

Pension Policy and the Financial System

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ABSTRACT

This paper examines the effect of pension policy on the structure of financial systems around the world. In particular, I explore the hypothesis that policies that promote pension savings also promote the development of capital markets. I present a model that endogenizes the extent to which savings are intermediated through banks or capital markets, and derive implications for corporate finance, household finance, banking, and the size of the financial sector. I then present a number of facts that are broadly consistent with the theory and examine a variety of alternative explanations of my findings.

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Countries around the world have made vastly different choices about how to meet the retirement needs of their populations. Some have chosen to finance retirement incomes largely by taxing current workers, in so-called pay-as-you-go ("PAYGO") pension systems. Others have promoted private pension saving as a way to fund retirement benefits. For example, according to the OECD, in Italy and Denmark the average worker entering the labor force in 2014 could retire at age 67 and expect to have almost 70% of his or her pre-retirement income replaced by pension income (OECD (2015)). In Italy this pension income would be financed in large part by taxes on current workers, while in Denmark much of this income would be generated by the assets of private pension schemes. These different approaches are reflected in differences in pension assets across the two countries: in 2014 private pension assets were less than 10% of GDP in Italy, while in Denmark they were about 180% of GDP (OECD (2015)). Table I, described in greater detail in the next section, documents the remarkable variation in pension systems across the OECD.

Countries also vary in the structure of their financial systems. They vary in bank dependence (Levine (2002)), corporate ownership structure (La Porta, Lopez-de-Silanes, and Shleifer (1999)), household assets and liabilities (Badarinza, Campbell and Ramadorai (2016)), the composition of bank balance sheets (Barth, Caprio, and Levine (2004)), and the size of the financial sector (Philippon and Reshef (2013)).

In this paper, I connect the structure of financial systems in advanced economies to their pension policies. In particular, I explore the hypothesis that policies that promote the accumulation of pension savings also promote the development of capital markets, which in turn affects corporate finance, household finance, banking, and the size of the financial sector. The idea that pension saving stimulates capital market development has figured in pension reform proposals for both developed and emerging market economies (World Bank (1994)). However, the theoretical basis for this claim and the full set of implications of pension policy for financial systems are not well understood. Indeed, while an abundant academic literature studies the effect of pension policy on savings, there is little theory and evidence on how pension policy affects the way the financial system transforms savings into

investment.

I start my analysis with a model that links pension policy to the structure of the financial system. The theory I propose builds on William Diamond's (2017) model of financial intermediation, which I use to derive implications for how pension policy affects the extent to which savings are intermediated through banks or capital markets. I then use the framework to link pension policy to risk-taking by firms, the composition of corporate and bank balance sheets, household assets and liabilities, and the size of the financial sector.

Following Diamond (2017), in my model households choose to allocate their savings between safe bank deposits and securities. Banks want to issue safe deposits because households value the liquidity services that they provide and are thus willing to accept a low return on these investments. However, to offer safe deposits, banks will invest only in relatively safe assets and will issue equity as a buffer to protect depositors. By contrast, households will want to invest some of their savings in risky assets through the capital markets in addition to investing in the safe and liquid deposits that banks issue. This leads to a bifurcation in the allocation of risk between banks, which fund relatively safe projects, and capital markets, which fund relatively risky projects.

I depart from Diamond (2017) in four important respects. To simplify the model, I assume that savings are exogenous and randomly distributed across households within an economy but that there are greater average household savings in economies that rely on pre-funded private pensions (i.e., economies that are less dependent on PAYGO public pensions). Second, I model a production economy, which enables me to derive implications for the types of projects undertaken in the economy. Third, I assume that households incur fixed costs to invest in capital markets, implying that only households with a lot of pension savings invest in capital markets. Finally, in an extension of the model, I assume that households buy homes against which they can borrow to fund their purchases. This assumption allows me to incorporate the main asset of many households into the model.

The above assumptions generate cross-sectional implications that link pension policy to key features of the financial system. Among the implications is that the financial systems of countries with PAYGO-oriented pension systems — those with less pension savings — are more bank-based and less capital-market intensive. Another implication is

that there is less risk-taking in PAYGO-oriented pension systems because banks have less risk-bearing capacity than capital market investors. Moreover, as more households invest in capital markets, the fee for managing a unit of capital market assets falls, which pulls more households into capital markets, resulting in a form of "capital market deepening." The model also implies that in PAYGO-oriented pensions systems, households devote a larger share of their savings to housing equity because there are fewer households who have enough savings to make it worthwhile to invest in capital markets. Finally, because there is less mortgage credit in countries with more PAYGO-oriented pension systems, the model predicts that a larger share of bank assets will be devoted to business loans.

The facts are broadly consistent with these implications. In countries with retirement systems that rely more on PAYGO pensions, companies are more likely to be funded with bank loans. Firms in more PAYGO-oriented countries are also smaller, consistent with the idea that banks are less willing to fund risky growth strategies, and a larger fraction of company shares are held by corporate insiders, consistent with there being less demand for shares from pension funds. Households in countries with PAYGO-oriented pension systems use less leverage to purchase their homes, and they hold more deposits as a share of their wealth. Bank assets in these countries are more concentrated in corporate loans, rather than residential mortgages and other forms of household credit.

The model also suggests a link between the structure of pensions and the overall size of the financial sector. Empirically, countries with pre-funded pension systems have larger financial sectors as measured by their value added relative to GDP. In part this is because there is more intermediation of pension assets in these countries, and as a result more fees are paid for asset management services. But the magnitude of the effect of pension assets on the size of the financial sector — \$1.90 for every \$100 of pension assets — is likely too large for asset management fees to be the whole story. One possible explanation is that pensions stimulate security issuance and other sorts of financial activity, which leads to the kind of capital market deepening implied by the model.

Of course, there may be alternative interpretations of these findings. One possibility is that there is reverse causality, whereby countries that have less robust financial sectors are more likely to choose PAYGO-oriented pension systems. Another possibility is that

countries are more likely to choose PAYGO-oriented pension systems if they have weak investor protections or if people have less trust in the financial system. While there is some truth to these observations, I will present evidence that suggests that these alternative explanations do not tell the whole story. Nevertheless, I want to be clear from the outset that my empirical approach is a simple cross-country analysis; I do not have instruments that would allow me to isolate exogenous variation in pension structure, nor do I study significant changes in policy that might enable me to conduct a difference-in-difference analysis. Rather, my modest goal here is to put forward the idea that pension policy may play an important role in shaping the structure of financial systems around the world and to provide some evidence consistent with this idea.

My paper sits at the intersection of public economics and finance. Public economics has been interested in the macroeconomic implications of pension policy since the publication of Samuelson's 1958 classic overlapping generations model that, among other things, elucidated the value of a PAYGO pension system. This literature, reviewed by Feldstein and Liebman (2002), has focused mainly on the effects of pension policy on aggregate savings.

The finance literature on pensions, by contrast, has focused largely on a different set of issues. One stream of the literature examines optimal portfolio allocation and funding decisions for pension funds and workers (Treyner (1977), Viceira (2001)). Other research explores incentive and funding problems in pension fund management in the U.S. (Novy-Marx and Rauh (2009), Bergstresser, Desai, and Rauh (2006)). And another body of research examines the behavioral biases that lead people to make suboptimal retirement contribution decisions and the strategies that can be used to get them to make better decisions (Thaler and Benartzi (2004), Choi et al. (2002), Beshears et al. (2015)).

My model combines the public economics view of pensions with the theory of financial intermediation. The theoretical framework I propose is in the tradition of models that see financial institutions as having an important role in transforming savings into investment (Douglas Diamond (1984)). This view is a departure from the public economics literature on pension policy, which abstracts from the details of how savings are transformed into investment. My model shows how pension policy affects financial intermediation and how it determines important characteristics of the financial system.

While the idea that pension policy affects the development of the financial system is not new, existing theoretical and empirical support for this view is fairly limited. One notable empirical exception is Niggemann and Rocholl (2010), who study the effect of pension funding reforms on stock and bond issuance in a sample of 57 countries from 1976 to 2007. They show that in the years following reforms intended to increase pension fund assets, stock and bond issuance increased, presumably to meet greater pension fund demand for securities. There are at least two other, more focused, studies of the effect of pension reform on financial markets. Kortum and Lerner (2000) show that a pension policy change in the U.S. that allowed pension funds to invest in venture capital served to stimulate venture capital fundraising and R&D. Giannetti and Laeven (2008) show that a policy change in Sweden that increased assets of pension funds led to increased ownership of company stock, which then affected corporate governance and stock valuations.

The rest of the paper is organized as follows. Section I provides a brief description of pensions in advanced economies and introduces the sample that I will use in much of my empirical analysis. Section II presents a model of how pension policy affects the structure and size of the financial system. I examine the basic empirical links between pension policy, corporate finance, household finance, banking, and the size of the financial system in Section III. In Section IV, I examine alternative hypotheses that could explain the connection between pension policy and the financial outcomes I examine here. Finally, I discuss some broader implications of this research in Section IV.

I. A Brief Description of Pension Systems

Pensions, in one form or another, have been around since at least medieval times (Lewin (2004)).¹ The first large-scale contributory pension scheme was introduced by the German Empire under Chancellor Otto von Bismarck. Now seen as the father of the modern public pension system, Bismarck advocated the creation of a pension system in part as a response to growing social unrest. Denmark soon followed in 1891, New Zealand in 1899, and Britain in 1908 (Blackburn (2002)). The U.S. did not introduce a public pension system until the Great Depression, with passage of the Social Security Act of 1935.² While most advanced economies had public pension systems by World War II, alongside some private pensions, they were fairly limited in scope and benefits (Feldstein and Liebman (2002)).

After World War II, pensions expanded and evolved into the systems we observe today. Modern-day pensions vary along a number of important dimensions: whether they are sponsored by the government or an employer; whether contributions are mandatory or voluntary; whether contributions pay for the current benefits of retired workers or are used to invest in assets to pay future benefits; and whether benefits are based on earnings, years in the workforce, or the value of assets in a pension fund. For example, in the U.S., the Social Security system is a government-sponsored program with mandatory contributions from employers and employees. It makes payments to currently retired workers based largely on their earnings history. This system exists alongside a voluntary personal and employer-sponsored private pension system in which employer and employee contributions are used to invest in assets. Benefits can be based on either contractual commitments of the employer (defined benefit plans) or on the value of assets at retirement (defined contribution plans).

While most countries have the variety of pensions described above, what differs across countries is the extent to which they rely on the different types of pensions. For example, countries such as France, Germany, Greece, Italy, and Spain rely very heavily on

¹During the middle ages, pensions were provided to select clergy and favored civil servants. Later, pensions were given to military personnel. In the U.S., at one point, veterans' pensions provided by the now-defunct U.S. Pension Bureau amounted to 43% of government expenditures (Blackburn (2002)).

²Leading up to 1935, 28 states had pension benefits but none was contributory and the benefits, which were typically modest, varied widely across states (Moss (2004)).

mandatory public pensions funded on a PAYGO basis. In countries like Australia, Denmark, Iceland, and the Netherlands, a large share of retirement benefits are instead pre-funded through mandatory private contributions to pension funds. In yet other countries, such as Canada, Ireland, the U.S., and the U.K., voluntary private schemes are more important. Table I, using data reported in the OECD publication, *Pensions at a Glance 2015*, lists the key pension characteristics of 23 countries that joined the OECD prior to 1975. This table excludes Luxembourg because of its outsized financial sector and the 11 countries that joined the OECD after 1975, largely developing country members of the OECD and formerly socialist economies with relatively new pension systems.

— Table I about here —

The first column of Table I reports the OECD’s estimate of a country’s public pension replacement rate in 2014. For a worker entering the labor force in 2014, this is a forecast of the share of a worker’s average lifetime earnings that would be replaced by the public pension system at a normal retirement age assuming the worker has mean earnings over his or her working life.³ To generate this estimate, the OECD makes assumptions about future demographics, rates of return on pension assets, inflation, discount rates, real wage growth and real GDP growth. The assumptions are the same across countries except for mortality rates. On the low end of gross public replacement rates are Iceland (3.4%), Australia (13.5%), and the U.K. (21.6%), while Spain (82.1%), Austria (78.1%), and Turkey (75.7%) are on the high end. For the most part, public pension benefits are funded by employee and employer contributions. The average employee contribution is 5.9% of income and the average employer contribution is 10.1% of income. Public pension assets relative to GDP are modest in most countries. It is highest in Sweden (28.7% of GDP), Finland (27.6%), and Japan (25.2%).⁴ Public pension assets in the U.S. — the so-called Social Security Trust Fund — amounts to 15.9% of GDP.⁵ Eleven of the 23 countries have no public pension assets,

³This is the gross public pension replacement rate, which measures earnings and replacement income on a pre-tax basis.

⁴Note that the OECD calculates public pension assets and replacement rates of the central government. This means that state and municipal government pensions in the U.S. are considered private pensions.

⁵While the Social Security Trust Fund is invested in U.S. Treasury bonds, other countries such as Norway, Sweden, and Canada invest in a mix of fixed income instruments and equities. In 2014, the average public

and the average across all countries is 6.8% of GDP.

Private pension replacement rates are shown in the second column of Table I. The private pension replacement rate is high in countries such as Iceland (65.8%) the Netherlands (63.4%), and Denmark (46.3%), and it is low in countries such as Japan, France, Spain and Italy. While there are private pensions in all countries, the OECD does not model private pension replacement rates in countries where private pensions are not broadly available, and replacement rates are reported as zero in these countries.⁶ In general, both employees and their employers contribute to private pensions on a mandatory or voluntary basis in defined benefit or defined contribution plans.⁷ In our sample, seven countries set mandatory contribution rates for private pensions, with an average contribution rate of 10.7% of income. The value of private pension assets relative to GDP averages 58.6% across the countries in the sample, much greater than the 6.8% of GDP in public pension assets. The ratio of private pension assets to GDP is large in Denmark (186.2%), the Netherlands (145.7%), Iceland (141.1%), Canada (137.3%), and the U.S. (136.8%), and very low in Greece (0.6%), Turkey (4.4%), and Belgium (5.2%).

Figure 1, Panel A shows a strong negative relationship between a country's private pension replacement rate and its public pension replacement rate. Not surprisingly, public pensions tend to crowd out private pensions (or vice versa). Figure 1, Panel B plots the ratio of total pension assets to GDP (i.e., the sum of private pension assets and public pension assets divided by GDP) against the public pension replacement rate.⁸ The relationship between the two is also strongly negative: countries with high public pension benefits tend to have less pension assets. Countries in the southeast quadrant of the figure are PAYGO-dominated countries that offer generous public pension benefits and have almost no assets

pension fund invested 29.4% in equities, with Norway the highest at 59.4%.

⁶Private pension assets average just 13.6% of GDP in countries with a reported private pension replacement rate of zero, as compared to 87.5% in countries with a reported positive private pension replacement rate. Finland is the only country with relatively significant private pension assets (54.6% of GDP) for which the OECD does not model the private pension replacement rate.

⁷Employer-based pensions can also be funded through pension insurance contracts, which are effectively defined benefit plans offered by insurers, or through book reserves, which are unfunded pension liabilities of employers. Pension insurance contracts are an important source of funding in France, Sweden, and Denmark; reserves are important in Austria and Germany.

⁸Niggemann and Rocholl (2010) plot a similar figure to describe the variation in in pension systems across countries.

to back pension claims. Countries in the northwest corner of the figure offer modest public pension benefits and instead tend to rely on private pre-funded pensions for retirement income. As the figure makes clear, the hybrid model, where countries offer a mixture of pre-funded and PAYGO pensions is also common. Such hybrid systems are often referred to as "multi-pillar" pension systems. The World Bank and other international organizations have advocated for this approach in both developed and emerging market economies (World Bank (1994)).

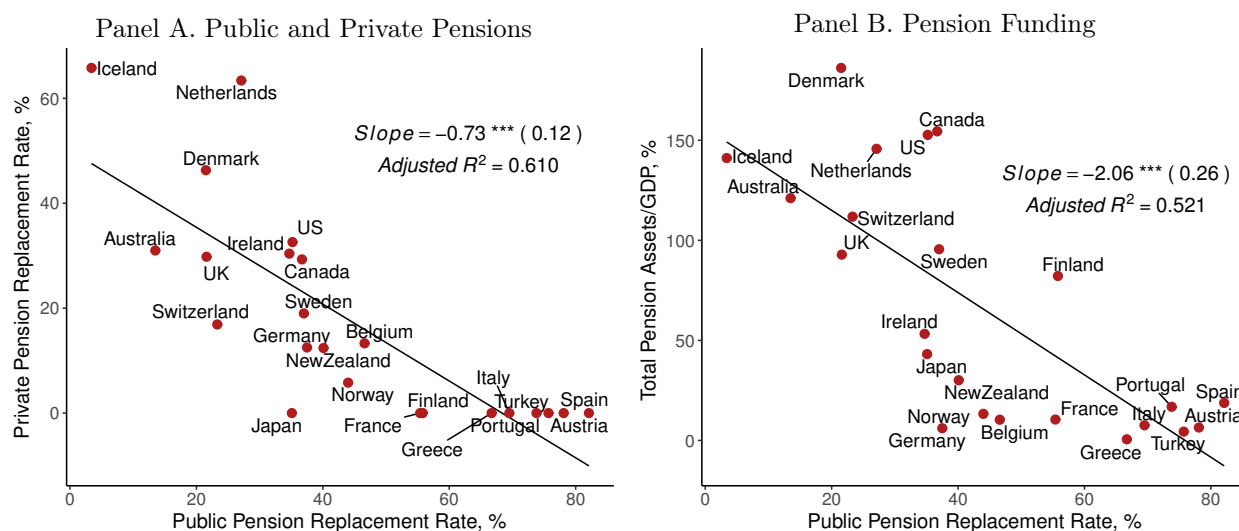


Figure 1. Public pensions, private pensions and total pension assets. Panel A displays the relationship between private and public pension replacement rates. Panel B displays the relationship between the total pension assets to GDP ratio and the public pension replacement rate. The public (private) pension replacement rate is the OECD's forecast of the percentage of average lifetime pre-retirement income provided by the public (private) pension system for a retired worker with mean pre-retirement income. Total pension assets are the sum of private pension assets and public pension assets. Robust standard errors of the slope estimates are reported in parentheses. *** denotes significance at the 1% level.

Figure 2 plots the relationship between the ratio of total pension assets to GDP and the total pension replacement rate (the sum of public and private pension replacement rates). The average total pension replacement rate is 62% of income and does not vary systematically with the funding method — on average, countries with PAYGO-oriented pension systems and those with pre-funded pension systems offer equivalent retirement income benefits for the average worker. For example, the total pension replacement rates for Canada, the U.S. and Denmark, which have high pension assets to GDP ratios, are similar to the replacement rates of Italy, Greece and Portugal, which have much lower pension assets to GDP ratios.

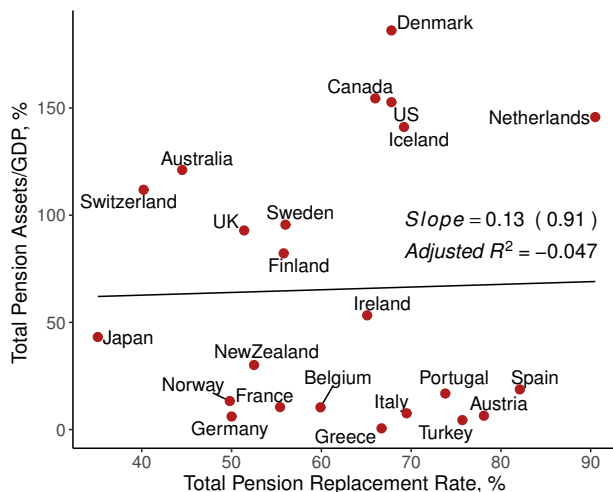


Figure 2. Total pension assets and the total pension replacement rate. This figure displays the relationship between ratio of total pension assets to GDP and the total pension replacement rate. Total pension assets are the sum of private pension assets and public pension assets. The total pension replacement rate is the sum of public and private pension replacement rates. The robust standard error of the slope estimate is reported in parentheses.

Although PAYGO and pre-funded pension systems provide the same level of retirement benefits on average, these systems can have different implications for household savings and thus asset accumulation. Most importantly, the evidence suggests that PAYGO pensions crowd out private savings, which is a critical assumption in the model I present below. Early evidence of crowding out comes from Feldstein (1974), who documents in aggregate time series data that an increase in Social Security wealth in the U.S. is associated with a reduction in household savings. Samwick (2000) shows that the savings rate is lower in countries with more PAYGO-oriented pension systems. Other studies show that when pension reforms reduce public pension benefits, they lead to an increase in savings. See, for example, Attanasio and Rohwedder (2003) for evidence in the U.K. and Attanasio and Brugiavini (2003) for evidence in Italy.

While PAYGO pensions may reduce the incentive to save, private pensions may also encourage household savings through tax subsidies, automatic enrollment, and pre-set payroll deductions. Indeed, Poterba, Venti, and Wise (1996) conclude that programs in the U.S. that provide tax subsidies for saving (such as Individual Retirement Accounts and 401(k) plans) increase household savings even when one considers the possibility that individuals

reduce nonsubsidized savings to fund subsidized accounts.⁹

Consistent with these findings, using data from national accounts reported by the OECD (2018a), Figure 3, Panel A documents that the ratio of household financial assets to GDP is lower in more PAYGO-oriented countries. Household financial assets include bank deposits, securities holdings, mutual funds, equity in life insurance policies, as well as private pension assets. The negative relationship between household financial assets and the public pension replacement rate is driven by a strong negative relationship between pension assets and the public pension replacement rate. Figure 3, Panel B shows that there is a relatively weak and statistically insignificant negative relationship between nonpension financial assets and the public pension replacement rate.¹⁰

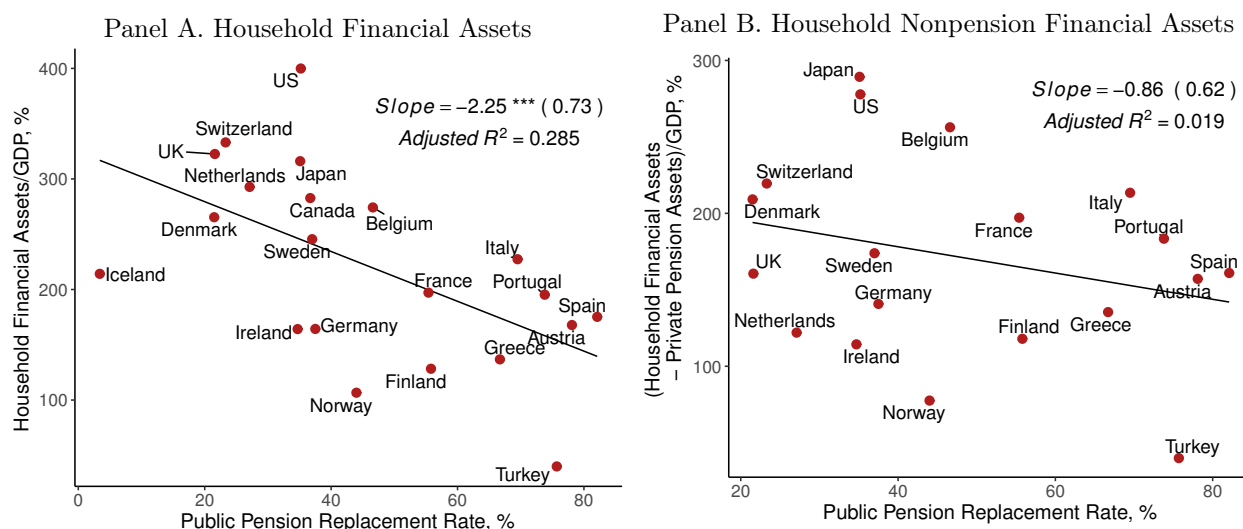


Figure 3. Household financial assets and the public pension replacement rate. Panel A displays the relationship between household financial assets relative to GDP and the public pension replacement rate. Panel B displays the relationship between household nonpension financial assets relative to GDP and the public pension replacement rate. Robust standard error of the slope estimates are reported in parentheses. *** denotes significance at the 1% level.

Thus, the cross-country data suggest that public pensions crowd out household

⁹A number of more recent studies attempt to address concerns about the endogeneity of pension plan participation, namely, that workers who sign up for employer-based pension plans are more prone to save. Gelber (2011) finds that when U.S. workers become eligible for participation in 401(k) plans their savings increase relative to a control group of workers that are already eligible for 401(k) plans. Chetty et al. (2014) find that in Denmark savings do not increase in response to pension-related tax subsidies, but automated payroll deductions and mandatory pension contributions have a positive effect on savings.

¹⁰The findings in Figure 3 are robust to including log of GDP per capita as a control. This suggests that the findings probably come from lower savings in PAYGO-oriented countries rather than lower incomes.

savings largely through a reduction in the accumulation of private pension assets.¹¹ With this background in mind, I now turn to the question of how pension systems could, in theory, affect the size and structure of financial systems around the world.

II. Model

The theoretical literature on pension policy focuses on how the pension system affects savings, retirement decisions, and the transfer of income and risk across and within generations. I focus instead on the implications of pension policy for the structure of the financial system. In doing so, I abstract from the dynamic and intergenerational aspects of pension policy. Indeed, I make the heroically simplifying assumption that household savings are exogenously determined by pension policy. In particular, I assume that there is more saving and asset accumulation in countries that rely more on pre-funded pensions than on PAYGO pensions.

My model attempts to link savings to one of the key differences across financial systems, namely, the extent to which banks or capital markets are used to finance firms and households. To do so, one approach might be to work with a model along the lines of Diamond (1991) and Holmstrom and Tirole (1997). In these models, the key role of banks is to monitor or screen borrowers, and the main determinant of bank versus bond financing is the extent to which firms need to be monitored or screened. While firm characteristics that drive the need for monitoring or screening could vary across countries and thus help to explain variation in financial systems, it is less clear how this type of model could help to explain the link between pension savings and the structure of the financial system.¹² Thus instead, I build on a class of models that connects more directly to household savings. In these models, the main function of banks is to offer households safe and liquid instruments for their savings. Models along these lines include Gorton and Pennacchi (1990) and, more recently, Stein (2012), Greenwood et al. (2015), and Diamond (2017). The last of these

¹¹There is no meaningful relationship between household savings and pension policy in my sample. There are a number of issues in the measurement of savings that may make it hard to find such a relationship.

¹²It is possible that the level of savings affects the choice between bank and bond financing through its effect on required rates of return, but this effect is indirect.

papers is specifically interested in understanding which types of activities are funded by banks versus capital markets. In addressing this question, Diamond develops a model of banks that is quite useful for exploring the sets of issues I have in mind. I therefore use his bank model, although I embed it in a very different model of the economy — one in which savings are exogenous and there are fixed costs of investing in capital markets. I also present variants of the model in which households pay for asset management and can borrow against housing assets.

A. Households

Let households savings, s , vary across households uniformly on the interval $[d^*, d^* + 2\alpha]$. The average level of household savings is therefore $d^* + \alpha$.¹³ One can think of α as the extent to which the pension system encourages saving, whether through limiting public pension benefits or subsidizing private pensions. Empirically, I will associate high values of α with countries that rely on private pre-funded pensions and low values of α with countries that rely on public PAYGO pensions.

Households allocate savings, s , between a portfolio of capital market investments, m , and money-like claims or deposits, d . While money does not enter directly into household utility functions as in Stein (2012), there is a minimum amount, d^* , that households must hold to satisfy their day-to-day liquidity needs.¹⁴

I assume that all savings must be allocated domestically, that is, no one can invest abroad or raise capital from abroad. In practice, there is some home bias, but it is obviously not as extreme as I assume.¹⁵ To invest in the capital market, households pay a fixed cost, K . One can think of K as the actual cost of setting up an account or the cognitive cost of becoming informed about capital market investments. The expected gross return on these capital market investments is R^m , while the guaranteed gross return on deposits is R^d . The demand for money-like claims is met by banks that fund themselves in part by the issuance

¹³Note that α also changes the variance of savings, but this is not critical for the results.

¹⁴For evidence that investors value money-like claims see Poterba and Rotemberg (1987), Krishnamurthy and Vissing-Jorgensen (2012), and Sunderam (2015). One can also think of d^* as the minimum amount of safe claims that households demand.

¹⁵A survey conducted by the OECD indicates that the average large pension fund invested 66.5% of its assets domestically, well above the average country's share of global capital markets (OECD (2016)).

of completely safe deposits. We will see that $R^m > R^d$ in equilibrium.

Although risk-neutral households have utility over consumption in periods 1 and 2, their consumption in period 1 is pinned down by the exogenous level of savings. Thus, the only decision they face is how to allocate their savings between capital market investments and deposits. A household with savings, s , will invest in the capital market provided that

$$R^m(s - d^* - K) + R^d d^* \geq sR^d,$$

or

$$s \geq d^* + \frac{R^m}{R^m - R^d} K \equiv \hat{s}. \quad (1)$$

Savings therefore have to exceed a threshold level of savings, \hat{s} , for it to be worthwhile for a household to invest in capital market assets, which have higher expected returns than deposits. The threshold is increasing in the fixed cost of investing in the capital market, K , and in the return to investing in deposits, R^d , and is decreasing in the expected return on capital market investments, R^m .

Deposit demand, $D(R^d, R^m; \alpha)$ is therefore given by:

$$\begin{aligned} D(R^d, R^m; \alpha) &= \frac{1}{2\alpha} \left[\int_{d^*}^{d^* + \frac{KR^m}{R^m - R^d}} s \, ds + \int_{d^* + \frac{KR^m}{R^m - R^d}}^{d^* + 2\alpha} d^* \, ds \right] \\ &= d^* + \frac{1}{4\alpha} \left[\frac{KR^m}{R^m - R^d} \right]^2. \end{aligned} \quad (2)$$

Deposit demand is increasing in R^d and decreasing in R^m and α . Households put more of their savings in deposits when the return on deposits increases and less of it in deposits when the return on capital market investment increases. As the overall level of savings in the economy (measured by α) increases, more households decide to pay the fixed cost, K , and invest in the capital market, which reduces the demand for deposits.

B. Projects

There are two types of projects: low risk and high risk. The low-risk project, Project- L , requires an investment of one and pays off $A + x$ in the good state of the world,

which occurs with probability θ , and A in the bad state of the world, which occurs with probability $1 - \theta$. Here $A < 1$ so there is some risk of a negative net return. The high-risk project, Project- H , pays off γx in the good state, where $\gamma > 1$, and zero in the bad state. Project- H has larger expected payoffs than project- L :

$$\theta\gamma x > \theta x + A. \tag{3}$$

There is an infinite supply of both types of projects.

C. Banks and Capital Markets

I model banks using the basic insights of William Diamond’s (2017) model of financial intermediation in which financial intermediaries emerge endogenously to satisfy household demand for money-like claims. While many of the details of the two models differ, in both models intermediaries invest in relatively safe assets and households invest in relatively risky capital market assets along with safe money-like claims issued by intermediaries.

In my model, banks choose how much to invest in the safe and risky projects described above. For simplicity, as in Stein (2012), I abstract from the contracting problem between a bank and entrepreneurs who may own the project, and assume that the bank receives all the economic rent from the project.¹⁶ Thus, let I_L^b be a bank’s investment in the low-risk project and let I_H^b be its investment in the high-risk project. To invest in these projects, banks need to raise funds from households. If households are willing to accept a low return on money-like claims, it is in the interest of banks to issue such claims (i.e., deposits). However, to do so, they have to be able to make payments on these claims in all states of the world, both good and bad. Since the high-risk project pays off nothing in the bad state, this project will prove unhelpful in backing deposits; only the low-risk project, which pays off A in the bad state, can be used to back deposits. Thus, if the bank invests I_L^b , it can issue deposits up to AI_L^b/R^d and will be able to pay depositors AI_L^b in both states of the world. The ability to use the low-risk project to back low-cost deposit funding makes the low-risk project an attractive investment for the bank even though it has lower expected

¹⁶By contrast, Diamond (2017) shows that banks want to hold relatively safe debt instruments, which leads entrepreneurs to issue such claims.

payoffs. Provided $R^d < R^m$, which will hold in equilibrium, the bank will want to issue the most deposits that it can, AI_L^b/R^d , to take advantage of this low-cost funding. In this case, the rest of the bank's funding will be equity equal to $I_H^b + I_L^b - AI_L^b/R^d$.

The equity that banks issue is subject to an agency problem, as in Diamond (2017). In particular, bank managers can divert resources to themselves by claiming that the state is bad and that they have insufficient cash flow to make payments to shareholders. They can pocket only some fraction, $\eta < 1$, of the difference between good-state and bad-state payoffs, with the remaining fraction $1 - \eta$ destroyed in the process. To prevent such value-destroying diversion, shareholders pay bank managers η times the amount they would attempt to divert.¹⁷ Thus, managers receive an agency rent of $\eta [xI_L^b + \gamma xI_H^b]$ in the good state since the term in brackets is the difference between good-state and bad-state payoffs.

Given these assumptions, the bank chooses I_L^b and I_H^b to maximize V^b , the expected value of bank equity net of the equity investment, which can be written as

$$V^b = [\theta(A + x) + (1 - \theta)A] I_L^b + \theta\gamma x I_H^b - \theta\eta [xI_L^b + \gamma xI_H^b] - AI_L^b - R^m \left[I_L^b + I_H^b - \frac{AI_L^b}{R^d} \right]. \quad (4)$$

The first two terms are the gross payoffs of the two projects given investments of I_L^b and I_H^b . The third term is the expected payment to the manager stemming from the agency rent. The fourth term, AI_L^b , is the payment to depositors. The last term is the cost of issuing equity, which includes the required return on equity, R^m . We can write (4) more compactly as

$$V^b = \theta x(1 - \eta)I_L^b + \theta\gamma x(1 - \eta)I_H^b - R^m \left[I_L^b + I_H^b - \frac{AI_L^b}{R^d} \right]. \quad (5)$$

Thus, the expected value of bank equity is just the expected payoffs in the good state net of agency costs and net of the cost of issuing equity. Note that bank equity has no value in the bad state since all assets are pledged to depositors in the bad state.

The first-order conditions for I_L^b and I_H^b are

¹⁷This is essentially the model of Lacker and Weinberg (1989), which Diamond (2017) uses in a more general specification of the diversion function to model the agency costs of bank equity.

$$\frac{\partial V^b}{\partial I_L^b} = \theta x(1 - \eta) - R^m \left[1 - \frac{A}{R^d} \right] \leq 0 \quad (6)$$

$$\frac{\partial V^b}{\partial I_H^b} = \theta \gamma x(1 - \eta) - R^m \leq 0. \quad (7)$$

Because there is positive demand for deposits, banks have to issue deposits in equilibrium ($AI_L^b/R^d > 0$), which implies that I_L^b is positive and the first-order condition (6) is satisfied with equality. Note the difference between the two first-order conditions, (6) and (7). On the one hand, Project-*H* is more attractive than Project-*L* because the payoff in the good state is augmented by $\gamma > 1$. On the other hand, Project-*L* is more attractive because some of it can be financed with low-cost deposits while all of Project-*H* must be financed with high-cost equity. I will show, however, that the inequality (7) is always slack and banks never invest in the high-risk project; rather, such investment is undertaken directly in the capital market.

To see this, let I_L^m and I_H^m denote household capital market investments in the low-risk project and the high-risk project, respectively. Once they pay K , the fixed cost of investing in the capital market, households need to earn a return equal to R^m on their investments. Thus, the first-order conditions for investing in the low-risk and high-risk project in the capital market can be written as

$$A + \theta x - R^m \leq 0 \quad (8)$$

and

$$\theta \gamma x - R^m \leq 0. \quad (9)$$

Three observations follow from these conditions. First, the bank does not invest in the high-risk project. To see this, note that if investors in the capital market fund the high-risk project in positive finite amounts, condition (9) is met with equality. This means that the expression in (7) would be negative, and it never makes sense for the bank to invest in the high-risk project. This is because the bank bears an agency cost, while capital market investors do not. Second, in equilibrium the required return on capital market investments

is determined by the expected return on the high-risk project, $R^m = \theta\gamma x$, otherwise demand for the high-risk project would be infinite or zero. Thus, required capital market returns are determined by the production technology, not preferences. Third, given that $\theta\gamma x > \theta x + A$, households never want to invest directly in the low-risk project as they have access to the better high-risk project. These arguments imply a perfect segmentation of investment as in Diamond (2017) whereby banks invest in low-risk projects and households invest in high-risk projects. Thus, $I_L^b > 0$, $I_H^b = 0$, $I_L^m = 0$, and $I_H^m > 0$.

Using the equilibrium value of R^m and the fact that (6) is satisfied with equality, the return on deposits can be written as

$$R^d = \frac{\gamma}{\gamma - (1 - \eta)} A, \quad (10)$$

which one can show is less than $R^m = \theta\gamma x$.

My assumptions about preferences mean that the equilibrium return on deposits, like the return on capital market investments, is not affected directly by household preferences but instead is determined by the production technology. This is in contrast to Diamond (2017) and Stein (2012), where preferences figure more directly in the determination of R^d . Here, R^d is increasing in A and decreasing in γ and η .

Substituting the equilibrium values of R^m and R^d into condition (1) implies that the threshold level of savings, \hat{s} , above which the household will invest in the capital market is given by

$$\hat{s} = d^* + \frac{\gamma - (1 - \eta)}{\gamma - (1 - \eta) - A/(\theta x)} K. \quad (11)$$

This threshold for investing in capital markets declines when risky projects are more attractive relative to safe projects (higher γ), when agency problems in banking are more pronounced (higher η), when the fixed cost of investing in the capital market is higher (higher K), and when the bad-state payoff (and thus the ability to create safe deposits) is lower relative to the total project payoffs (lower $A/\theta x$).

D. Project Investments, Bank Deposits and Bank Equity

To determine the equilibrium quantities of investment, deposits and bank equity, we set deposit supply equal to deposit demand. The supply of deposits is simply AI_L/R^d . Deposit demand is given by equation (2) above. Using the equilibrium values of R^d and R^m while setting deposit supply equal to demand implies

$$I_L^b = \left[d^* + \frac{1}{4\alpha} \left(\frac{\gamma - (1 - \eta)}{\gamma - (1 - \eta) - A/(\theta x)} K \right)^2 \right] \left[\frac{\gamma}{\gamma - (1 - \eta)} \right]. \quad (12)$$

Importantly, bank investment is decreasing in the savings parameter, α . When α increases, deposit demand falls as more households invest in the capital market instead of deposits. This reduces the ability of banks to raise low-cost deposits, which decreases the appeal of investing in the low-risk project. Likewise, when the high-risk project becomes more attractive, as measured by γ , or when the return on investing in the capital market increases, deposit demand falls, and banks invest less in low-risk projects. Finally, following similar logic, bank investment in the low-risk project increases in K as fewer households want to pay the fixed cost to invest in the high-risk project in the capital market.

To solve for investment in the high-risk project, we exploit the fact that aggregate saving, $d^* + \alpha$, equals investment. We thus have

$$\begin{aligned} I_H^m &= d^* + \alpha - I_L^b \\ &= d^* + \alpha - \left[d^* + \frac{1}{4\alpha} \left(\frac{\gamma - (1 - \eta)}{\gamma - (1 - \eta) - A/(\theta x)} K \right)^2 \right] \left[\frac{\gamma}{\gamma - (1 - \eta)} \right]. \end{aligned} \quad (13)$$

The model therefore implies that the size of the capital market is increasing in α , while the size of the banking sector is decreasing in α . Importantly, overall expected output is increasing in α given that the high-risk project undertaken by the capital market has higher expected payoffs. I summarize the main implications of the model in the following proposition.

PROPOSITION 1: *Bank investment, as measured by I_L^b , is decreasing in the pension savings parameter α , while capital market investment, as measured by I_H^m , is increasing in pension savings. Moreover, expected output increases with an increase in α .*

E. Asset Management Costs and Capital Market Deepening

I have assumed an exogenous cost, K , of investing in the capital market. Some of this cost may be pecuniary, but there may also be nonpecuniary costs, such as the cognitive costs of understanding how to make capital market investments. Over time, in high α economies, these costs may fall as people become more familiar with capital market investments. Moreover, it is possible that pension contributions, particularly those invested in defined contribution plans (such as 401(k) plans in the U.S.), familiarize people with the products they can invest in, thus further lowering K . If this is the case, then over time there may be further divergence in the capital market allocations of high α and low α economies, as capital markets become increasingly accessible and familiar in high α economies.

So far, the model assumes that there is no cost of investing in capital markets beyond the fixed cost, K . Suppose, however, that there is a fee for managing capital market investments such as pension fund assets or other forms of private capital market savings. Let the total fee be ϕ times the date-2 value of capital market assets.¹⁸ Provided $\phi < \eta$, it is still optimal for the high-risk project to be undertaken in the capital market and the low-risk project to be undertaken by the bank. Now the return on capital market projects is given by $R^m = (1-\phi)\gamma\theta x$, and arguments like those above imply that $R^d = \gamma(1-\phi)/[\gamma(1-\phi)-(1-\eta)]$.

To determine ϕ , suppose that asset management firms earn zero profits in equilibrium. Then we have

$$\phi\theta\gamma x \frac{I_H^m}{n} = F, \quad (14)$$

where F is the fixed cost of running an asset management firm and n is an exogenously determined number of asset management firms.¹⁹ Importantly, the greater is I_H^m (and thus assets under management), the lower is ϕ .

When we introduce fees, equation (13) becomes

$$I_H^m = d^* + \alpha - \left[d^* + \frac{1}{4\alpha} \left(\frac{(1-\phi)\gamma - (1-\eta)}{(1-\phi)\gamma - (1-\eta) - A/(\theta x)} K \right)^2 \right] \left[\frac{(1-\phi)\gamma}{(1-\phi)\gamma - (1-\eta)} \right]. \quad (15)$$

¹⁸For simplicity, I assume that there is no fee to manage investment in bank equity.

¹⁹One could endogenize the number of asset management firms in addition to fees in a model in which there is oligopolistic competition and free entry. See Gennaioli, Shleifer and Vishny (2014, 2015) for models along these lines.

One can solve (14) and (15) simultaneously for I_H^m and ϕ . Note that both (14) and (15) imply that low fees are associated with high values of I_H^m . This means that there can be multiple equilibria: one with low fees and high levels of I_H^m and one with high fees and low levels of I_H^m . When fees are low it is relatively more attractive to undertake risky projects in the capital market, and when there are more capital market projects asset managers can charge low fees while covering costs. But the reverse is also true: when fees are high it is relatively less attractive to invest in capital markets, and the low level of capital market assets justifies the higher fees. Thus, two countries with similar levels of savings could end up with very differently sized capital markets.

But perhaps more important than the possibility of multiple equilibria is the idea that with fixed costs of asset management, an increase in aggregate savings can lower asset management fees and bring more households into the capital market. To see this, note that the condition for investing in the capital market when there are fees can be written as

$$s \geq d^* + \frac{(1 - \phi)\gamma - (1 - \eta)}{(1 - \phi)\gamma - (1 - \eta) - A/(\theta x)} K \equiv \hat{s}(\phi), \quad (16)$$

where $\hat{s}(\phi)$ is the threshold level of savings above which households invest in the capital market. This threshold is increasing in ϕ . Furthermore, as α increases, I_H^m increases per (15) above, which decreases fees, ϕ , as well as the threshold for investing in the capital market, $\hat{s}(\phi)$. This brings more low-savings households into the capital market as it becomes more worthwhile for them to pay the fixed cost, K , of entering the capital market when ϕ is low. As a result, there is more investment in high-risk, high-value projects and expected output increases.

Thus, in the model with fixed costs of asset management, there are two effects of an increase in α . The first is that it pays for more households to invest in the capital market given the threshold. The second is that the threshold for investing in the capital market is reduced. In this sense, an increase in pension savings leads to "capital market deepening," whereby asset management fees decline, which draws more people into the capital market and in turn spurs capital investment.

One can see the effect of capital market deepening more formally by comparing the

effect of an increase in pension savings, α , on capital market investment, I_H^m , in the model with fixed costs of asset management ($F > 0$) to the effect of an increase in α on I_H^m in the baseline model with no costs of asset management ($F = 0$). From (15), an increase in α directly increases I_H^m regardless of whether there are asset management fees. But with asset management fees, the increase in I_H^m lowers ϕ per (14), which further increases I_H^m (as the derivative of I_H^m in (15) with respect to ϕ is negative). This second effect does not exist when there are no asset management fees (i.e., when $F = 0$). After totally differentiating (14) and (15) and solving for $\partial I_H^m / \partial \alpha$, it is straightforward to show that this derivative is greater when $F > 0$ than when $F = 0$. Thus, an increase in pension savings has a bigger impact on capital market investment in the model with asset management fees.

These effects are summarized by the following proposition.

PROPOSITION 2: *When there are fixed costs of asset management, an increase in aggregate pension savings reduces the threshold level of pensions savings for households to invest in the capital market. The effect of an increase in pension savings on the size of capital markets is therefore greater than when there are no fixed costs of asset management. Formally,*

$$\left. \frac{\partial I_H^m}{\partial \alpha} \right|_{F>0} > \left. \frac{\partial I_H^m}{\partial \alpha} \right|_{F=0}.$$

While this amplification effect is driven by the fixed costs of asset management, it is possible that pension funds also stimulate capital market development by increasing investor familiarity with capital markets (lowering K) or by creating incentives for market participants and regulators to develop capital market infrastructure and investor-friendly regulations. Over time we might expect this to lead to a divergence in the capital market depth of countries with pre-funded versus PAYGO pension systems, as the threshold for household participation in capital markets falls in countries with more pre-funded pensions relative to PAYGO pensions.

F. Extending the Model to Include Household Debt

In the model outlined above, the only available projects are productive investments. Yet consumer credit – largely mortgage debt – comprises a large share of credit in most developed economies. For example, in the U.S. in 2016, credit to households in the form of mortgages, credit card loans, auto loans, and student loans was about equal to business loans.²⁰ Indeed, much of the growth of the U.S. financial sector since the 1980s has been driven by the expansion of consumer credit (Greenwood and Scharfstein (2013)). Because of its importance to the financial sector, in this section I extend the model to include mortgage credit.

To that end, now suppose that each household must own h units of housing. For simplicity, and because housing assets tend to be relatively low risk, suppose further that a unit of housing has the same payoffs as the low-risk project: $A + x$ in the good state and A in the bad state. As a result, the expected return on a unit of housing, R^h , is $A + \theta x$. Households choose how much to invest in the housing asset. If they invest equity of h_e in their house, they receive h_e/h of the returns to housing and other investors (the bank or the capital market) receive $1 - h_e/h$. Thus, I am not formally modeling mortgages, just as investments by the bank and the capital market are not really loans or bonds but rather investments in projects. Nevertheless, I refer to the portion of the house that is financed as a "mortgage" even though it is formally a share in the house.

Households in this setting allocate their savings across three assets: capital market investments, housing, and deposits. Given the assumption on housing returns relative to capital market returns, households that pay the fixed cost of investing in the capital market want to invest as little as possible in housing; they put up the minimum down payment and finance the rest. For simplicity, I assume that the minimum down payment is zero. Thus, conditional on investing in the capital market, a household invests d^* in deposits, $s - d^* - K$ in the capital market, and no equity in the house, which means that the household takes out a mortgage of h . By contrast, if a household does not pay the fixed cost of investing in the capital market, it invests d^* in deposits and $s - d^*$ in housing, which implies that the household owns a share $\frac{s-d^*}{h} < 1$ of the house and finances the rest with a mortgage. The

²⁰Based on Tables L.101 and L.T102 of the *Financial Accounts of United States*, 2016.

condition to invest in the capital market therefore becomes

$$s \geq d^* + \frac{R^m}{R^m - R^h} K \equiv \hat{s}^h. \quad (17)$$

This condition is analogous to condition (1) except that R^d is replaced by R^h because now households that do not invest in the capital market can invest their savings above d^* in housing. The portion of housing that they do not purchase is funded by banks or capital market investors.

The above discussion implies that for $s < \hat{s}^h$, the mortgage is $h - (s - d^*)$, while for $s \geq \hat{s}^h$, the mortgage is h . Thus, mortgage demand is the value of the housing stock, h , less the housing equity put in by households with relatively low savings:

$$h - \frac{1}{2\alpha} \int_{d^*}^{d^* + \frac{R^m K}{R^m - R^h}} (s - d^*) ds. \quad (18)$$

Recall that for simplicity, I make the strong assumption that an investment in a mortgage is no different than an investment in a low-risk project, with both paying off A in the bad state and $A + x$ in the good state. Thus, as in the baseline model, high-risk projects are only undertaken in the capital market, which implies that R^m is unchanged from the baseline model: $R^m = \gamma\theta x$. Banks invest in the low-risk project and mortgages. Thus, the bank's first-order condition for low-risk projects and mortgages is identical to that of the baseline model (6), which means that R^d is the same as in the baseline model: $R^d = \frac{\gamma}{\gamma - (1 - \eta)} A$. In equilibrium, banks hold all of the mortgages.

As before, to determine the amount of investment in the low-risk project, we set deposit supply equal to deposit demand. Deposit supply is the value of bank assets in the bad state (the sum of mortgages and the low-risk project in the bad state) divided by R^d , and deposit demand is simply d^* . Thus, we have

$$\frac{A}{R^d} \left[h - \frac{1}{2\alpha} \int_{d^*}^{d^* + \frac{KR^m}{R^m - R^h}} (s - d^*) ds + I_L^b \right] = d^*, \quad (19)$$

where $R^m = \gamma\theta x$, $R^d = \gamma A / (\gamma - (1 - \eta))$, and $R^h = A + \theta x$. One can show that $R^m > R^h > R^d$. Given that mortgage demand is increasing in α and deposit supply is fixed at d^* , I_L^b

must be decreasing in α as in the baseline model.

Finally, to determine the level of investment in the high-risk project, I use the fact that aggregate investment equals savings:

$$h + I_L^b + I_H^m = d^* + \alpha. \quad (20)$$

Because I_L^b is decreasing in α and the housing stock is fixed, (20) implies that I_H^m is increasing in α .

As in the baseline model, in high-savings economies there is more investment in high-risk projects and less investment in low-risk projects. But now we have two additional implications. The first is that housing leverage — the expression in (18) divided by h — is

$$1 - \frac{1}{h} \frac{1}{2\alpha} \int_{d^*}^{d^* + \frac{KR^m}{R^m - R^h}} (s - d^*) ds, \quad (21)$$

which is increasing in α . A second implication follows from equation (19). As α increases, mortgage credit increases and banking sector investment, I_L^b , falls. Thus, a great share of bank assets is invested in mortgage credit relative to corporate credit in economies with a high level of pension savings.

Note, as well, that deposits are equal to d^* in this version of the model and therefore do not vary with pension savings. However, financial assets — deposits plus the capital market investments — are increasing in α . As a result, the share of financial assets invested in deposits is decreasing in α . Moreover, total housing equity is decreasing in α , so housing equity as a share of total household assets, $d^* + \alpha$, is also decreasing in α .

I summarize these results in the following proposition.

PROPOSITION 3: *In economies with high pension savings,*

- (a) *household leverage is greater, and housing equity is a smaller share of total household assets;*
- (b) *a larger share of bank credit is in mortgages;*
- (c) *a larger share of household financial investments is invested in the capital market;*
- (d) *a smaller share of household financial assets is invested in deposits, though the level of deposits is no different than in economies with low pension savings.*

In the model, household leverage is increasing in savings because capital market investments offer higher returns than housing equity, and it only pays for higher-savings households to pay the fixed cost of accessing the capital market.²¹ While not captured by the model, another potential mechanism for why pension funding could increase household credit, is that an increase in pension savings leads to capital market deepening (per Proposition 2), which lowers the cost of credit and induces households to borrow more.

III. Empirical Analysis

This section examines the empirical implications of the model for capital markets, corporate finance, household finance, banking, and the size of the financial sector. Here I simply plot and regress country-level financial outcomes against the public pension replacement rate, my main measure of the PAYGO-orientation of a country’s pension system. In the next section, I will explore the robustness of my findings to a variety of alternative explanations. Sources for all data are mentioned below and described in more detail in the Appendix. Table II reports summary statistics for the pension variables and financial outcome variables used in the analysis.

— Table II about here —

A. Capital Markets

I start by examining one of the main empirical implications of the model, namely, that capital markets are smaller in countries with more PAYGO-oriented pension systems. To measure the size of capital markets, I use data on aggregate stock market capitalization and private (nongovernment) debt securities from the World Bank’s *Global Financial Development Database*. Figure 4, Panel A demonstrates that there is a negative relationship between the average stock market capitalization to GDP ratio from 2005 to 2014 and the

²¹This probably does not line up well with evidence in the U.S., where low-income households likely are more leveraged. I know of no studies that have examined the relationship between household income and leverage for other countries.

public pension replacement rate. Figure 4, Panel B demonstrates that there is also a negative relationship between the average private debt securities to GDP ratio from 2002 to 2011 and the public pension replacement rate.²²

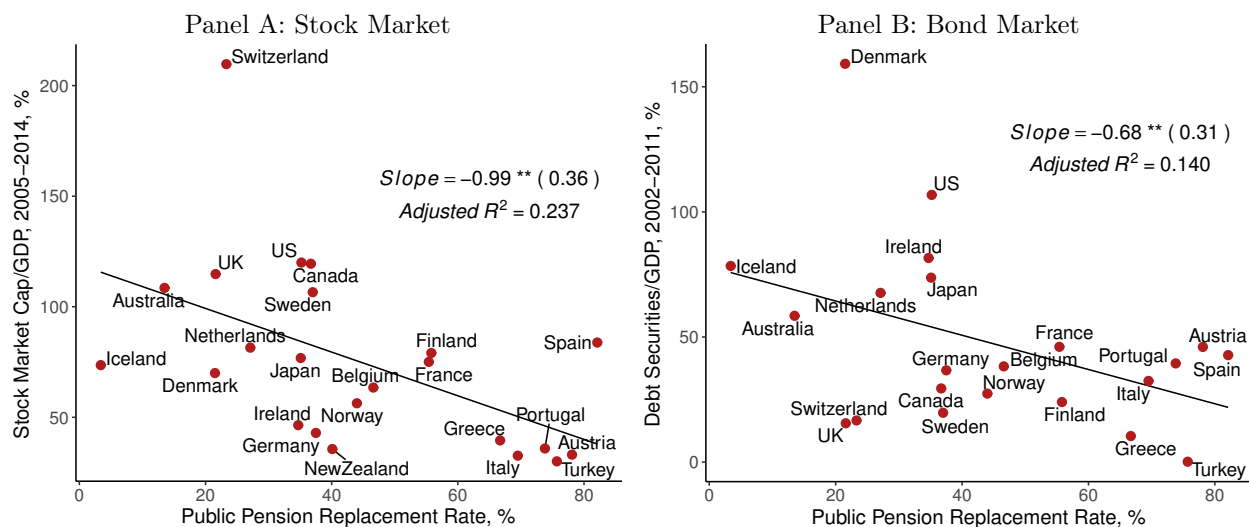


Figure 4. Capital market size and the public pension replacement rate. Panel A displays the relationship between average stock market capitalization relative to GDP from 2005 to 2014 and the public pension replacement rate. Panel B displays the relationship between average private debt securities relative to GDP from 2002 to 2011 and the public pension replacement rate. Robust standard errors of the slope estimates are reported in parentheses. ** denotes significance at the 5% level.

The economic magnitudes of the estimated effects are reasonably sizable. A one standard deviation increase in the public pension replacement rate (22.0%) reduces the stock market capitalization to GDP ratio (mean of 75.4%) by 21.8 percentage points, or 52% of the standard deviation of the stock market capitalization measure. The effect on private bond markets is also economically meaningful: a one standard deviation increase in the public pension replacement rate reduces the private bond market to GDP ratio (mean of 47.8%) by 15.0 percentage points, or 41% of the standard deviation of the private bond market measure.

B. Corporate Finance

In this subsection, I analyze the implications of the model for a variety of aspects of corporate finance: the share of corporate debt from bank loans, firm size, and insider

²²In both cases, I average across years to address year-over-year fluctuations in value, particularly in the stock market. I do not have data past 2011 for private debt securities.

ownership.

B.1. Bank Loans versus Bonds

One of the implications of the model, described in Proposition 1, is that firms in countries with more PAYGO-oriented pension systems receive more bank financing relative to bond financing. To explore this implication, I use OECD country-level balance sheet data to calculate the share of bank loans in the debt issued by nonfinancial firms. The data come from national accounts data available from the OECD (2018a). Figure 5 plots the bank loan share against the public pension replacement rate. The figure shows that the corporate sector in countries with more PAYGO-oriented pension systems is indeed more dependent on bank financing.

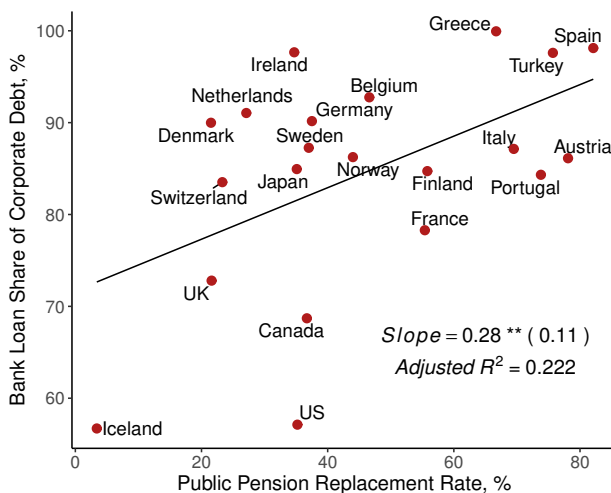


Figure 5. Bank loan share of corporate debt and the public pension replacement rate. This figure displays the relationship between the bank loan share of corporate debt and the public pension replacement rate. The bank loan share of corporate debt is the ratio of corporate bank loans to nonfinancial sector corporate debt. The robust standard error of the slope estimate is reported in parentheses. ** denotes significance at the 5% level.

The variation across countries in the bank loan share of corporate debt is fairly modest — the standard deviation is just 14% of the mean — but the regression picks up a reasonable amount of the variation that exists. A one standard deviation increase in the public pension replacement rate increases the bank loan share (mean of 84.5%) by 6.2 percentage points, or 44% of a standard deviation of the bank loan share.

B.2. Firm Size

Proposition 1, loosely interpreted, implies that firms in countries with PAYGO-oriented pension systems will be smaller on average. In countries that are more bank-centered, there is more investment in firms that take low-value, safe projects. These projects are less likely to have payoffs that would lead firms to operate at larger scale, implying that countries with more PAYGO-oriented pension systems should have smaller firms.

Outside the narrow confines of the model, there are reasons to think that firms will be smaller in countries where banks play a more prominent role in funding companies. Rajan (1992) argues that banking relationships give banks market power over borrowers, raising firms' funding costs and stunting their growth. Indeed, there is evidence that firms grow less rapidly and that there are fewer new firms in more concentrated banking markets (Black and Strahan (2002)). Moreover, firm growth may be limited in bank-centered economies because risk management and regulatory constraints lead banks to try to limit their credit exposure to a specific firm, industry, or geography. Indeed, consistent with this idea, banks require higher yields on loans that do little to diversify their loan portfolio (Ivashina (2009)).

To explore the relationship between pension policy and firm size, I examine data from the OECD's *Structural and Demographic Business Statistics* (2018b) database. For 22 of the countries in my sample, the database provides information on employment in enterprises with 1 to 9 employees, 10 to 19 employees, 20 to 49 employees, 50 to 249 employees, and 250 or more employees. For 17 of these countries, the database provides reliable information on employment in these size buckets for 12 industry groupings.

Figure 6, Panel A plots the share of employment in firms with 1 to 9 employees on the public pension replacement rate. There is a positive and statistically significant relationship between the two variables. Similarly, Figure 6, Panel B plots the employment share of companies with 250 or more employees on the public pension replacement rate. Here, as predicted, the relationship is negative and statistically significant. Both findings are consistent with the hypothesis that firms are smaller in more PAYGO-oriented countries. I find similar results (not shown here) at the country-industry level: in a panel regression with industry fixed effects, the small- (large-) firm share in an industry is positively (negatively)

related to the public pension replacement rate.

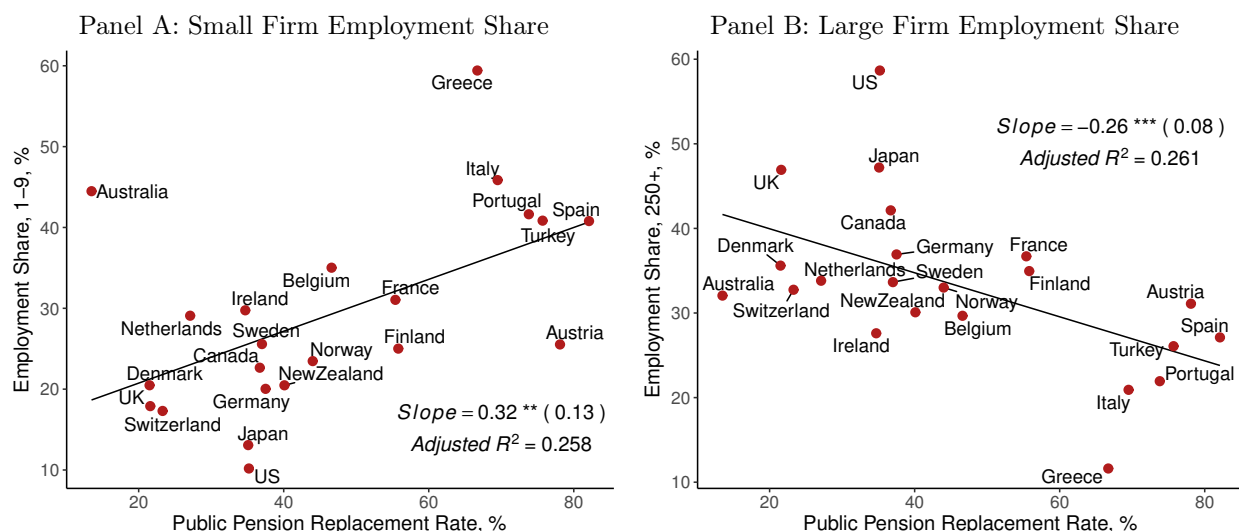


Figure 6. Firm size and the public pension replacement rate. Panel A displays the relationship between the employment share of firms with 1 to 9 employees and the public pension replacement rate. Panel B displays the relationship between the employment share of firms with 250 or more employees and the public pension replacement rate. Robust standard errors of the slope estimates are reported in parentheses. ** and *** denote significance at the 5% and 1% level, respectively.

The magnitudes of the effects in both regressions are fairly large. For example, a one standard deviation increase in the public pension replacement rate reduces the large-firm employment share (mean of 33.2%) by 5.7 percentage points, or 58% of the standard deviation of the large firm employment share.

B.3. Insider Ownership

Proposition 1 also has implications for firm ownership structure. Because the proposition predicts greater capital market financing of firms, it suggests that there will be greater scope for corporate insiders to sell their shares to outsiders in countries with high pension savings. This implies that a smaller percentage of equity will be held by insiders and that governance will be determined to a greater extent by institutional investors. Thus, pension policy could affect the governance of firms in an economy through its indirect effect on ownership structure. This point is made by Giannetti and Laeven (2008) in their study of pension reform in Sweden, which led to greater holdings of stock by Swedish pension funds.

To explore the link between pension policy and ownership, I use data on shareholdings of corporate insiders reported by *Worldscope*, a database of firms from around the

world.²³ Figure 7 plots the insider ownership share of outstanding equity on the public pension replacement rate. There is a strong positive and statistically significant relationship between the variables. One might be concerned that this result is driven by differences across countries in firm size or industry composition. For example, if firms are smaller in countries with PAYGO-oriented pension systems, they will have less need to raise outside equity. However, this is not the whole story as regressions (not shown here) exploring the relationship between insider ownership and the public pension replacement rate are robust to size and industry controls.

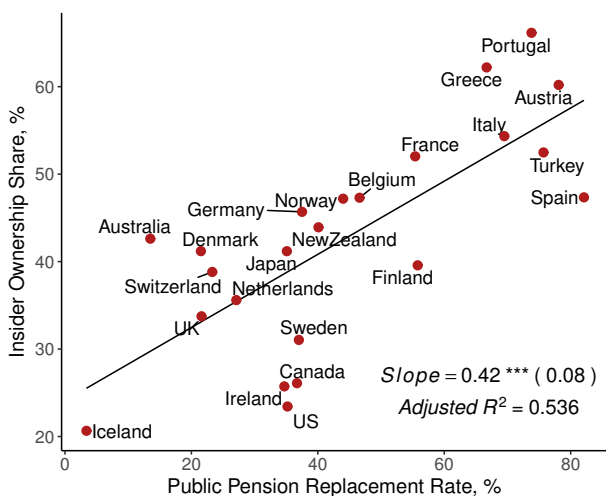


Figure 7. Insider ownership share and the public pension replacement rate. This figure displays the relationship between insider ownership share and the public pension replacement rate. The robust standard error of the slope estimate is reported in parentheses. *** denotes significance at the 1% level.

The magnitude of the effect is very large given the relatively limited variation in insider ownership across countries. A one standard deviation increase in the public pension replacement rate increases the insider ownership share (mean of 42.6%) by 9.2 percentage points, or 75% of its standard deviation.

C. Household Finance

In this section I examine the implications of the model for the composition of household financial assets and liabilities. A key implication of the model, described in

²³I find similar results (not shown here) using data on the percentage of shares owned by the three largest shareholders in a firm as reported by La Porta et al. (1998).

Section II.F and summarized in Proposition 3, is that households in countries with greater private pension savings finance a larger portion of housing with debt rather than equity; where savings are high, more households are willing to pay the fixed cost of investing in capital markets, and thus choose to invest less in housing equity.

To examine this hypothesis, I calculate the loan-to-value (LTV) ratio of the housing sector as the ratio of mortgage debt to the value of housing assets using data on mortgage debt and housing assets from and Credit Suisse’s *Global Wealth Data Book*.²⁴ Figure 8 plots the LTV ratio on the public pension replacement rate and shows that it is indeed lower in countries with more PAYGO-oriented pension schemes. The size of the estimated effect is similar in size to a number of the other findings: a one standard deviation increase in the public pension replacement rate reduces the LTV ratio (mean of 32.9%) by 9.0 percentage points, or one half of its standard deviation.

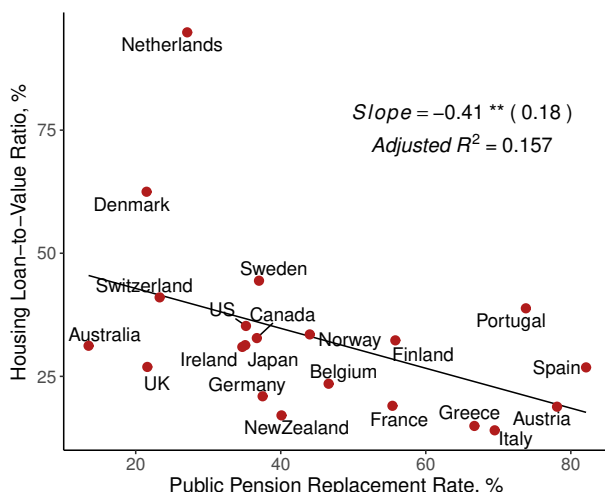


Figure 8. Housing loan-to-value ratio and the public pension replacement rate. This figure displays the relationship between the housing loan-to-value ratio and the public pension replacement rate. The housing loan-to-value ratio is the ratio of household mortgage debt outstanding to housing assets. The robust standard error of the slope estimate is reported in parentheses. ** denotes significance at the 5% level.

One might be concerned that this finding is driven by lower housing values in countries with more PAYGO-oriented pensions if households in those countries have to borrow less to buy a home. However, Figure 9 suggests that this is not what is going on. While there

²⁴Data on the value of housing assets come from the *Global Wealth Data Book*, which also reports household debt. I estimate mortgage debt by assuming that all long-term household debt is mortgage debt, and I estimate long-term debt using data on the long-term debt to total debt ratio in the *OECD National Accounts, Financial Balance Sheets*.

is considerable variation across countries in the value of housing assets relative to GDP, this variation does not appear to be correlated with the public pension replacement rate.

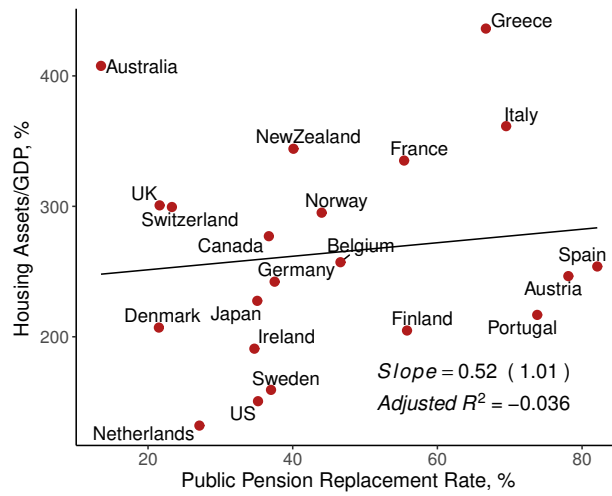


Figure 9. Housing assets and the public pension replacement rate. This figure displays the relationship between the housing assets to GDP ratio and the public pension replacement rate. The robust standard error of the slope estimate is reported in parentheses.

Given that mortgage debt is the lion's share of household debt and that the value of housing assets does not vary systematically with the pension system, it follows almost mechanically that the household debt to GDP ratio is lower in countries with a high public pension replacement rate, as shown in Figure 10. A one standard deviation increase in the public pension replacement rate reduces the household debt ratio (mean of 85.1%) by 19.8 percentage points, or 70% of the standard deviation of the household debt ratio.

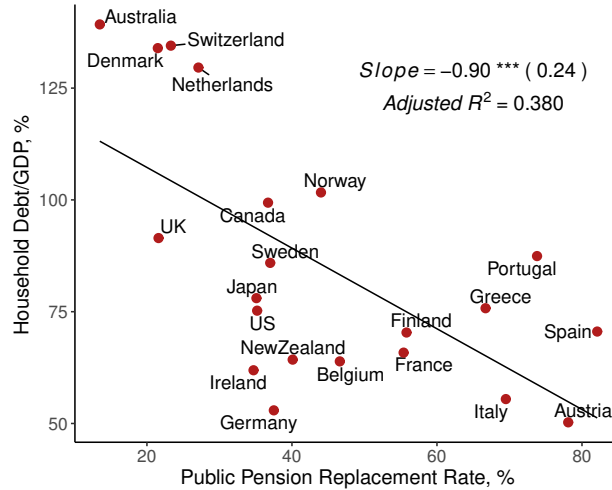
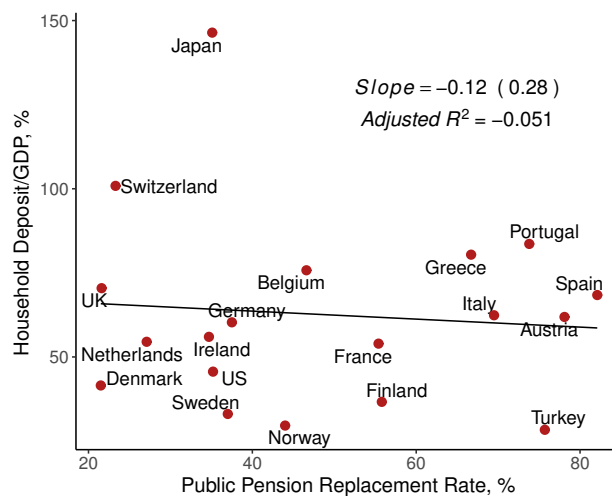


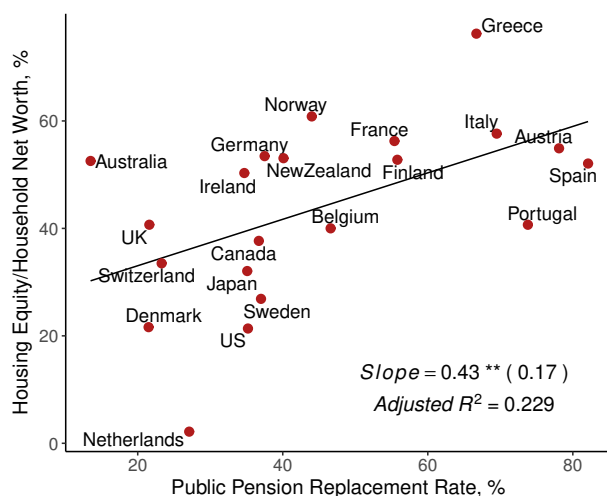
Figure 10. Household debt and the public pension replacement rate. This figure displays the relationship between the household debt to GDP ratio and the public pension replacement rate. The robust standard error of the slope estimate is reported in parentheses. *** denotes statistical significance at the 1% level.

One of the basic assumptions of the model is that households need a minimum amount of deposits, d^* , to meet their liquidity needs. In the version of the model with housing, any savings in excess of d^* is invested in housing equity or the capital market. Thus, the deposits to GDP ratio should not vary systematically with the pension system, as Figure 11 shows.



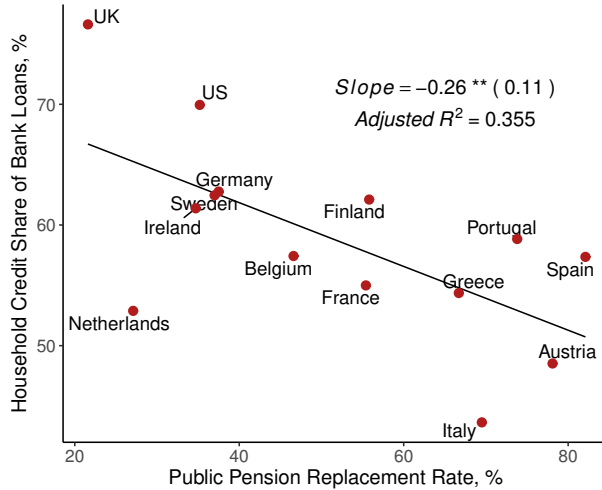
Figures 11. Household deposits and the public pension replacement rate. This figure displays the relationship between the household deposits to GDP ratio and the public pension replacement rate. The robust standard error of the slope estimate is reported in parentheses.

Because financial assets are lower in more PAYGO-oriented countries, as documented in Figure 3, and LTV ratios are also lower in those countries, housing equity as a share of total household net worth is greater in more PAYGO-oriented countries, as can be seen in Figure 12.



Figures 12. Housing equity share of net worth and the public pension replacement rate. This figure displays the relationship between the housing equity to net worth ratio and the public pension replacement rate. Housing equity is calculated as the difference between housing assets and mortgages outstanding. Household net worth is calculated as the sum of household financial assets and housing assets less household debt. The robust standard error of the slope estimate is reported in parentheses. ** denotes significance at the 5% level.

Finally, the theory has implications for the composition of bank assets. Because there is less mortgage debt in more PAYGO-oriented countries, the banking sector can fund more low-risk projects and, as a result, mortgages are a smaller share of bank assets. Figure 13 shows that this is indeed the case. Using bank balance sheet data from the European Central Bank for a more limited sample of countries, one can see that household credit is a smaller share of bank assets in more PAYGO-oriented countries. While there is not a tremendous amount of variation in household credit as a share of total bank loans, the public pension replacement rate does a good job explaining the variation: a one standard deviation increase in the pension variable decreases the household credit share (mean of 58.8%) by 5.7 percentage points, or 69% of its standard deviation.



Figures 13. Household credit share of bank loans and the public pension replacement rate. This figure displays the relationship between the household credit share of bank loans and the public pension replacement rate. The robust standard error of the slope estimate is reported in parentheses. ** denotes significance at the 5% level.

D. Size of the Financial System

This section considers the relationship between pension policy and the size of the financial sector. My measure of the size of a country's financial sector is its value added as a share of GDP — what I refer to as the "finance share." A sector's value added is equal to profits plus compensation in the sector. Philippon and Reshef (2013) report a significant drop in the finance share during the Great Depression in the U.S., followed by a significant increase after World War II and accelerating growth beginning in the 1980s. Greenwood and Scharfstein (2013) attribute much of the growth in the U.S. finance share since the 1980s to an increase in asset management services and household debt.

There is no exact correspondence between finance value added as calculated in practice and in my model. This is because in the model financial intermediation is competitive, so economic profits are zero. But if one supposes that there is some imperfect competition in the financial sector, then the financial sector would capture some fraction of the net increase in output that it creates as economic profits plus compensation (i.e., value added). In this case, the empirical measure of value added would be proportional to the net increase in output made possible by the financial sector, which is the additional expected output created by investing I_L^b and I_H^m :

$$[A + \theta x]I_L^b - I_L^b + \gamma\theta x I_H^m - I_H^m. \quad (22)$$

This value is increasing in α because overall investment is greater as α increases, and because more high-risk, high-output projects are taken as α increases. Thus, I view the model as being consistent with the idea that where pension savings are high, financial sector value added is high.²⁵

Figure 14, Panel A shows that there is considerable cross-country variation in the finance share. On average, the finance share is 6%. On the low end, the finance share is around 4% in countries such as Germany, Sweden, Spain, France, and Japan; on the high end, the finance share is around 8% in countries such as the U.S., the U.K., the Netherlands, and Ireland.

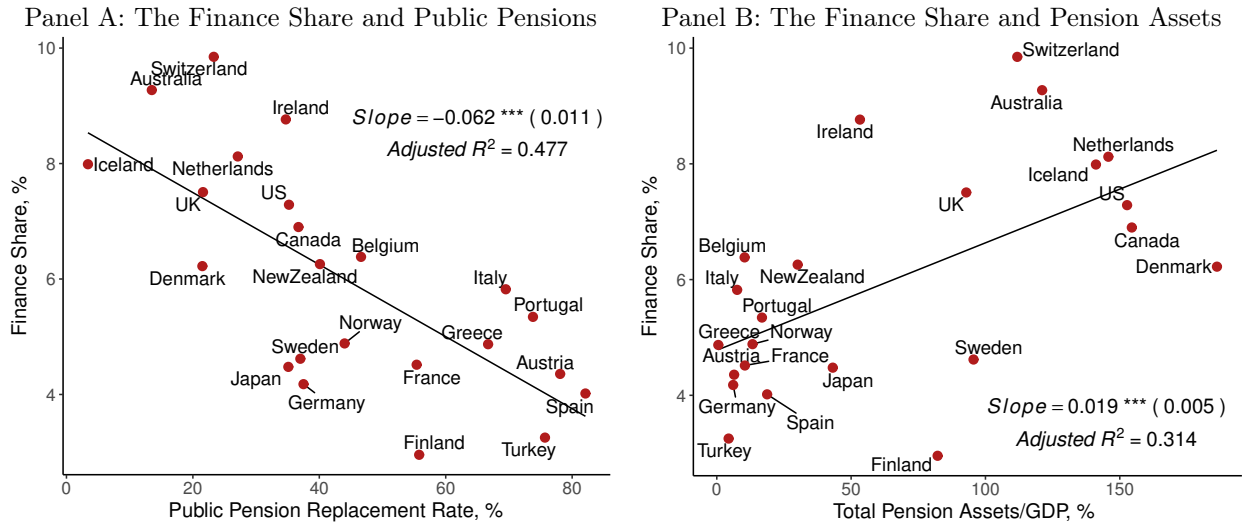


Figure 14. The finance share, public pensions, and pension assets. Panel A displays the relationship between the finance share and the public pension replacement rate. Panel B displays the relationship between the finance share and ratio of total pension assets to GDP. The finance share is financial sector value added divided by GDP. Total pension assets include both private and public pension assets. The robust standard error of the slope estimate is reported in parentheses. *** denotes significance at the 1% level.

²⁵In making this argument, I am assuming that financial sector competition does not vary across countries. In theory, countries with less competitive financial sectors could have greater finance shares simply because higher unit fees makes financial firms more profitable. However, this is unlikely to explain all of the cross-country variation in the finance share since the level of financial services, including asset management and household credit, is greater in countries with more private pensions. If anything, unit fees may fall with an increase in financial intermediation as suggested in the simple model of section II.E and the more nuanced model of Gennaioli et al. (2014). Further exploration of the link between pension savings, competition, and the cost of financial intermediation could be a fruitful avenue of research. See Philippon (2015) for an approach to measuring the cost of financial services, which may be helpful in exploring these issues.

The figure shows that there is a strong negative relationship between the finance share and the public pension replacement rate. The economic magnitude of the effect is quite large: a one standard deviation increase in the public pension replacement rate reduces the finance share (mean of 6.0%) by 1.4 percentage points, or about 70% of the finance share standard deviation.

In Figure 14, Panel B one can also see that there is a strong positive relationship between the finance share and the pension assets ratio. This is not surprising given the strong negative relation between the pension assets ratio and the public pension replacement rate, as documented in Figure 1, Panel B.

The regression coefficient reported in Panel B of Figure 14 implies that going from no pension assets (a purely PAYGO system) to a pension assets ratio of 100% increases the finance share by 1.9 percentage points. Thus, each additional dollar of pension fund assets increases financial sector value added by 1.9 cents. I argue below that the size of this effect is large and suggests that pension savings may play a role in capital market deepening, as discussed in Proposition 2. The proposition states that the size of the financial sector rises steeply with private pension savings because there is a virtuous cycle: more funds invested in capital markets reduce the unit costs of asset management, which attracts more assets to capital markets and in turn stimulates the creation of more financial assets.

To see why capital market deepening may help explain the magnitude of the effect documented in Panel B of Figure 14, note that there is a somewhat mechanical relationship between pension assets and value added because the financial sector is paid fees to manage the assets of pension funds and incurs costs in the operation of these funds. The OECD (2015) reports that the average operating cost of private pensions funds for a small subset of countries is 45 basis points. A conservative estimate of asset management fees is 150 basis points. I get this by doubling the estimate of French (2008), who reports overall asset management fees of equity investing plus equity trading costs of around 75 basis points in 2006. These fees are likely lower now given further growth in passive investing since 2006. Moreover, fees are generally lower for managing fixed income assets (Malkiel (2013)). Thus, 75 basis points is almost certainly an upper bound estimate of overall asset management and trading costs in the U.S., and because fees are likely higher outside the U.S., I take

the conservative approach of doubling these fees as an estimate of asset management fees in other OECD countries. My estimate of fees plus operating costs is therefore 195 basis points of pension assets. These constitute *revenues* (i.e., output) of the financial sector from investing pension assets and operating pension funds.

To get to value added (profits plus compensation) from output, one has to subtract intermediate costs (e.g., printing, rent, heating, transportation). I do not observe these costs for OECD countries, but in the U.S. securities and investment industry, intermediate costs account for about one-half of output, with the other half going to value added (profits and compensation).²⁶ To the extent that these intermediate costs are similar in other OECD countries, each dollar of pension assets should be associated with 97.5 basis points of value added, which is far less than the 190 basis points implied by the slope of the regression line. Of course, there are costs of creating the financial assets in which pension funds invest, and these are not measured by the investment costs described above. But unless pension funds stimulate the creation of financial assets or other types of financial activity, these added costs would not explain the empirical relationship between pension assets and the finance share. This suggests that pension savings may deepen capital markets, bringing more investor wealth into capital markets and stimulating the creation of financial assets and other types of financial activity, in line with Proposition 2.

IV. Alternative Explanations: Legal Systems, Faith in Financial Markets, and Reverse Causality

Documenting a cross-country statistical relationship between financial outcomes and pension policy obviously does not prove that pension policy causes the financial outcomes I observe. There are two related concerns. The first is that the structure of the pension system proxies for an omitted factor that affects the financial system. One potential such factor is the structure of the legal system, in particular, whether it is based on common law or civil law, which La Porta et al. (1997a, 1998), hereafter LLSV, link to a variety of financial outcomes. Another potential omitted factor is the extent to which a country (its people and policymakers) have faith in financial markets, such as how much they trust

²⁶See *Gross-Domestic-Product-by-Industry Data*, Bureau of Economic Analysis.

others to treat them fairly in financial transactions (Guiso, Sapienza, and Zingales (2004)) or how confident they are that investing in financial markets will result in wealth accumulation (Roe (2006), Perotti and Schwienbacher (2009)). If less faith in financial markets leads to less financial market activity and less willingness to use private pensions, then we might observe the correlation between financial outcomes and pension policy documented above.

The second broad class of concerns is one of reverse causality. In particular, a country may choose a PAYGO pension system precisely because its financial markets are less developed and its financial system would not be able to accommodate the increased demand for securities from pension funds.

I consider each of these causality issues in turn. I am, of course, limited in what I can conclude because I have no more than 23 country observations to analyze, and I have no instruments for pension system choice. Nevertheless, I can present some evidence that may be useful in interpreting the data.

A. Legal Systems

As LLSV demonstrate, financial markets are more developed in countries with legal systems that derive from English common law (mainly English-speaking countries) as compared to legal systems based on civil law, such as France and the other countries in Continental Europe and Scandinavia. Common law countries are characterized by greater investor protection for both shareholders and creditors, higher stock market capitalization to GDP ratios, and a more widely dispersed base of minority shareholders (La Porta, Lopez-de Silanes, and Shleifer (2008)). To the extent that civil law countries are more likely to adopt PAYGO pension systems, the pension variable could proxy for the type of legal system; in this case, the relationships between the finance outcomes of interest and the public pension replacement rate that I document would say more about the effect of the legal system on financial development than it would say about the effect of pension policy. Indeed, there is reason to believe that civil law countries would be more likely to adopt PAYGO pensions, as LLSV present a wealth of evidence suggesting that "civil law is associated with a heavier hand of government ownership and regulation than common law" (La Porta, Lopez-de Silanes, and Shleifer (2008)). One way that the "heavier hand" manifests itself is in a greater likelihood

that governments own banks in civil law countries(La Porta et al. (2002)) , which suggests that governments in these countries are more comfortable providing financial services directly to households, as would be the case under a PAYGO-oriented pension system.

Table III provides evidence on whether a country’s legal system can explain the patterns that I document. The first column shows that civil law countries are indeed more likely to adopt more PAYGO-centered pension systems. In particular, the public pension replacement rate is about 19 percentage points higher in civil law countries than in common law countries. The next columns look at whether the financial outcomes that I examine — stock market capitalization and private debt securities relative to GDP, the bank loan share of corporate debt, the employment share of large firms, insider ownership share, household debt to GDP, and the finance share — continue to be related to pension policy after I include a civil law dummy. In all of the regressions, the pension variable continues to be statistically significant at various confidence levels and has the same sign as in the basic regressions reported in the figures. For the most part, the civil law dummy has the expected sign, but it is not statistically significant except for the regression in which the finance share is the dependent variable. With only 23 observations it is difficult to run a horse race between the theories, but the results suggest that there should be no presumption that my findings are driven by differences in legal systems across countries.²⁷

— Table III about here —

B. Faith in Finance: Trust and Wartime Destruction

As noted above, it is possible that where people have little faith in finance — where they are concerned about entering into financial transactions or where they are skeptical about whether financial markets function properly — they will engage in less financial activity. In this case, policymakers may be more likely to adopt PAYGO-oriented pension

²⁷I have experimented with using other controls in these regressions and the ones that follow, including GDP per capita. The magnitude of the coefficient on the public pension replacement rate changes little. However, given that I have 23 or fewer data points, in some cases the statistical significance of my results is somewhat lower, while GDP per capita is almost never statistically significant. This is not too surprising given that the sample is made up of developed OECD economies and there is less variation in GDP per capita than one would see in a much broader sample of countries.

policies, which are less reliant on financial markets. Thus, the relationship between finance and pension policy may not be causal but rather driven by the omitted factor "faith in finance" that drives both variables.

One version of the faith-in-finance view is related to notions of trust. Guiso, Sapienza, and Zingales (2004) argue that trust facilitates financial transactions and thus financial development. In a society where people believe that others will treat them fairly, perhaps because of high levels of social capital derived from strong networks of social connections, individuals will be more likely to enter financial transactions. Indeed, Guiso, Sapienza, and Zingales (2004) show that in regions of Italy that appear to have high degrees of social capital (measured through blood donations and other charitable activities), individuals are more likely to buy stock and engage in other types of financial transactions.

To explore this explanation, I start by examining whether trust is, in fact, related to pension policy choice. A standard measure of trust is the percentage of people in a country who respond positively to the *World Values Survey* question, "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" (Knack and Keefer (1997), La Porta et al. (1997b)).²⁸

— Table IV about here —

The first column of Table IV, using data on trust reported by La Porta et al. (1997b), shows that the public pension replacement rate is negatively related to the trust measure.²⁹ If one believes that trust is itself related to a faith in finance, then this finding is consistent with the view that where there is little faith in finance, policymakers will choose a more PAYGO-like pension system. The remaining columns explore whether pension policy can explain financial outcomes after controlling for the trust measure. The inclusion of the trust measure in the regressions weakens the statistical significance of the pension variable in explaining the size of stock and bond markets, but does not materially affect the coefficient. The statistical significance and sign of the pension variable in the other regressions are not

²⁸This is surely a crude measure of trust. See Glaeser et al. (2000) for research suggesting that this question better predicts whether people act in a trustworthy fashion than if they trust others.

²⁹These data are from the 1990s, and thus a bit stale, but they include more countries than I was able to find in more recent *World Values Surveys*.

affected. Moreover, trust is not statistically significant in the regressions. Empirically, this is likely because the trust variable is high in Scandinavian countries, but their capital markets and financial systems are relatively small. Of course, this measure of trust is imperfect and may not capture the elements of trust that are important in the development of an active financial sector.

Another version of the faith-in-finance explanation is based on arguments by Roe (2006) and Perotti and Schwiabacher (2009). Roe argues that the loss of wealth between the start of World War I and end of World War II eroded faith in financial markets, which stunted the development of policies that would facilitate the growth of financial markets, such as policies promoting shareholder and creditor protection. One could argue that a particularly wealth-destroying wartime experience led to an aversion to using financial markets to fund pensions. As a result, the wartime experience could have simultaneously led to greater PAYGO adoption and policies that retarded financial development, even if pension policy itself does not affect financial development. Perotti and Schwiabacher (2009) argue that episodes of high inflation were particularly damaging to the middle class and eroded their confidence in financial markets. Indeed, the authors present evidence that countries that experienced hyperinflation were more likely to adopt PAYGO-centered pension systems.

— Table V about here —

The first column of Table V suggests that there is some truth to the argument that wealth destruction helps to explain pension policies. Countries that experienced greater GDP growth between the start of World War I and the end of World War II were less likely to adopt more PAYGO-oriented pension systems. The other columns explore whether the public pension replacement rate continues to explain financial outcomes even after controlling for wartime GDP growth. Except for private debt securities and the bank loan share of corporate debt, all of the other financial outcomes continue to be significantly related to the public pension replacement rate. In regressions not shown here, historical experience with hyperinflation does not diminish the impact of pension policy on the financial outcomes I consider.

C. Financial Development as a Determinant of Pension System Choice

While the basic story that I explore is one whereby pension policy impacts the financial system, it is possible that the effect runs in the reverse direction, that is, that the financial system affects the choice of pension policy. Indeed, in debates around the design of pension systems, policymakers have noted that requiring pensions to be pre-funded could be disruptive to financial markets if those markets are not sufficiently deep to accommodate a significant increase in pension fund demand for securities.

There are no plausible instruments for pension system design that would allow me to cleanly tease out causality. Instead, I look at whether financial market development around the time that pension systems were developing helps explain current pension system characteristics. As noted above, government pension systems developed in the early 1900s. However, in the early years of these programs, they were quite modest in scale and scope. Most of the expansion occurred in the middle part of the 20th century – from 1935 through the 1960s (Perotti and Schwiabacher (2009)). Thus, I use a country’s stock market capitalization to GDP ratio in 1950 as a measure of financial development around the time that modern pension systems were taking shape.³⁰ Unfortunately, I have only 14 observations for stock market capitalization in 1950, so statistical inference is limited.

— Table VI about here —

The findings in column 1 of Table VI indicate that stock market capitalization in 1950 is related to pension system characteristics today — countries that had larger stock markets in 1950 have less PAYGO-oriented pension systems in 2014, as suggested by this explanation. Including 1950 stock market capitalization in the financial outcome regressions eliminates the statistical significance of the pension variable in some cases, but the 1950 stock market variable is insignificant in all regressions except one. Insider ownership, the large-firm employment share, and the finance share continue to be statistically significant. In any case, with only 14 observations it is difficult to draw strong conclusions. While this evidence does not prove that there is no reverse causality, it does cast some doubt on a

³⁰I could use stock market capitalization from an even earlier period, but there are concerns about the reliability of data from this earlier period (La Porta, Lopez-de Silanes, and Shleifer (2008)).

simple story whereby countries with funded pension systems had large capital markets and financial systems even before the expansion of private pension systems.

V. Conclusion

In this paper, I present a theory of how pension policy affects the structure of the financial system, and I provide cross-country evidence in support of the theory. More work could be done to flesh out the theory and address limitations of the empirical work. I have already discussed the possibility of addressing issues of causality by looking at the effect of pension reforms on the structure of financial systems. Indeed, as more countries move towards private pensions because of heightened fiscal concerns associated with PAYGO pensions, there may be greater opportunities to examine the effects of changes in pension policy on financial systems. Apart from issues of causality, there are nuances in the theory and empirical analysis that warrant further attention. For example, the theory and empirical work make no distinctions among the various types of pensions that are used. Yet the asset holdings of defined benefit plans are quite different from those of defined contribution plans, with the former more likely make less liquid investments in real estate, hedge funds, and private equity. Thus it is possible that there is more demand for these types of investments in countries that are more reliant on private defined benefit plans, which could then have downstream consequences for the financial system and the real economy. Moreover, household investment and financing decisions may be very different if a worker participates in a defined benefit plan rather than a defined contribution plan.

My findings may have implications for how we think about the risk of various types of pension systems. The current literature on pension risk, which is largely theoretical, focuses on the distributional and risk-sharing implications of various pension systems. In particular, in a defined contribution pension system, a lot of risk is borne by individuals directly, whether because investment returns are low or because income shocks, behavioral biases, or ignorance leads them to save inadequately. In private defined benefit plans, some of the risk is borne by shareholders, some by workers who may not receive the benefits they were promised, and some by taxpayers to the extent that there are government guarantees of

private pensions. PAYGO pension systems, by contrast, facilitate risk-sharing and redistribution within and across generations.³¹ These risk and redistribution issues are prominent in pension policy discussions.

The model and empirical results that I present point to other ways in which a pension system could affect risk in an economy through indirect effects on the financial system. One particular mechanism could operate through mortgage credit. Jordà, Schularick, and Taylor (2016) present evidence that mortgage credit is central to many financial crises, and that banks have increased their exposure to real estate over time. Adverse shocks to real estate thus impair the banking system and its ability to extend credit. Excessive mortgage credit could also lead to excessive volatility in consumption and amplify business cycles, a point made by Mian, Rao, and Sufi (2013) with respect to the most recent crisis in the U.S. and by Mian, Sufi, and Verner (2017) for a broader set of countries over a longer period. Because households in countries with funded pension systems take on more mortgage debt, and because banks are more exposed to mortgage credit in those countries, it is possible that an unintended consequence of pre-funded pension systems is to make countries more vulnerable to business cycles and financial crises.

The findings reported here also relate to the debate on the costs and benefits of a market-based versus bank-based financial system to the extent that the pension funding model pushes a financial systems towards one form of finance over another. This is not the place for a full analysis of the two systems, so I will simply point out that they have different implications for financial and economic stability, monetary policy, bank regulation, and the cost of credit, with neither system clearly dominating the other. For example, a market-based system may involve less stable funding of the banking system (Gorton and Metrick (2012)), exacerbating a financial crisis, but such a system may also enable nonfinancial firms to raise bond financing from the capital market when bank credit supply is tight (Kashyap, Stein, and Wilcox (1993), Becker and Ivashina (2014)). Moreover, monetary policy and bank regulation are more complex in a world in which banks can raise capital market funding and activities can migrate outside of the banking sector to avoid constraints on banks (Stein

³¹This is a gross simplification of the issues. See Diamond and Geanakoplos (2003) for a much more nuanced analysis that examines the general equilibrium effects on risk premia and interest rates when shifting from a PAYGO system to a pre-funded pension system.

(2012), Sunderam (2015), Greenwood, Hanson, and Stein (2016), and Hanson, Kashyap, and Stein (2011)).

The broader point is a variant of one that Barr and Diamond (2006) make in their discussion of pension policy, namely, that pension policies have wider implications for the economy and they cannot be evaluated with a single objective in mind such as reducing labor market distortions. This paper could add other considerations to an already complex policy mix — the effects on capital market development, household leverage, and financial and economic stability.

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Table I
Summary Statistics of Pension Variables

This table presents characteristics of pension systems in 23 OECD countries. All data are reported in percentages. The public (private) pension replacement rate is the OECD's forecast of the percentage of lifetime average pre-retirement income provided by the public (private) pension system for a retired worker with mean pre-retirement income. A private pension replacement rate of zero indicates that the OECD does not calculate a replacement rate because coverage is not broad, although there may be some private pensions in the country. Public (private) pension assets are assets held by the public (private) pension system. The mandatory pension contribution rate is the OECD's estimate of the percentage of an average worker's wage that is required to be contributed by an employer or an employee to a private or public pension scheme. See the Appendix for detailed variable definitions and sources.

Country	Pension Replacement Rate, %			Pension Assets/GDP, %			Mandatory Pension Contribution Rate, %			
	Public	Private	Total	Public	Private	Total	Public, employee	Public, employer	Private, employee	Private, employer
Australia	13.5	31.0	44.5	5.9	115.2	121.1	0.0	9.5	0.0	0.0
Austria	78.1	0.0	78.1	0.0	6.4	6.4	10.3	12.6	0.0	0.0
Belgium	46.6	13.3	59.9	5.2	5.2	10.4	7.5	8.9	0.0	0.0
Canada	36.7	29.3	66.0	17.1	137.3	154.5	5.0	5.0	0.0	0.0
Denmark	21.5	46.3	67.8	0.0	186.2	186.2	0.5	0.8	0.0	12.0
Finland	55.8	0.0	55.8	27.6	54.6	82.2	7.1	17.8	0.0	0.0
France	55.4	0.0	55.4	2.5	7.9	10.5	6.8	8.5	3.0	3.0
Germany	37.5	12.5	50.0	0.0	6.1	6.1	9.5	9.5	0.0	0.0
Greece	66.7	0.0	66.7	0.0	0.6	0.6	6.7	13.3	0.0	0.0
Iceland	3.4	65.8	69.2	0.0	141.1	141.1	0.0	7.8	4.0	8.0
Ireland	34.7	30.4	65.1	0.0	53.3	53.3	4.0	10.8	0.0	0.0
Italy	69.5	0.0	69.5	0.0	7.6	7.6	9.2	23.8	0.0	0.0
Japan	35.1	0.0	35.1	25.2	17.9	43.2	8.7	8.7	0.0	0.0
Netherlands	27.1	63.4	90.5	0.0	145.7	145.7	4.9	0.0		16.0
New Zealand	40.1	12.4	52.5	10.3	19.8	30.1	0.0	0.0	3.0	3.0
Norway	44.0	5.8	49.8	5.8	7.5	13.3	8.2	14.1	0.0	0.0
Portugal	73.8	0.0	73.8	7.0	9.8	16.8	6.4	13.8	0.0	0.0
Spain	82.1	0.0	82.1	5.4	13.3	18.7	4.7	23.6	0.0	0.0
Sweden	37.0	19.0	56.0	28.7	66.9	95.6	7.0	11.4	0.0	4.5
Switzerland	23.3	16.9	40.2	0.0	111.8	111.8	4.2	4.2	7.7	10.4
Turkey	75.7	0.0	75.7	0.0	4.4	4.4	9.0	11.0	0.0	0.0
UK	21.6	29.8	51.4	0.0	92.9	92.9	9.1	11.9	0.0	0.0
US	35.2	32.6	70.3	15.9	136.8	152.7	6.2	6.2	0.0	0.0
Average	44.1	17.8	62.0	6.8	58.6	65.4	5.9	10.1	1.5	1.9

Table II**Summary Statistics of Pension and Financial Outcome Variables**

This table presents summary statistics of pension and financial outcome variables. All data are reported in percentages. The public pension replacement rate is the OECD's forecast of the percentage of lifetime average pre-retirement income provided by the public pension system for a retired worker with mean pre-retirement income. Total pension assets are the sum of private pension assets and public pension assets. Household financial assets are the sum of currency and deposits, debt securities, loans, equity and investment fund shares, and insurance, pension, and standardized guarantees that are owned by the household sector. Nonpension financial assets are household financial assets less pension fund claims. Stock market cap/GDP is the average stock market capitalization to GDP ratio from 2005 to 2014. Private bonds/GDP is the average domestic private debt securities outstanding to GDP ratio from 2002 to 2011 (not extended to 2014 due to data limitations). Bank loan share of corporate debt is the ratio of corporate bank loans to nonfinancial sector corporate debt. Employment share, 1-9 (250+) is the share of workers employed by firms that have 1 to 9 (250 or more) employees. Insider ownership share is the percentage of outstanding shares held by insiders. Housing LTV ratio (loan-to-value ratio) is the ratio of mortgage debt outstanding to housing assets. Housing equity is the difference between housing assets and mortgages outstanding. Household net worth is the sum of household financial assets and housing assets less household debt. Household credit share of bank loans is the share of bank loans that are loans to households. Finance share is financial sector value added divided by GDP. See the Appendix for detailed variable definitions and sources.

	Mean	Median	St. Dev.	25th percentile	75th percentile
Public Pension Replacement Rate	44.1	37.5	22.0	27.1	66.7
Total Pension Assets/GDP	65.4	43.2	61.4	10.4	121.1
Household Financial Assets/GDP	221.4	214.2	87.3	164.3	282.7
Nonpension Financial Assets/GDP	170.9	161.0	65.0	122.0	213.5
Stock Market Cap/GDP	75.4	73.6	41.7	39.5	106.6
Private Bonds/GDP	47.8	38.9	36.2	24.0	67.6
Bank Loan Share of Corporate Debt	84.5	86.2	12.1	83.5	91.0
Employment Share, 1-9	29.1	25.6	12.2	20.5	40.8
Employment Share, 250+	33.2	32.9	9.9	27.6	36.7
Insider Ownership Share	42.5	42.6	12.3	33.7	52.0
Housing LTV Ratio	32.9	31.2	18.1	21.0	35.2
Housing Assets/GDP	264.1	253.9	81.5	207.1	300.7
Household Debt/GDP	85.11	75.8	28.2	64.3	99.4
Household Deposit/GDP	62.6	60.3	28.1	41.5	75.8
Housing Equity/Household Net Worth	43.7	50.3	16.7	33.5	53.5
Household Credit Share of Bank Loans	58.8	58.1	8.3	54.4	62.5
Finance Share	6.0	5.8	1.9	4.5	7.5

Table III
Law, Pensions, and the Financial System

This table presents regressions of financial outcome variables on the public pension replacement rate and the civil law dummy. The civil law dummy is equal to one if the country's legal system is based on civil law, and zero if it is based on common law, according to La Porta et al. (1998). The public pension replacement rate is the OECD's forecast of the percentage of lifetime average pre-retirement income provided by the public pension system for a retired worker with mean pre-retirement income. See Table II and the Appendix for additional variable definitions and sources. Robust standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Dependent variable:	(1) Public Pension Replacement Rate	(2) Stock Market Cap/GDP	(3) Private Bonds/GDP	(4) Bank Loan Share of Corporate Debt	(5) Insider Ownership Share	(6) Employment Share, 250+	(7) Household Debt/GDP	(8) Finance Share
Public Pension Replacement Rate		-0.966* (0.472)	-0.688* (0.388)	0.229* (0.130)	0.367*** (0.087)	-0.217*** (0.075)	-1.081*** (0.281)	-0.052*** (0.013)
Civil Law	18.676** (6.989)	-2.742 (22.314)	0.481 (22.930)	9.046 (8.974)	6.616 (4.676)	-4.088 (5.424)	16.698 (11.605)	-1.282* (0.618)
Constant	30.300*** (4.047)	120.073*** (18.884)	77.864*** (20.095)	66.728*** (8.731)	21.474*** (5.455)	46.158*** (5.295)	121.325*** (12.820)	9.253*** (0.518)
Observations	23	23	22	21	23	22	21	23
Adjusted R ²	0.105	0.200	0.095	0.270	0.568	0.253	0.411	0.534

Table IV
Trust, Pensions, and the Financial System

This table presents regressions of outcome variables on the public pension replacement rate and a trust measure. Trust is the percentage of people in a country who respond positively to the World Values Survey question, “Generally speaking, would you say that most people can be trusted or that you can’t be too careful in dealing with people?” (as reported in La Porta et al. (1997b)). The public pension replacement rate is the OECD’s forecast of the percentage of lifetime average pre-retirement income provided by the public pension system for a retired worker with mean pre-retirement income. See Table II and the Appendix for additional variable definitions and sources. Robust standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Dependent variable:	(1) Public Pension Replacement Rate	(2) Stock Market Cap/GDP	(3) Private Bonds/GDP	(4) Bank Loan Share of Corporate Debt	(5) Insider Ownership Share	(6) Employment Share, 250+	(7) Household Debt/GDP	(8) Finance Share
Public Pension Replacement Rate		-0.836 (0.569)	-0.603 (0.365)	0.286** (0.124)	0.359*** (0.084)	-0.258*** (0.088)	-0.710** (0.318)	-0.069*** (0.016)
Trust	-0.812*** (0.224)	0.350 (0.533)	0.171 (0.551)	0.077 (0.144)	-0.212 (0.129)	0.015 (0.084)	0.321 (0.384)	-0.028 (0.025)
Constant	79.440*** (10.089)	99.936* (51.093)	68.746* (33.673)	67.681*** (11.175)	34.511*** (7.561)	46.025*** (7.480)	101.626*** (29.759)	10.129*** (1.710)
Observations	20	20	20	20	20	19	18	20
Adjusted R ²	0.267	0.175	0.062	0.146	0.608	0.256	0.298	0.415

Table V

Wartime Experience, Pensions, and the Financial System

This table presents regressions of financial outcome variables on the public pension replacement rate and GDP 1945/GDP 1913. GDP 1945/GDP 1913 is the ratio of GDP in 1945 to GDP in 1913, which measures GDP growth from the start of World War I to the end of World War II. The public pension replacement rate is the OECD's forecast of the percentage of lifetime average pre-retirement income provided by the public pension system for a retired worker with mean pre-retirement income. See Table II and the Appendix for additional variable definitions and sources. Robust standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Public Pension Replacement Rate	Stock Market Cap/GDP	Private Bonds/GDP	Bank Loan Share of Corporate Debt	Insider Ownership Share	Employment Share, 250+	Household Debt/GDP	Finance Share
Public Pension Replacement Rate		-0.877** (0.380)	-0.677 (0.427)	0.066 (0.091)	0.333** (0.118)	-0.185** (0.083)	-0.815** (0.292)	-0.068*** (0.016)
GDP 1945/GDP 1913	-12.662** (4.882)	22.934*** (7.282)	-0.424 (13.124)	-9.530** (3.496)	-4.605 (3.717)	5.537 (3.553)	6.373 (8.652)	-0.195 (0.476)
Constant	65.695*** (9.242)	80.078*** (23.553)	78.273** (35.116)	97.162*** (7.521)	35.430*** (10.276)	33.084*** (7.566)	111.389*** (25.461)	9.315*** (1.390)
Observations	22	22	21	20	22	22	21	22
Adjusted R ²	0.130	0.379	0.057	0.405	0.501	0.354	0.368	0.429

Table VI

Historical Financial Development, Pensions, and the Financial System

This table presents regressions of financial outcome variables on the public pension replacement rate and stock market cap/GDP, 1950. Stock market cap/GDP, 1950 is the stock market capitalization to GDP ratio in 1950, a measure of financial development at that time. The public pension replacement rate is the OECD's forecast of the percentage of lifetime average pre-retirement income provided by the public pension system for a retired worker with mean pre-retirement income. See Table II and the Appendix for additional variable definitions and sources. Robust standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Dependent variable:	(1) Public Pension Replacement Rate	(2) Stock Market Cap/GDP	(3) Private Bonds/GDP	(4) Bank Loan Share of Corporate Debt	(5) Insider Ownership Share	(6) Employment Share, 250+	(7) Household Debt/GDP	(8) Finance Share
Public Pension Replacement Rate		-0.727 (0.764)	-1.075 (0.739)	0.056 (0.147)	0.178** (0.080)	-0.177 (0.106)	-1.110** (0.413)	-0.046* (0.022)
Stock Market Cap /GDP, 1950	-0.394** (0.136)	0.399 (0.388)	-0.794 (0.468)	-0.252** (0.098)	-0.096 (0.088)	0.041 (0.093)	-0.004 (0.290)	0.027* (0.015)
Constant	49.754*** (7.720)	109.393** (46.302)	116.347** (48.192)	86.692*** (7.011)	35.886*** (4.137)	42.603*** (6.184)	136.727*** (24.160)	7.266*** (1.434)
Observations	14	14	14	13	14	14	14	14
Adjusted R ²	0.224	0.100	0.111	0.197	0.191	0.042	0.402	0.431

Appendix: Variable Definitions and Sources

Name	Definition	Source
Public pension replacement rate	OECD forecast of the percentage of lifetime average pre-retirement income provided by the public pension system for a retired worker with mean pre-retirement income. The worker is assumed to enter the workforce in 2014 at age 20, and retire after a full career. He or she is further assumed to earn the average worker income throughout his or her career. See data source for further assumptions.	OECD, 2015, <i>Pensions at a Glance 2015: OECD and G20 indicators</i> , (OECD Publishing, Paris). http://dx.doi.org/10.1787/pension_glance-2015-en
Private pension assets	Assets of all pension plans, including defined benefit plans, defined contribution plans, and pension insurance contracts.	OECD, 2018, Private pension assets (indicator). doi: 10.1787/e694378a-en Accessed on January 2, 2018.
GDP	Gross domestic product.	The World Bank, <i>World Development Indicators (2018)</i> . GDP (Current US\$). Retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD . Accessed on January 2, 2018.
Civil law	Dummy equals to one if the country's legal system is based on civil law, and zero if it is based on common law, according to La Porta et al. (1998).	La Porta et al. (1998)
Trust	Percentage of people in a country who respond positively to the <i>World Values Survey</i> question, "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" (as reported in La Porta et al. (1997b)).	La Porta et al. (1997b)
GDP 1945/GDP 1913	The ratio of GDP in 1945 to GDP in 1913, which measures GDP growth from the start of World War I to the end of World War II.	Maddison, Angus, 2007, <i>The World Economy Volume 1: A Millennial Perspective Volume 2: Historical Statistics</i> , (Academic Foundation).

Stock market cap/GDP, 1950	Stock market capitalization to GDP ratio in 1950.	Rajan, Raghuram G., and Luigi Zingales, 2003, The great reversals: The politics of financial development in the twentieth century, <i>Journal of Financial Economics</i> , 69, 5-50. <i>Global Financial Data (2018)</i> . Available at: Subscription Service. Accessed on January 2, 2018.
Household financial assets	The sum of currency and deposits, debt securities, loans, equity and investment fund shares, and insurance, pension, and standardized guarantees that are owned by the household sector.	OECD, 2018, <i>National Accounts, Financial Accounts, 720. Financial Balance Sheets – Non-consolidated – SNA 2008</i> . Retrieved from https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABL E720R . Accessed on January 2, 2018.
Nonpension financial assets	Household financial assets less pension fund claims.	
Household deposits	All bank deposits held by the household sector.	
Stock market cap/GDP	The average stock market capitalization to GDP ratio from 2005 to 2014.	World Bank, 2015, <i>Global Financial Development Database</i> . Retrieved from http://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database . Accessed on January 2, 2018. CEIC, Market Capitalization of various countries. Accessed on January 2, 2018.
Private bonds /GDP	The average domestic private debt securities outstanding to GDP ratio from 2002 - 2011 (not extended to 2014 due to data limitations).	World Bank, 2015, <i>Global Financial Development Database</i> . Retrieved from http://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database . Accessed on January 2, 2018.

Bank loan share of corporate debt	The ratio of corporate bank loans to nonfinancial sector corporate debt.	OECD, 2018, <i>National Accounts, Financial Accounts, 720. Financial Balance Sheets – Non-consolidated – SNA 2008</i> . Retrieved from https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABL E720R . Accessed on January 2, 2018.
Employment share, 1-9	The share of workers employed by firms that have one to nine employees.	OECD, 2018, <i>Structural and Demographic Business Statistics</i> . Retrieved from http://www.oecd.org/sdd/business-stats/structuraland-demographicbusinessstatisticsssdbsoecd.htm Accessed on January 2, 2018.
Employment share, 250+	The share of workers employed by firms that have 250 or more employees.	OECD, 2018, <i>Structural and Demographic Business Statistics</i> . Retrieved from http://www.oecd.org/sdd/business-stats/structuraland-demographicbusinessstatisticsssdbsoecd.htm Accessed on January 2, 2018.
Insider ownership share	The percentage of outstanding shares held by insiders. Based on Datastream variable, Closely Held Shares.	Datastream, 2018, <i>Thomson Reuters Datastream, World Scope</i> . [Online]. Available at: Subscription Service. Accessed on January 2, 2018.
Housing assets	The total value of housing owned by the household sector.	Credit Suisse. <i>Global Wealth Databook 2016</i> .
Household debt	The sum of all liabilities of the household sector.	
Household net worth	The sum of housing and financial assets owned by the household sector less household debt (including mortgage).	
Housing LTV ratio	The ratio of mortgage debt outstanding to housing assets (loan-to-value ratio).	Credit Suisse. <i>Global Wealth Databook 2016</i> .
Housing equity	The difference between housing assets and mortgages outstanding.	OECD, 2018, <i>National Accounts, Financial Accounts, 720. Financial Balance Sheets – Non-consolidated – SNA 2008</i> . Retrieved from https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABL E720R . Accessed on January 2, 2018.
		Author's calculation.

Household credit share of bank loans	The share of bank loans that are loans to households, including mortgages and other forms of consumer credit.	European Central Bank, <i>The Balance Sheets of Monetary Financial Institutions</i> . Retrieved from https://www.ecb.europa.eu/stats/money_credit_banking/mfi_balance_sheets/html/index.en.html . Accessed on January 2, 2018.
Finance share	Financial sector value added divided by GDP. Value added is industry profit plus compensation.	Board of Governors of the Federal Reserve System, 2018, <i>Financial Accounts of the United States</i> . Accessed on January 2, 2018. OECD, 2018, Value added by activity (indicator). doi: 10.1787/a8b2bd2b-en. Accessed on January 2, 2018.