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**DOI**

[10.1007/s10645-018-9325-z](https://doi.org/10.1007/s10645-018-9325-z)

**Publication date**

2018

**Document Version**

Final published version

**Published in**

De Economist

**License**

CC BY

[Link to publication](#)

**Citation for published version (APA):**

Bijlsma, M., Bonekamp, J., van Ewijk, C., & Haaijen, F. (2018). Funded Pensions and Economic Growth. *De Economist*, 166(3), 337-362. <https://doi.org/10.1007/s10645-018-9325-z>

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# Funded Pensions and Economic Growth

Michiel Bijlsma<sup>1</sup> · Johannes Bonekamp<sup>2</sup>  · Casper van Ewijk<sup>3</sup>  ·  
Ferry Haaijen<sup>4</sup>

Published online: 21 June 2018  
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## Abstract

If larger pension savings lead to deeper capital markets, this can be expected to have a positive effect on economic growth in particular for firms that rely on external finance. We employ this differential impact on firms with less or more external finance to identify the effect of pension saving on economic growth. Using data for 69 industrial sectors in 34 OECD countries for the period 2001–2010, we find a significant impact of pension assets on growth for sectors that are more dependent on external financing. This relation is not significantly changed by the 2007–2008 banking crisis.

**Keywords** Funded pensions · Financial structure · Economic growth

**JEL Classification** C23 · J26 · O43

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This paper is supported by the MoPAct (Mobilising the potential of active aging) Program of the EU Seventh Framework program.

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✉ Casper van Ewijk  
c.vanewijk@uva.nl

Michiel Bijlsma  
m.j.bijlsma@cpb.nl

Johannes Bonekamp  
J.L.M.Bonekamp@uvt.nl

Ferry Haaijen  
f.haaijen@gmail.com

- <sup>1</sup> CPB Netherland Bureau for Economic Policy Analysis, Tiltec, Department of Economics, Tilburg University, Tilburg, The Netherlands
- <sup>2</sup> Tilburg University and Netspar, Tilburg, The Netherlands
- <sup>3</sup> University of Amsterdam and Netspar, Amsterdam, The Netherlands
- <sup>4</sup> De Nederlandsche Bank, Amsterdam, The Netherlands

## 1 Introduction

Many countries promote private pension saving in response to population ageing and the rising burden of PAYG (pay-as-you-go) pensions (OECD 2017). A larger role of funded pensions is seen as necessary to keep up individual pensions. Moreover it could strengthen economic growth by deepening capital markets (World Bank 1994). Pension saving may directly fuel economic growth by providing more funds for investment. In addition, and maybe more important, funded pensions may deepen private capital markets thereby leading to better allocation of capital, and thus improving overall efficiency. Larger pension saving could also strengthen the role of institutional investors which can be expected to more be committed to long term investment (e.g. Lakonishok et al. 1992). Finally, these institutional investors may increase efficiency in firms directly by improving governance by acting as large shareholders (Thomas and Spataro 2016).

Although the arguments for a positive effect on growth seem convincing at first sight, such a positive effect of pension savings on economic growth is hard to substantiate in empirical studies. Direct tests of the impact of pension saving on growth in aggregate cross-country regressions (see e.g. Davis and Hu 2008; Zandberg and Spierdijk 2013) typically suffer from endogeneity and causality problems. Moreover, the number of observations (i.e. countries) is relatively small compared to the many diverse factors that may affect pensions and growth.

In this paper we follow a different approach. If direct evidence of an impact of pensions on growth is hard to get, we can look for a ‘smoking gun’ by focusing on the transmission mechanism. This method is established in a seminal paper by Rajan and Zingales (1998), and followed by others when investigating the impact of financial development on growth (see Pasali (2013) for a survey). Our study fits in this tradition, but focuses on the pension system as one of the key determinants of the financial system. The hypothesis is as follows: if larger pension funding leads to deeper capital markets, one would expect especially those firms to benefit that rely stronger on external finance. Thus, we focus on the interaction between an industry’s dependence on external finance with the size of pension assets at the national level. This approach mitigates the endogeneity problem that is innate in standard regressions for pension savings and growth.

We study the effect of pension assets on economic growth using a data set for 69 manufacturing industries in 34 OECD countries for the period 2001–2010. We find that pension savings have a positive effect on the growth in sectors that rely more on external finance relative to sectors with less external finance. One has to be careful to interpret this as a positive effect on growth at the aggregate level. The estimates refer to the differential effect on growth in industries. Yet it is interesting to get some indication of the potential effect on growth through this causal mechanism. Under some assumptions we may conjecture that an increase in pension assets as a fraction of GDP by 40 percentage points would increase growth for the sector with average external dependency by 0.24 percentage points.

Interestingly, this positive relation between pension funding and growth is not significantly changed during the banking crisis. This is relevant as there have been concerns that larger pension funding may have a negative side-effect on the banking sector

(Davis 1998; Cecchetti et al. 2011). With pension funds and insurance companies taking over some of the financial intermediation activities this may draw long term savings away from banks, thus weakening their deposit base (Davis and Steil 2004). This could have made banks more vulnerable during the financial crisis, with detrimental effects for credit and growth. Our results, however, give little support for this concern.

Our paper contributes to the sparse empirical literature on the effect of pension systems on economic growth.<sup>1</sup> Davis and Hu (2008) find a positive effect of pension savings on output 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 lead to an increase in output by 0.14% in the long run. In general, for emerging countries stronger effects are found than for the OECD countries. These positive results are not confirmed in the study of Zandberg and Spierdijk (2013). Using standard cross-country regressions, they find no significant effects of pension savings on economic growth in the 2001–2010 period for 54 OECD and non-OECD countries. 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. This finding is, however, not robust to exclusion of individual countries. Some other papers focus on the impact of pension reforms on aggregate savings. Samwick (2000) shows that countries with PAYG pensions tend to have lower aggregate saving rates than countries with funded pensions. Similar results were found by Bailliu and Reisen (1998) for both OECD countries and developing countries. Finally, in a recent study Altiparmakov and Nedelkovic (2018) analyze the growth consequences of carve-out pension privatization in Latin America and Eastern Europe. Applying different econometric methods on a panel of 36 countries over the period 1990–2013 they find only limited impact on aggregate savings, and no statistically significant effects on growth.

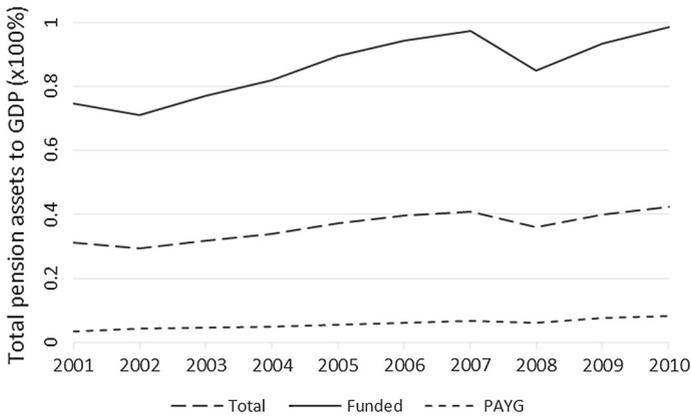
Our paper also relates to a much larger literature on financial structure and economic growth. Although for low levels of financial development the consensus is that more finance—as measured by bank credit or stock market turnover—enhances growth, conclusions are mixed for higher levels of financial development, see e.g. the literature reviews by Levine (2005), Ang (2008) and Pasali (2013) and the meta studies by Valickova et al. (2015) and Arestis et al. (2015). Our study shows that taking into account the pension system could be a relevant factor in assessing the impact of the financial structure on growth.

More specific, the Rajan–Zingales methodology has been used in several papers studying the impact of the financial sector on economic growth. Dell’ariccia et al. (2008) use the methodology to identify the impact of banking crises on the real economy, Laeven and Valencia (2013) to find the effect of financial sector intervention on the real economy, and Beck et al. (2016) for the impact of financial innovation on growth and volatility. Typically these papers look at period averages for growth. Our paper distinguishes from this literature by using a panel, for the period 2001–2010.

The 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

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<sup>1</sup> Also the theoretical literature is quite scarce, and most of the time focuses on aggregate savings and portfolios, see e.g. Staveley-O’Carroll and Staveley-O’Carroll (2017).



**Fig. 1** Total pension assets-to-GDP for ‘funded pensions’ countries and ‘PAYG’ countries, 2001–2010  
*Source:* OECD Database (2013). *Notice:* 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

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 discusses the robustness of the results, and Sect. 6 concludes.

## 2 Funded Pensions, Financial Intermediation and Economic Growth

The role of funded 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 PAYG pensions. The growing importance of pension savings is illustrated in Fig. 1. Despite the considerable losses due to the financial crises in 2002 and 2008, total pension assets relative to GDP increased by 11 percentage points in OECD countries, from 31% on average in 2001 to 42% in 2010.<sup>2</sup> Most of the increase is driven by OECD countries with already larger funded pension systems. The ratio of pension assets for this group increased with nearly 25 percentage points from 74.7 to 98.6%. However, also for the average PAYG country the ratio of pension assets more than doubled from 3.4 to 8.2%. Despite this common trend for pension savings to increase, great diversity remains across individual countries as illustrated by Table 1. In general countries with Bismarckian PAYG systems possess less pension assets than Beveridgean countries that more rely on (private) funded pensions. These latter countries feature pension assets ratios that even may exceed 100% of GDP, which can be expected to have a substantial impact on the financial landscape in these countries. Pension policies are typically determined at the national level, and are subject to specific historical and political circumstances, and are sometimes erratic.<sup>3</sup>

<sup>2</sup> Unweighted average for all 34 OECD countries (Source: OECD—total pension assets to GDP statistics). For a detailed description, see “Appendix 1”.

<sup>3</sup> The recent incidents in Poland and Hungary where private pensions were re-nationalized—mainly for budgetary reasons—fall outside the scope of our observation period.

**Table 1** Pension assets as a ratio to GDP for ‘funded pensions’ countries and ‘PAYG’ countries, 2001–2010. *Source:* OECD Database (2013), Bank of Japan (2013)

‘PAYG’ countries		‘Funded pensions’ countries	
Country	Total pension assets to GDP (in %)	Country	Total pension assets to GDP (in %)
Greece	0.01	Israel	34.65
Luxembourg	0.87	Ireland	43.23
Turkey	0.91	Sweden	46.89
Slovakia	2.53	Chile	59.53
Slovenia	2.62	Japan	66.06
Italy	3.07	Finland	72.46
Estonia	3.32	United Kingdom	73.72
Czech Republic	4.25	Australia	85.91
Belgium	4.26	Switzerland	109.14
Germany	4.26	Netherlands	114.34
Austria	4.50	United States	114.36
Norway	6.56	Iceland	115.43
France	6.66	Canada	116.21
Hungary	8.68	Denmark	136.30
Korea	8.97		
Poland	9.12		
Mexico	9.34		
Spain	11.66		
New Zealand	12.41		
Portugal	13.47		

Unweighted average of pension assets-to-GDP for all 34 OECD countries. Funded (PAYG) countries have pension assets of more than (less) 25% of nominal GDP in 2002

There are several mechanisms that can potentially explain a positive impact of the size of funded pensions on economic growth. There are two broad categories of explanations.

1. Pension savings may lead to deeper and more efficient capital markets. Pension savings directly increase funds in capital markets available for private investment. In addition, deeper capital markets may lead to better allocation of capital, thereby improving overall efficiency and economic growth (Wurgler 2000).
2. Higher pension savings may affect the financial landscape, increasing the weight of institutional investors as pension funds and life-insurance companies. Given the long maturity of liabilities of these institutional investors, they can afford to make long-term investments, for example through long-term equity stakes. Pension funds and insurance companies are generally found to behave as long term investors (e.g. Lakonishok et al. 1992). Furthermore, 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 (Davis and Steil 2004).

In contrast to these positive effects, there are also concerns that higher pension savings could have adverse effects through their impact on banks. This could happen if larger capital funding of pensions diverts private savings from banks to pension funds and life-insurance companies, thereby weakening the base of stable household deposits for banks. This could be aggravated if better prospects on pension income induce households to lengthen their balance sheets by taking on more mortgage and other debt (Davis 1998; Cecchetti et al. 2011). Larger funding gaps of banks in countries with strong funded pensions imply 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 closing the financing gap, but it may increase liquidity risks in bad states of the world. Cecchetti et al. (2011) argue that higher loan-to-deposit ratios and larger funding gaps are associated with worse performance during the banking crisis. This would imply that the impact of pension assets on economic growth is less favorable, or even negative, in particular in bad states of the world. In the subsequent empirical analysis we check this by examining whether the relation between pensions assets and economic growth was changed during the banking crisis.

### 3 Method and Data

We analyze the effect of pension assets on economic growth in OECD countries for the period 2001–2010 using a cross-industry, cross-country regression focusing on the difference in dependence on external finance across manufacturing industries.<sup>4</sup> 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 defined as the gap between capital expenditures on fixed assets and the cash flow from operations taken as a fraction of capital expenditures on fixed assets:

$$\begin{aligned} & \textit{External dependence} \\ & = \frac{\textit{Capital expenditures on fixed assets} - \textit{Cash flows from operations}}{\textit{Capital expenditures on fixed assets}}. \end{aligned} \quad (1)$$

Rajan and Zingales have constructed the index using data for listed US (United States) firms, and extended it to the industry level. By using data for the US—the country with the best developed financial markets—the observed external dependence can be considered as being determined by structural firm characteristics (i.e. technology) rather than—possibly restrained—capital market conditions. The authors argue that differences in external dependence are persistent and essentially technologically determined, and therefore typical for an industry over time and across countries.

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 contributes to deeper and more efficient financial markets. Essentially we

<sup>4</sup> For a detailed description of the data, see “Appendix 1”.

estimate the impact of differences in pension systems across countries—as measured by the size of pension assets as a percentage of GDP—on similar industries with a particular external dependency, taking the US sectors as a benchmark. More specific, we test whether an industry with a large external dependence (*ED*) grows more in countries with large pension assets (*PA*) compared to sectors with small *ED*.

Equation (2) shows the basic model with cross-industry, cross-country fixed effects. In addition, we include a crisis dummy to see whether the relation changed during the banking crisis, or even might have changed sign.

$$y_{c,i,t} = constant + \alpha y_{c,i,t-1} + \beta_1 IS_{c,i,t-1} + \beta_2 [PA_{c,t-1} ED_i] + \beta_3 [PA_{c,t-1} ED_i crisis_t] + \mu_{c,i} + \gamma_{c,t} + \varepsilon_{c,i,t} \tag{2}$$

Here, the dependent variable  $y_{c,i,t}$  is the value-added growth (in logs) for sector  $i$  in country  $c$  and year  $t$ ,  $\mu_{c,i}$  denotes country-industry fixed effects and  $\gamma_{c,t}$  denotes country-time fixed effects.  $IS_{c,i,t-1}$  is the size of sector  $i$  in country  $c$  relative to total manufacturing of that particular country<sup>5</sup>; 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 US is excluded from the regression because it is the benchmark for external dependence per industry. Because of the endogeneity issues<sup>6</sup> arising due to presence of a lagged dependent variable on the right-hand side in Eq. (1), we estimate the model using the two-step system<sup>7</sup> GMM estimator of Blundell and Bond (1998) with the Windmeijer (2005) correction for the standard errors.

To examine whether the relation of pension assets and economic growth might have changed during the crisis, we also include a crisis dummy in the interaction term  $PA_{c,t-1} ED_i crisis_t$ . We expect the coefficient on this term to be negative if the crisis has hit countries with large funded pensions harder, and firms with large external financing suffer from impaired bank lending in particular. We define the crisis period dummy to be one from 2008 to 2010 and zero otherwise in our preferred model specification.

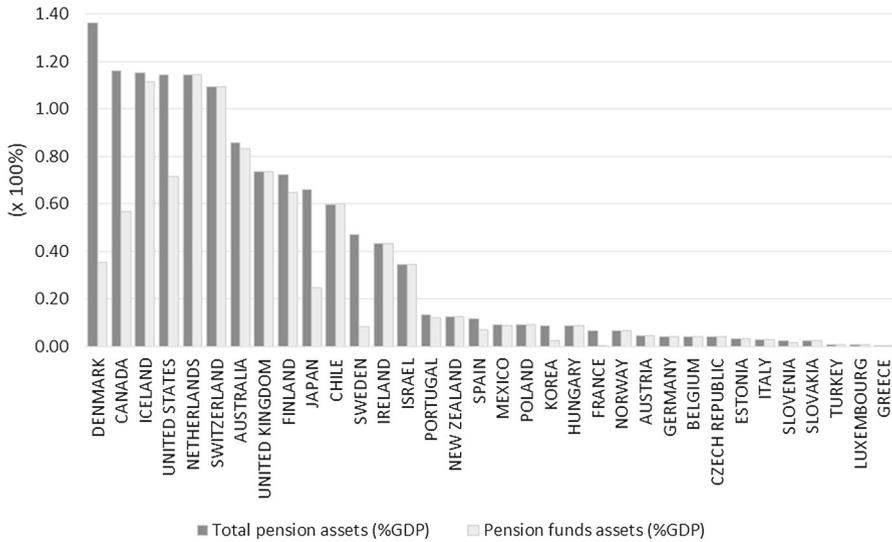
Our panel includes all 34 OECD countries and 69 manufacturing industries. The OECD provides annual data on total pension assets relative to its country’s nominal *GDP* (current prices, local currency) for all OECD countries in the 2001–2010 period.<sup>8</sup> Total pension assets comprise pension fund assets, pension insurance contracts, funds managed as part of financial institutions and the value of funds book reserve systems.

<sup>5</sup>  $IS_{c,i,t-1} = \frac{IndustrySize_{c,i,t-1}}{\sum_{i=1}^n IndustrySize_{c,i,t-1}}$  where the sum of total value added is given as a variable in the INDSTAT dataset.

<sup>6</sup> Note that  $y_{c,i,t-1}$  endogenous to the fixed effects (in the error term). In the academic literature this is known as the “dynamic panel bias” (Roodman 2006). Both OLS and LSDV will thus lead to biased estimates (Nickell 1981).

<sup>7</sup> To strengthen the instrument set without using outside instruments, we prefer to use system GMM over first-differenced GMM, as suggested by Bond et al. (2001).

<sup>8</sup> See <http://www.oecd.org/finance/private-pensions/globalpensionstatistics.htm>.



**Fig. 2** Total pension assets-to-GDP and pension funds assets-to-GDP, 2001–2010

We prefer this broad measure of pension assets over the series for ‘pension funds assets’ also supplied by the OECD, although the role of pension funds with regard to economic performance could also be interesting per se. We therefore perform a robustness test (Sect. 5) using the data for pension funds assets. The difference between the two definitions of pension assets for each country is illustrated in Fig. 2.

Missing pension asset data for Japan are complemented by total *PA*-to-*GDP* ratio from the Bank of Japan.<sup>9</sup> Limited availability of industry data (INDSTAT) and a change in sector classification 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 1862 unique country and sector combinations. The panel is not perfectly balanced; there are some missing years for specific countries or industries.

Our estimation period 2001–2010 is more recent than the period 1980–1989 for which the *ED* index was constructed by Rajan and Zingales. This raises the question whether this index is still relevant. According to the authors the index may be expected to be robust across countries and over time as technological characteristics of sectors are persistent. Indeed, several papers use this index when analyzing growth in more recent periods (e.g. Laeven and Valencia 2013). Yet the assumption that technological characteristics of sectors are persistent may not be fully obvious. For example, it is well-known that firms feature a life-cycle pattern with larger needs for external finance early in life and, and less external funding when becoming more mature. Rajan and Zingales, however, show that this is true for individual firms only in the very early

<sup>9</sup> 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.

**Table 2** Descriptives

Variable (2001–2010)	Mean	SD	Min	Max	Obs.
<i>Value added growth</i>					
Overall	0.013	0.282	− 5.508	3.229	$N = 13,682$
Between		0.143	− 0.919	3.229	$n = 1862$
Within		0.263	− 4.939	2.976	$\bar{T} = 7.3$
<i>Industry size</i>					
Overall	0.013	0.022	0.000	0.566	$N = 13,682$
Between		0.021	0.000	0.356	$n = 1862$
Within		0.007	− 0.240	0.332	$\bar{T} = 7.3$
<i>External dependence</i>					
Overall	0.210	0.402	− 1.530	1.470	$N = 13,682$
Between		0.412	− 1.530	1.470	$n = 1862$
Within		0.000	0.210	0.210	$\bar{T} = 7.3$
<i>PA-to-GDP ratio</i>					
Overall	0.330	0.402	0.000	1.654	$N = 13,682$
Between		0.397	0.000	1.456	$n = 1862$
Within		0.067	− 0.048	0.764	$\bar{T} = 7.3$

stages of life; thereafter the need for external finance proves to be stable. Moreover, at industry level it can be expected that life cycles of individual firms average out as the formation of firms is spread over time. Indeed, several papers have checked robustness by constructing the measure with more recent data yielding similar results. For example, Laeven and Valencia recalculated the index for an extended observation period 1980–2010, and found a correlation of 75% with the original Rajan–Zingales data. Earlier, Kroszner et al. (2007) found a similar result when comparing the external dependency in the 1980s and the 1980–1999 period (correlation 82%).

Rajan and Zingales distinguish 36 manufacturing industries which has been extended to 70 manufacturing industries at four digit ISIC level by Raddatz (2006). The authors take the median of the (time-averaged) external dependence of all listed firms per sector in the 1980–1989 period to compute the aggregate external dependence ratio. 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).<sup>10</sup> We use the original Rajan–Zingales set as has been enlarged by Raddatz.

Table 2 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.<sup>11</sup>

<sup>10</sup> See “Appendix 1”, Table 7 for all ratios.

<sup>11</sup> Further details about data adjustments for the value added data is elaborated in “Appendix 1”.

## 4 Empirical Results

In this section we estimate the model in Eq. (2). The results are summarized in Table 3 for our baseline model, first without crisis dummy and then including this dummy. To account for country- and sector-specific effects, as well as for omitted variables, each regression includes country-industry and country-year fixed effects with standard errors clustered by country-industry. Furthermore, in line with Kroszner et al. (2007), we winsorize 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 size variable are winsorized capping the top 1% ratio from  $0.57$  to  $0.10$ , and is normalized. The *PA-to-GDP* ratio has no extreme outliers. External dependence does have an extreme outlier; we cap (negative) external dependence from  $-1.53$  to  $-0.6$ .<sup>12</sup> Moreover, we normalize external dependence so that it ranges from 0 for the sector with the lowest *ED* and 1 for the sector with the highest *ED*. The GMM results are given in columns (1) and (2). The *p*-values for the Hansen test indicate that the null hypothesis for joint validity of the instruments is not rejected at conventional levels. The same holds for the Arellano–Bond test for no second-order correlation in differences. For the sake of completeness, also the biased OLS and least square dummy variables (LSDV) estimations are reported, in columns (3) to (6).

In correspondence with Rajan and Zingales (1998), we find that large industry size in the previous period has a negative effect on growth (see column (1) in Table 3). The intuition behind this result is that saturated markets with high industry sizes and more competition inevitably hinder growth. The results for the key interaction  $PA_{c,t-1} * ED_i$  are significant at the 99% confidence level in all models and, moreover, stable across alternative specifications of the model when estimated by system GMM (see column (1) in Tables 3, 8 in “Appendix 2”). Larger pension savings 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.

The estimates apply to the growth differential between industries with less or more external dependence. In order to obtain some feeling for the size of the effect we can follow Rajan and Zingales and calculate the effect of an increase in pension assets (*PA*) going from the 25th to the 75th percentile (per country) on the growth differential between the sectors with the 75th percentile and 25th percentile in external dependence (*ED*). For our model this gives an increase in growth of 0.6 percentage points for the sector with higher external dependence (0.35) relative to the sector with lower external dependence (accidentally 0.00) when pension assets rise from 6 to 67%.

Still, this gives only information on the growth differential between sectors. Strictly spoken our analysis delivers no result for the effect of pension assets on growth in absolute terms. Yet it could be interesting to have some impression of the possible size of aggregate effect. Therefore we could make the following conjecture following Raddatz (2006); if the impact of higher pension assets on growth would be zero for the sector with the lowest *ED*, then we find that an increase in pension assets as a

<sup>12</sup> As an additional robustness check, we estimate the model without capping the external dependence outlier. This does not affect the point estimate and *t*-statistic (rounded at two decimals).

**Table 3** Main results. Dependent variable value-added growth per sector ( $y_{c,i,t}$ )

	(1) SYS-GMM second-lag instruments	(2) SYS-GMM second-lag instruments	(3) OLS	(4) OLS	(5) LSDV	(6) LSDV
$y_{c,i,t-1}$	-0.0943*** (-5.39)	-0.0946*** (-5.40)	-0.111*** (-8.14)	-0.112*** (-8.17)	-0.209*** (-14.07)	-0.210*** (-14.17)
$IS_{c,i,t-1}$	-0.133*** (-7.04)	-0.132*** (-7.02)	0.0399*** (3.47)	0.0395*** (3.41)	-1.069*** (-8.57)	-1.072*** (-8.60)
$PA_{c,i,t-1} * ED_i$	0.0595** (2.86)	0.0804*** (3.37)	-0.0317*** (-3.61)	0.0157 (1.72)	0.651*** (3.97)	0.987*** (4.50)
$PA_{c,i,t-1} * ED_i * crisis_t$		-0.0762 (-1.21)		-0.178*** (-7.45)		-0.199* (-2.43)
<i>Constant</i>	-0.180*** (-7.38)	-0.167*** (-6.20)				
Observations	11,887	11,887	11,887	11,887	11,887	11,887
Instruments	269	270				
Arellano-Bond test for AR(2) in differences (p-value)	0.460	0.467				
Hansen test of joint validity of instruments (p-value)	0.415	0.409				
<i>Country-industry f.e.</i>	X	X			X	X
<i>Country-time f.e.</i>	X	X			X	X

\*, \*\*, \*\*\* Significance at 95, 99 and 99.9% respectively. Country-time dummies not reported. Estimation of (1) and (2) via two-step system GMM with the Windmeijer (2005) correction. Instrument matrix is not collapsed. Endogenous variable is  $y_{c,i,t-1}$ .  $t$ -statistics clustered by country in parentheses. Note that  $y_{c,i,t-1}$  is endogenous to the fixed effects (in the error term). Both OLS and LSDV will thus lead to biased estimates (Nickell 1981)

fraction of *GDP* by one standard deviation of 40 percentage points (Table 2) would increase growth for the sector with average external dependency of 0.21 (Table 2) by 0.24 percentage points.<sup>13</sup> Obviously, one should be careful in taking our result to the aggregate level.<sup>14</sup>

To investigate whether this relation between pension assets and growth changes during the banking crisis, column (2) in Table 3 includes a dummy for the crisis period (2008–2010) interacted with our key external dependency variable.<sup>15</sup> This variable turns out to be insignificant. Thus, we find no support for the argument that larger pension savings may make the economy more vulnerable for a banking crisis. The coefficient is persistently negative across different specifications and robustness tests, however, and in some—non preferred—specifications also statistically significant. So, if anything, there might be some suspicion of a smaller impact of pension funding on growth during the crisis. Our analysis is, however, not able to provide better evidence for such an effect.

Table 3 also reports the OLS and LSDV estimates. As these estimates do not address the endogeneity problem, they will be biased. From Table 3, we observe that results indeed vary across the OLS (column 3) and LSDV specification (column 5). However, the bounds implied by OLS and LSDV for  $y_{c,i,t-1}$  provide a check on the two-step GMM results (Blundell and Bond 2000). According to Roodman (2006), good estimates of the lagged parameter should be within or close to these bounds, which, in our view, holds.

## 5 Robustness of the Results

We have performed a range of additional robustness tests on our preferred specification (see column (1) in Table 3). The main results are reported in Table 4. First, we have redone our initial regressions and take the top and bottom 2.5% of output growth as threshold for winsorization [columns (1) and (2)]. Second, as an alternative to winsorization we trim the 1% outliers [columns (3) and (4)], in the same vein as Dell’Ariccia et al. (2008). Third, noting that several papers correct output growth for inflation, we convert our nominal output growth to real growth with the GDP deflator retrieved from INDSTAT and winsorize the new variable at 1% [columns (5) and (6)]. All these robustness tests produce significant results for the key variable at the 99% confidence level.

Table 5 reports the results when ‘pension fund assets’ is taken as an explanatory variable instead of the broader measure of total pension assets. The results are remark-

<sup>13</sup> Note that the coefficient is estimated for the normalized *ED*; for the impact on growth one has therefore divide the effect by 2.07 being the difference between the highest and the lowest *ED*.

<sup>14</sup> Also for the manufacturing industries one has to treat this figure with care; it may be biased as sectors relying on external finance tend to be smaller in size; the aggregate effect can therefore be expected to be smaller.

<sup>15</sup> As an additional robustness check, 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 and re-estimate our model. This variable turns out to be insignificant as well (estimated coefficient of  $-0.0477$  and a *t*-statistic of  $-0.40$ ).

**Table 4** Robustness checks. Dependent variable output growth per sector ( $y_{c,i,t}$ ) under alternative definitions

	(1)	(2)	(3)	(4)	(5)	(6)
	SYS-GMM second-lag instruments					
$y_{c,i,t-1}$	-0.0860*** (-5.15)	-0.0862*** (-5.17)	-0.0833*** (-5.05)	-0.0834*** (-5.05)	-0.0929*** (-5.30)	-0.0931*** (-5.31)
$IS_{c,i,t-1}$	-0.108*** (-7.04)	-0.108*** (-7.03)	-0.115*** (-7.26)	-0.115*** (-7.26)	-0.132*** (-7.07)	-0.132*** (-7.05)
$PA_{c,i,t-1} * ED_t$	0.0581** (3.21)	0.0732*** (3.44)	0.0728*** (3.90)	0.0788*** (3.67)	0.0599** (2.88)	0.0807*** (3.39)
$PA_{c,i,t-1} * ED_t * crisis_t$	-	-0.0550 (-1.02)	-	-0.0240 (-0.45)	-	-0.0758 (-1.22)
<i>Constant</i>	-0.0308 (-1.19)	-0.0313 (-1.21)	-0.188*** (-7.80)	0.184*** (0.702)	-0.0624* (-2.09)	-0.0630* (-2.11)
Observations	11,887	11,887	11,644	11,644	11,887	11,887
Instruments	269	270	269	270	269	270
Arellano-Bond test for AR(2) in differences ( <i>p</i> -value)	0.755	0.762	0.814	0.820	0.542	0.551
Hansen test of joint validity of instruments ( <i>p</i> -value)	0.378	0.372	0.065	0.065	0.320	0.313
<i>Country-industry f.e.</i>	X	X	X	X	X	X
<i>Country-time f.e.</i>	X	X	X	X	X	X

Robustness test regressions for Table 3. Regressions are similar to Table 3 with one specific alternation. Regressions (1) and (2) winsorize the dependent variable at 2.5%. Regressions (3) and (4) trim the 1% outliers. Regressions (5) and (6) convert the dependent variable from nominal growth to real growth with a GDP deflator retrieved from INDTSTAT

\*, \*\*, \*\*\* Significance at 95, 99 and 99.9% respectively. Country-time dummies not reported. Estimation via two-step system GMM with the Windmeijer (2005) correction. Instrument matrix is not collapsed. Endogenous variable is  $y_{c,i,t-1}$ . *t*-statistics clustered by country-industry in parentheses

**Table 5** Robustness checks. Pension fund assets ( $\widetilde{PA}$ ) instead of total pension assets. Dependent variable output growth per sector ( $y_{c,i,t}$ )

	(1) SYS-GMM second-lag instruments	(2) SYS-GMM second-lag instruments
$y_{c,i,t-1}$	-0.0888*** (-4.90)	-0.0891*** (-4.91)
$IS_{c,i,t-1}$	-0.128*** (-6.56)	-0.127*** (-6.53)
$\widetilde{PA}_{c,t-1} * ED_i$	0.0791** (3.00)	0.108** (3.19)
$\widetilde{PA}_{c,t-1} * ED_i * crisis_t$		-0.120 (-1.26)
Constant	-0.0415 (-1.40)	-0.0418 (-1.41)
Observations	11,119	11,119
Instruments	250	251
Arellano–Bond test for AR(2) in differences ( <i>p</i> -value)	0.432	0.440
Hansen test of joint validity of instruments ( <i>p</i> -value)	0.327	0.330
Country-industry <i>f.e.</i>	X	X
Country-time <i>f.e.</i>	X	X

\*, \*\*, \*\*\* Significance at 95, 99 and 99.9% respectively. Country-time dummies not reported. Estimation via two-step system GMM with the Windmeijer (2005) correction. Instrument matrix is not collapsed. Endogenous variable is  $y_{c,i,t-1}$ . *t*-statistics clustered by country in parentheses

ably similar to those in our baseline model. The coefficient for differential impact of PA is a little higher than in the original model. The banking crisis dummy is still insignificant (and again negative).

Finally, we also check robustness of our results to inclusion of domestic credit to the private sector ( $DCPS_{c,t-1}$ ) and stock market turnover ( $ST_{c,t-1}$ ) as control variables. These variables are often taken as indicators of financial development, for example, in studies on the impact of the financial sector on economic growth (e.g. Rajan and Zingales 1998). It could be argued that countries with larger financial sector may have both more efficient financial markets and high pension savings not endogenous so that the effect of pension assets on growth could be due to spurious correlation. Moreover, checking for the impact of these variables on our results may provide some insight into the underlying mechanism. Table 6 summarizes the results.

First, we find significant positive effects for these financial indicators on economic growth when taken separately from the pension assets variable [columns (2), (3) and (4)]. This corresponds to the results found by Rajan and Zingales. This lends support to the idea underlying our analysis that finance matters for growth. Next, including both pension assets and these control variables, we find diverging results. Stock market turnover has little effect on the relation between pension assets and growth [column (5)]. This is different for the credit variable. Adding this variable keeps the

**Table 6** Robustness checks. Inclusion of other indicators of financial development. Dependent variable output growth per sector ( $y_{c,i,t}$ )

	(1) SYS-GMM second-lag instruments	(2) SYS-GMM second-lag instruments	(3) SYS-GMM second-lag instruments	(4) SYS-GMM second-lag instruments	(5) SYS-GMM second-lag instruments	(6) SYS-GMM second-lag instruments
$y_{c,i,t-1}$	-0.0946*** (-5.67)	-0.0949*** (-5.69)	-0.0944*** (-5.46)	-0.0946*** (-5.47)	-0.0943*** (-5.39)	-0.0944*** (-5.20)
$IS_{c,i,t-1}$	-0.130*** (-7.05)	-0.130*** (-7.05)	-0.129*** (-7.10)	-0.128*** (-7.07)	-0.132*** (-6.94)	0.128*** (-6.92)
$PA_{c,i,t-1} * ED_i$					0.0663** (2.58)	0.0244 (0.73)
$ST_{c,i,t-1} * ED_i$	0.0118 (1.24)	0.0314** (2.93)			-0.00562 (-0.43)	
$ST_{c,i,t-1} * ED_i * crisis_t$		-0.0661** (-2.83)				
$DCPS_{c,i,t-1} * ED_i$			0.0305** (2.75)	0.0453*** (4.18)		0.0207 (1.18)
$DCPS_{c,i,t-1} * ED_i * crisis_t$				-0.0542 (-1.93)		
<i>Constant</i>	-0.0490 (-1.65)	-0.0616* (-2.11)	-0.0572 (-1.92)	-0.0647* (2.20)	0.159*** (5.98)	-0.184*** (-7.09)
Observations	12,983	12,983	12,881	12,881	11,887	11,785
Instruments	290	291	288	289	270	268
Arellano-Bond test for AR(2) in differences ( <i>p</i> -value)	0.256	0.268	0.199	0.207	0.459	0.369

Table 6 continued

	(1)	(2)	(3)	(4)	(5)	(6)
	SYS-GMM second-lag instruments					
Hansen test of joint validity of instruments ( <i>p</i> -value)	0.418	0.421	0.155	0.156	0.417	0.160
Country-industry <i>f.e.</i>	X	X	X	X	X	X
Country-time <i>f.e.</i>	X	X	X	X	X	X

Robustness test regressions for Table 3. Regressions are similar to Table 3 with one specific alternation. Regressions (1) and (2) include the stock traded turnover ratio as percentage of GDP ( $ST_{c,t-1}$ ) instead of  $PA_{c,t-1}$  whereas regressions (3) and (4) include the domestic credit provided by the private sector as percentage of GDP ( $DCPS_{c,t-1}$ ) instead of  $PA_{c,t-1}$ . Regression (5) and (6) include  $ST_{c,t-1}$ , respectively  $DCPS_{c,t-1}$  to the regression of Table 3. \*, \*\*, \*\*\* Significance at 95, 99 and 99.9% respectively. Country-time dummies not reported. Estimation via two-step system GMM with the Windmeijer (2005) correction. Instrument matrix is not collapsed. Endogenous variable is  $y_{c,i,t-1}$ . *t*-statistics clustered by country-industry in parentheses

basis results the same but takes away all significance from the pension assets variable [column (6)]. It should be noted here that the credit variable is strongly correlated with pension assets, with correlation coefficient 0.63. We therefore interpret this result as indicating that pension saving find their way to the private investment at least partly through the banking sector, giving little evidence for the funding gap argument according to which pension saving may crowd-out banking credit by channeling long-term savings away from banks. As a final test we randomly assigned external dependence to sectors in order to check for spuriousness of our results (not reported). We find that results become insignificant.

## 6 Conclusion

Many countries encourage private funded pensions as a supplement to public pensions, which face increasing demographic pressure. It is likely that the role of institutional investors as pension funds and insurance companies in financial intermediation will increase in the future. This may positively affect economic growth as these institutional investors can be expected to be more committed to long term investments. We focus on this feature when analyzing the impact of private pension savings on economic growth. Following Rajan and Zingales (1998), we use the differential impact on firms that less or more rely on external finance to identify the effect on growth, thus mitigating endogeneity issues in standard growth regressions. Using data on 69 manufacturing industry sectors in 34 OECD countries for the period 2001–2010 we find that increased pension savings are associated with higher growth of firms that rely more on external finance. Although our analysis only applies to the growth differential between industries, we may—under some strong assumptions—obtain some indication for the absolute size of the impact through this transmission mechanism. For a sector with average external dependence we then find that an increase in the pension assets to GDP ratio by one standard deviation (40 percentage points) increases growth by 0.24 percentage points for the manufacturing sector with average dependence on external finance.

We do not find support for a change in this relation during the 2008 financial crisis. This may alleviate concerns that larger pension savings may weaken the banking sector by reallocation savings from banks to pensions funds, and thus make the economy more vulnerable to shocks like the banking system.

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## Appendix 1: Data Description

This appendix provides more detailed 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 1999–2010 from INDSTAT. We focus on sectors for which we have the dependence of external financing ratio

Table 7 External dependence ratio per sector

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	1711	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

Table 7 continued

Sector	isic2	isic3	External dependency
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
Printih; uuhng 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
Manufacture of miscellaneous products of petroleum and coal	3540	2310	0.12
Tyre and tube industries	3551	2511	- 0.11

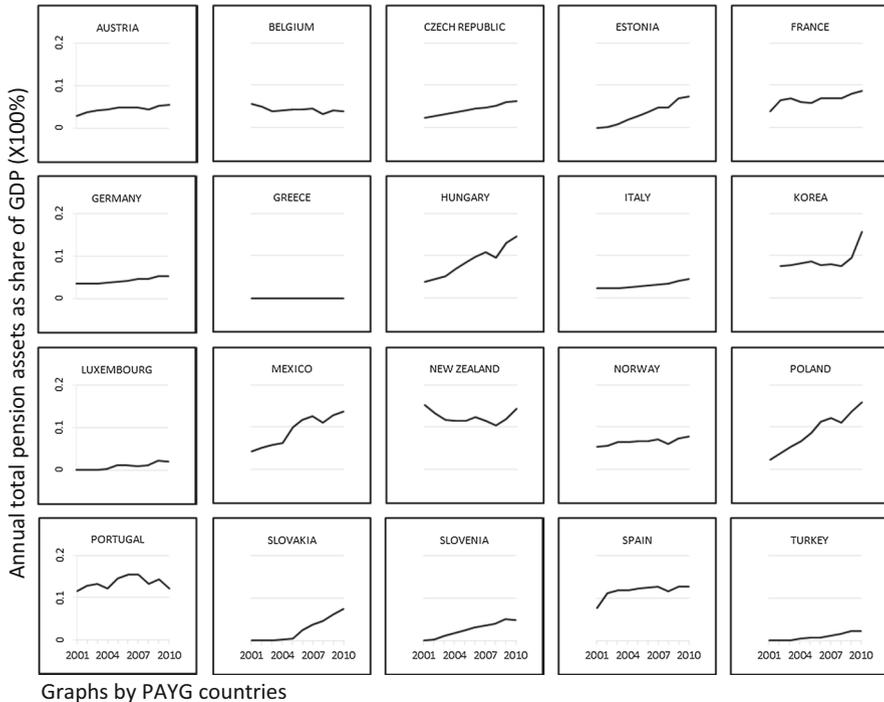
Table 7 continued

Sector	istic2	istic3	External dependency
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

Table 7 continued

Sector	isic2	isic3	External dependency
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 equipment	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

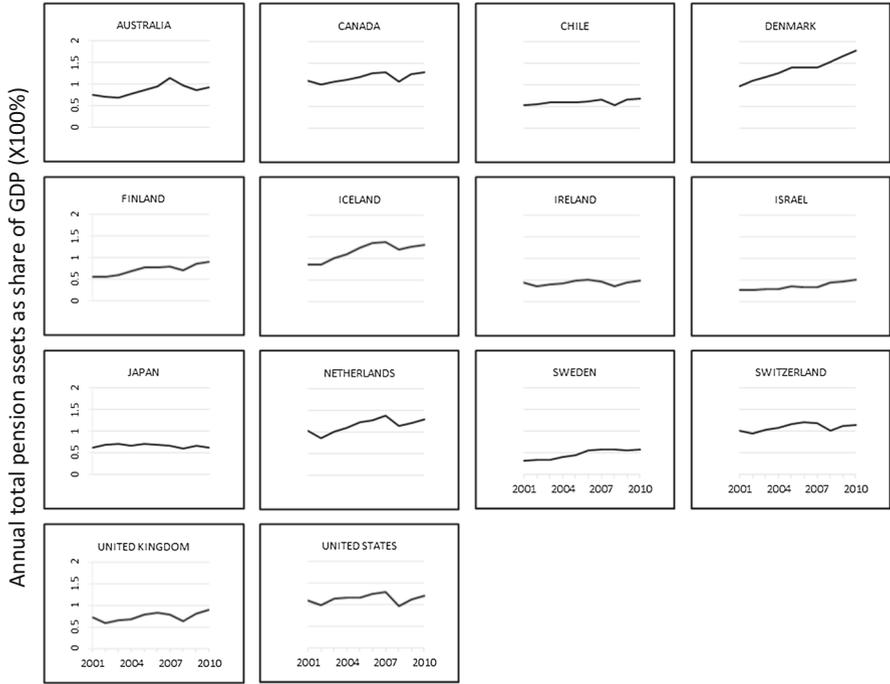
External dependence is the median fraction of capital expenditures not financed with cash flow from operations or each industry (Raddatz 2006). The external dependence ratio is computed over the 1980–1989 period



**Fig. 3** Annual total PA-to-GDP (PAYG countries)

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 can be seen in Table 7 of 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.

Figures 3 and 4 show annual pension assets-to-GDP growth as retrieved from OECD.Stat for all countries included in the sample. Figure 3 shows the external dependence ratio as obtained from Raddatz (2006). Finally, Fig. 2 comparing total pension assets and pension fund assets as percentage of GDP (unweighted average over the ten years period) for all 34 OECD countries is based on the OECD Database (2013).



Graphs by 'funded pensions' countries

Fig. 4 Annual total PA-to-GDP ('funded pensions' countries)

## Appendix 2: Additional Robustness Check

See Table 8.

**Table 8** Robustness check. Different specification of the instrument matrices. Dependent variable output growth per sector ( $y_{c,i,t}$ )

	(1) SYS-GMM collapsed second-lag instruments	(2) SYS-GMM collapsed second-lag instruments	(3) SYS-GMM collapsed instruments	(4) SYS-GMM collapsed instruments	(5) SYS-GMM full instruments	(6) SYS-GMM full instruments
$y_{c,i,t-1}$	-0.0958*** (-5.33)	-0.0998*** (-5.52)	-0.107*** (-6.57)	-0.108*** (-6.59)	-0.110*** (-6.60)	-0.110*** (-6.61)
$IS_{c,i,t-1}$	-0.130*** (-7.01)	-0.131*** (-6.89)	-0.126*** (-6.83)	-0.126*** (-6.80)	-0.112*** (-5.64)	-0.112*** (-5.64)
$PA_{c,i,t-1}$ * $ED_t$	0.0543** (2.59)	0.0763** (3.19)	0.0511* (2.46)	0.0708** (2.97)	0.0673** (2.95)	0.0725** (2.78)
$PA_{c,i,t-1}$ * $ED_t$ * $crisis_t$		-0.0808 (-1.29)		-0.0741 (-1.19)		-0.0221 (-0.31)
<i>Constant</i>	-0.179*** (-7.53)	-0.167*** (-6.31)	-0.180*** (-7.62)	-0.168*** (-6.37)	-0.179*** (-6.84)	-0.175*** (-5.96)
Observations	11,887	11,887	11,887	11,887	11,887	11,887
Instruments	253	254	261	262	305	306
Arellano-Bond test for AR(2) in differences ( $p$ -value)	0.407	0.341	0.247	0.250	0.220	0.219
Hansen test of joint validity of instruments ( $p$ -value)	0.236	0.132	0.262	0.256	0.000	0.000
<i>Country-industry f.e.</i>	X	X	X	X	X	X
<i>Country-time f.e.</i>	X	X	X	X	X	X

\*, \*\*, \*\*\* Significance at 95, 99 and 99.9% respectively. Country-time dummies not reported. Estimation via two-step system GMM with the Windmeijer (2005) correction. Endogenous variable is  $y_{c,i,t-1}$ .  $t$ -statistics clustered by country-industry in parentheses

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