthermore, In line with Kroszner, Laeven and Klingebiel (2007) we Winsorise the top and bottom 1% of the outliers which caps negative output growth from - 551% to -86% and positive growth from 323% to 75%. Also, the top and bottom 1% of our industry share variable are Winsorised capping the top 1% ratio from 0.57 to 0.10. The PA-to-GDP ratio has no extreme outliers.

The first two columns in Table 2 (columns a and b) presents our regression results without the industry-year fixed effects. These fixed effects take into account common factors across industries; we now have to include lagged output growth to account for autocorrelation at the industry level. Columns c and d present our complete model including country-industry, country-year and industry-year fixed effects. In line with Rajan and Zingales (1998), we find that high industry share in the previous period has a negative effect on growth. The intuition is that saturated markets with high industry shares and more competition inevitably hinder growth. The results for the key interaction $PA_{c,t-1} * ED_i$ are significant at the 99.9% confidence level in all models and, moreover, stable across alternative specifications of the model. Larger funded pension systems thus positively stimulate growth of manufacturing sectors with a higher dependence on external financing, pointing to a positive impact of deeper capital markets on financial intermediation and, thereby, on economic growth.

[9] See Appendix 1, Table B for all ratios.

Table 2: Dependent variable: output growth ($y_{c,i,t}$) per sector.

	(a)	(b)	(c)	(d)
$Lagged\ growth\ (y_{c,i,t-1})$	-0.204***	-0.205***	-	-
	(0.015)	(0.015)		
$Industry\ share_{c,i,t-1}$	-1.141***	-1.141***	-1.451***	-1.451***
	(0.136)	(0.136)	(0.154)	(0.154)
$PA_{c,t-1} * ED_i$	0.723***	0.860***	0.804***	0.781***
	(0.165)	(0.188)	(0.184)	(0.192)
$PA_{c,t-1} * ED_i * crisis_{c,t}$	-	-0.149	-	0.028
		(0.102)		(0.095)
N	11159	11159	11717	11717
adj. R-sq	0.219	0.219	0.264	0.264
Country-industry f.e	✓	✓	✓	✓
Country-time f.e	✓	✓	✓	✓
Industry-time f.e			✓	✓

Explanation: Regressions 1a and 1b are with country-year fixed effects and regressions 1c and 1d are with country-year industry-year fixed effects. All regressions are clustered per country-industry group. The regressions are performed for groups with at least 5 consecutive growth data points. *** denote significance at 99.9%.

Columns b and d in Table 2 test whether the positive effect of pension assets on growth breaks down during the crisis. For this we interact the crisis period with our key independent variable. This variable, however, turns out to be insignificant. Also the sign changes across the regressions. We thus find no support for the argument that larger funded pensions may have a destabilising impact on the financial system and the economy in the event of a severe crisis. This conclusion is further supported by the insignificant result for a similar crisis dummy in a standard cross-country regression (see Appendix 2).

We have performed several robustness tests and we report the results of the four most important tests in Appendix 1 (Table D). First, we have redone our initial regressions and take the top and bottom 2.5% of output growth as threshold for Winsorisation, which turns out to cap output growth at -50% and 50%. Second, as an alternative to Winsorisation we trim the 1% outliers, in line with Dell'Ariccia et al. (2008). Third, we note that the majority of papers correct output growth for inflation, thus we convert our nominal output growth to real growth with the GDP deflator retrieved from INDSTAT and Winsorise the new variable at 1%. Fourth, we repeat the initial regressions with a loop that each time omits either two countries or three industries in alphabetic order to check for country outliers. All these robustness tests produce significant results for the key variable at the 99.9% confidence level. We also check what happens when we drop the requirement of 5 consecutive growth data points. Significance now falls, but our results remain significant at the 95% confidence level. The fall in significance arises because inclusion of sectors with substantial periods of missing output growth data are generally small with less accurate data and lower consistency of their reported value added, which increases noise. Most of this data comes from Greece, Turkey, Portugal and Belgium.

5. Conclusion

Many countries encourage private pension savings as a supplement to public pensions, which face increasing demographic pressure. It is likely that the role of pension savings and institutional investors

in financial intermediation will increase in the future. The increasing size of pension assets may impact the financial landscape, with a growing role of institutional investors (pension funds and life-insurance companies). We explore whether this has consequences for economic growth and what the channel may be. We find supporting empirical evidence that growth of funded pension systems has a positive effect on economic growth in OECD countries. Following Rajan and Zingales (1998) we focus on one specific channel, the external financing of firms. Using data on 69 industry sectors in 34 OECD countries for period 2001-2010 we find that increasing pension saving is in particular beneficial for firms heavily relying on external finance. This suggests that an increased amount of assets held by pension funds and other institutional investors is associated with more efficient financial markets and therefore higher economic growth.

An interesting conjecture is that this relationship might have changed during the banking crisis, as the diversion of household savings from banks to pension funds might have weakened banks, making them more dependent on wholesale markets. We do not find any support for a negative impact on economic performance during a crisis.

We see several routes for future research. First, our analysis is restricted to the manufacturing industry; the analysis could be broadened including other sectors as well, in particular the service industry. Second, our analysis focuses on one particular transmission mechanism; there are other factors that could influence the impact of pension savings on the economy, for example, regulations with regard to the investments and funding of pensions funds and life-insurance companies.

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Appendix 1: Data description

This appendix provides more detail information on the data used. For the industry output data we use annual value added in local currency and current prices from 152 sectors in the manufacturing industry for the period 1999-2009 from INDSTAT. We focus on sectors for which we have the dependence of external financing ratio from Raddatz (2006). We construct a concordance table between isic3 codes from INDSTAT and the isic2 codes from Raddatz. Some of the isic2 sectors include either two or three isic3 sectors as seen in Table B in this appendix. At the country level, some observations of one of the isic3 subgroups that belong to the same isic2 group are missing. In order to maintain consistency of the former group we only compute the total sector value of these subgroups if there are no missing values in that time series. For some countries the calculation of an industry's value added has changed from some particular year onwards. We identify the transition year and ignoring this specific output growth observation to eliminate distorted growth values resulting from the change in definition. We end up with 69 sectors which have the dependence of external financing ratio from Raddatz. Table A shows annual pension assets-to-GDP growth as retrieved from OECD.Stat for all countries included in the sample. Table B shows the external dependence ratio as obtained from Raddatz (2006).

Table A: annual total PA-to-GDP

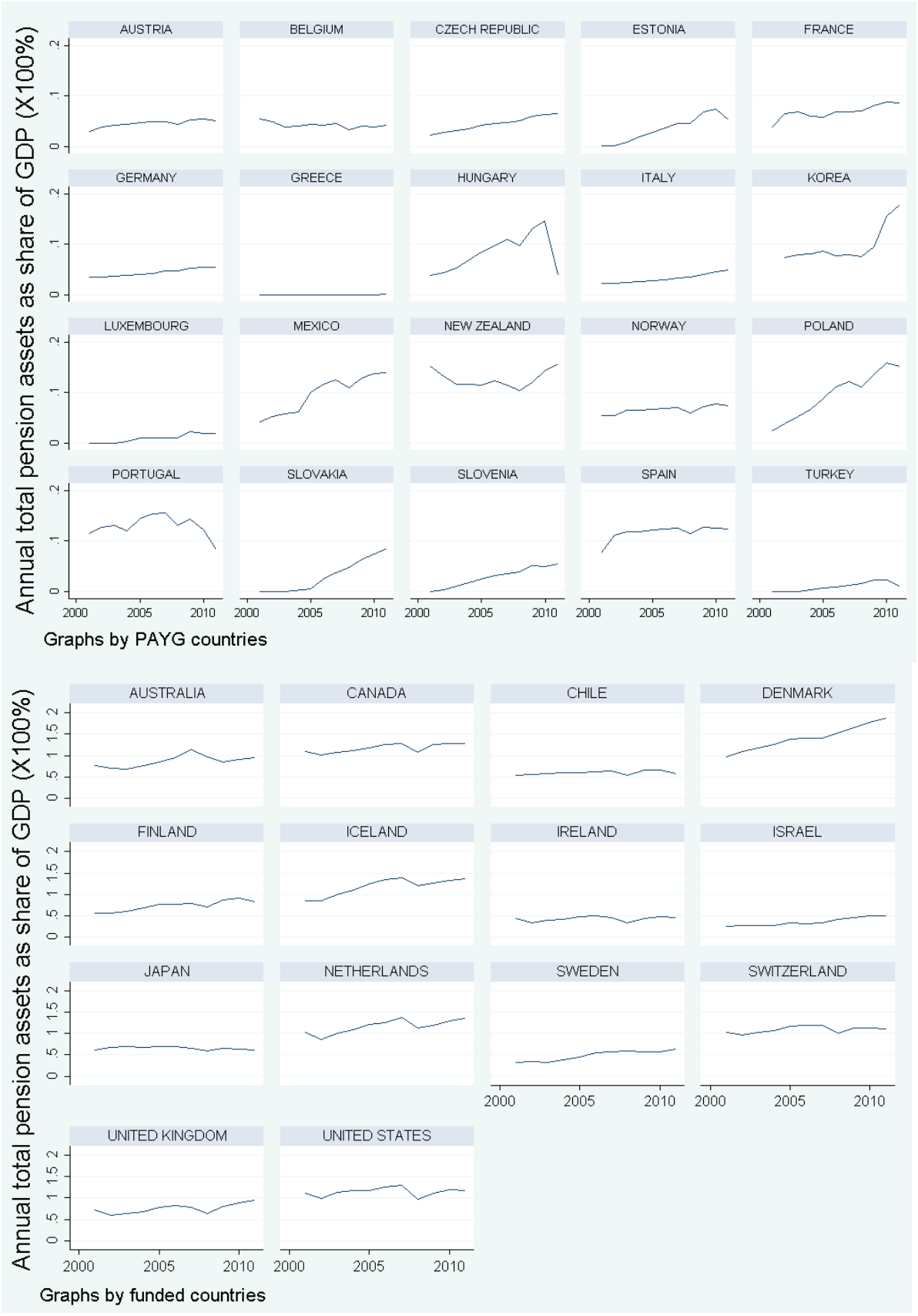

Table B: External dependence ratio per sector

External dependence is the median fraction of capital expenditures not financed with cash flow from operations or each industry (Raddatz, 2006). The external dependence ratio is computed over the 1980-1989 period.

Sector	isic2	isic3	External dependency
Slaughtering preparing and preserving meat	3111	1511	-0.02
Manufacture of dairy products	3112	1520	0.41
Canning and preserving of fruits and vegetables	3113	1513	0.08
Manufacture of vegetable and animal oils and fats	3115	1514	0.01
Grain mill products	3116	1531	0.04
Manufacture of bakery products	3117	1541	-0.05
Sugar factories and refineries	3118	1542	-0.21
Manufacture of cocoa chocolate and sugar confectionery	3119	1543	-0.32
Manufacture of food products not elsewhere classified	3121	1549	-0.53
Distilling rectifying and blending spirits	3131	1551	0.7
Malt liquors and malt	3133	1553	-0.2
Soft drinks and carbonated waters industries	3134	1554	-0.47
Tobacco manufactures	3140	1600	-0.27
Spinning weaving and finishing textiles	3211	171	0
Manufacture of made-up textile goods except wearing apparel	3212	1721	0.01
Manufacture of carpets and rugs	3214	1722	0.59
Manufacture of textiles not elsewhere classified	3219	1729	0.05
Manufacture of wearing apparel except footwear	3220	1810	0.09
Manufacture of products of leather and leather substitutes except footwear and wearing apparel	3233	1912	-1.53
Manufacture of footwear except vulcanized or molded rubber or plastic footwear	3240	1920	-0.22
Sawmills planning and other wood mills	3311	2010	0.2
Manufacture of furniture and fixtures except primarily of metal	3320	3610	0.19
Manufacture of pulp paper and paperboard	3411	2101	0.12
Manufacture of containers and boxes of paper and paperboard	3412	2102	-0.07
Manufacture of pulp paper and paperboard articles n.e.c	3419	2109	0.06
Printing publishing and allied industries	3420	221,222	0.2
Manufacture of basic industrial chemicals except fertilizers	3511	2411	0.35
Manufacture of fertilizers and pesticides	3512	2412,2421	0.1
Manufacture of synthetic resins plastic materials and man-made fibers except glass	3513	2430	0.21
Manufacture of paints varnishes and lacquers	3521	2422	0.13
Manufacture of drugs and medicines	3522	2423	1.47
Manufacture of soap and cleaning preparations perfumes cosmetics and other toilet preparations	3523	2424	-0.02
Manufacture of chemical products not elsewhere classified	3529	2429	0.02
Petroleum refineries	3530	2320	0.03

Sector	isic2	isic3	External dependency
Manufacture of miscellaneous products of petroleum and coal	3540	2310	0.12
Tyre and tube industries	3551	2511	-0.11
Manufacture of rubber products not elsewhere classified	3559	2519	-0.03
Manufacture of plastic products not elsewhere classified	3560	2520	0.31
Manufacture of pottery china and earthenware	3610	2691	-0.21
Manufacture of glass and glass products	3620	2610	0.26
Manufacture of structural clay products	3691	2693	0.22
Manufacture of cement lime and plaster	3692	2694	0.27
Manufacture of non-metallic mineral products not elsewhere classified	3699	2699	-0.09
Iron and steel basic industries	3710	2710,2731	0
Non-ferrous metal basic industries	3720	2720,2732	0.02
Manufacture of cutlery hand tools and general hardware	3811	2893	-0.09
Manufacture of structural metal products	3813	2811	0.45
Manufacture of fabricated metal products except machinery and equipment not elsewhere classified	3819	2899	0.3
Manufacture of engines and turbines	3821	2911	0.23
Manufacture of agricultural machinery and equipment	3822	2921	0.33
Manufacture of metal and wood working machinery	3823	2922,2923	0.17
Manufacture of special industrial machinery and equipment except metal and wood working machinery	3824	2924,2925,2926	0.37
Manufacture of office computing and accounting machinery	3825	3000	1.07
Machinery and equipment except electrical not elsewhere classified	3829	2919	0.3
Manufacture of electrical industrial machinery and apparatus	3831	3110,3120	0.27
Manufacture of radio television and communication equipment and apparatus	3832	3210,3220,3230	0.93
Manufacture of electrical appliances and house wares	3833	2930	0.29
Manufacture of electrical apparatus and supplies not elsewhere classified	3839	3190	0.42
Ship building and repairing	3841	351	0.46
Manufacture of railroad eqquipment	3842	3520	0.18
Manufacture of motor vehicles	3843	3410,3420,3430	0.72
Manufacture of aircraft	3845	3530	0.28
Manufacture of professional and scientific and measuring and controlling equipment not elsewhere classified	3851	3312,3313	1.05
Manufacture of photographic and optical goods	3852	3320	0.72
Manufacture of watches and clocks	3853	3330	0.79
Manufacture of jewelry and related articles	3901	3691	0.79
Manufacture of musical instruments	3902	3692	0.59
Manufacture of sporting and athletic goods	3903	3693	0.16

Table C: Funded countries and non-funded countries

Average total pension assets-to-GDP ratio per country in the 2001-2011 period to separate the more PAYG countries from the more funded countries where funded countries have pension assets of more than 25% of nominal GDP in 2002.

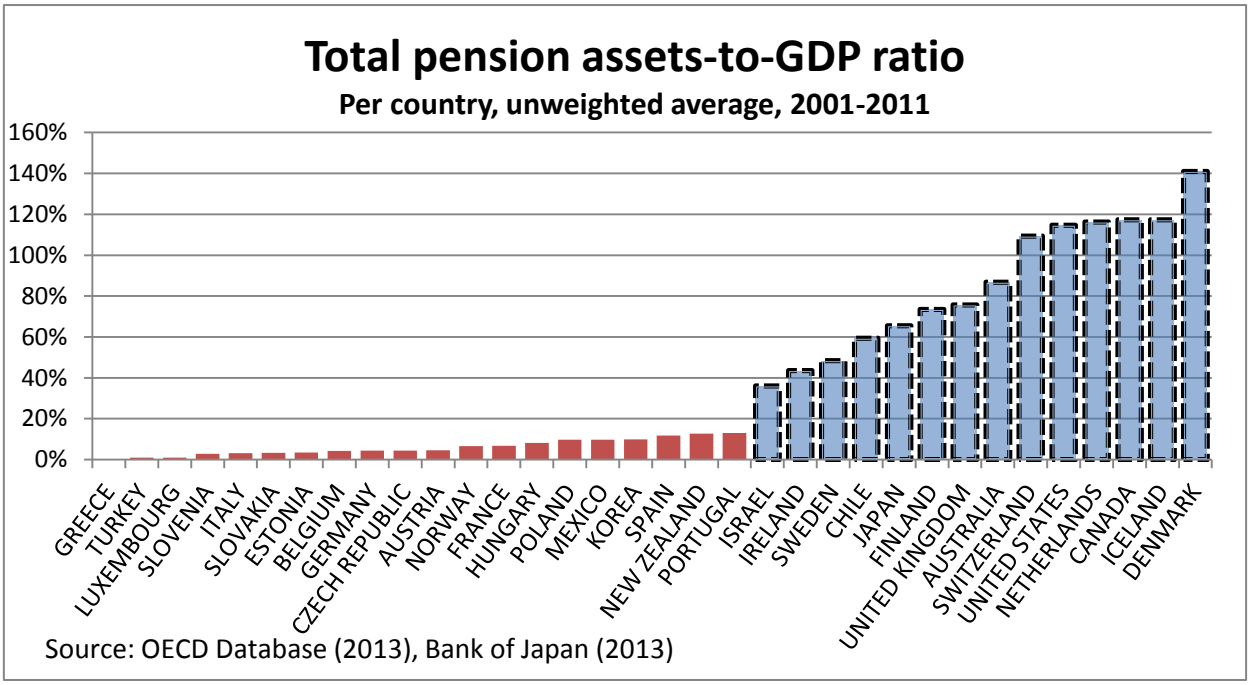

Table D: Robustness tests Cross-sector cross-country difference-in-difference regression

Robustness test regressions for Table 1. Regressions are similar to Table 1 with one specific alternation. Regressions 2 Winsorize the dependent variable at 2.5%. Regressions 3 trim the 1% outliers. Regressions 4 do not exclude data points with less than 5 consecutive growth data. Regressions 5 convert the dependent variable from nominal growth to real growth with a GDP deflator retrieved from INDSTAT. *, ** and *** denote significance at 95%, 99% and 99.9% respectively.

	(2a)	(2b)	(2c)	(2d)	(3a)	(3b)	(3c)	(3d)
$VA\ growth_{c,t-1}$	-0.174***	-0.174***	-	-	-0.152***	-0.152***	-	-
	(0.012)	(0.012)			(0.013)	(0.013)		
$Industry\ share_{c,i,t-1}$	-0.920***	-0.919***	-1.436***	-1.436***	-0.934***	-0.934***	-1.194***	-1.194***
	(0.120)	(0.120)	(0.153)	(0.153)	(0.133)	(0.133)	(0.142)	(0.142)
$PA_{c,t-1} * ED_{c,i}$	0.643***	0.763***	0.702***	0.808***	0.535***	0.614***	0.624***	0.616***
	(0.144)	(0.164)	(0.151)	(0.167)	(0.155)	(0.172)	(0.164)	(0.173)
$PA_{c,t-1} * ED_{c,i} * crisis_{c,t}$	-	-0.129	-	-0.118	-	-0.087	-	0.010
		(0.090)		(0.097)		(0.093)		(0.089)
N	11159	11159	11717	11717	10942	10942	11493	11493
adj. R-sq	0.221	0.221	0.187	0.187	0.195	0.195	0.241	0.241
Country-industry f.e	✓	✓	✓	✓	✓	✓	✓	✓
Country-time f.e	✓	✓	✓	✓	✓	✓	✓	✓
Industry-time f.e			✓	✓			✓	✓

	(4a)	(4b)	(4c)	(4d)	(5a)	(5b)	(5c)	(5d)
$VA\ growth_{c,t-1}$	-0.209***	-0.209***	-	-	-0.204***	-0.205***	-	-
	(0.015)	(0.015)			(0.015)	(0.015)		
$Industry\ share_{c,i,t-1}$	-1.069***	-1.067***	-1.342***	-1.342***	-1.135***	-1.134***	-1.451***	-1.451***
	(0.125)	(0.125)	(0.153)	(0.153)	(0.131)	(0.131)	(0.154)	(0.154)
$PA_{c,t-1} * ED_{c,i}$	0.651***	0.833***	0.453*	0.521*	0.720***	0.857***	0.804***	0.781***
	(0.164)	(0.194)	(0.221)	(0.217)	(0.165)	(0.188)	(0.184)	(0.192)
$PA_{c,t-1} * ED_{c,i} * crisis_{c,t}$	-	-0.191	-	-0.073	-	-0.148	-	0.028
		(0.120)		(0.119)		(0.102)		(0.095)
N	11887	11887	12949	12949	11159	11159	11717	11717
adj. R-sq	0.215	0.216	0.249	0.249	0.211	0.211	0.257	0.257
Country-industry f.e	✓	✓	✓	✓	✓	✓	✓	✓
Country-time f.e	✓	✓	✓	✓	✓	✓	✓	✓
Industry-time f.e			✓	✓			✓	✓

Appendix 2 Cross-country growth regressions

In this appendix present results from a standard cross country regression between GDP growth and pension assets. Following Zandberg & Spierdijk (2013) we estimate the following model:

$$y_{c,t} = \delta_t + \beta_1\, y_{c,t-1} + \beta_2\, PA_{c,t-1} + \beta_3 ror_{c,t-1} + \gamma X_{c,t} + \varepsilon_{c,t} \qquad \text{(a)}$$

We relate nominal GDP growth $y_{i,t}$ to the lagged total pension assets-to-GDP growth $PA_{c,t-1}$ and the lagged rate of return on pension assets $ror_{c,t-1}$ (Equation a). We include country fixed effects and year fixed effects δ_t to take account of any common factors over time. Standard errors are clustered by country. Because total funded pension assets also change due to the realized return on existing pension assets, we control for investment returns on pension assets, $ror_{c,t-1}$. In order to compute the annual rate of returns on pension assets of country i at year t we use the OECD Global Pension Statistics Database, which has data at country-level on how pension funds allocate their investments. Under the assumption of perfect global diversification (each investment vehicle grants an annual rate of return that is identical between countries at a given year) we derive the annual return of pension assets

$$ror_{c,t} = \frac{StockReturns_t * \omega_{c,t} + BondReturns_t * \alpha_{c,t} + CashReturns_t * \pi_{c,t}}{\omega_{c,t} + \alpha_{c,t} + \pi_{c,t}}, \qquad \text{(b)}$$

where ω, α, π represent the ratios of how pension funds asset portfolios are constructed. Finally, we control for some additional factors to single out other possible determinants of GDP growth. Finally, we add again a dummy for the crisis to check whether the relationship between pension savings and growth may have changed during the crisis, for all countries and for funded countries taken apart.

Economic growth is measured by GDP growth per capita in current prices and local currency, retrieved from the World Bank. We also use the widely used inverse old age dependency ratio as a control variable to correct for changing demographics influencing pension assets. The inverse old age dependency ratio captures changes in the working population relative to the population above 65.

To compute the annual rate of return on total pension assets we use detailed information from OECD on how pension funds allocate their assets amongst 11 different securities investments, ranging from short-term cash to stocks, mutual funds and longer term bonds (Table III). Mutual funds have been subdivided into several investment groups. Bonds represent the largest investment category in total pension assets with 44% in 2001 and 42% in 2011. Countries with missing years of pension allocations are computed by taking the average of all available years of that particular country. If, at country-level, there is no data available whatsoever, worldwide averages of that particular year are used.

To reproduce the rate of return on pension assets variable we use a mixture of stocks (MSCI World Gross Return Index), bonds (Barclays Global Aggregate Unhedged Bond Index) and short-term cash (3m T-bill) return indices to calculate the average rate of return on total pension assets, depending on how pension funds allocate their assets on annual bases. We combine some of the most commonly used global securities return indices per investment category, retrieved from DataStream. Accordingly each DataStream ESNM code is reported in Table IV below. For short-term cash returns we use the 3-month

Treasury bill rate and the 3-month LIBOR rate, annualized from monthly rates. For stock returns we take average market returns of the MSCI World Gross Total Return Index and the S&P 500 Composite Gross Total Return Index. Lastly, for bond returns we use average market value returns of the Barclays Global Aggregate Bond Index, IBOXX European All Maturities Bond Index and JPMorgan Global All Maturities Bond Index. For the remaining pension funds asset allocations we compute the average of these 3 return indices. Rate of return estimations in countries with a complete absence of pension asset allocations data (France and New Zealand) are retrieve from annual reports of their largest national pension fund.[10]

In comparison with Zandberg & Spierdijk (2013) we add one more year of observations, the year 2011. Also we include a set of financial market variables as indicators for the financial development of the country. Following Beck, Levine and Laoyza (1999) we include the stocks-to-GDP ratio and domestic credit to the private sector as a percentage of GDP. Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of non-equity securities and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises. The stocks-to-GDP ratio refers to the total value of shares traded during the period. This indicator complements the market capitalization ratio by showing whether market size is matched by trading. Especially in 2001 and 2008-2009 we find large drops in the stocks-to-GDP ratio due to financial turmoil and dried up liquidity in financial markets.

In line with the literature we include PA-to-GDP growth $y_{c,t-1}$ with a lag as capital growth does not immediately lead to new investments. Also we interact the PA-to-GDP growth variable with a dummy variable that separates PAYG countries from more funded countries. This is to account for the possibility that PAYG countries with lower total PA-to-GDP ratios experience higher PA-to-GDP growth rates which could drive regression results. Finally, we test again whether the relation changed during the crisis period of 2008-2011.

Table I summarizes the results for the impact of growth in assets-to-GDP on GDP growth in the 2001-2011 period. We report results with country-fixed effects to correct for individual country characteristics. In line with Kroszner, Laeven and Klingebiel (2007) we Winsorize the top and bottom 1% of the outliers of GDP growth and total PA-to-GDP growth because we do not want spurious outliers to distort results. This method typically produces a higher robustness than simply omitting outliers (Bollinger and Chandra, 2005). As a result, this caps the log of negative GDP growth from -16.5% to -7.2% and the log of positive growth from 37.8% to 20.6%. Similarly this caps the log of total PA-to-GDP growth from -136% to -34% and 184% to 139%.

In all regressions PA-to-GDP growth shows a statistically significant and positive sign at the 99—99.9% confidence level. On average, a 10% increase in PA-to-GDP results to a 0.24-0.30 percentage points increase in GDP, keeping everything else constant. Our lagged rate of return on pension assets control variable shows a negative coefficient. This concurs with the idea, that pension asset returns do not necessarily have a positive effect on growth. It is the increase in the flow of pension savings that drives economic growth. Furthermore, simple OLS regressions show a weakly significant and positive interaction between PA-to-GDP growth and a dummy for funded countries, meaning that the already

[10] New Zealand Superannuation Fund and Fonds de réserve pour les retraites (Annual reports 2012-2013)

funded countries benefit more from becoming even more funded. There is no evidence of a changing relation due to the financial crisis. Lastly, the positive and sometimes weakly significant inverse old age ratio logically implies that an increasing amount of workers relative to retirees stimulates economic growth. This strengthens our negative conclusion on the impact of the crisis on the basis of the Rajan Zingales model.

Table I: Regressions for the impact of pension assets on GDP growth, 2001 - 2011.

	LSDV			OLS			OLS fixed effects		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)	(1c)	(2c)	(3c)
$GDP\ growth_{c,t-1}$	0.452***	0.437***	0.437***	0.616***	0.603***	0.610***	0.292***	0.278***	0.276***
	(0.076)	(0.079)	(0.078)	(0.058)	(0.060)	(0.060)	(0.065)	(0.066)	(0.068)
$PA\ growth_{c,t-1}$	0.024**	0.028**	0.025**	0.024**	0.026**	0.026**	0.027**	0.030***	0.029***
	(0.009)	(0.010)	(0.010)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.007)
$Rate\ of\ return_{c,t-1}$	-0.042	-0.042	-0.060	-0.026	-0.023	-0.044	-0.045	-0.046	-0.062
	(0.039)	(0.038)	(0.045)	(0.048)	(0.047)	(0.055)	(0.043)	(0.042)	(0.048)
$Inv\ old\ age\ dep\ growth_{c,t-1}$		0.620	0.628		0.219	0.212		0.630*	0.650*
		(0.324)	(0.329)		(0.181)	(0.184)		(0.286)	(0.273)
$Stocks\ to\ GDP\ growth_{c,t-1}$		0.002	0.001		0.005	0.005		0.001	0.001
		(0.004)	(0.004)		(0.003)	(0.003)		(0.004)	(0.004)
$PA\ growth_{c,t-1} * funded$			0.025			0.068*			0.044
			(0.029)			(0.030)			(0.023)
$PA\ growth_{c,t-1} * crisis$			-0.006			0.004			0.017
			(0.030)			(0.048)			(0.043)
$PA\ growth_{c,t-1} * crisis * funded$			0.009			0.033			0.057
			(0.053)			(0.052)			(0.049)
N	299	299	299	299	299	299	299	299	299
adj. R-sq	-	-	-	0.622	0.625	0.624	0.585	0.589	0.586

Explanation: Dependent variable: GDP growth in local currency and current prices. Regressions are estimated by (a) the bias-corrected LSDV estimator with bootstrapped standard errors (Blundell-Bond estimator with first order bias $O(T^{-1})$ and a 50x bootstrap variance-covariance matrix), (b) OLS with clustered standard errors and (c) OLS with fixed effects and clustered standard errors. Country and year dummies are not reported and the LSDV regression does not report the R-squared. Regressions 1 are our standard regressions and regressions 2 include relevant control variables. Regressions 3 includes additional interaction terms of PA-to-GDP growth with a funded dummy variable for funded countries with at least 25% pension assets-to-GDP in 2002 and a crisis dummy for the 2008-2011 period for countries which were hit by the financial crisis. PA, GDP, stocks-to-GDP and the inverse age dependency ratio are all in growth(log). *, ** and *** denote significance at 95%, 99% and 99.9% respectively.

We perform three different robustness tests. First, we add a higher restriction to outliers and Winsorize at 2.5% instead of 1% which caps nominal GDP growth between -4.7% and 16.4% and PA-to-GDP growth between -23% and 60%. Second, we trim the 1% outliers instead of Winsorizing. Both methods result in higher coefficients of our PA-to-GDP variable but also result in a lower significance. None the less, results always stay significant no less than the 95% confidence interval and on average we find that a 10% increase in PA-to-GDP results to a 0.25-0.47 percentage point increase in nominal growth. Regression results of these robustness tests can be found in Table II. Third, we look at country outliers in our 2nd and 3rd regressions by each time omitting one different country. This is repeat 34 times, matching our amount of OECD countries. Excluding either Estonia, Luxembourg or Mexico (non-funded countries) in our original regressions of Table I again slightly drops the significance of our PA-to-GDP growth variable but no less than the 99% confidence interval. Excluding Denmark (largest funded country) from the fixed effects OLS regression makes the interaction term between PA-to-GDP growth

and funded countries significant at the 95% confidence level, supplementary to our simple OLS regression.

To conclude, in our cross-country growth regressions we find a statistically significant and robust effect of PA-to-GDP growth on economic growth and this effect is approximately 0.24-0.30 percentage point on GDP growth per 10% PA-to-GDP growth. Our interaction terms between PA-to-GDP growth and funded is positive and hints towards a larger effect of PA-to-GDP growth of the already funded countries. These relationships are stable; there is no indication that pension funding makes countries more vulnerable during the financial crisis.

Table II : Robustness tests Cross-country growth regressions

Table J: Robustness tests with 2.5% Winsorization and 1% trimming of outliers. Dependent variable: GDP growth in local currency and current prices. For a more detailed description we refer to Table 3 in our paper. *, ** and *** denote significance at 95%, 99% and 99.9% respectively.

2.5% Winsorized	LSDV			OLS			OLS fixed effects		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)	(1c)	(2c)	(3c)
$GDP\ growth_{c,t-1}$	0.453***	0.438***	0.424***	0.624***	0.610***	0.608***	0.299***	0.286***	0.274***
	(0.077)	(0.080)	(0.078)	(0.053)	(0.056)	(0.058)	(0.055)	(0.057)	(0.058)
$PA\ growth_{c,t-1}$	0.040**	0.043**	0.043**	0.039**	0.040**	0.044*	0.041**	0.044**	0.047*
	(0.014)	(0.014)	(0.015)	(0.014)	(0.014)	(0.016)	(0.015)	(0.015)	(0.018)
$Rate\ of\ return_{c,t-1}$	-0.058	-0.059	-0.067	-0.044	-0.041	-0.055	-0.061	-0.062	-0.069
	(0.037)	(0.037)	(0.042)	(0.045)	(0.045)	(0.048)	(0.039)	(0.040)	(0.042)
$Inv\ old\ age\ dep\ growth_{c,t-1}$		0.591*	0.643*		0.218	0.228		0.595*	0.656*
		(0.299)	(0.308)		(0.173)	(0.179)		(0.288)	(0.266)
$Stocks\ to\ GDP\ growth_{c,t-1}$		0.001	0.001		0.004	0.003		0.001	0.000
		(0.004)	(0.004)		(0.003)	(0.003)		(0.004)	(0.004)
$PA\ growth_{c,t-1} * funded$			0.007			0.070*			0.044
			(0.027)			(0.029)			(0.023)
$PA\ growth_{c,t-1} * crisis$			-0.022			0.004			0.018
			(0.032)			(0.050)			(0.046)
$PA\ growth_{c,t-1} * crisis * funded$			0.028			0.037			0.059
			(0.051)			(0.057)			(0.054)
N	299	299	299	299	299	299	299	299	299
adj. R-sq	-	-	-	0.635	0.636	0.637	0.593	0.598	0.595

1% trimmed	LSDV			OLS			OLS fixed effects		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)	(1c)	(2c)	(3c)
$GDP\ growth_{c,t-1}$	0.409***	0.392***	0.367***	0.594***	0.582***	0.584***	0.253***	0.232**	0.223**
	(0.062)	(0.063)	(0.066)	(0.059)	(0.062)	(0.064)	(0.066)	(0.066)	(0.075)
$PA\ growth_{c,t-1}$	0.039***	0.042***	0.044**	0.025*	0.026*	0.027*	0.025*	0.028**	0.028**
	(0.011)	(0.011)	(0.014)	(0.009)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)
$Rate\ of\ return_{c,t-1}$	-0.054	-0.055	-0.065	-0.023	-0.021	-0.042	-0.048	-0.050	-0.062
	(0.035)	(0.035)	(0.037)	(0.050)	(0.049)	(0.056)	(0.044)	(0.043)	(0.047)
$Inv\ old\ age\ dep\ growth_{c,t-1}$		0.710	0.806*		0.225	0.228		0.747**	0.809**
		(0.391)	(0.400)		(0.191)	(0.195)		(0.270)	(0.263)
$Stocks\ to\ GDP\ growth_{c,t-1}$		-0.000	-0.001		0.004	0.003		-0.001	-0.001
		(0.004)	(0.004)		(0.003)	(0.003)		(0.004)	(0.005)
$PA\ growth_{c,t-1} * funded$			-0.001			0.062*			0.034
			(0.039)			(0.030)			(0.024)
$PA\ growth_{c,t-1} * crisis$			-0.041			-0.002			0.002
			(0.028)			(0.050)			(0.053)
$PA\ growth_{c,t-1} * crisis * funded$			0.060			0.042			0.059
			(0.058)			(0.054)			(0.055)
N	292	292	292	292	292	292	292	292	292
adj. R-sq	-	-	-	0.594	0.596	0.595	0.547	0.555	0.553

Table III: structure of pension asset allocations

Pension asset allocation	2001	2011	Rate of return indicator
(1) Bills & bonds	44.32%	41.61%	Bond indices
(2) Cash & Deposits	5.81%	7.01%	Cash indices
(3) Hedge funds	0.00%	0.29%	Average of the 3 indices
(4) Land and buildings	3.10%	2.44%	Stocks indices
(5) Loans	3.39%	2.69%	Bond indices
(6) Mutual funds	13.30%	24.56%	Sum of (7) till (11)
(7) of which: bonds	29.29%	33.26%	Bond indices
(8) of which: cash	1.87%	1.96%	Cash indices
(9) of which: land	0.04%	7.02%	Average of the 3 indices
(10) of which: shares	30.72%	21.29%	Stocks indices
(11) of which: others	38.08%	36.47%	Average of the 3 indices
(12) Other investments	6.10%	4.56%	Average of the 3 indices
(13) Private equity funds	0.00%	0.78%	Average of the 3 indices
(14) Shares	21.37%	11.62%	Stocks indices
(15) Structured products	0.06%	0.74%	Average of the 3 indices
(16) Unallocated insurance contracts	2.55%	3.69%	Average of the 3 indices
Total	100.00%	100.00%	

Table IV: variable description, DataStream ESNM codes

Variable	Description	Source	Years
PA	Total pension assets as share of GDP	World Bank (IT), BOJ (Japan), OECD(others)	1999-2011
GDP	GDP per capita, at current prices and local currency	World Bank	1970-2012
$Inv\ old\ age\ dep$	1 / Age dependency ratio, old (% of working-age population)	World Bank	1970-2012
$Stocks\ to\ GDP$	Stocks traded, total value (% of gdp)	World Bank	1970-2012
USGBILL3	Cash returns - US TREASURY BILL RATE - 3 MONTH (EP)	Datastream	1972-2012
SWPRATE	Cash returns - SW 3 MONTH LIBOR TARGET RATE	Datastream	1972-2012
MSWRLDRI	Stocks returns - MSCI WORLD U$ - TOT RETURN IND - GROSS	Datastream	1970-2012
SPCOMPRI	Stocks returns - S&P 500 COMPOSITE - TOT RETURN IND - GROSS	Datastream	1989-2012
LHMGAGGMV	Bond returns - BARCLAYS GLOBAL AGGREGATE - MARKET VALUE	Datastream	1991-2012
IBEURALMV	Bond returns - IBOXX EURO OVERALL INDEX ALL MATS. - MARKET VALUE	Datastream	1999-2012
JGGIALCMV	Bond returns - JPM GBI GLOBAL ALL MATS. (LOC) - MARKET VALUE	Datastream	2004-2012

Rate of return on stocks, bonds and short-term cash for the 2001-2011 period.

Variable	Mean	Std.Dev	Min	Max	Obs
USGBILL3	1.95%	1.62%	0.06%	4.70%	N = 374
SWPRATE	1.16%	0.97%	0.15%	2.96%	N = 374
cash_combi_ret	1.56%	1.19%	0.11%	3.38%	N = 374
MSWRLDRI_ret	2.08%	23.16%	-51.64%	29.09%	N = 374
SPCOMPRI_ret	1.47%	20.65%	-46.20%	25.22%	N = 374
stock_combi_ret	1.78%	21.83%	-48.92%	27.15%	N = 374
LHMGAGGMV_ret	10.32%	6.12%	-3.12%	18.98%	N = 374
IBEURALMV_ret	7.69%	5.22%	0.15%	16.83%	N = 374
JGGIALCMV_ret	12.04%	7.41%	-4.52%	18.85%	N = 272
bonds_combi_ret	10.12%	4.88%	-0.91%	18.04%	N = 374
BSC	4.48%	7.30%	-12.01%	14.48%	N = 374

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