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*Does pension privatization increase economic growth? Evidence from Latin America and Eastern Europe**

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Abstract

Analyses of pension funding effects on economic growth should differentiate between 'carve-out' pension privatization in Latin America and Eastern Europe and typical 'add-on' pension funding in Western Europe and North America. We find no evidence that pension privatization in Latin America and Eastern Europe was associated with higher economic growth. The result is robust across both continents and several alternative econometric specifications. Positive growth effects are particularly unlikely in countries resorting to debt-financed privatization. Furthermore, we note the lack of positive pension privatization effects on savings in Eastern Europe, with limited evidence of positive savings effects in Latin America. These findings suggest that cost-containment parametric reforms should be given priority over carve-out pension privatization when considering options for restoring financial sustainability of public Pay-As-You-Go systems.

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Keywords: Pension funding, economic growth, national saving, emerging economies.

1 Introduction

Following the reform lead of Chile, many countries in Latin America and Eastern Europe have implemented 'carve-out' pension privatization over the past 25 years. This radical reform approach entails partial or complete termination of existing public Pay-As-You-Go (PAYG) pension schemes and the introduction of mandatory private

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individual pension accounts in their place, the so-called 'second pension pillar' in World Bank terminology. The carve-out approach is in contrast to the add-on approach typical in most advanced economies, where private funds develop in the form of (voluntary) supplementary funds on top of public pension schemes. At the time, the professional public was strongly divided regarding the feasibility of carve-out pension privatization. The World Bank (1994) favored pension privatization and argued that it would not only enable higher pensions for future beneficiaries (micro level), but would also accelerate economic growth and increase national saving at the macro level. The opponents challenged most of the expected reform benefits (Beattie and McGillivray, 1995; Singh, 1996; Barr, 2000; Orszag and Stiglitz, 2001).

One of crucial anticipated pension privatization benefits was an acceleration of economic growth that could generate additional resources to meet the future needs of an aging population. If positive effects on economic growth are absent, then it might be more feasible to instead consider parametric reforms that would financially stabilize existing PAYG systems amid demographic aging. At the time pension privatizations were implemented, a beneficial impact on economic growth was expected to arise through various channels. First and foremost, the contributions from privatized pension systems would be saved in individual accounts, thus increasing private savings. Increased savings would then lead to higher aggregate growth rates, provided that these funds were channeled into (productive) domestic investment. Second, privatized funds are used primarily in the local financial market, which could stimulate financial innovation at the local level (Holzmann, 1997), reduce local financial market volatility (Thomas *et al.*, 2014), promote foreign investor participation (Reece and Sam, 2012), and stimulate overall capital market development (Catalan, 2004). Financial development, in turn, has a well-discussed positive impact on economic growth (Demirguc-Kunt and Levine, 2001). Third, pension privatization could also have positive effects on firms' productivity and growth arising from improved corporate governance (Davis, 2002; Davis and Hu, 2008) and higher labor market efficiency (Disney *et al.*, 2004).

This paper aims to expand the existing empirical literature on the cross-country effects of pension funding on economic growth, which has reported mixed results (see Thomas and Spataro, 2016 for a recent survey). While Davis and Hu (2008) document a positive impact of pension asset size to growth in a sample of 38 developed and emerging economies, Zandberg and Spierdijk (2013) find limited impact in the long run and no effect in the short run in their samples of 54 countries. Their findings are in line with Samwick (2000), who finds limited evidence for higher trends in the rate of savings following pension system reforms in a broad sample of developed and emerging economies.

All these studies differentiate between pension funding effects in developed and emerging economies, but they do not distinguish between add-on and carve-out approaches to pension funding. As the result of individual (welfare maximizing) decisions, add-on funding in the form of voluntary supplementary pension funds might be more likely to increase national savings than legally prescribed mandatory carve-out pension privatization. In the latter case, workers can decide to offset mandatory pension savings with reductions in other forms of voluntary saving, or the government might not implement the strict and long-lasting austerity measures required to preclude the emergence of transitional deficits and reductions in public saving (Barr, 2000). Furthermore, Brown (1997) explains that in

order to stimulate growth, any increased national savings need to be channeled into productive investments, which is more likely if the savings are the result of market interactions and welfare-maximizing decisions at the individual level rather than legally prescribed and mandatory. Finally, when assessing the financial development channel to economic growth, Orszag and Stiglitz (2001) highlight that capital market development depends on a myriad of factors, notably adequate institutional capacity and efficient regulation, which are also likely to differ since the add-on approach was typical in developed countries while the carve-out approach was prevalent in developing countries in Latin America and Eastern Europe. Thus, the add-on versus the carve-out approach to pension funding could have different effects on national savings and economic growth, and cross-sectional studies need to control for this possible source of heterogeneity.

In this paper, we focus on investigating the growth and savings effects of carve-out pension privatizations in emerging economies and aim to expand the existing empirical literature, which reports mixed results in this area. Early studies (Holzmann, 1997; Schmidt-Hebbel, 1999) focus on the Chilean experience and find a positive relationship between pension reform and economic growth. Mesa-Lago (2002) examines the experience of Latin American countries in the early years of pension privatization and finds a lack of empirical support for the positive impact on national savings. The independent evaluation group of the World Bank (2006) concluded that 'there is little evidence that privately funded pillars have succeeded in increasing national savings or in developing capital markets'. More recently, the World Bank noted the lack of studies in this area for Eastern Europe (Schwarz and Arias, 2014). We hope to fill this gap and to enrich existing analyses by examining the data from both Eastern Europe and Latin America.

To analyze the impact on growth and savings, we use unbalanced panel data covering 36 comparable countries in Eastern Europe, Central Asia, and Latin America over the 1990–2013 periods. Nine countries in Latin America, ten in Eastern Europe, and one in Central Asia initiated pension privatization at some point in our sample, along with Chile, which privatized earlier. We employ several panel data estimators, controlling for static, dynamic, and time-varying effects of pension reform. The primary variable of interest – pension reform – is defined as the share of an employee's wage that is allocated to private funds in the second pillar. This choice has some useful advantages, among which are that it allows capturing cross-sectional variation in the magnitude of pension privatization reforms and also implicitly controls for potentially endogenous factors that drive the level of gross domestic product (GDP) and the growth of pension assets.

Econometric analysis reveals that carve-out pension privatization failed to produce statistically significant positive impact on the growth rates of reforming countries compared to the general evolution of growth in non-reforming countries. The strength of the impact is even smaller for Eastern European countries. We also find a limited positive impact of pension reform on aggregate savings rates, which become statistically significant only after 7 years following the reform, thus partially explaining the lack of evidence for the growth impact. Furthermore, we uncover an important conditional role of the private pension funds' portfolio allocation: the impact of pension reform on growth was systemically and often statistically significantly lower in countries where government bonds represent the dominant share (above 50%) in the pension funds' portfolios.

This paper is organized as follows. Section 2 describes relevant methodological features and our dataset. Section 3 presents econometric analysis of pension privatization effects on economic growth and national saving. Relevant implications for policy-making are discussed in Section 4, while Section 5 is concluding remarks.

2 Data and methodology description

Pension privatization came in several flavors in Latin America. The Chilean prototype of completely terminating the existing public system and introducing private individual accounts in its place was followed in Bolivia (1997), Mexico (1997), El Salvador (1998), and the Dominican Republic (2003). Argentina (1994), Uruguay (1994), and Costa Rica (2000) opted for partial pension privatization whereby existing PAYG systems were reformed and partially scaled-down to make room for the second pension pillar. Peru (1993) and Columbia (1994) implemented parallel systems whereby workers were given an exclusive choice of participating either in a reformed public PAYG system or in second pillar individual accounts (Mesa-Lago, 2002). In Eastern Europe, all countries opted for the partial pension privatization approach. Hungary initiated the process in 1998 and by 2008 ten Eastern European countries had introduced second pension pillars: Poland (1999), Latvia (2001), Bulgaria (2002), Croatia (2002), Estonia (2002), Lithuania (2004), Slovakia (2005), FYR Macedonia (2006), and Romania (2008). Finally, from Central Asia we include Kazakhstan, which completely privatized its pension system in 1998. Pension funding in all these countries was implemented in the carve-out fashion, with the exception of Estonia, which partially relied on the add-on approach (James, 2005, Table 1).[1]

Our dataset includes annual data for 36 countries in Eastern Europe, Central Asia, and Latin America over the 1990 to 2013 period. Macro-level data for Eastern European and Central Asian countries starts in 1995 to avoid structural breaks and significant outliers appearing in the early transitional period. The data for Latin American countries cover the entire sample.[2] Table 1 shows 21 countries that have implemented pension reform, together with the year of privatization and contribution rates over time. Our identification of the 'treatment effect' thus relies on the data of 15 countries that did not pursue pension privatization and on the pre-reform data for countries that later privatized. The control group of 15 includes Albania, Armenia, Brazil, Czech Republic, Ecuador, Georgia, Guatemala, Honduras, Moldova, Nicaragua, Panama, Paraguay, Slovenia, Turkey, and Ukraine.[3]

By using the second pillar contribution rate as the primary explanatory variable we are able to capture not only cross-country variation, but also within-country variation

[1] In Estonia mandatory private pension funds' (MPFs) contributions total 6% of gross wages with 4% being diverted from the PAYG system and 2% representing additional contributions for workers participating in the second pillar.

[2] The macro data are winsorized at 1% to eliminate the impact of extreme outliers; however, the results for our main variable of interest do not change with or without winsorizing.

[3] In Panama, individual accounts do exist for higher earners. However, this arrangement will not be considered as a second pension pillar for our purposes, as is the case in most other papers in this area. Armenia implemented a second pillar in 2014, but some of the legal provisions have been disputed in the constitutional court.

Table 1. *Second pillar contribution rates, % of earnings*

	1990	1995	2000	2005	2010	2013
Argentina (1994)	0	7.7	7.7	4.4	0	0
Bolivia (1997)	0	0	10.0	10.0	10.5	10.5
Bulgaria (2002)	0	0	0	4.0	5.0	5.0
Chile (1981)	10.0	10.0	10.0	10.0	10.0	10.0
Columbia (1994)	0	10.0	10.0	10.5	11.5	11.5
Costa Rica (2000)	0	0	4.3	4.3	4.3	4.3
Croatia (2002)	0	0	0	5.0	5.0	5.0
Dominican Rep (2003)	0	0	0	6.0	8.0	8.0
El Salvador (1998)	0	0	10.0	10.0	10.3	10.8
Estonia (2002)	0	0	0	6.0	2.0	6.0
Hungary (1998)	0	0	6.0	8.0	8.0	0
Kazakhstan (1998)	0	0	10.0	10.0	10.0	10.0
Latvia (2001)	0	0	0	2.0	2.0	4.0
Lithuania (2004)	0	0	0	3.5	2.0	2.5
Macedonia (2006)	0	0	0	0	7.4	7.4
Mexico (1997)	0	0	4.9	5.0	7.7	7.8
Peru (1993)	0	8.0	8.0	8.0	10.0	10.0
Poland (1999)	0	0	7.3	7.3	7.3	2.8
Romania (2008)	0	0	0	0	2.5	4.0
Slovakia (2005)	0	0	0	9.0	9.0	4.0
Uruguay (1996)	0	0	12.3	12.0	12.0	12.0

Notes: Data sources are explained in Data Appendix.

since many countries progressively increased the second pillar contribution rate after the start of pension privatization, while several countries have also implemented partial or complete reform reversals in recent years. Alternatively, the second pillar annual contribution inflows (as a share of GDP) could be used as the primary explanatory variable. The advantage of this approach would be more precise measurement of relevant variation between different countries and across time, but the drawback is the need to deal with endogeneity issues inherent in its measurement. In addition, comprehensive and comparable data on this variable is not presently available for a broad number of countries in our sample, and this remains a possible avenue for future research.

Another important explanatory variable is the extent to which pension privatization is debt-financed, since the dominance of domestic government bonds in second pillar portfolios represents disguised-PAYG financing and not genuine pension funding (Altiparmakov, 2015). In order to control for this heterogeneity we define a dummy variable that includes only countries where domestic government bonds account for less than half of second pillar portfolios: Chile, Columbia, Dominican Republic, and Peru in Latin America, and Bulgaria, Estonia, Latvia, Lithuania, and Slovakia in Eastern Europe.[4]

[4] This classification is based on Arenas De Mesa and Mesa-Lago (2006) for Latin American countries and national statistics at the end of 2012 for Eastern European economies.

Table 2 presents descriptive statistics for the main dependent variables of interest, growth rate of real GDP per capita and aggregate savings (as percentage of GDP), together with a few other relevant macro variables and control variables used in the empirical analysis. Summary statistics were obtained by first averaging the relevant variables within single countries, whereby for non-privatizing countries data were averaged over the entire time period and for privatizing countries time periods were split into before and after privatization. Then the overall mean values were obtained by using unweighted averaging across countries. Data for Chile were not used since Chile privatized pensions prior to the period covered in our analysis. The sources for all variables are described in the Appendix.

While pension privatization was led by more developed Latin American countries such as Chile and Argentina, the most developed countries in Eastern Europe, Slovenia and the Czech Republic, opted not to privatize.[5] We can nonetheless observe many common features across Latin America and Eastern Europe. Most importantly, there seems to be no obvious relationship between pension privatization and economic growth. GDP growth improved slightly after pension privatization in Eastern Europe and Central Asia, but GDP per capita growth deteriorated. The opposite pattern is observed in Latin America. With respect to the other variable of interest, the average savings rate increased in both Latin America and Eastern Europe after privatization.[6] The same is true for investments, with a more tangible investment increase observed in Eastern Europe (likely due to high foreign investments from Western Europe during the transition process). Furthermore, we can observe reductions in inflation and improvements in political stability in privatizing countries in both Latin America and Eastern Europe. Nonetheless, it should be remembered that the period of pension privatization coincided with other large economic and societal changes – the period of great moderation in the case of Latin America and EU accession in the case of Eastern Europe. We thus turn to formal econometric analysis to isolate the effects of pension privatization on growth and savings.

3 Pension privatization effects on economic growth and national savings

3.1 Framework

In this section, we move to the econometric analysis. In particular, we estimate different variants of the following reduced-form model:

$$y_{it} = a_i + \mu_t + \beta P_{it} + X'_{it-1}\phi + \varepsilon_{it}. \quad (1)$$

The dependent variable y_{it} is the growth rate of real GDP per capita (Section 3.2) and gross domestic savings as percentage of GDP (Section 3.3) in country i at time t. We include country-fixed effects and year fixed effects to control for time-invariant

[5] After prolonged political debate, the Czech Republic did implement a second pillar in 2013, only to terminate it less than a year after it was introduced. Since a marginal number of workers (voluntarily) entered the second pillar in 2013, we will be treating the Czech Republic as a non-privatizing country in this paper.

[6] Domestic saving for non-privatized countries in Eastern Europe is somewhat downward biased due to tangibly negative savings in many years in Albania, Armenia, and Moldova.

Table 2. *Summary description of the data*

	Non-privatized countries mean	Privatized countries mean	
		Before privatization	After privatization
19 Eastern Europe and Central Asia countries, 1995–2013			
GDP growth, in %	3.97	3.25	3.45
GDPpc growth, in %	4.10	4.07	3.86
Govt Consumption (% GDP)	15.89	16.62	17.01
Imports (% of GDP)	51.41	40.30	57.21
Exports (% of GDP)	38.58	35.64	52.31
Inflation (GDP deflator), in %	1.17	1.33	1.05
Domestic savings (% of GDP)	12.31	15.89	21.00
Investment (% of GDP)	23.70	19.55	24.35
Polity Index	7.26	6.48	7.90
Dependency ratio, in %	48.22	49.37	45.92
GDPpc in USD	5571	4753	7984
Unemployment rate, in %	11.13	14.36	12.50
16 Latin America countries, 1990–2013			
GDP growth, in %	3.80	3.82	3.69
GDPpc growth, in %	1.83	2.19	2.49
Govt Consumption (% GDP)	12.24	9.83	12.49
Imports (% of GDP)	42.89	24.80	29.35
Exports (% of GDP)	37.88	21.98	26.02
Inflation (GDP deflator), in %	2.16	4.17	1.08
Domestic savings (% of GDP)	16.84	14.66	16.33
Investment (% of GDP)	20.05	16.57	18.88
Polity Index	7.44	7.20	7.99
Dependency ratio, in %	70.37	69.60	60.70
GDPpc in USD	2621	3359	4276
Unemployment rate, in %	6.17	8.08	8.58

Notes: Data sources are explained in Data Appendix.

drivers of growth/savings and global trends, respectively. The vector X_{it} includes time-varying covariates, typically included in the growth (Barro and Sala-i-Martin, 2004) and savings literature (see survey in Cusolito and Nedeljkovic, 2013). The primary variable of interest is pension reform, P_{it}, which we define in two ways. First, we define P_{it} to equal zero or the second pillar contribution rate, as discussed previously. Second, to allow for the possibility of the time-varying impact of the reform and minimize the associated misspecification bias, we follow Laporte and Windmeijer (2005) and alternatively define P_{it} as a vector of dummy ('pulse') variables for three non-overlapping periods.[7] P_{it}^{0-2} equals zero for all years apart from the year of second

[7] The same methodology has been applied in growth studies in other contexts: see, inter alia, Papaioannou and Siourounis (2008) and Smith (2015).

pillar introduction and the two subsequent years; P_{it}^{3-6} is non-zero over 3–6 years following pension privatization, and P_{it}^{7+} covers the period starting from 7 years after the reform.[8] Finally, our particular interest in identifying differences between Eastern Europe and Latin America and between countries resorting to debt-financing versus countries implementing adequate austerity policies leads us to include two interaction terms with the pension reform variable: interaction with a dummy that takes the value 1 for Eastern European countries and interaction with a dummy that takes the value 1 for countries in which domestic government bonds represent a small share (bellow 50%) of pension fund assets.

In empirical analysis, we need to make several econometric choices. First, we estimate specification (1) in three temporal settings: static fixed effect regression, dynamic fixed effect regression, and fixed effect regression with non-overlapping 5-year averages (classical empirical growth model).

The static fixed effect regression serves as the benchmark. We then assess the impact of the persistence in the dependent variable by estimating a dynamic specification. Nickell (1981) showed the inconsistency of the standard fixed effect estimator in the presence of the lagged dependent variable. Since the cross-sectional dimension is relatively small to efficiently employ common Arellano–Bond and Blundell–Bond estimators (Arellano and Bond, 1991; Blundell and Bond, 1998), we follow Zandberg and Spierdijk (2013) and use the bias-corrected least-squares dummy variable (LSDV) estimator (Bun and Kiviet, 2003; Bruno, 2005). We use higher-order approximation of the bias, of order $O(N^{-1}T^{-1})$, and initialize the procedure with a standard Blundell–Bond estimator. Finally, to alternatively assess the long-run impact of the pension reforms, we also estimate fixed effect regression with non-overlapping 5-year averages, noting that the last observation is based on a 3-year (2011–13) average.[9]

Second, the inclusion of country-fixed effects controls for factors such as social norms, colonial and legal origin, and geography, which may influence both economic and social development. In this way, some of the endogeneity concerns are mitigated, as the consistency of the fixed effect estimator allows for correlation with the persistent component of the error term and requires the pension reform variable to be uncorrelated only with innovations in the omitted time-varying factors and shocks to the dependent variable that enter the error term (Wooldridge, 2010). In addition, year fixed effects account for common global trends in growth rates (Section 3.2) and savings (Section 3.3). Despite using the fixed effects and the standard set of covariates, the dependent variable and the pension variable may still be driven by the omitted time and country-varying factors. Our definition of the pension variable relative to the more commonly used ratio of pension assets to GDP is targeted toward mitigating these concerns. Nevertheless, it is still possible that the decision to privatize may be affected by additional omitted growth and savings factors. In further robustness checks, we allow for this possibility and estimate the model parameters using the two-stage procedure; however, the results remain unaffected. Finally, a necessary

[8] Since Argentina and Hungary terminated the second pillar close to the end of our sample, we also check the results when the P_{it}^{7+} is set to zero from the first year of the reversal and find no significant impact on the results.

[9] We also estimate the model with overlapping 5-year averages data, with no impact on the main results.

condition for establishing causality is the randomness of the pension reform variable. The non-selectivity assumption is difficult to attain as pension reform is typically pre-announced and is the result of a multi-year process. Our second (vector) definition of the pension reform variable aims to control the anticipation bias by including the additional term $P_{it}^{-2 \text{ to } -1}$ for the 2 years that precede the reform. The main results, however, remain unaffected.

Third, our fixed effect difference-in-difference model suffers from a downward bias in the standard errors arising from positive residual serial correlation (Bertrand *et al.*, 2004). To control for this in the static model we use robust standard errors, allowing for country-level clustered autocorrelation and heteroscedasticity. In dynamic and overlapping specification, we bootstrap the standard errors, using 500 bootstrap repetitions.

3.2 Results of growth regressions

This section presents the results of the growth regressions. We start by presenting the results of our benchmark specification, first assuming a time-invariant impact of the reform (Table 3) and then tracing the time-varying effects (Table 4). Last, we compare the evidence using alternative temporal frameworks (Table 5).

Table 3, columns (1)–(3), report results from a simple univariate regression estimated via OLS, including country and year effects, respectively. Estimated coefficients for pension reform in pooled OLS and country fixed effect regression are positive but statistically insignificant. The fit of the models, however, is rather poor. Inclusion of year effects improves the fit, but the coefficient for pension reform remains statistically insignificant. In columns (4) and (5), we add interaction terms. None of the coefficients for the pension reform variables is statistically significant. Nevertheless, we see the first signal that the growth performance of Eastern Europe countries that privatized pensions was additionally negative. Moreover, privatizing countries with lower shares of government bonds in pension funds' portfolios appear to have a stronger growth association. Columns (6)–(8) report conditional results when the set of growth determinants is included. We include the standard growth determinants in the literature (Barro and Sala-i-Martin, 2004): (i) the real GDP per capita level (lagged two periods) as a proxy for convergence effects; (ii) lagged real investment to real GDP ratio as a proxy for the effect of the savings rate in the neoclassical growth model; (iii) lagged government consumption to GDP ratio and lagged inflation as a proxy for adverse effects of government actions and macroeconomic uncertainty on private decisions; (iv) male upper-level schooling (Barro and Lee, 2010) and life expectancy at birth as proxies for the quality of human capital; (v) polity index as a proxy for the growth impact of democracy (Acemoglu *et al.*, 2008); and (vi) lagged trade openness and lagged terms-of-trade changes as a proxy for the impact of trade policies and commodity shocks.[10] With the exception of human capital proxies and the real GDP per capita level, all control variables enter

[10] We adjust the trade openness series to control for the impact of the country size, proxied by the logs of population and area.

Table 3. *Growth regressions: fixed effect static estimation*

Variable	1	2	3	4	5	6	7	8
Pension reform	0.0191	0.0353	−0.0201	−0.0184	−0.0508	0.00378	−0.0233	−0.0603
	(0.0536)	(0.0637)	(0.0742)	(0.0856)	(0.0855)	(0.0549)	(0.0651)	(0.0650)
Pension ref.*E. Europe				−0.00427			0.0819	
				(0.158)			(0.128)	
Pension ref.*Low Gov. bond					0.0976			0.214*
					(0.140)			(0.125)
Per capita GDP						−12.07***	−12.17***	−12.20***
						(1.797)	(1.768)	(1.812)
Investment						0.137***	0.137***	0.134***
						(0.0423)	(0.0415)	(0.0419)
Government consumption						−0.277***	−0.269***	−0.290***
						(0.0889)	(0.0888)	(0.0882)
Inflation						−2.264**	−2.220**	−2.318**
						(0.910)	(0.936)	(0.924)
Male upp. lev. schooling						−0.849	−0.945	−1.064
						(0.931)	(0.943)	(1.030)
Life expectancy at birth						−0.520*	−0.518*	−0.511*
						(0.282)	(0.284)	(0.285)
Polity index						0.0236***	0.0233***	0.0255***
						(0.00809)	(0.00844)	(0.00875)
Terms of trade						0.0320*	0.0319*	0.0300*
						(0.0164)	(0.0163)	(0.0175)
Trade openness						0.0108	0.00963	0.0117
						(0.0125)	(0.0128)	(0.0125)

Table 3 (*cont.*)

Variable	1	2	3	4	5	6	7	8
Observations	764	764	764	764	764	636	636	636
Cross sections	36	36	36	36	36	33	33	33
R^2	0.000	0.001	0.302	0.302	0.303	0.464	0.465	0.469
Adjusted R^2	−0.001	−0.001	0.279	0.278	0.279	0.437	0.437	0.440
Time/country FE	No/No	No/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes

Notes: The dependent variable is the annual growth rate of real GDP per capita multiplied by 100. The numbers in parentheses are robust clustered standard errors. *, **, and *** denote significance at 10%, 5%, and 1%. Pension reform variable is defined equal zero or the second pillar contribution rate. Eastern European is zero-one dummy for Eastern European countries. Low government bond is zero-one dummy for countries and periods in which <50% of total pension fund assets is invested in local government bonds. Per capita GDP is logged and twice lagged. Investment and Government consumption are defined in share of GDP. Inflation is based on GDP deflator. Terms of trade are defined in percentage change. Trade openness is corrected for the country size. All macro variables are lagged once.

Table 4. *Growth regressions: time-varying estimation*

Variable	1	2	3	4	5	6	7	8	9
Pension (0–2)	0.0684	0.0711	0.0384	0.0410	0.0545	−0.00434	0.0352	0.0443	−0.0123
	(0.0483)	(0.0590)	(0.0577)	(0.0466)	(0.0447)	(0.0734)	(0.0498)	(0.0470)	(0.0870)
Pension (3–6)	−0.0808	−0.0800	−0.142	−0.0602	−0.0555	−0.171**	−0.0690	−0.0680	−0.180**
	(0.0830)	(0.0764)	(0.113)	(0.0671)	(0.0690)	(0.0813)	(0.0685)	(0.0709)	(0.0860)
Pension (7+)	−0.0222	0.0715	−0.0525	−0.0760	−0.0569	−0.165*	−0.0831	−0.0620	−0.175*
	(0.0773)	(0.0777)	(0.0802)	(0.0678)	(0.0761)	(0.0863)	(0.0675)	(0.0740)	(0.0863)
Pens.(0–2)*E. Europe		−0.0577			−0.0639			−0.0527	
		(0.106)			(0.142)			(0.152)	
Pens.(3–6)*E. Europe		−0.165			−0.187**			−0.183**	
		(0.118)			(0.0847)			(0.0811)	
Pens.(7+)*E. Europe		−0.304***			−0.0186			−0.0125	
		(0.110)			(0.142)			(0.140)	
Pens.(0–2)*Low Gov. bond			0.0536			0.0665			0.0710
			(0.0886)			(0.0942)			(0.104)
Pens.(3–6)*Low Gov. bond			0.125			0.229**			0.221**
			(0.114)			(0.0931)			(0.0905)
Pens.(7+)*Low Gov. bond			0.0665			0.217			0.223
			(0.121)			(0.138)			(0.133)
Per capita GDP				−12.05***	−11.68***	−12.19***	−12.03***	−11.69***	−12.15***
				(1.740)	(1.806)	(1.675)	(1.724)	(1.846)	(1.652)
Investment				0.138***	0.131***	0.130***	0.135***	0.125**	0.126***
				(0.0440)	(0.0462)	(0.0411)	(0.0445)	(0.0465)	(0.0415)
Government consumption				−0.264***	−0.267***	−0.288***	−0.267***	−0.278***	−0.292***
				(0.0891)	(0.0904)	(0.0850)	(0.0895)	(0.0894)	(0.0859)
Inflation				−2.247**	−2.303**	−2.257**	−2.205**	−2.246**	−2.215**
				(0.926)	(0.942)	(0.900)	(0.929)	(0.941)	(0.899)
Male upp. lev. schooling				−0.673	−0.427	−1.144	−0.697	−0.412	−1.187
				(0.963)	(0.963)	(1.140)	(0.953)	(0.960)	(1.142)

Table 4 (*cont.*)

Variable	1	2	3	4	5	6	7	8	9
Life expectancy at birth				−0.559*	−0.574*	−0.684**	−0.566**	−0.588**	−0.700**
				(0.278)	(0.282)	(0.284)	(0.274)	(0.275)	(0.283)
Polity index				0.0225**	0.0215***	0.0244**	0.0231***	0.0219***	0.0250***
				(0.00833)	(0.00745)	(0.00916)	(0.00825)	(0.00763)	(0.00895)
Terms of trade				0.0332*	0.0342**	0.0308*	0.0329*	0.0326*	0.0303
				(0.0166)	(0.0167)	(0.0181)	(0.0167)	(0.0170)	(0.0182)
Trade openness				0.0130	0.0178	0.0177	0.0123	0.0178	0.0170
				(0.0125)	(0.0130)	(0.0118)	(0.0125)	(0.0129)	(0.0118)
Pension (−2 to −1)							−0.0397	−0.0803	−0.0381
							(0.0652)	(0.0751)	(0.100)
Pens.(−2 to −1)*E. Europe								0.115	
								(0.139)	
Pens.(−2 to −1)*Low Gov. bond									−0.0219
									(0.121)
Observations	764	764	764	636	636	636	636	636	636
Cross sections	36	36	36	33	33	33	33	33	33
R^2	0.307	0.323	0.311	0.469	0.473	0.479	0.469	0.475	0.480
Adjusted R^2	0.283	0.297	0.283	0.440	0.441	0.448	0.439	0.441	0.447
Time/country FE	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes

Notes: The dependent variable is the annual growth rate of real GDP per capita multiplied by 100. The numbers in parentheses are robust clustered standard errors. *, **, and *** denote significance at 10%, 5%, and 1%. Pension reform variables are defined as P(0–2) equals zero for all years apart from the year of the change in the contribution rate and the subsequent 2 years; P(3–6) is non-zero over 3–6 years following the change and P(7on) covers period starting from 7 years following the reform. Eastern European is zero-one dummy for Eastern European countries. Low government bond is zero-one dummy for countries and periods in which <50% of total pension fund assets is invested in local government bonds. Per capita GDP is logged and twice lagged. Investment and Government consumption are defined in share of GDP. Inflation is based on GDP deflator. Terms of trade are defined in percentage change. Trade openness is corrected for the country size. All macro variables are lagged once. P(−2 to −1) is non-zero for 2 years that precede the reform.

Table 5. *Growth regressions: dynamic and long-run regressions*

Variable	1	2	3	4	5	6
Pension reform	−0.0214	−0.0335	−0.0743	−0.0612	−0.0747	−0.0719
	(0.0519)	(0.0619)	(0.0606)	(0.0458)	(0.0492)	(0.0629)
Pens. ref.*E. Europe		0.0380			0.0690	
		(0.103)			(0.131)	
Pens. ref.*Low Gov. bond			0.183*			0.0264
			(0.100)			(0.0963)
Per capita GDP (2 y)	−6.671***	−6.701***	−6.950***			
	(1.356)	(1.355)	(1.354)			
Lagged pc GDP growth	0.207***	0.207***	0.199***			
	(0.0381)	(0.0382)	(0.0380)			
Per capita GDP (5 y)				−1.493**	−1.610**	−1.462**
				(0.606)	(0.667)	(0.674)
Investment	0.188***	0.188***	0.189***	−0.134**	−0.136**	−0.138**
	(0.0457)	(0.0459)	(0.0456)	(0.0521)	(0.0546)	(0.0581)
Government consumption	−0.215**	−0.210**	−0.231***	0.0277	0.0260	0.0275
	(0.0842)	(0.0860)	(0.0837)	(0.0623)	(0.0619)	(0.0690)
Inflation	−2.272***	−2.252***	−2.371***	0.0470	0.0479	0.0466
	(0.799)	(0.804)	(0.804)	(0.549)	(0.515)	(0.635)
Male upp. lev. schooling	0.344	0.309	0.0634**	1.219***	1.187***	1.216***
	(0.571)	(0.578)	(0.0276)	(0.332)	(0.336)	(0.348)
Life expectancy at birth	0.179	0.192	−0.00939	0.103	0.120	0.0971
	(0.155)	(0.158)	(0.0266)	(0.0917)	(0.104)	(0.0956)
Polity index	−0.0129	−0.0137	0.189	0.0120	0.0120	0.0131
	(0.0265)	(0.0265)	(0.155)	(0.0923)	(0.0907)	(0.0989)

Table 5 (*cont.*)

Variable	1	2	3	4	5	6
Terms of trade	0.0659**	0.0658**	0.198	0.0498	0.0577	0.0462
	(0.0277)	(0.0277)	(0.580)	(0.0591)	(0.0634)	(0.0632)
Trade openness	0.00400	0.00328	0.00452	−0.00273	−0.00389	−0.00233
	(0.0108)	(0.0108)	(0.0108)	(0.00741)	(0.00854)	(0.00790)
Observations	634	634	634	115	115	115
Cross sections	33	33	33	33	33	33
R^2				0.383	0.386	0.384
Adjusted R^2				0.303	0.300	0.297
Time/country FE	Yes/Yes	Yes/Yes	Yes/Yes	Yes/No	Yes/No	Yes/No

Notes: The dependent variable in columns (1–3) is the annual growth rate of real GDP per capita multiplied by 100. The dependent variable in columns (4–6) is the average annual growth rate of real GDP per capita multiplied by 100 over five year windows. The numbers in parentheses are bootstrap standard errors. *, **, and *** denote significance at 10%, 5%, and 1%. Pension reform variable is defined equal zero or the second pillar contribution rate. Eastern European is zero-one dummy for Eastern European countries. Low government bond is zero-one dummy for countries and periods in which <50% of total pension fund assets is invested in local government bonds. The pension reform variables in columns (4–6) are lagged 5 years (the start of the window). The macro explanatory variables in columns (1–3) are lagged once (per capita GDP twice). The macro explanatory variables in columns (4–6) are lagged 5-year averages. Per capita GDP, human capital variables and Polity index in columns (4–6) enter with 5 year lag. Coefficients for the changes in the covariates in columns (1–3) are not reported to save space.

with a lag to control for potential reverse causality. The results when each covariate is included separately do not qualitatively or quantitatively differ and are not reported for paper parsimony. The results yet again confirm the absence of a statistically significant impact of the reform on growth rates relative to the case of no privatization. On the other hand, typical growth covariates have the expected signs and the estimated coefficients for most of them are statistically significant. The only exception is the Barro and Lee (2010) measure of male secondary school attainment, which enters with a negative sign, though it is not statistically significant.[11]

Table 4 repeats the exercise, now allowing for the time-varying effects of pension privatization. Indeed, the estimated coefficients fluctuate over the reform horizon with different signs and statistical significance. Columns (1)–(3) report the results when pension privatization is defined as a vector of pulse variables, together with interaction terms. While all coefficients for the base variables are statistically insignificant, the interaction term for Eastern European countries from 7 years after the reform is negative and statistically significant. This seems to suggest a negative link between pension reform and growth performance in European countries, though, despite, including year dummies, a part of the effect could be related to the impact of the global financial crisis, which overlaps with the post-privatization period in most of the European countries. When the covariates are included in the regressions, columns (4)–(6), the signs and the magnitudes of the coefficients for the control variables remain similar to earlier results in Table 3. On the other hand, the signs and statistical significance of the pension reform variable change in certain directions. In particular, the association becomes negative and weakly statistically significant 3 years after privatization in the case of Eastern European countries (the p-value for the sum of the coefficients is 0.019) and for countries in which government bonds represent a dominant share of second pillar assets. As mentioned earlier, negative results for Eastern Europe could be driven by the coincidence of the post-privatization period and the global financial crisis, which impacted the European region more severely than Latin America. It could also indicate a systematic difference between pension privatization performance in Latin America and Eastern Europe. On the other hand, results in columns (4)–(6) could indicate that the dominance of government bonds in second pillar portfolios, which is a well-known feature of suboptimal pension privatization design, could have detrimental effects on economic growth. Both of these issues will be explored further in Section 4. The last three columns, (7)–(9), control for the anticipation bias by including the $P_{it}^{-2 \text{ to } -1}$ variable and its interaction terms, with no significant impact on the earlier results.

Table 5 presents the results of alternative temporal settings: dynamic fixed effect regression, columns (1)–(3), and traditional long-run growth (non-overlapping 5-year averages) regressions, columns (4–6).[12] Following Bond *et al.* (2010), dynamic specification is estimated as the autoregressive distributed lag model (ARDL), which

[11] The finding can be related to the interpolation procedure used to construct the variable (which is available only at 5-year frequency) and the fact that the human capital effects tend to materialize in the long run. Indeed, the variable becomes statistically significant and positive with 5-year averages data.

[12] We also estimated benchmark and time-varying specifications with alternative measures of GDP per capita (in constant PPP dollars, in constant local currency) with no impact on the results.

includes the first lag of the dependent variable (growth), the first lag of the change in explanatory variables and the lag of the levels of each variable. The results from the dynamic analysis confirm the lack of a statistically significant impact of pension privatization on growth and are mostly in line with previous results.[13]

The long-run growth regressions are estimated over the 1996–2000, 2001–05, 2006–10, and 2011–13 periods. The pension variable enters with a value before the beginning of the period (1995, 2000, 2005, and 2010). To control for endogeneity, macro covariates enter as 5-year averages over the previous period, while human capital, democracy, and initial income enter with a five-period lag. We also include three period dummies to control for country invariant events. Even though the time series dimension is small (both for constructing the averages and for the number of averages), it is still useful to compare the findings to earlier results. Our 'long-run' estimates indicate no evidence of positive effects of carve-out pension funding on long-run growth. On the other hand, Zandberg and Spierdijk (2013), working with another sample of 54 advanced and developing countries over the 2001–10 period, found limited evidence for positive effects of pension funding on growth. However, Zandberg and Spierdijk (2013) do not control for carve-out versus add-on approaches to pension funding, and they note that positive correlation is driven by several outliers – huge percentage increases in pension assets in countries with low-base pension accumulations. Since our approach precludes the possibility of such outliers, we can conclude that our results are very much in line with the results of Zandberg and Spierdijk (2013) that exclude the aforementioned outliers.

We perform several other robustness checks, which are reported in Tables A1–A3 in the Appendix. First, to control for the potential endogeneity of the pension privatization variable, we estimate control function instrumental variable regressions. In particular, given the censored character of the pension privatization variable, we estimate first-stage Tobit regressions and use generalized residuals from the first-stage model as an additional explanatory variable in the second-stage regressions. Following Reece and Sam (2012), we use the expected increase in the pensioner-to-worker ratio (which we proxy with the 20-year difference in the old-age dependency ratio, Lane and Milessi-Ferretti, 2012) and the number of regional peer countries that have enacted privatization as the first-stage instruments.[14] Both instruments are statistically significant and enter the first-stage regressions with the expected sign. More importantly, the second-stage estimates of pension privatization impact do not deviate from earlier findings. Second, the inclusion of country fixed effects (while controlling for the time-invariant drivers of economic development) may also drive the results to the extent that the within-variation in the pension privatization variable may not be sufficiently large to allow capturing the growth effects of

[13] We also perform Im *et al.*'s (2003) unit root tests, which reject the null hypothesis of non-stationarity of the growth series at all conventional significance levels. On the other hand, the test suggests non-stationarity of the log-level series. The ARDL specification offers a useful framework that does not violate the time series properties of the data, while it avoids estimating panel cointegration models, given the modest time-series dimension of the sample.

[14] The lagged growth rate of GDP as an alternative instrument is not statistically significant in the first-stage regressions.

privatization. Analogously, time-fixed effects may capture the positive growth effects of pension privatizations, if the reforms were implemented in the same year across a number of countries. To mitigate these concerns we repeat our regressions without fixed effects and the results remain broadly the same.[15] Third, another related concern is whether the analysis suffers from the small sample problem – the lack of power of the estimators to detect any significant association between the pension variable and our dependent variables. To evaluate the extent of the small sample problem we perform a small Monte Carlo experiment where we use actual data on the pension reform variable and generate 5,000 artificial datasets of the same size as our actual dataset, allowing for fixed effects, exogenous covariates, and within-cluster autocorrelation and heteroscedasticity. The results show that the parameters are tightly estimated and that the *t*-test of the statistical significance of the pension variable is not oversized. The power of the *t*-test increases with the magnitude of the coefficient on the pension reform variable, as expected, but even for assumed values of the parameters that imply small economic effects (0.05), the power of the test is above 50% and very quickly reaches 95%. Overall, Monte Carlo results indicate that small sample issues are not likely to drive our findings.

In sum, the econometric results suggest limited association between carve-out pension privatization and growth performance over the first 20 or less years after the reform. The link is negative and statistically significant for a period of 3–6 years following the reform for Eastern European countries. Moreover, it is also negative and statistically significant over the medium term in countries with a higher share of (domestic) government bonds in pension funds' portfolios.

3.3 Results of savings regressions

This section analyzes whether a part of the explanation for the lack of positive evidence on growth can be rationalized from the relation between carve-out privatization and aggregate savings.[16] Tables 6–8 repeat the structure of the growth analysis, now with a modified set of covariates that reflects the common determinants of savings discussed in the literature. We include: (i) the lagged level of GDP per capita and the lagged government consumption to GDP ratio; (ii) credit to the private sector (as share of GDP) as a proxy for financial deepening and relaxation of borrowing constraints: (iii) dependency ratio as a proxy for the impact of demographic change; (iv) unemployment rate as a proxy for higher macroeconomic uncertainty and consequently higher precautionary savings; (v) terms-of-trade changes as a proxy for the impact of temporary versus permanent increases in income in commodity-exporting countries; and (vi) inflation rate as a proxy for the potential depreciation of savings returns. Factors related to real interest rates, social security programs, and labor market policies are not included due to the lack of consistent data of sufficient

[15] The only difference to our previous results is that the coefficient on P_{it}^{0-2} is positive and statistically significant when fixed effects are excluded.

[16] We use gross domestic savings as the dependent variable of interest; the results do not change if gross national savings are used instead.

Table 6. *Savings regressions: fixed effect static estimation*

Variable	1	2	3	4	5	6	7	8
Pension reform	0.419	0.228	0.130	0.0822	0.141	−0.00632	0.157	0.0255
	(0.298)	(0.138)	(0.170)	(0.215)	(0.211)	(0.138)	(0.209)	(0.188)
Pens. ref.*E. Europe				0.125			−0.409	
				(0.303)			(0.286)	
Pens. ref.*Low Gov. bond					−0.0365			−0.108
					(0.293)			(0.328)
Per capita GDP						13.05***	13.51***	13.21***
						(4.433)	(4.206)	(4.454)
Credit to private sector						−0.0705*	−0.0692*	−0.0720*
						(0.0375)	(0.0369)	(0.0383)
Government consumption						−0.844***	−0.890***	−0.841***
						(0.170)	(0.175)	(0.175)
Dependency ratio						0.195	0.198	0.195
						(0.143)	(0.141)	(0.146)
Inflation						−0.653	−0.882	−0.646
						(1.470)	(1.429)	(1.506)
Terms of trade						0.0692**	0.0690**	0.0699*
						(0.0339)	(0.0322)	(0.0349)
Unemployment rate						0.190	0.171	0.182
						(0.195)	(0.192)	(0.204)
Observations	758	758	758	758	758	700	700	700
Cross sections	36	36	36	36	36	36	36	36
R^2	0.032	0.016	0.054	0.055	0.054	0.291	0.300	0.291
Adjusted R^2	0.031	0.015	0.023	0.023	0.022	0.260	0.268	0.260
Time/country FE	No/No	No/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes

Notes: The dependent variable is the share of gross domestic savings in GDP. The numbers in parentheses are robust clustered standard errors. *, **, and *** denote significance at 10%, 5%, and 1%. Pension reform variable is defined equal zero or the second pillar contribution rate. Eastern European is zero-one dummy for Eastern European countries. Low government bond is zero-one dummy for countries and periods in which <50% of total pension fund assets is invested in local government bonds. Per capita GDP is logged. Credit to private sector and Government consumption are defined in share of GDP. Inflation is based on GDP deflator. Terms of trade are defined in percentage change. All macro variables are lagged once.

Table 7. *Savings regressions: time-varying estimation*

Variable	1	2	3	4	5	6	7	8	9
Pension (0–2)	0.0134	0.0589	−0.0330	−0.0379	0.0321	−0.0793	−0.0603	0.00708	−0.103
	(0.101)	(0.0977)	(0.172)	(0.0857)	(0.0903)	(0.156)	(0.0973)	(0.102)	(0.187)
Pension (3–6)	0.0463	0.0545	−0.0245	0.00513	−0.00480	−0.0356	−0.0300	−0.0486	−0.0621
	(0.130)	(0.131)	(0.189)	(0.127)	(0.122)	(0.183)	(0.126)	(0.118)	(0.193)
Pension (7+)	0.445*	0.386	0.419	0.414*	0.497*	0.399	0.387*	0.476*	0.369
	(0.262)	(0.297)	(0.332)	(0.209)	(0.269)	(0.296)	(0.212)	(0.266)	(0.309)
Pens.(0–2)*E. Europe		−0.119			−0.290*			−0.307*	
		(0.173)			(0.148)			(0.172)	
Pens.(3–6)*E. Europe		0.00969			−0.0868			−0.108	
		(0.104)			(0.136)			(0.126)	
Pens.(7+)*E. Europe		0.202			−0.324			−0.375	
		(0.308)			(0.283)			(0.283)	
Pens.(0–2)*Low Gov. bond			0.0963			0.0922			0.107
			(0.181)			(0.171)			(0.198)
Pens.(3–6)*Low Gov. bond			0.150			0.0857			0.0469
			(0.174)			(0.233)			(0.229)
Pens.(7+)*Low Gov. bond			0.0449			0.0212			0.0282
			(0.364)			(0.321)			(0.325)
Per capita GDP				13.83***	14.74***	13.68***	13.83***	14.89***	13.78***
				(4.313)	(4.211)	(4.344)	(4.272)	(4.144)	(4.316)
Credit to private sector				−0.0601*	−0.0537	−0.0592*	−0.0616*	−0.0547	−0.0611*
				(0.0329)	(0.0335)	(0.0328)	(0.0329)	(0.0334)	(0.0327)

Table 7 (*cont.*)

Variable	1	2	3	4	5	6	7	8	9
Government consumption				−0.842***	−0.871***	−0.845***	−0.851***	−0.884***	−0.854***
				(0.162)	(0.169)	(0.163)	(0.161)	(0.169)	(0.163)
Dependency ratio				0.125	0.150	0.125	0.126	0.155	0.128
				(0.140)	(0.138)	(0.142)	(0.139)	(0.137)	(0.140)
Inflation				−0.970	−1.144	−0.951	−0.809	−0.968	−0.776
				(1.274)	(1.236)	(1.275)	(1.222)	(1.161)	(1.220)
Terms of trade				0.0637*	0.0623*	0.0630*	0.0630**	0.0616*	0.0617*
				(0.0314)	(0.0313)	(0.0314)	(0.0308)	(0.0309)	(0.0310)
Unemployment rate				0.212	0.215	0.218	0.215	0.219	0.223
				(0.186)	(0.189)	(0.186)	(0.184)	(0.188)	(0.185)
Pension (−2 to −1)							−0.144*	−0.159*	−0.0996
							(0.0845)	(0.0850)	(0.146)
Pens. (−2 to −1)*E. Europe								−0.0560	
								(0.164)	
Pens (−2 to −1)*LowGov. Bond									−0.121
									(0.171)
Observations	758	758	758	700	700	700	700	700	700
Cross sections	36	36	36	36	36	36	36	36	36
R^2	0.093	0.096	0.097	0.331	0.341	0.331	0.335	0.348	0.337
Adjusted R^2	0.060	0.060	0.061	0.299	0.308	0.297	0.303	0.313	0.301
Time/country FE	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes

Notes: The dependent variable is the share of gross domestic savings in GDP. The numbers in parentheses are robust clustered standard errors. *, **, and *** denote significance at 10%, 5%, and 1%. Pension reform variables are defined as P(0–2) equals zero for all years apart from the year of the change in the contribution rate and the subsequent 2 years; P(3–6) is non-zero over three to 6 years following the change and P(7on) covers period starting from 7 years following the reform. Eastern European is zero-one dummy for Eastern European countries. Low government bond is zero-one dummy for countries and periods in which <50% of total pension fund assets is invested in local government bonds. Per capita GDP is logged. Credit to private sector and Government consumption are defined in share of GDP. Inflation is based on GDP deflator. Terms of trade are defined in percentage change. All macro variables are lagged once. P(−2 to −1) is non-zero for 2 years that precede the reform.

Table 8. *Savings regressions: dynamic and long-run regressions*

	1	2	3	4	5	6
Pension reform	0.0682 (0.0578)	0.0483 (0.0467)	0.0383 (0.0498)	0.0563 (0.243)	−0.0632 (0.239)	−0.0213 (0.326)
Pens. ref.*E. Europe		−0.0565 (0.0944)			0.521 (0.463)	
Pens. ref.*Low Gov. bond			0.0498 (0.0957)			0.215 (0.367)
Per capita GDP (1 y)	2.895** (1.202)	2.827** (1.187)	2.776** (1.193)			
Lagged change in savings	0.0536 (0.0364)	0.0525 (0.0364)	0.0519 (0.0366)			
Per capita GDP (5 y)				10.37*** (2.939)	9.835*** (2.967)	10.52*** (3.073)
Credit to private sector	−0.0173* (0.00900)	−0.0171* (0.00899)	−0.0170* (0.00901)	0.0154 (0.0502)	0.0246 (0.0502)	0.0107 (0.0536)
Government consumption.	−0.253*** (0.0665)	−0.244*** (0.0647)	−0.249*** (0.0655)	0.0174 (0.225)	−0.0391 (0.226)	0.0437 (0.243)
Dependency ratio	0.0541* (0.0327)	0.0511 (0.0319)	0.0510 (0.0320)	0.0475 (0.178)	0.0555 (0.176)	0.0612 (0.185)
Inflation	1.619** (0.687)	1.622** (0.686)	1.623** (0.686)	−0.488 (1.833)	−0.484 (2.062)	−0.464 (2.030)
Terms of trade	0.0582** (0.0240)	0.0582** (0.0240)	0.0577** (0.0241)	0.654*** (0.188)	0.692*** (0.188)	0.633*** (0.200)
Unemployment rate	0.128*** (0.0475)	0.131*** (0.0473)	0.135*** (0.0482)	0.232 (0.183)	0.254 (0.196)	0.228 (0.183)
Observations	686	686	686	123	123	123
Cross section	36	36	36	36	36	36
R^2				0.561	0.576	0.565
Adjusted R^2				0.518	0.529	0.517
Time/country FE	Yes/Yes	Yes/Yes	Yes/Yes	Yes/No	Yes/No	Yes/No

Notes: The dependent variable in columns (1–3) is the change in the savings to GDP ratio. The dependent variable in columns (4–6) is the average share of gross domestic savings in GDP over 5-year windows. The numbers in parentheses are bootstrap standard errors. *, **, and *** denote significance at 10%, 5%, and 1%. Pension reform variable is defined equal zero or the second pillar contribution rate. Eastern European is zero-one dummy for Eastern European countries. Low government bond is zero-one dummy for countries and periods in which <50% of total pension fund assets is invested in local government bonds. The pension reform variables in columns (4–6) are lagged 5 years (the start of the window). The macro explanatory variables in columns (1–3) are lagged once. The macro explanatory variables in columns (4–6) are lagged 5 year averages. Per capita GDP and dependency ratio in columns (4–6) enter with 5-year lag. Coefficients for the changes in the covariates in columns (1–3) are not reported to save space.

cross-sectional dimension. All control variables outside demographics enter with a lag to control for potential reverse causality.

Table 6, columns (1)–(5), show that the magnitude of the coefficients for pension reform decreases with the inclusion of country and year fixed effects. Estimated coefficients for the pension reform variable shrink further when the control variables are included. Although none of the coefficients is statistically significant, we see that the effect of pension reform in Eastern European countries could potentially be negative. With the exception of the dependency ratio, all covariates have the expected signs and the majority are statistically significant.

Table 7, columns (1)–(6), document a significant time variation in the direction and the strength of the effect. Privatization has a positive impact on gross domestic savings with the horizon of 7 years and the estimated coefficient is weakly statistically significant with and without covariates. Column (5) shows that Latin American countries drive the observed pattern. The estimated coefficient in levels is positive and statistically significant, while the interaction term for Eastern European countries is negative and the sum of the two terms is not statistically significant (p-value equal to 0.61). Moreover, in Eastern European reforming countries, gross savings also fall in the short run as both the interaction term and the sum of the coefficients for P_{it}^{0-2} are negative and statistically significant (p-value equal to 0.057). The anticipation bias (columns (7)–(9)) again does not influence the main results, although we see that in all privatization countries savings fall in the 2 years preceding the reform, relative to earlier periods.

Table 8 repeats the analysis using dynamic fixed effect regression, columns (1)–(3), and long-run OLS regression with non-overlapping 5-year averages, columns (4–6). Dynamic specification is again estimated as the ARDL model, which includes the first lag of the change in the dependent (savings) and explanatory variables and the first lag of the levels of each variable. The long-run regressions are estimated over the 1996–2000, 2001–05, 2006–10, and 2011–13 periods. The pension variable, dependency ratio, and gross income enter with a value before the beginning of the period (1995, 2000, 2005, and 2010), while macro covariates enter as 5-year averages over the previous period. As before, we include three period dummies to control for country-invariant events. The pension variables remain statistically insignificant in all specifications. Income effects and terms-of-trade changes appear to be the dominant explanatory variables of savings behavior over the sample.

In addition, we perform several other robustness checks, which are reported in Tables A4 and A5 in the Appendix. As in the previous section, the main results do not change, if we use two-stage estimates or if we exclude country and time-fixed effects.

4 Implications for policymaking

There are two basic approaches to dealing with aging-induced financing problems of earnings-related public pension schemes. The first approach, followed in traditional Bismarckian countries, such as Germany and Austria, is to implement cost-containment parametric reforms to restore financial sustainability of the PAYG system and to foster the (voluntary) development of private funds in an add-on manner to supplement more modest public benefits in coming decades. In the second

approach, instead of supplementing, private pension funds partially or completely substitute publicly provided pension benefits. Over the last 25 years many countries in Latin America and Eastern Europe opted for this second, more radical, reform approach, hoping to achieve significant economic benefits. Existing literature describes that, contrary to initial expectations, pension privatization failed to deliver many of the anticipated benefits.[17] In this paper, we analyzed the salient issue of pension privatization effects on economic growth.

Our analysis shows no evidence that pension privatization was associated with accelerated economic growth. These findings are robust across several different specifications, and applicable to privatizing countries in both Latin America and Eastern Europe. To confirm this result we further analyze the main anticipated channel of growth acceleration via increased savings. The evidence on savings effects seems to be mixed. While there is some evidence that pension privatization was associated with higher domestic saving in Latin America, there is no such indication for Eastern Europe. While this evidence should be considered as preliminary and requiring more elaborate further research, it could point to systematic differences in pension privatization effects in Latin America and Eastern Europe.

Although all Eastern European countries opted for partial pension privatization (to reduce transition costs), complete privatization was prevalent in Latin America. Transition costs were severely underestimated and neglected during preparatory reform stages on both continents (Mesa-Lago, 2002; Arza, 2008; Drahokoupil and Domonkos, 2012). Groundbreaking privatization in Chile was accompanied with strict and long-lasting austerity measures that produced a surplus of 8.5% of GDP in the non-pension part of the public sector over the 1981–2004 period (Arenas De Mesa and Mesa-Lago, 2006). However, Impavido and Rocha (2006) note that other reforming countries were mostly unsuccessful in implementing adequate austerity measures and have thus resorted to debt-financed transitions and large issues of government bonds, which ended up in the portfolios of second pillar pension funds. These circular transactions do not constitute genuine pension funding but are basically a disguised-PAYG financing mechanism that increases public debt (Altiparmakov, 2015). To cope with unresolved transition costs, financing countries can either implement adequate austerity measures or consider reform reversals.[18] However, reversing a complete pension privatization is arguably more challenging and less likely than reversing a partial one. Latin American countries were thus more likely to implement additional austerity measures that would increase public (and aggregate) savings, which possibly would help explain the different savings effects in Latin America compared with Eastern Europe.[19]

[17] Arenas De Mesa and Mesa-Lago (2006) show that worker coverage, instead of increasing, actually decreased in all ten Latin American countries after privatization. Arza (2008) shows that second pillar returns net of management fees were lower than the PAYG internal rate of return in Argentina. Altiparmakov (2011, 2015) shows that the same was true in most Eastern European countries, even before the emergence of the global financial crisis.

[18] We use 'reform reversals' in this article, since this term has become widespread after being introduced by the World Bank. We make use of this term without imputing any implicit value judgment.

[19] In support of this hypothesis we note several instances of reform reversal in Eastern Europe, such as that in Hungary, Poland, Slovakia, and Latvia. Some authors argue that these reversals were driven by unaccommodating EU fiscal rules (Casey, 2014; Schwarz and Arias, 2014). Without debating the cause of

Unresolved transition-cost financing issues manifest themselves through the emergence of disguised-PAYG financing, where second pillar funds invest most of their assets in government bonds that were issued to finance transition costs in the first place. This feature, common to both Latin America and Eastern European reformers, indicates an inefficient pension system design that both increases public debt and reduces beneficiaries' rates of return compared with traditional (non-financial defined contribution (NDC)) PAYG financing. Our econometric analysis indicates that disguised PAYG financing could also have detrimental effects on growth and savings. The results of savings regressions are in line with Schwarz and Arias's (2014) suggestions that debt-financed transition is unlikely to increase savings. Regarding possible detrimental growth effects, we note the possibility of deteriorating investor confidence, since explicit public debt is treated less favorably than the implicit pension debt (Cuevas *et al.*, 2008). Overall, we can conclude that the lack of political support for the strict and long-lasting austerity measures required to preclude the emergence of disguised-PAYG financing severely undermines the feasibility of carve-out pension privatization.

Davis and Hu (2008) note that a key issue in pension reform is whether shifting from PAYG to funding is largely a matter of reallocation of the burden of aging (with the risk of a generation paying twice), or whether funding improves economic performance sufficiently to generate at least some of the additional resources required to meet the needs of an aging population. The absence of growth-enhancing evidence we have documented undermines pension privatization feasibility and highlights the importance of cost-containment parametric reforms that can restore the financial sustainability of existing PAYG systems; for example, by introducing NDC systems. This option seems especially appealing for reforming countries with pronounced presence of disguised-PAYG financing.

5 Concluding remarks

When analyzing the effects of pension funding on growth and savings, it is necessary to differentiate between carve-out pension privatization in Latin America and Eastern Europe and the add-on pension funding that is typical of North America and Western Europe. We found no evidence that the carve-out pension privatization in Latin America and Eastern Europe is associated with higher economic growth, compared with similar countries that did not privatize. This finding is robust across both continents and across several different econometric specifications. Since privatization plans highlighted increased savings as the major anticipated channel for growth acceleration, we further analyze pension privatization effects on saving.

We find no evidence that privatization in Eastern Europe was associated with higher domestic saving, while there is limited evidence of higher saving in Latin America. This could potentially indicate systematic differences between the effects of partial privatization in Eastern Europe and of the complete pension privatization that was prevalent in Latin America. More elaborate future research is needed to establish firmer evidence on

reform reversals, we note that Argentina, one of three Latin American countries that also opted for partial privatization, also implemented reform reversals in 2001 (partially) and in 2008 (completely).

differing effects in Latin America versus Eastern Europe. To this end, future research efforts could establish a comprehensive database on second pillar annual contribution inflows, which would allow for more refined econometric analyses.

We further note the importance of adequate and long-lasting austerity measures to accompany carve-out pension privatization: otherwise, reforming countries will resort to large issues of government bonds, which will likely end up in second pillar portfolios. This results in disguised PAYG financing and an inefficient pension system that is particularly unlikely to stimulate economic growth or aggregate savings.

A lack of positive growth effects undermines the feasibility of carve-out pension privatization compared with traditional cost-containment parametric PAYG reform. Thus, when considering options for restoring the financial sustainability of earnings-related public pension schemes amid demographic aging, countries are advised to pay more attention to the experience of the gradual reforms implemented in traditional Bismarckian countries such as Germany than to the radical pension privatization pioneered by Chile.

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Data Appendix

Variable	Definition	Source
Pension reform	Legally prescribed second pillar contribution rate, as percentage of earnings	FIAP data for Latin America, authors' compilation of official data for Eastern Europe
Eastern European	Dummy for Eastern European countries	–
Low Government bond	Dummy variable for countries with government bonds accounting less than half of second pillar assets	Arenas De Mesa and Mesa-Lago (2006) for Latin America, authors compilation of official end-2012 statistics for Eastern Europe
Real GDP per capita	In constant 2011 PPP USD	WDI
Gross Domestic Savings	In percentage of GDP	WDI
Gross Investment	In percentage of GDP	WDI
General government consumption	In percentage of GDP	WDI
Inflation	1+(GDP deflator/100)	WDI
Male upper level schooling	Years of Secondary Schooling of male population	Barro and Lee (2010)
Life expectancy at birth	Years	WDI
Polity index	Signed variable	The Center for Systemic Peace
Terms of trade	Percentage change	WEO
Trade openness	Sum of exports and imports over GDP, corrected for country size	WDI
Credit to private sector	In percentage of GDP	WDI
Unemployment rate	In percentage of total working force	WDI
Dependency ratio	Share of population below 15 and above 65	WDI
Aging speed	The 20-year difference in the old-age dependency ratio	UN and WDI

Appendix

This Appendix reports the results from several additional robustness checks.

Tables A1 and A4 report the two-stage estimates of the growth and savings regressions, respectively. In particular, given the censored character of the pension reform variable, we estimate the first-stage Tobit regressions and use generalized residuals from the first-stage model as an additional explanatory variable in the second-stage regressions. Following Reece and Sam (2012), as the first-stage instruments we use the expected increase in the pensioner to worker ratio (which we proxy with the 20-year difference in the old-age dependency ratio, Lane and Milessi-Ferretti, 2012) and the number of regional peer countries that have enacted privatization by the given year of the observation. The results from the first-stage regressions are reported in the first columns of Tables A1 and A4, while the remaining columns report the second-stage estimates. We bootstrap the standard errors and use interaction of the instruments with the dummies as instruments for the pension interaction terms. The first-stage estimates suggest that both instruments are statistically significant and enter with the expected sign, analogous to Reece and Sam (2012). A higher expected increase in the pensioner to worker ratio decreases the share of the employee's wage that is allocated to private funds in the second pillar to accommodate a higher transitional deficit due to the larger number of pensioners. The higher number of similar countries that have enacted privatization reduces the uncertainty associated with the reform and has a positive impact on the reform. The remaining columns of Tables A1 and A4 show that the second-stage estimates of pension privatization impact do not deviate from earlier findings.[20] In addition, the coefficients for generalized residuals are not statistically significant, suggesting that the use of fixed effects and our construction of the pension reform variable control for potential endogeneity.

Tables A2 and A5 report the pooled estimates of the broader growth and savings regressions, respectively. The idea is to assess the sensitivity of the main results with respect to the fixed effect assumptions. The inclusion of country fixed effects (while controlling for the time-invariant drivers of economic development) may drive the results to the extent that the within-variation in the pension variable may be insufficiently large to allow capturing the growth and savings effects of privatization. Analogously, time-fixed effects may capture the positive growth effects of pension privatization if the reforms were implemented in the same year across a number of countries. The results from the regressions remain broadly the same as in the baseline estimations, in line with the fact that the timing of the pension reform was heterogeneously spread over our sample period, the only exceptions being 1998 and 2002, when three countries initiated the reform. The only difference to our previous results is that the coefficient on P_{it}^{0-2} is positive and statistically significant in

[20] We do not estimate two-stage time-varying regressions, as this would require controlling for three to six endogenous regressors. The pension reform variable enters long-run regressions with a lag, which mitigates reverse causality issues.

growth regressions when all fixed effects are excluded. However, the positive impact on growth and savings is absent in all other regressions.

Finally, Table A3 reports the results from a small Monte Carlo experiment where we use actual data on the pension reform variable and generate 5,000 artificial datasets of the same size as our actual dataset, allowing for fixed effects, exogenous covariates, and within-cluster autocorrelation and heteroscedasticity. We run several experiments for static and time-varying fixed effects estimators[21]: (1) set the coefficient for pension variables equal to zero to assess the performance of the estimators and empirical size of the corresponding *t*-statistic; (2) vary the positive value of the pension variable coefficient and examine the empirical power of the *t*-statistic based on static and time-varying estimators; (3) allow that pension reform only has a significant impact in the long run. The results show that the parameters are tightly estimated and the *t*-test of the statistical significance of the pension variable is not oversized (Column 1). As expected, the power of the *t*-test increases with the magnitude of the coefficient on the pension reform variable, but even for assumed values of the parameters that imply small economic effects (0.05), the power of the test is above 50% and very quickly reaches 95% (Columns 2–4). Overall, the Monte Carlo results imply that small sample issues are unlikely to drive our findings, even when fixed effects are included.

[21] We leave simulations of the dynamic model for future research, as each Monte Carlo repetition requires a nested bootstrap loop of the dynamic model in order to obtain the estimates of the standard errors and the corresponding t-statistics.

Table A1. *Growth regressions: two stage estimates*

Variable	1	2	3	4	5	6	7
Pension reform		−0.0198 (0.142)	−0.0813 (0.760)	−0.0657 (0.518)	−0.0569 (0.099)	−0.0622 (0.171)	−0.0755 (0.132)
Pension ref.*E. Europe			0.0901 (0.775)			−0.109 (0.212)	
Pension ref. *Low Gov. bond				0.0933 (0.222)			−0.0362 (0.191)
Aging speed	−0.227* (0.131)						
Peers	0.464*** (0.0567)						
Per capita GDP	5.285*** (1.706)	−12.08*** (2.109)	−12.32*** (4.169)	−12.26*** (2.820)	−7.835*** (2.053)	−8.932*** (2.724)	−8.552*** (2.165)
Investment	0.0654 (0.0555)	0.139*** (0.0479)	0.139* (0.0779)	0.120 (0.0916)	0.200*** (0.065)	0.185** (0.084)	0.204*** (0.067)
Government consump.	−0.0292 (0.119)	−0.280*** (0.0997)	−0.260 (0.160)	−0.295 (0.273)	−0.270** (0.113)	−0.234 (0.149)	−0.319*** (0.113)
Inflation	−6.747*** (1.763)	−2.152 (1.366)	−1.769 (7.340)	−2.263 (4.030)	−2.447 (1.546)	1.350 (4.935)	−2.715 (1.771)
Male upp. lev. schooling	0.967 (0.740)	−0.765 (1.052)	−0.863 (1.201)	−0.994 (1.512)	0.0598* (0.034)	0.0744* (0.045)	0.0580 (0.038)
Life expectancy at birth	−0.930*** (0.235)	−0.492 (0.362)	−0.459 (0.506)	−0.436 (0.561)	−0.00116 (0.089)	−0.0919 (0.269)	0.00625 (0.107)
Polity index	0.0192 (0.0253)	0.0231 (0.0661)	0.0156 (0.752)	0.0242 (0.138)	−0.375 (0.311)	−0.282 (0.395)	−0.355 (0.286)
Terms of trade	0.00245 (0.0282)	0.0328* (0.0181)	0.0334 (0.0361)	0.0307 (0.0286)	−0.0868 (0.908)	−0.292 (0.963)	−0.381 (0.924)
Trade openness	0.00652 (0.0151)	0.0109 (0.0144)	0.00900 (0.0208)	0.0115 (0.0194)	0.00659 (0.017)	0.00712 (0.017)	0.00868 (0.017)
Lagged pc GDP growth					0.185*** (0.071)	0.170** (0.073)	0.169** (0.072)
Residual Pension ref.		0.125 (0.457)	0.224 (0.785)	−0.00633 (0.966)	0.0341 (0.351)	−0.0896 (0.431)	−0.135 (0.404)

Residual Pens. ref.*E. Europe			0.0676 (0.654)			0.714 (0.574)	
Residual Pens. ref.*Gov. bond				0.477 (0.504)			0.742 (0.556)
Observations	636	636	636	636	636	636	636
Cross sections	33	33	33	33	33	33	33
Time/country FE	Yes/No	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes

Notes: The dependent variable in columns (1) is Pension reform (first-stage estimates). The dependent variable in columns (2–7) is the annual growth rate of real GDP per capita multiplied by 100 (second stage). Columns (2–4) report estimates from the static fixed effect model. Columns (5–7) report estimates from the dynamic fixed effect model. The numbers in parentheses are bootstrap standard errors. *, **, and *** denote significance at 10%, 5%, and 1%. Old-age speed and Peers are used as instruments in the first stage. All covariates are as in the main text. Residual pension ref is generalized residual from the first-stage Tobit regression with Pension reform as the dependent variable (column 1). Residual pension ref E.Europe (Gov. bond) is generalized residual from Tobit regression with interaction term Pension reform*Eastern Europe (High share of government bonds) as the dependent variable (not reported).

Table A2. *Growth regressions: removing fixed effects*

Variable	1	2	3	4	5	6	7	8	9
Pension reform	−0.0126	0.0132	−0.0428				−0.0181	−0.0601	−0.0741
	(0.0372)	(0.0507)	(0.0498)				(0.0523)	(0.0616)	(0.0609)
Pension ref.*E. Europe		0.0981						0.136	
		(0.0852)						(0.105)	
Pension ref.*Low Gov. bond			0.0663						0.201*
			(0.0576)						(0.105)
Pension (0–2)				0.112**	0.0693	0.0128			
				(0.0520)	(0.0537)	(0.0659)			
Pension (3–6)				−0.115	−0.0969	−0.137			
				(0.0715)	(0.0668)	(0.118)			
Pension (7+)				−0.0438	0.0835	−0.0184			
				(0.0618)	(0.0585)	(0.0809)			
Pens.(0–2)*E. Europe					0.121				
					(0.166)				
Pens.(3–6)*E. Europe					−0.0765				
					(0.178)				
Pens.(7+)*E. Europe					−0.312***				
					(0.104)				
Pens.(0–2)*Low Gov. bond						0.223**			
						(0.102)			
Pens.(3–6)*Low Gov. bond						0.0325			
						(0.132)			
Pens.(7+)*Low Gov. bond						−0.0675			
						(0.0964)			
Per capita GDP	−1.416***	−1.655***	−1.361**	−1.371***	−1.138**	−1.350***	−5.447***	−5.615***	−5.756***
	(0.502)	(0.465)	(0.517)	(0.478)	(0.497)	(0.477)	(1.352)	(1.350)	(1.352)
Investment	−0.0461	−0.0758*	−0.0548	−0.0553	−0.0898**	−0.0661	0.175***	0.176***	0.175***
	(0.0396)	(0.0386)	(0.0402)	(0.0383)	(0.0366)	(0.0394)	(0.0469)	(0.0470)	(0.0468)

Government consump.	−0.0102	−0.0557	−0.0103	−0.00950	−0.0697	−0.0111	−0.211**	−0.193**	−0.226**
	(0.0570)	(0.0584)	(0.0582)	(0.0545)	(0.0647)	(0.0531)	(0.0892)	(0.0914)	(0.0886)
Inflation	−1.007	−0.929	−1.067	−1.178	−1.190	−1.265	−1.957**	−1.886**	−2.079**
	(1.096)	(1.089)	(1.111)	(1.106)	(1.133)	(1.124)	(0.836)	(0.839)	(0.842)
Male upp. lev. schooling	1.095***	0.643**	1.087***	1.124***	0.694**	1.126***	0.0908***	0.0904***	0.0868***
	(0.208)	(0.251)	(0.213)	(0.205)	(0.269)	(0.204)	(0.0294)	(0.0295)	(0.0294)
Life expectancy at birth	0.0709	0.118*	0.0616	0.0831	0.0631	0.0878	−0.0121	−0.0149	−0.00903
	(0.0700)	(0.0673)	(0.0733)	(0.0687)	(0.0796)	(0.0684)	(0.0281)	(0.0280)	(0.0282)
Polity index	0.0322**	0.0296**	0.0320**	0.0284*	0.0147	0.0295**	0.266*	0.314**	0.296*
	(0.0133)	(0.0134)	(0.0131)	(0.0147)	(0.0207)	(0.0143)	(0.154)	(0.155)	(0.154)
Terms of trade	0.0577***	0.0639***	0.0566***	0.0580***	0.0536**	0.0572***	0.931	0.793	0.772
	(0.0188)	(0.0193)	(0.0188)	(0.0191)	(0.0201)	(0.0195)	(0.590)	(0.603)	(0.600)
Trade openness	−0.00241	−0.00167	−0.00201	−0.00278	0.00248	−0.00335	0.00276	0.0000888	0.00275
	(0.00594)	(0.00695)	(0.00608)	(0.00565)	(0.00725)	(0.00571)	(0.0112)	(0.0112)	(0.0112)
Observations	636	636	636	636	636	636	634	634	634
Cross sections	33	33	33	33	33	33	33	33	33
R^2	0.101	0.120	0.103	0.117	0.148	0.125			
Adjusted R^2	0.087	0.103	0.087	0.100	0.126	0.104			
Time/country FE	No/No	No/No	No/No	No/No	No/No	No/No	No/Yes	No/Yes	No/Yes

Notes: The dependent variable is the annual growth rate of real GDP per capita multiplied by 100. Columns (1–3) report estimates from static regressions without fixed effects. Columns (4–6) report estimates from model with time-varying effects. Columns (7–9) report estimates from dynamic model The numbers in parentheses are robust clustered standard errors (1–6) and bootstrap standard errors (7–9). *, **, and *** denote significance at 10%, 5%, and 1%. All covariates are as in the main text.

Table A3. *Monte Carlo results*

Parameter value	0	0.05	0.1	
Pension reform				
Coefficient	0.001	0.0497	0.099	
90% coverage	[−0.036 0.037]	[0.013 0.087]	[0.064 0.136]	
t-stat	0.108	0.712	0.998	
Parameter values	0; 0; 0	0.05; 0.05; 0.05	0.075; 0.075; 0.1	0; 0; 0.1
Pension (0–2)				
Coefficient	0.000	0.050	0.075	0.000
90% coverage	[−0.047 0.047]	[0.004 0.097]	[0.029 0.121]	[−0.046 0.045]
t-stat	0.103	0.527	0.831	0.096
Pension (3–6)				
Coefficient	0.000	0.050	0.075	0.000
90% coverage	[−0.045 0.046]	[0.005 0.095]	[0.031 0.119]	[−0.046 0.045]
t-stat	0.112	0.571	0.858	0.110
Pension (7+)				
Coefficient	0.001	0.050	0.100	0.100
90% coverage	[−0.042 0.043]	[0.008 0.092]	[0.058 0.142]	[0.059 0.141]
t-stat	0.103	0.614	0.987	0.986

Notes: Each row reports Monte Carlo coefficient estimate, 90% Monte Carlo coverage and the percentage of rejections of the null hypothesis of the simple *t*-test at the 10% significance level. Each column within two panels (top and bottom) reports results from one experiment. The top panel reports results from the static fixed effect regressions where Pension reform variable takes three alternative values given in column heading. The lower panel reports results from time-varying fixed effect regressions where pension reform variables are defined as P(0–2) equals zero for all years apart from the year of the change in the contribution rate and the subsequent 2 years; P(3–6) is non-zero over 3–6 years following the change and P(7on) covers period starting from 7 years following the reform. The true values of the variables are given in the column heading for each experiment. Each experiment uses 5,000 simulations.

Table A4. *Savings regressions: two-stage estimates*

Variable	1	2	3	4	5	6	7
Pension reform		0.228	0.384	0.210	0.128	0.168	0.0860
		(0.355)	(0.540)	(1.077)	(0.174)	(0.187)	(0.178)
Pension ref.*E. Europe			−0.261			−0.0955	
			(0.660)			(0.229)	
Pension ref.*Low Gov. bond				0.188			0.177
				(0.635)			(0.185)
Aging speed	−0.254*						
	(0.147)						
Peers	0.323***						
	(0.0569)						
Per capita GDP	4.229***	13.47***	14.13***	13.71	2.497**	2.488**	2.908**
	(1.436)	(4.989)	(5.307)	(8.819)	(1.20)	(1.17)	(1.365)
Credit to private sector	0.00794	−0.0688*	−0.0675*	−0.0736	−0.0170	−0.0171	−0.0200
	(0.0134)	(0.0360)	(0.0350)	(0.0491)	(0.012)	(0.011)	(0.014)
Government consump.	−0.234**	−0.856***	−0.914***	−0.863*	−0.239*	−0.241	−0.226
	(0.116)	(0.183)	(0.194)	(0.464)	(0.145)	(0.159)	(0.155)
Dependancy ratio	−0.0792	0.174	0.172	0.197	0.0654	0.0631	0.0780
	(0.0805)	(0.160)	(0.178)	(0.354)	(0.052)	(0.056)	(0.058)
Inflation	−5.783***	−1.663	−2.540	−1.432	1.531	1.661	1.800
	(1.700)	(1.919)	(2.937)	(11.75)	(1.458)	(1.548)	(1.610)
Terms of trade	−0.00756	0.0709**	0.0742**	0.0702	0.0566	0.0567*	0.0545
	(0.0292)	(0.0325)	(0.0357)	(0.0964)	(0.039)	(0.034)	(0.039)
Unemployment rate	0.126*	0.192	0.176	0.167	0.134*	0.131	0.132*
	(0.0692)	(0.195)	(0.202)	(0.330)	(0.081)	(0.083)	(0.080)
Residual Pension ref.		−0.930	−0.900	−0.723	−0.360	−0.432	−0.169
		(1.048)	(1.242)	(3.037)	(0.387)	(0.574)	(0.411)
Residual Pens. ref.*E. Europe			−0.285			0.0964	
			(1.034)			(0.459)	

Table A4 (*cont.*)

Variable	1	2	3	4	5	6	7
Residual Pens. ref.*Gov. bond				−0.412			−0.572
				(1.365)			(0.363)
Observations	700	700	700	700	700	700	700
Cross sections	36	36	36	36	36	36	36
Time/country FE	Yes/No	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes

Notes: The dependent variable in columns (1) is Pension reform (first-stage estimates). The dependent variable in columns (2–4) is the share of gross domestic savings in GDP (second stage).The dependent variable in columns (5–7) is the change in the share of gross domestic savings in GDP (second stage). Columns (2–4) report estimates from the static fixed effect model. Columns (5–7) report estimates from the dynamic fixed effect model. The numbers in parentheses are bootstrap standard errors. *, **, and *** denote significance at 10%, 5%, and 1%. Old-age speed and Peers are used as instruments in the first stage. All covariates are as in the main text. Residual pension ref is generalized residual from the first-stage Tobit regression with Pension reform as the dependent variable (column 1). Residual pension ref E.Europe (Gov. bond) is generalized residual from Tobit regression with interaction term Pension reform*Eastern Europe (high share of government bonds) as the dependent variable (not reported).

Table A5. *Savings regressions: removing fixed effects*

Variable	1	2	3	4	5	6	7	8	9
Pension reform	−0.0203	−0.165	−0.211				0.0548	0.0734	0.0667
	(0.248)	(0.298)	(0.352)				(0.0443)	(0.0538)	(0.0496)
Pension ref.*E. Europe		0.432						−0.0553	
		(0.439)						(0.0907)	
Pension ref.*Low Gov. bond			0.414						−0.0406
			(0.436)						(0.0851)
Pension (0–2)				−0.134	−0.154	−0.300			
				(0.192)	(0.235)	(0.268)			
Pension (3–6)				−0.261	−0.269	−0.428			
				(0.202)	(0.208)	(0.284)			
Pension (7+)				0.176	0.0919	0.00866			
				(0.207)	(0.264)	(0.306)			
Pens.(0–2)*E. Europe					0.0821				
					(0.257)				
Pens.(3–6)*E. Europe					0.0163				
					(0.172)				
Pens.(7+)*E. Europe					0.235				
					(0.396)				
Pens.(0–2)*Low Gov. bond					−1.656	0.276			
					(2.817)	(0.287)			
Pens.(3–6)*Low Gov. bond						0.264			
						(0.312)			

Table A5 (*cont.*)

Variable	1	2	3	4	5	6	7	8	9
Pens.(7+)*Low Gov. bond						0.318			
						(0.365)			
Per capita GDP	11.44***	10.82***	11.49***	11.58***	11.29***	11.71***	2.831***	2.966***	2.902***
	(2.113)	(2.184)	(2.139)	(2.188)	(2.208)	(2.230)	(1.009)	(1.044)	(1.027)
Credit to private sector	0.0172	0.0133	0.0115	0.00901	0.00377	0.00189	−0.0169*	−0.0171*	−0.0177*
	(0.0439)	(0.0388)	(0.0446)	(0.0445)	(0.0413)	(0.0476)	(0.00877)	(0.00878)	(0.00904)
Government consump.	−0.0722	−0.0392	−0.0490	−0.0346	−0.0131	−0.0164	−0.247***	−0.256***	−0.245***
	(0.193)	(0.195)	(0.199)	(0.192)	(0.200)	(0.199)	(0.0630)	(0.0651)	(0.0632)
Dependancy ratio	0.0870	0.0295	0.102	0.102	0.0611	0.115	0.0387	0.0420	0.0394
	(0.125)	(0.151)	(0.129)	(0.126)	(0.158)	(0.129)	(0.0263)	(0.0275)	(0.0264)
Inflation	0.523	0.473	0.346	0.388	0.322	0.165	1.473**	1.485**	1.493**
	(1.939)	(1.909)	(1.926)	(1.893)	(1.858)	(1.882)	(0.656)	(0.655)	(0.658)
Terms of trade	0.153***	0.156***	0.148***	0.142***	0.146***	0.141***	0.0635***	0.0637***	0.0636***
	(0.0527)	(0.0544)	(0.0543)	(0.0518)	(0.0531)	(0.0498)	(0.0231)	(0.0231)	(0.0231)
Unemployment rate	−0.220	−0.211	−0.228	−0.202	−0.192	−0.222	0.124***	0.122***	0.121***
	(0.146)	(0.155)	(0.143)	(0.145)	(0.150)	(0.138)	(0.0453)	(0.0454)	(0.0460)
Observations	700	700	700	700	700	700	686	686	686
Cross sections	36	36	36	36	36	36	36	36	36
R^2	0.464	0.472	0.482	0.474	0.477	0.495			
Adjusted R^2	0.458	0.464	0.474	0.467	0.466	0.484			
Time/Country FE	No/No	No/No	No/No	No/No	No/No	No/No	No/Yes	No/Yes	No/Yes

Notes: The dependent variable in columns (1–6) is the share of gross domestic savings in GDP. The dependent variable in columns (7–9) is the change in the share of gross domestic savings in GDP. Columns (1–3) report estimates from static regressions without fixed effects. Columns (4–6) report estimates from model with time-varying effects. Columns (7–9) report estimates from dynamic model. The numbers in parentheses are robust clustered standard errors (1–6) and bootstrap standard errors (7–9). *, **, and *** denote significance at 10%, 5%, and 1%. All covariates are as in the main text.