Demographics, Old-Age Transfers and the Current Account*

Mai Chi Dao† Callum Jones‡

November 2018

Abstract

Demographic trends affect a country's saving-investment balance and current account, in part through their implications for the sustainability of pension systems. We link, in theory, the generosity of pay-as-you-go (PAYG) pensions to the future evolution of demographic variables and use our theory to compute a proxy for the natural generosity of PAYG in a large panel dataset. We show that countries with higher life expectancy have higher savings and more positive current account balances when facing lower natural pension generosity, as measured by our proxy.

Keywords: Demographics, Current Account Flows, Pensions, External Imbalances.

JEL classifications: E2, J1.

1 Introduction

Standard life-cycle theory predicts that a country's demographics affect its aggregate savings and current account balance. Theory also predicts that the generosity of intergenerational pay-as-you-go (PAYG) pension transfers can affect incentives to save, as individuals forecast how much of their consumption needs will be covered by expected pension receipts (Auerbach and Kotlikoff, 1987).

*We thank Alan Auerbach, Nicolas Coeurdacier, Luis Cubeddu, and Cyril Rebillard for helpful comments and discussions. Jair Rodriguez provided excellent research assistance. The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.

†Research Department, International Monetary Fund, mdao@imf.org

‡Research Department, International Monetary Fund, cjones3@imf.org

An aging population, underpinned by past and current fertility, immigration and longevity trends, reduces the size of the tax base from which future PAYG payments are drawn, thereby increasing private saving. In this paper, we link the generosity of future expected PAYG payments to the future old-age dependency ratio (OADR) in a two-country OLG model. We then present new evidence that the future OADR strongly correlates with current account balances in a panel dataset of 49 countries, and show that the sensitivity of changes in savings and current account balances to changes in life expectancy is higher when PAYG transfer schemes are less generous. These empirical relationships, predicted by our model, are robust to including other theorized predictors of current account flows.

2 Model

We use a standard two-country model to link the generosity of PAYG transfers to the underlying demographic structure and to introduce new sources of non-linearity for the effect of demographics on the current account.[1] Households live for three periods, receiving an endowment when they are middle-aged. When young, households borrow off the middle-aged to finance consumption. The middle-aged's lending to the young finances their consumption when they are old. The middle-aged are taxed at a set lump sum rate to finance contemporaneous transfers to the old which cover a fraction of their middle-age endowment.

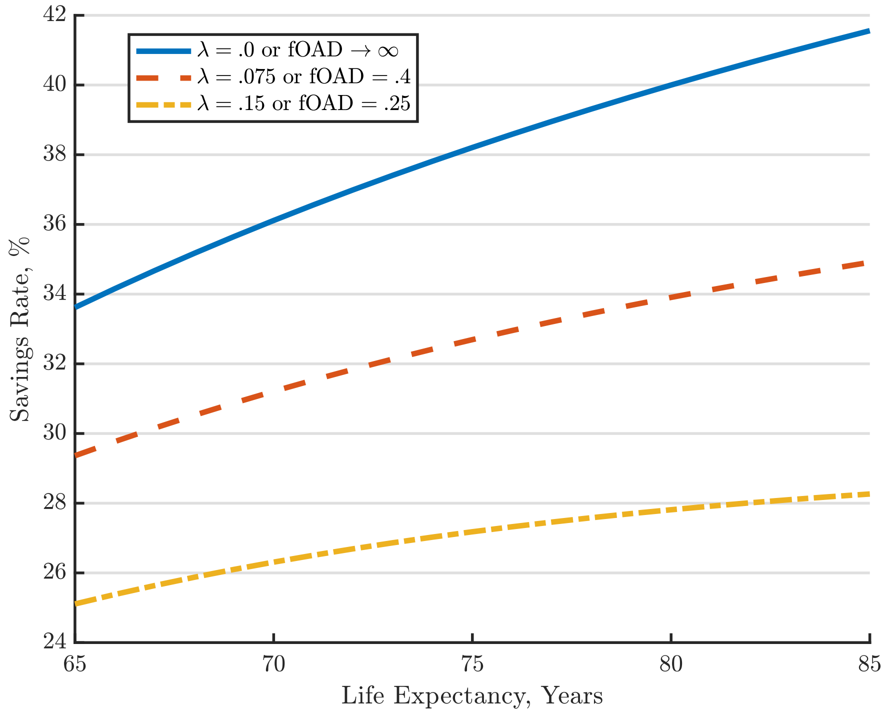
Our model predicts that countries with more generous PAYG payments have lower saving rates. The model also predicts that saving rates are more sensitive to changes in life expectancy when the old-age transfer system is less generous. Intuitively, workers save more not only when they expect to live longer, but also when they expect to rely less on future generations for support (see also Eugeni, 2015).

We link the generosity of the transfer from middle-aged to old to demographics through a balanced budget constraint:

$$\lambda = \frac{\tau}{y} \times \frac{1}{\text{Old-Age Dependency Ratio}},$$

[1] See the appendix for details and Eggertsson et al. (fc), and Bárány et al. (2018) for similar models.

Figure 1: Savings Rate and Life Expectancy

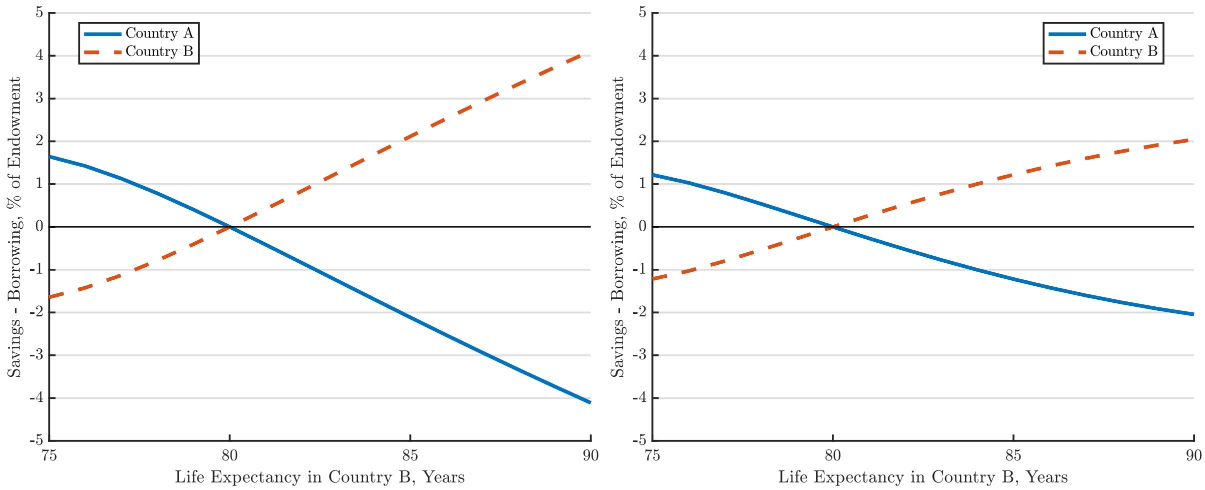


where τ is the tax rate on the middle-aged, y is the middle-age endowment, the OADR is the ratio of the number of the elderly to the number of the middle-aged, and λ is our proxy for the generosity of the transfer which covers a fraction λy of the endowment. There is, therefore, an inverse relationship between the future OADR and the future generosity of the PAYG system. Because current saving is affected by the expected generosity of the transfer, when the future OADR is expected to be high, current savings increases. We show this relationship in steady-state in our model in Figure 1. Savings rates increase with life expectancy, but are lower and less sensitive to changes in life expectancy when the natural generosity of the PAYG pension system is higher.

We examine the implications of demographics and PAYG transfers in our model for capital flows. In Figure 2a, we calibrate the life expectancy of country A to 80 years, and adjust the life expectancy of country B between 75 years and 90 years, and plot the difference between savings and borrowing in percent of the endowment. In this simulation, there are no formal or informal intergenerational transfers in either country other than transfers through the bond market. The simulation shows that capital flows from the country with the higher

Figure 2: Cross-Country Capital Flows and Life Expectancy

(a) Without Intergenerational Transfers (b) With Intergenerational Transfers



life expectancy to the lower life expectancy country, reflecting the higher savings made by those who expect to live for longer.

Finally, we study the sensitivity of capital flows to the generosity of the PAYG transfers. In Figure 2b, we plot the implied cross-country capital flows in steady-state against life expectancy in country B, where both countries have an equally generous system of transfers from the middle-aged to the old, covering 15% of the middle-aged endowment ($\lambda = 0.15$). Compared to the steady-state profiles in Figure 2a, savings within a country are less sensitive to changes in life expectancy and, as a consequence, cross-country capital flows are less sensitive to differences in life expectancy across countries.

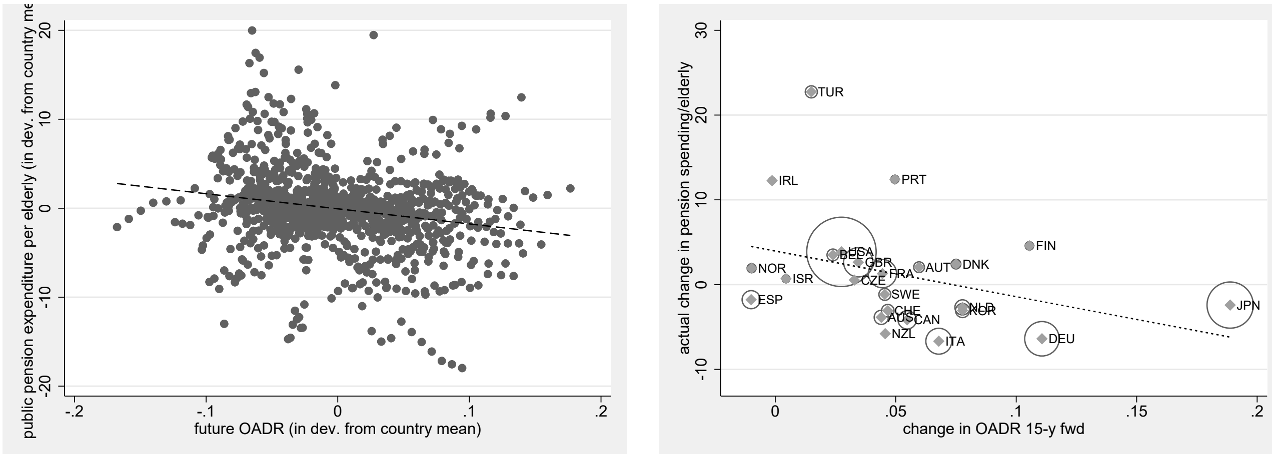
3 Empirics

Our sample includes 49 countries, both advanced and emerging economies, that encompass about 90 percent of global GDP, which at the same time have sizable access to global capital markets, and are geographically diverse. The time period for most countries covers the years 1986-2016.[2]

We first ascertain that future OADRs are related to the level of generosity of the public

[2] Current account data is from the IMF WEO database and the demographic data is from the UN World Population Prospects database, 2017 revision.

Figure 3: Correlation of Future Old-Age Dependency Ratio and Public Pension Benefit Ratio



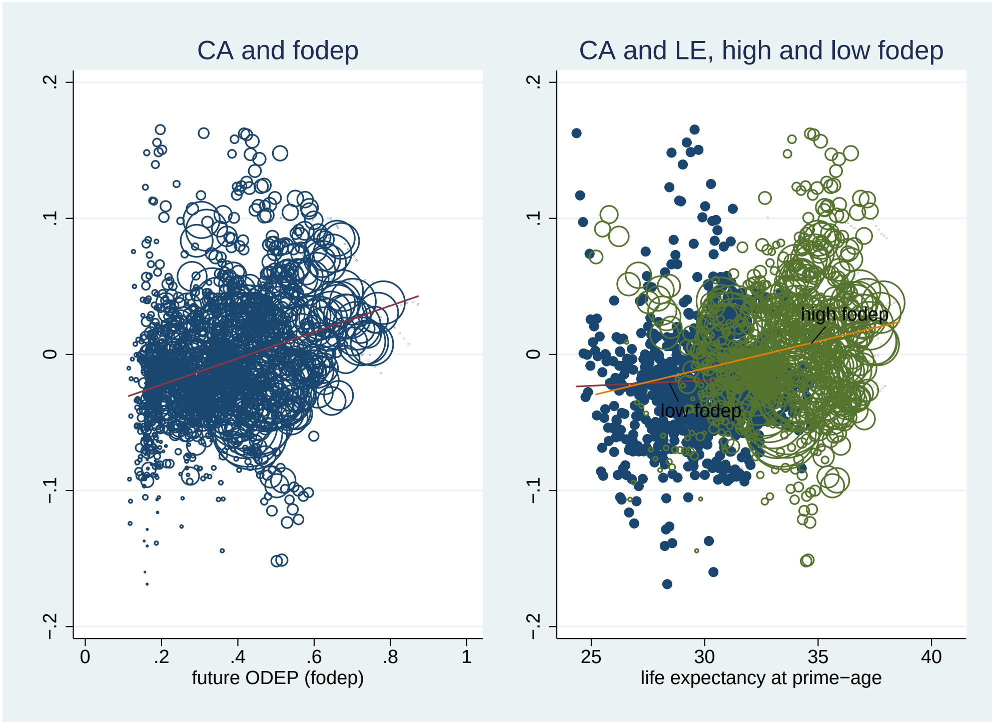
Pension spending/elderly is total government spending on public old-age pension in cash divided by the 65+ population, scaled by nominal GDP per worker.

PAYG pension benefit. Although data on such benefits are only available for a subset of OECD countries over a shorter time period than our sample, we can explore the correlation within this subsample. The left panel of Figure 3 documents that variation in future OADRs within our sample is negatively correlated with the level of generosity of public pension schemes, measured as the public pension spending per elderly relative GDP per worker (with a correlation coefficient of about -0.2). Moreover, as illustrated in the right panel of Figure 3, expected shifts of population age compositions in the future are associated with decreases of public pension generosity over the same horizon, supporting our model-based proxy λ for the sustainable level of the intergenerational transfer, computed from the prospective demographic composition.

Next, we plot the simple correlation between the current account and the future OADR (proxying for the future generosity of inter-generational transfer schemes). The future OADR is computed as a moving average of the OADR 15 to 25 years forward, reflecting the time horizon for retirement of a prime-age worker. The model predicts a positive correlation driven by a higher need to rely on life-cycle saving, which is exactly what we find in the left panel of Figure 4.

Moreover, as predicted by the lifecycle theory, the sensitivity of current accounts to variations in life expectancy also increases with higher future OADR, due to a stronger need

Figure 4: Current Account and the Future OADR



Note: High future OADR observations are those at or above median, low future OADR below median. Bubble size proportionate to nominal GDP.

to rely on life-cycle saving. This is exactly what the data bears out in the right panel of Figure 4, which shows that the slope for the correlation between the current account and life expectancy is strongly positive for countries with a high future OADR (that is, a future OADR above the sample median) while essentially flat for countries with below median future OADRs.

Overall, while simple and parsimonious, our proxy and theoretical framework produces sharp empirical predictions that are strongly borne out by the data when viewed in a bivariate setting. Do they maintain statistical significance when modeled jointly and how much of the actual variation in current accounts across countries can they explain? In the following, we combine all demographic variables into a multivariate regression model. To maintain multilateral consistency, all demographic explanatory variables as expressed in deviations from world averages, that is, demographic variables should only affect current accounts to the extent that they evolve differently across countries. Table 1 summarizes the results.

Table 1: Demographic Determinants of the Current Account

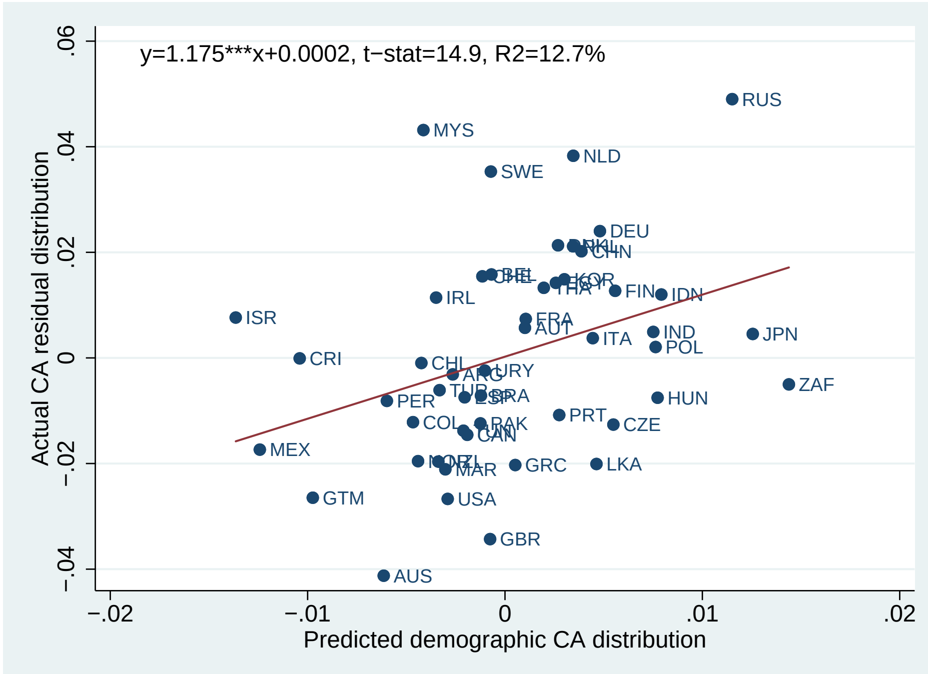
	Dependent Variable: CA balance (% of GDP)				
	(1)	(2)	(3)	(4)	(5)
Old-age dependency ratio	0.044**	-0.008	-0.058**	-0.074***	-0.074***
	(0.022)	(0.022)	(0.027)	(0.027)	(0.028)
Population growth	-0.643***	-1.044***	-0.824***	-1.025***	-1.024***
	(0.201)	(0.204)	(0.210)	(0.203)	(0.201)
Life expectancy	0.000	-0.037***	-0.035***	-0.007	-0.006***
	(0.001)	(0.006)	(0.006)	(0.011)	(0.001)
Life exp squared		0.001***	0.001***	0.000	
		(0.000)	(0.000)	(0.000)	
Prime-saver share			0.132***	0.196***	0.198***
			(0.037)	(0.040)	(0.036)
Life exp $\times$ Future OADR				0.023***	0.024***
				(0.006)	(0.003)
Constant	-0.001	-0.004***	-0.003**	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N	1495	1495	1495	1495	1495
R^2	0.037	0.058	0.064	0.077	0.077

Notes: Significance levels: *, 10%; **, 5%; ***, 1%. Sample is 1986 to 2016. Variables are expressed in deviation from world averages.

In columns 1 to 5, we add the demographic variables progressively to a pooled regression of current account balances using the same sample as in the External Balance Assessment (EBA) framework of the IMF (documented in Cubeddu et al. 2018). As in the bivariate correlation, life expectancy does not appear to have a linear effect on the current account and instead, by the strongly significant positive squared term, only has a positive effect on the current account at relatively high levels of life expectancy, consistent with the stylized facts and model predictions above. The prime-saver share, capturing the cohort composition among working-age population, has a strong positive effect on the current account in the joint specification. That is, past baby booms that lead to a higher share of prime-age saver cohorts among the present working age population leads, all else equal, to a higher aggregate saving and current account. This composition effect is consistent with our OLG model.

Finally, the interaction term between life expectancy and future OADR enters with a

Figure 5: Role of Demographics: Predicted and Actual CA residuals (1986-2016 average)



Note: The y-axis measures the actual mean current account residual conditional on all other (non-demographic) regressors in the variables in column 4 of Table 2. Values on the x-axis are current account levels predicted by regressing these residuals on the demographic variables.

strong positive sign, consistent with the model prediction of a stronger need to rely on own saving given natural limits to future intergenerational transfers. Importantly, this non-linear effect of life expectancy renders the squared term insignificant, suggesting that most of the non-linear effect is accounted for by the mechanism of the model. Finally, in column 5, we show that the model without the squared term achieves the same fit and allows each coefficient estimate to be statistically significant and comply with our economic prior.

The demographic indicators included in the pooled regression of column 5 of Table 1 are not only statistically, but also economically significant. Jointly, they are able to explain almost 13 percent of the cross-country variation in current account balances over the long run (see Figure 5). This magnitude is consistent with the literature that relies on demographic forces generated by calibrated structural models to explain current account variation across major advanced economies (see for example, Domeij and Floden, 2006; Brooks, 2003; Backus et al. 2014).

In Table 2 we subject the baseline regression to some robustness checks. In column 1, we further add country fixed effects and show that the demographic mechanisms identified also operate within countries, thus addressing concerns of slow-moving demographic indicators spuriously capturing country-specific time-invariant factors. In addition, time fixed effects are added in column 2, removing any common trends that can potentially co-move with demographics across countries. As many of the slow-moving demographic variables are likely auto-correlated, column 3 estimates the baseline model allowing for panel-specific heteroskedasticity and auto-correlation (see Greene, 2012). Finally, the estimated coefficients are robust in magnitude and statistical significance when we control for other country-specific fundamentals which may correlate with demographics, such as income per capita, level of public health spending, and so on (Cubeddu et al. 2018). All demographic coefficients retain similar magnitudes and statistical significance, indicating empirical salience and stability of the identified mechanisms.

4 Conclusion

This paper explores the relationship between the current account balance and demographics, in theory and in the data. We introduce a PAYG transfer system to a two-country overlapping generations model and use the model to compute a proxy for the natural generosity of PAYG pensions in a large panel dataset. Consistent with the theory, countries with naturally less generous PAYG pensions have current account balances that are more sensitive to changes in life expectancy.

Table 2: Robustness of Demographic Determinants

	Dependent Variable: CA balance (% of GDP)			
	(1)	(2)	(3)	(4)
Old-age dependency	-0.205***	-0.190***	-0.050	-0.100**
	(0.043)	(0.043)	(0.055)	(0.045)
Population growth	-2.136***	-1.673***	-1.205***	-0.951**
	(0.269)	(0.291)	(0.433)	(0.374)
Life expectancy (at prime-age)	-0.005***	-0.007***	-0.006***	-0.005***
	(0.002)	(0.002)	(0.002)	(0.001)
Prime saver share	0.145***	0.172***	0.138**	0.115**
	(0.036)	(0.037)	(0.069)	(0.058)
Life exp.*Future old-age dep.	0.030***	0.027***	0.024***	0.011**
	(0.005)	(0.005)	(0.006)	(0.005)
$(\text{NFA/Y})_{t-1}$				0.029***
				(0.006)
$(\text{NFA/Y})_{t-1}$ if $(\text{NFA/Y})_{t-1} < -60\%$				-0.018
				(0.012)
$(Y/\text{worker})_{t-1}$, rel. to top 3 economies				0.019
				(0.020)
$(Y/\text{worker})_{t-1} \times$ Capital Openness				0.037*
				(0.021)
Oil, Natural Gas × Resource Temp.				0.312***
				(0.090)
GDP growth forecast in 5 years				-0.175*
				(0.100)
$(\text{Public Health Spending/GDP})_{t-1}$				-0.462***
				(0.138)
$(\text{VIX} \times \text{Cap. Open.})_{t-1}$				0.045***
				(0.014)
$(\text{VIX} \times \text{Cap. Open.} \times \text{Reserves Share})_{t-1}$				-0.087
				(0.063)
Own currency's share in world reserves				-0.032***
				(0.012)
Output gap				-0.368***
				(0.031)
Commodity ToT gap × Trade Openness				0.203***
				(0.034)
Detrended private credit/GDP				-0.108***
				(0.013)
Constant	-0.006*	-0.001	-0.004	-0.005*
	(0.003)	(0.005)	(0.003)	(0.003)
Country FE	Y	Y	N	N
Time FE	N	Y	N	N
N	1495	1495	1495	1372
R^2	0.063	0.102	0.023	0.304

Notes: Significance levels: *, 10%; **, 5%; ***, 1%. Sample is 1986 to 2016. Most explanatory variables are expressed in deviation from world averages. The data sources are described in Cubeddu et al. (2018).

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Appendix

A Model

There are two countries in the model with symmetric problems. We denote one country's variables with $\star$, and the non-starred variables as those of another country. We describe the setup for the non-starred country. Individuals survive between middle-age and old-age between periods $t-1$ and t with probability γ_t. We define n_t^s as the size of the generation born in period s at time t so that the mortality process implies $n_{t+1}^t = n_t^t$ and:

$$n_{t+1}^{t-1} = \gamma_{t+1} n_t^{t-1}.$$

Unintentional bequests are redistributed to those of the same generation, scaling the return on savings by $\frac{1}{\gamma_t}$.

Denoting c_t^s as the consumption at time t of an individual born in period s, the household's optimization problem is given by:

$$\max_{\left\{c_t^t, c_{t+1}^t, c_{t+2}^t\right\}} \mathbb{E}\left[\log c_t^t + \log c_{t+1}^t + \gamma_{t+2} \log c_{t+2}^t\right].$$

subject to a budget constraint when young:

$$c_t^t \leq b_t^t,$$

where b_t^t is the borrowing of the young, and a budget constraint when middle-aged:

$$c_{t+1}^t \leq y_{t+1}^t - (1+r_t) b_t^t + b_{t+1}^t - \tau_{t+1},$$

where y_{t+1}^t is the endowment in middle-age, r_t is the interest paid on past borrowing, τ_t is a lump-sum tax, and a budget constraint when old:

$$c_{t+2}^{t} \leq -\frac{(1+r_{t+1})}{\gamma_{t+2}} b_{t+1}^{t} + \lambda y_{t+1}^{t}.$$

The taxes τ_t are used to finance immediate payments to the old at time t which cover $\lambda < 1$ of their endowment received in the previous period, which for the old in period t is y_{t-1}^{t-2}. Total old-age transfers or benefits are equivalent to the taxes paid by the middle-aged, such that the government budget is balanced at period t:

$$n_t^{t-1} \tau_t = \lambda n_t^{t-2} y_{t-1}^{t-2}.$$

The borrowing of the young is assumed to be constrained by an exogenous borrowing limit:

$$b_t^t \leq \frac{d_t}{1+r_t},$$

which we will also assume is binding.

With two countries, the interest rate is such that total savings across the two countries equals total borrowing across the two countries. The demand for borrowing in the starred country is:

$$n_t^{t\star} b_t^{t\star} = n_t^{t\star} \frac{d_t^{\star}}{1+r_t},$$

and supply of savings is $-n_t^{t-1\star} b_t^{t-1\star}$. With equivalent expressions for the non-starred economy and equating demand and supply, we get that the interest rate is the price that clears the global savings and borrowing market:

$$1 + r_t = \left[n_t^{t\star} d_t^{\star} + n_t^t d_t \right] \left[-n_t^{t-1\star} b_t^{t-1\star} - n_t^{t-1} b_t^{t-1} \right]^{-1}.$$

Optimal Saving It is straightforward to show that optimal saving by the middle-aged in the non-starred country in steady-state is:

$$-b = \frac{\gamma}{1+\gamma}\left[y - d - \lambda y\left(\gamma + \frac{1}{1+r}\right)\right].$$

This shows that desired saving is decreasing in the generosity of the transfers λy.

Proxy for Pension Generosity To construct our proxy for the natural generosity of pension systems, assuming tax rates are fixed at the level τ, we link the generosity of the transfer λ to demographics through the balanced budget equation:

$$\lambda_t = \tau\frac{n_t^{t-1}}{n_t^{t-2}}\frac{1}{y_{t-1}^{t-2}}.$$

The expected transfer (or generosity) of the system, which is the quantity that affects current saving, is then given by:

$$\lambda_{t+1} = \frac{\tau}{y_t^{t-1}}\frac{n_{t+1}^{t}}{n_{t+1}^{t-1}} = \frac{\tau}{y_t^{t-1}}\frac{1}{\text{Future Old-Age Dependency Ratio}}.$$

B Summary Statistics

Table 3 presents the variable definitions and their summary statistics.

Table 3: Definitions and Summary Statistics of Demographic Variables

Indicator	Definition	Obs.	Mean	Std. Dev.	Min	Max
Old-age dependency ratio	population 30-64/population 65+	1519	0.249	0.094	0.106	0.579
Population growth	Annual growth rate of total population	1519	0.010	0.008	-0.005	0.037
Life expectancy at prime age	Avg. life expectancy at 45 to 50 years old	1519	31.296	3.183	22.299	37.873
Prime-saver share	Population 45-64/population 30-64	1519	0.482	0.059	0.361	0.624
Future old-age dependency ratio		1519	0.336	0.142	0.114	0.782
Pension per elderly (in %)	(Public expenditure on old-age pension					
	/Population 65+)/(GDP/Working-age population)	775	25.600	9.633	0	59.809

Source: UN Population Prospects, OECD Pension at a Glance database, authors' calculations.