

A MATTER OF TRUST: UNDERSTANDING WORLDWIDE PUBLIC PENSION CONVERSIONS¹

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ABSTRACT

Fundamental reform of social security systems from traditional pay-as-you-go defined benefit systems toward defined-contribution accounts represents one of the most important fiscal policy changes worldwide during the past century. Current explanations of this phenomenon lack theoretical justification or empirical support. In fact, the traditional pension model is likely superior along several important dimensions. So why have so many countries reformed? Adding to this puzzle is that these reforms have taken on numerous shapes and sizes across the world, and typically have been *larger* in *developing* countries facing *less* severe demographic problems. We propose a simple model of “intergenerational trust” that is consistent with these stylized facts. Empirical analysis is provided that supports the basic tenets of the model.

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1. Introduction

One of the most far-reaching shifts in fiscal policy during the past two decades around the world has been the fundamental restructuring of public pension systems. At least 27 countries spanning five continents have converted at least part of their pay-as-you-go defined-benefit public pension systems to systems based on funded, defined-contribution accounts; reforms appear to be imminent in several more countries. Still, more countries like the United States have seriously debated converting their public pension systems as well.

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These conversions are potentially the most significant public policy reform during the past century, except perhaps for the adoption of a market economy system itself in some countries. At first glance, such a claim might seem to be a stretch; there have been many large public policy changes during the past 100 years. Trade barriers have been sharply curtailed; price controls have been dropped across many sectors; major industries have been deregulated; high tax rates levied on narrow bases have been replaced with lower taxes levied on broader bases; smarter monetary policy has brought inflation into check in many developed countries; and, many traditionally state-sponsored enterprises in developing countries have been removed from the public dole. But their gains likely pale in comparison to pension reform.

Computer simulation analysis suggests that moving the United States Social Security system from a pay-as-you-go financing to a full funding could produce as much as a 70 percent increase in the size of capital stock. As a result, the potential (full) lifetime income of the poorest two-percent in society could rise by over 20 percent through increased wages even if progressivity of the Social Security system itself were not protected.³ These potential gains are much larger than those associated with fundamentally reforming the US federal income tax (Altig, et al, 2000), as well as most other types of fiscal reforms, including free trade.⁴

While pension fund conversions from defined benefit to defined contribution plans in the *private* sector have been largely motivated by labor market mobility, this explanation

³ See, for example, Kotlikoff et al (2001) and Nishiyama and Smetters (2007).

⁴ {ref for value of free trade}

does not hold for *public* pension systems since they are already portable across employers.⁵ In fact, the public plan conversions seem fairly puzzling at first. In a deterministic setting, the traditional public DB pension systems could, in theory, be designed to be as efficient as the newer DC plans. In the presence of economic and demographic uncertainty, however, traditional plans more easily allow for inter-generational risk sharing. Financial literacy, moral hazard and adverse selection seem only to buttress the case for the traditional design.

So why have so many countries moved, or are in the process of moving, away from unfunded DB plans towards at least partially funded DC plans? Adding to the puzzle is that these reforms have taken on numerous shapes and sizes across the world, and typically have been *larger* in *developing* countries (see Table 1 and Figure 1). Indeed, these countries also face *less* severe demographic problems relative to many developed countries.

One central theme emerges from our study: the public pension conversions reflect a fundamental mistrust in the ability of the government to provide secure retirement resources. The exact nature of the distrust, though, differs between developing and developed countries.

In *developing* countries, where reforms have been the largest, the distrust in the government provision of public pensions is conditioned on previous downward movements in benefits, misuse of retirement resources, and other risks and inequities in the former public pension systems as well as projections for the future. In particular, workers in many developing countries don't trust the government to run even a strict pay-as-you-go system. Personal funded DC accounts, therefore, give workers access to a more transparent storage mechanism. While personal accounts can be subject to their own political risks, they provide workers with an easier way of monitoring government behavior. The concomitant increase

⁵ A vast set of international agreements has even made many public plans portable across national boundaries. A couple of countries have also adopted 'notional' accounts that promise a rate-of-return on contributions

in the level of funding is *not* the primary object of reform itself. Rather the increase in funding is a necessary byproduct of securing a safer retirement income through personal accounts.⁶ Personal retirement accounts probably would have been created even without reference to demographic concerns.

In sharp contrast, in *developed* countries, where reforms have been smaller, previous downward benefit adjustments and inequities, while existing, have been less important. Instead, the primary objective in many developed countries *is* to pre-fund future benefits since many of these countries face more severe demographic problems. However, the government is not fully trusted to properly save or invest the resources that are needed to pre-fund some future benefits. So, in developed countries, the creation of personal accounts *is* a byproduct of attempts to increase funding. If these countries faced no demographic pressures, the incentive to create personal accounts would be greatly reduced.

Section 2 critically analyzes the previous attempts to explain conversions to personal accounts. These common rationales include: seeking higher returns; improvements in domestic financial institutional development; improving labor supply and retirement incentives; and hedging demographic changes. In each case, a politically-stable and transparent government would have been able to achieve similar – if not superior – results within the traditional system. Moreover, the traditional system likely has lower transaction and other additional costs.

Section 3 presents a simple model of pension system trust. A pay-as-you-go social security system is an inter-generational game between median voters of successive

(rather than a stated benefit level), which can also be made highly portable.

⁶ A couple of countries have adopted unfunded ‘notional’ defined-contribution accounts, sometimes in addition to funded defined-contribution accounts. While a notional account does create a clearer contract with the

generations. The median voter of each generation is “middle aged” and not yet retired. The median voter supports the continuation of the traditional system only if he believes that the next generation will do likewise – a so-called “trigger strategy.” Factors that undermine this trust will naturally lead to an unraveling of the traditional pension system. Section 4 presents empirical evidence of the factors behind reform using a dataset, including countries that have and have not reformed. Section 5 concludes with a discussion on the applicability of the international experience to possible public pension reform in the United States.

2. Review of Common Explanations of Reform

We now examine several reasons provided in the literature for pension reform. We argue that these standard reasons lack theoretical or empirical support or both.

2.1. *Pursuing Higher Returns*

Probably the most important cited benefit by politicians for pension reform is the ability to earn a higher rate of return on payroll contributions. As public pension systems around the world begin to mature, it is becoming increasingly clear to policymakers and voters that public pension systems are becoming a bad deal for current and future generations.

Figure 1, for example, reports the average effective (or “internal”) annualized rates of return earned in the United States Social Security system by generation over time. Effective rates of return have declined dramatically over time. Consider the composite average U.S. worker born in the year 1876 and who, therefore, began to collect a benefit at age 65 in 1941,

government, the lack of funding still requires a lot of trust that future governments will fulfill previous promises.

soon after Social Security began. This worker received a 36½ percent effective annual rate of return on his pension contributions. In sharp contrast, a person born today into the mature U.S. Social Security system is projected to receive less than a 2 percent effective rate of return.

The declining rate of return stems directly from pay-as-you-go financing itself: money flowing into the pension system gets distributed immediately as benefit payments to retirees. Early retirees receive a windfall which is paid for in present value by future generations. Future generations receive a positive rate of return under a stationary tax rate only to the extent that payroll tax base grows with population and productivity.

Since windfalls to early generations have already been consumed, there is no potential for recovering them, thereby increasing returns in a costless fashion. This zero-sum condition of pay-as-you-go financing can be traced back to the seminal articles by Paul Samuelson (1958) and Peter Diamond (1965), and it has been explored by many authors since then. This result is demonstrated in Figure 2: in Panel B, the integral of the monetary windfalls across generations around the fully funded line must sum to zero. For example, Geanakoplis, Mitchell, and Zeldes (1999) demonstrate this rule in an experiment in which existing payroll taxes are diverted to personal account investments. To meet the system's current obligations (the "transition cost"), a tax is placed directly on the excess returns that private capital earns over the growth rate of the payroll tax base. They show that the tax rate that is required to meet existing obligations would exactly confiscate the excessive return that capital pays over pay-as-you-go financing during all future years. Intuitively, the tax is only enough to pay the debt service on the accrued liability (but not the principal), requiring an implicit infinite rollover of the principal. So, while no generation that accrued benefits under

the traditional public pension system is hurt, no future generation gains either. The outcome is zero-sum. Pension reform, therefore, does not provide a higher rate of return unless current consumption is reduced, that is, national savings is raised. National savings can also be increased, however, by increasing public savings within the traditional public pension system or reducing other national debt.

2.2. *Improvements in Financial Markets*

Another commonly cited reason for moving to personal accounts in many countries is to develop the domestic capital market by improving domestic financial institutions. Figure 3 shows the amount of private credit as a share of GDP in several countries before and after pension reform. Private credit includes the total financial resources provided to the private sector through loans, purchases of non-equity securities, trade credits and other accounts receivable that establish a claim for repayment. The amount of private credit is a good measure for an economy's level of financial sophistication, especially for less developed countries in which equity financing is less common. But changes in private credit also reflect the changes in the private savings level following pension reform rather than just changes in financial market institutions. Hence, the private credit for several reforming West European countries, where financial markets were already sophisticated before reform, are also shown in order to more isolate the saving effect.

Private credit levels in Latin American and Eastern European countries are indeed well below those in Western European countries. Even these differences underestimate the larger degree of capital market development in Western European countries, whose investments tend to be relatively more equity financed. Also notice that private credit indeed

expanded in each country following reform, except for Mexico and Argentina, both of which suffered currency and other financial crises. This evidence would seem to buttress the case for the hypothesis that the development of domestic capital market institutions was a major influence in reform. After reform, many of these Latin American and Eastern European countries also put in place restrictions to prevent workers from investing their money abroad, which also seems consistent with the desire to develop the domestic capital market.

But notice that the post-reform rise in private credit tended to be sharper in Western European countries despite the smaller size of their pension reforms relative to the Latin American and Eastern European nations. Since most Western European countries already had sophisticated financial markets prior to reform, much of their increase presumably stemmed purely from increases in the amount of capital, since pension reforms presumably had little impact on the relative reliance on equity financing. This result suggests that a large fraction of the increase in private credit in Latin American and Eastern European nations might also be driven by the saving effect rather than by financial institution development.

Moreover, except Mexico and Argentina, the availability of private credit began to increase in most Latin American and Eastern European countries before the introduction of personal accounts. (Also, since the personal accounts are unlikely to have a large effect for several years, the effective pre-reform trend is even longer.) Indeed, the introduction of personal accounts does not seem to increase the pre-reform trend in most countries, suggesting that other factors might also be playing an important role in the expansion of private credit.

The pension reforms in developing countries were typically part of larger reforms that spurred capital market development. As discussed by Walker and Lefort (2001), the largest

reforms in developing countries include: macroeconomic stability; tax incentives; capital control liberalization; deregulation and competition in the financial services; property rights, bankruptcy legislation and investor protection; and, privatization of state-owned enterprises. When indirectly controlling for country-specific factors (using a fixed-effects regression model), Walker and Lefort find little evidence supporting the role of pension reform in financial market development, including the impact on the cost of capital, stock market volatility and other measures. Only when country-specific factors are ignored (as in the pooled regression model), did pension reform have some effect in developing the domestic capital market. In sum, there is probably some evidence that public pension reform has helped lead to an increase in financial market sophistication in less developed countries, but it is not very strong evidence.

Moreover, personal accounts were not the only way to develop financial institutions. Pre-funding the existing traditional public pension could, in theory, have also done the job. Like in Chile's private account system, investments could have been restricted to be made locally. Like other large pension funds operating throughout the world, public pension funds could have been divided up among private mutual fund managers. If domestic capital market development were truly the motivating concern, local investments through the public pension system would have presumably better avoided the discontent with domestic investment restrictions that are placed directly on pensioners' accounts. (Indeed, more developed countries including Singapore have invested their public pension funds directly in public projects.) Investment restrictions on personal accounts look like a direct "tax" on returns earned by workers. In contrast, inside the traditional system, a home bias in pension

investments has no direct effect on a worker's pension benefit since benefits remain defined by law; instead, any shortfalls represent hidden obligations on future generations.

2.3. *Enhancements to Labor Supply*

The mandatory contributions that households make to the public pension system may be viewed as a "tax" that discourages a person's desire to supply pre-retirement labor. This tax exists for several reasons. First, the worker is being forced to invest into a pay-as-you-go public pension "asset" that pays a rate of return below what she could have earned in the private sector. Since the worker receives some future benefit, only part of the mandatory contribution, however, is a "pure tax." Second, a worker might not wish to make any contributions at all during his early years, even at the market rate of return, if they are "borrowing constrained." Third, redistribution within the social security system causes lower-income workers to receive a larger rate of return while higher-income workers receive a lower return. Fourth, particular features of the program, such as a spousal benefit, might cause additional sources of distortions. Fifth, as analyzed by Gruber and Wise (1999), specific rules might encourage early retirement.

Each of these distortions, however, can be just as easily addressed with the traditional pension system as with pension reform. The first effect – inferior rates of return – is a natural outcome of pay-as-you-go financing, and changing pension models will not address this problem directly. Smetters (2006) derives the neutrality of labor supply to pension reform under the ideal "carve out" scenario and demonstrates that "shutdown" reforms actually *reduce* labor supply incentives. The effects of borrowing constraints could be lessened by starting payroll tax rates low early in life and increasing them with age in order to collect the

same present value of income from each worker on average (Hubbard and Judd, *). Tax-induced distortions caused by redistribution are the cost of redistribution; the same distortions would exist in a private system with the same amount of redistribution. The other effects are consequences of the rules specific to different public pension systems and can be addressed within the existing pension system. Reforming the entire system when changing some rules would suffice seems like an overreaction.

2.4. *Addressing Demographic Changes*

It is also commonly claimed that traditional public pension systems are unable to deal effectively with demographic problems since payroll taxes must increase sharply or benefits decrease sharply as the ratio of retirees to workers increases. In contrast, private accounts should be less vulnerable to demographic changes since retirement benefits are directly tied to previous savings. However, as shown in Table 2 higher-income countries face the largest predicted declines in worker-retiree ratios; higher income countries are also those with the smallest pension reforms. In fact, as Figure 5 shows, among actual reforming countries, there appears to be an inverse correlation between demographic problems and the size of actual reform. It is not clear, therefore, that demographics is really the main impetus behind reform.

Moreover, in theory, a traditional public pension system could effectively deal with changes in fertility rates by accumulating large reserves when the worker-retiree ratio is large and then spending down the reserves as the ratio decreases. Since 1983, the United States has, in fact, been building up its Social Security “trust fund” in an attempt to buffer future costs associated with the retirement of baby boomers. *If* these reserves were saved, the payroll tax rate would remain flat throughout the entire period, as collections would initially

exceed costs and then fall below. A personal account system would do no better in hedging demographic risk.

As Elmendorf and Sheiner (2000) and Bohn (2001) demonstrate, however, it is not even clear that it is economically efficient for a public pension system to try to hedge fertility risk. In a strict pay-as-you-go system (i.e., no reserves), a worker in a relatively small cohort following a larger cohort will face an increase in payroll taxes in order to finance the benefits of the larger preceding generation. But they also benefit from a larger capital-labor ratio that increases their wages while the larger preceding generation suffers from lower stock returns associated with the abundance of capital. Hence, shifting some of the fertility burden to younger workers might be efficient on inter-generational risk sharing grounds. Computer-based simulation evidence of the importance of the change in capital-labor ratio, though, has yielded mixed results.

3. A Model of Trust

We now argue that pension reform can probably be best motivated by focusing more on politics than economics: traditional pension systems require inter-generational trust. A breakdown of this trust can lead to fundamental pension reform.

Following the notation in Smetters (2006), consider a simple overlapping-generations model. There are N_t first-period agents alive at time t . Population at time t grows at rate

$n_t \equiv N_t / N_{t-1}$. The total wage base at time t grows at a gross rate $G_t \equiv (1 + g_t) \equiv$

$(1 + n_t)(1 + x)$, where x is the exogenous and constant rate of technological change between

time periods. We assume that the population is stationary and so we drop the time subscripts for N and G in the subsequent discussion. The gross rate of return to risk-less capital is

$R = (1 + r)$, where r is the net rate of return. The wage rate at time t is w_t , which grows at rate x , i.e., $w_{t+1} = (1 + x)w_t$. These factor prices are stationary (or, in the case of wages, trend stationary) as in a small open economy or with linear technology.

An agent born at time t and lives for three periods. The agent has exogenous levels of productivity of α_1 and α_2 in the first and second periods, respectively. Productivity in the third period is zero, where he retires. Lifetime utility is given by $\sum_{k=1}^3 \beta^k u(c_{k,t}, 1 - l_{k,t})$, where $c_{k,t}$ is the level of consumption at age k for the generation t -th agent. $l_{k,t}$ is the level of labor supply where the total time endowment each period is normalized to unity. The function $u(\cdot)$ is increasing and concave in both arguments. Lifetime utility is maximized subject to the following budget constraints:

$$(1) \quad c_{1,t} + a_{1,t} = \alpha_1 w_t l_{1,t} (1 - \tau)$$

$$(2) \quad c_{2,t+1} + a_{2,t+1} = \alpha_2 w_{t+1} l_{2,t+1} (1 - \tau) + R a_{1,t}$$

$$(3) \quad c_{3,t+2} = R a_{2,t+1} + b_{t+2}$$

where b is the pay-as-you-go social security benefit received in the third period financed on a pay-as-you-go basis with a proportional tax τ on labor earnings.

For expositional simplicity the analysis herein focuses on a social security system where benefits are proportional to previous contributions. In a proportional and stationary system, every agent earns the same gross “internal” rate of return G on their social security

contributions, which is equal to the growth rate of the wage tax base. The pay-as-you-go social security benefit received by generation t during their third year, therefore, equals⁷

$$(4) \quad b_{t+2} = G^2 \tau \alpha_1 w_t l_{1,t} + G \tau \alpha_2 w_{t+1} l_{2,t+1}$$

Suppose that the population growth rate, n , is not too large, in particular, that $(1+n)^2 < (1+n) + 1 = (2+n)$. Then, the age-2 agent is the “median voter” that determines whether the pay-as-you-go system continues. Since the median voter is not retired himself, he’ll vote to continue the system if and only if two conditions are satisfied:

$$(A) \quad (\text{Incentive Compatible}) \quad \alpha_2 w_{t+1} l_{2,t+1} \tau < \frac{b_{t+2}}{R} = \frac{G^2 \tau \alpha_1 w_t l_{1,t} + G \tau \alpha_2 w_{t+1} l_{2,t+1}}{R}$$

(B) (Continuation) The current age-1 agent will vote to support the system

Condition (A) says that the present value of maintaining the pay-as-you-go social security program must exceed the value of the second-period taxes saved from abandoning the system. Even though pay-as-you-go social security represents a “bad deal” to age-1 households in a dynamically efficient economy where $R > G$ (due to the windfalls given to previous generations), age-2 households have already contributed to the system in the previous year. As a result, Condition (A) is likely to hold in most realistic stationary economies. To see this, suppose that $\alpha_1 = \alpha_2$ (i.e., flat productivity profiles) and $R = 1/\beta$ (i.e., interest rate equals the rate of time preference). Then condition (A) can be simplified to:

$$(A') \quad 1 < \frac{G}{R} + \frac{G^2}{R} = \frac{G + G^2}{R}$$

⁷ I.e., in a stationary economy, equation (4) can be rewritten as the standard pay-as-you-go constraint,

The first term G/R in equation (A') corresponds to the tax payments paid in the second period of life and represents the relative rate of return produced by pay-as-you-go financing G relative to the rate R which could have been received in the capital market. In a dynamically inefficient economy, $G/R < 1$, reflecting the opportunity cost of capital. In other words, the median voter would have been better off if he could have invested his payroll taxes into the capital market. The second term G^2/R reflects the fact that the age-2 median voter, however, already paid into the pay-as-you-go system in the first period, a contribution that would be lost if he voted to abandon the system. The inequality shown in equation (A'), therefore, holds except for fairly large values of $R \gg G$. In that case, the opportunity cost of the median voter's second-year contribution is so large that he is willing to forfeit his first-year contribution in order to obtain a larger rate of return.

Condition (B) simply recognizes that the current age-2 median voter won't vote to support continuation of the pay-as-you-go system unless the next median voter, when the current age-2 agent is retired, also supports continuation. Of course, recursively, that outcome requires *all* future median voters to vote likewise. This type of continuation can be supported by a standard "trigger strategy" mechanism (Verbon 1988a,b; Kotlikoff, Persson and Svensson 1988; Drazen 2001; Cooley and Soares 1999; Rangel 2003). In particular, any age-2 agent that abandons the system must be punished enough by reducing his third-period social security benefit by more in present value than his second-period tax savings, $\alpha_2 w_{t+1} l_{2,t+1} \tau$. This condition is trivial to satisfy (in fact, an infinite number of games produce continuation).

$$N_t b_{t+2} = N_{t+2} \tau \alpha_1 w_{t+2} l_{1,t+2} + N_{t+1} \tau \alpha_2 w_{t+2} l_{2,t+2}.$$

In this simple median voter framework, the pay-as-you-go system unravels if the discount rate R becomes too high, potentially in response to considerable economic turbulence or uncertainty. However, due to the recursive nature of the “trigger strategy,” the game collapses if the system is not incentive compatible for *any* future median voter. As a result, the game is potentially more fragile than at first glance.

The median voter model, however, implicitly assumes a direct democracy; policymakers, therefore, maximize the utility of only the median voter. In a *representative* democracy, however, policymakers might weight the utility of other living cohorts as well, especially if some cohorts are more likely to vote more “single issue” in electing their government representatives (Drazen 2001; Bassetto 2008). In the representative democracy model, continuation of a pay-as-you-go social security system might be “stickier” than indicated by the median voter model if third-period retirees care more intensely about social security than first-period and second-period workers. This factor is especially important in more *developed* and stable economies. However, in *developing* economies, politicians might also place more weight on the demands of first- and second-period workers after an extreme economic turbulence, especially if these workers can effectively migrate to the informal labor market and escape taxation anyway. Developing economies, therefore, are susceptible to larger political innovations in the design of their public pension systems.

The direct and representative democracy models, therefore, suggest that pay-as-you-go system is politically stable in a *developed* economy. So why would a developed economy ever reform its pension system? Potentially in response to demographic shocks. As argued above, a traditional pension system should be just as effective as a private account-based system at hedging demographic shocks *provided* that the government can successfully

reserve resources for the future. Using evidence from the United States, Smetters (2004) argues that social security trust fund reserves, however, might be spent elsewhere in the federal budget – financing lower taxes or increased spending – and not really saved. A partial move toward personal accounts, therefore

In sum, reforms to the public pension systems in developing economies are expected to be: (i) more motivated by economic turbulence that increases the effective discount rate and undermines the inter-generational trust (the “trigger strategy”) required to enforce continuation of the traditional public pension system; and, (ii) larger in magnitude (i.e., the unraveling of the game). In contrast, public pension system reforms in developed economies are predicted to be: (i) more motivated by demographic concerns and (ii) smaller in magnitude since inter-generational cooperation still remains -- the government is only not trusted to save the excess amount necessary to hedge the demographic risk.

4. Some Stylized Facts

The largest public pension reforms occurred in developing countries with considerable economic risks. One of the largest economic risks in these systems involves sudden inflation that quickly erodes the real value of the pension benefits. While inflation protection is more common in social security systems in more developed economies, including the United States, this feature is less prevalent in developing economies. Table 3 and Figure 6 show that larger reforming countries often had substantial more inflation in the decade prior to reform, indicating a greater risk present in the public pension system. Tables 4 and 5 demonstrate that developing countries with larger reforms also faced less stable

political situations prior to reforms, including poorer metrics of civil and political rights. More importantly, less durable governments typically had larger reforms.

5. Empirical Estimation

We test our prediction that the breakdown in inter-generational trust motivates reform of traditional public pension systems. We use historical political instability as a proxy for the degree of inter-generational trust existing in a given country. The interpretation is simple: countries with significant historic political instability, due to concomitant regime changes and systemic upheaval, naturally possess less inter-generational trust, and less trust between government and the people.

5.1. *The Data*

Our dataset forms a country by year panel containing detailed historic political and economic indicators for all countries identified as possessing, or having possessed, a pay-as-you-go state (PAYG) pension system. We assembled our panel by identifying 129 countries which operate or once operated a PAYG state pension system, using references such as *Social Security Programs Throughout the World*, a joint publication of the U.S. Social Security Administration and the International Social Security Administration.⁸ We excluded from our dataset 20 countries with provident fund systems.⁹ From the 129 countries with PAYG systems, a further 12 countries with PAYG systems were dropped due to insufficient

⁸ Some countries were not surveyed in *Social Security Programs Throughout the World* and are thus excluded from our study. These excluded countries consist mostly of developing smaller nations, such as Bhutan and Guinea-Bissau, or countries wracked by conflict, like Afghanistan, Iraq, Somalia, and Eritrea. Other excluded countries simply do not participate in the international community, such as North Korea. A notable exclusion is the United Arab Emirates, which are not recorded as possessing a state pension system.

⁹ The provident fund countries, many of which are former British colonies such as Singapore, Malaysia, and India, operate a mandatory savings scheme similar in spirit to the private account reforms which are the subject of this paper. However, unlike private account reforms, these provident fund systems typically offer little

data, leaving our dataset with 117 countries.¹⁰ The countries used in the analysis are listed in Appendix A which displays countries by their historic instability indices.

To capture historic instability since the inception of a country's state pension system, we obtained historic political regime durability data from the Polity IV Project, a widely used database for cross-national governance analysis. The Polity IV database contains political characteristics of 162 countries from 1800-2006, including *DURABLE*, a variable indicating the exact length of time that each historic political regime for a country has been in power. Our index measures the number of times a country had a regime lasting at least 5 years, since the inception of the state pension system. This index captures the frequency of regime change, while ignoring extremely short and volatile regimes which would have insufficient time to disrupt existing institutions severely.

A private account reform is not a binary decision, and countries have chosen varying degrees of reform. In order to capture these differences, we model the expected contribution of private account components of the state pension system to the average retiree's pension income, using the published parameters of the pension system. The maximum degree of reform is achieved when 100% of the average retiree's pension income is predicted to come from private account sources. Our model includes components of the state pension system that affect this amount, including welfare programs, state financed minimum pension guarantees, and the like. Basically, any payments to retirees not derived directly from private

individual control over investments. All the provident fund systems excluded from our analysis are systems that are the original (often since state independence) pension systems of the countries concerned.

¹⁰ These are the Bahamas, Belize, Barbados, Cape Verde, Malta, which are small nations for which sufficient reliable data is not available. For Iceland and Luxembourg, we have insufficient political data available from our primary sources because of their small size, although they are advanced economies. Hong Kong's unique political position also excludes it from the analysis. In addition, Cuba, Libya, Liberia, and Uzbekistan are excluded because reliable economic data is unavailable.

account sources are counted towards lowering the degree of reform. Details on model structure are in Appendix B.

Additional economic and demographic indicators are obtained from the World Bank's World Development Indicators publication. We use GDP measured in purchasing power parity per capita terms as our indicator of the country's wealth level, and use life expectancy and percentage of the population above 65 as our indicator of the country's demographic constraints. We supplement this with the United Nations World Population Prospects projected population indicator of the percentage of the population above 65 in the year 2025. However, due to extensive collinearity between current life expectancy, percentage of the population above 65, and predicted percentage of the same, we do not use all indicators in our estimated models.¹¹ We also use credit provided to the private sector, scaled by GDP, as a measure of the amount of financial investment and development of the local economy.

5.2. *Probit*

We test the prediction that a greater degree of historic instability contributes to a higher probability of reform. We consider reform as a dichotomous variable, which occurs once in the specific year of reform for each country, or never at all for non-reforming countries. While we do possess a panel dataset, we believe employing a dichotomous outcome panel data model, a la Heckman (1981) is unnecessary in this case. Our dependent variables represent factors such as GDP and age-related demographics which change slowly over time, and which are highly autocorrelated. Attempting to utilize the panel structure of the data thus is unlikely to yield significant additional identifying variation. We take the

approach that estimating a simple probit model with robust standard errors, based on country-year observations taken in the year of reform for reforming countries, and the year 2003 for non-reforming countries, will suffice:

$$\text{Reform} = \text{Historic Instability} + \text{Purchasing Power GDP in } \$1000\text{s} + \text{Percentage of the Population Above 65} + \text{2025 Percentage of the Population Above 65} + \text{Historic Democracy} + \text{Private Credit}$$

The results suggest greater historic instability is statistically significant as a predictor of reform, and has comparable magnitudes to other indicators traditionally thought to be responsible for reform. As expected, wealthier countries feel less pressure for reform, and the future expected demographic burden increases the chance of reform. A change of one unit in the index of historic instability increases the chance of reform by as much as an increase of about 1.5 percentage points of the population that will be above 65 in the year 2025. Note that while it appears that percent of the population above 65 at present has no effect on the probability of reform, eliminating the source of collinearity (future percentage of the population above 2025) restores the estimate on this coefficient to statistical significance in the right direction.

5.3. *Tobit Analysis*

Now we test the prediction that countries with more severe historic instability will enact reforms to a greater degree. Here, we replace the dichotomous reform indicator, with

¹¹ Current life expectancy, as one might expect, strongly predicts future demographic trends, especially the percentage of the population that will be above 65 in the future. In addition, it is highly correlated with the

the percentage of the average retirement income that is generated from private account sources, as projected by our country-specific models. We use the same explanatory variables to ease comparisons. We estimate a tobit model to correct for the limited range of this dependent variable, which can only be measured from 0% to 100%, and which is generally clustered at the lower limit – for countries with no reforms.

Percentage of Average Retirement Income attributable to Private Account = Historic Instability + Purchasing Power GDP in \$1000s + Percentage of the Population Above 65 + 2025 Percentage of the Population Above 65 + Historic Democracy

The results are consistent with those from the probit model. Greater degrees of historic instability are associated with deeper and more significant reforms. As before, the estimated impact of one more unit of instability (another historic regime change) is about as potent as a 1.25 percentage point increase in the future percentage of the population above 65.

5.4. *Cox Proportional Hazards*

Our final model uses a Cox proportional hazards model to estimate the contribution of Instability to the probability that the country will reform sooner rather than later. This duration model explicitly accounts for the length of time between the inception of a pension system and the date of reform, assuming a nonparametric form for the baseline ‘hazard’ or probability of reform. This baseline probability is modified by our covariates, allowing us to estimate the relative impact of different covariates on the chance of reform.

Reform = Historic Instability + Purchasing Power GDP in \$1000s + Life Expectancy

Once again, the results are consistent. Instability appears to be the only variable which is associated with increasing the baseline probability of reform significantly. The incremental effect of instability appears to be about three times as large as the incremental effect of increasing life expectancy on the chance of reform.

6. Conclusions

Fundamental reform of social security systems from traditional pay-as-you-go defined benefit systems toward defined-contribution accounts represents one of the most important fiscal policy changes worldwide during the past century. Current explanations of this phenomenon lack theoretical justification or empirical support. In fact, the traditional pension model is likely superior along several important dimensions. So why have so many countries reformed? Adding to this puzzle is that these reforms have taken on numerous shapes and sizes across the world, and typically have been *larger* in *developing* countries facing *less* severe demographic problems. We propose a simple model of “intergenerational trust” that is consistent with these stylized facts. Empirical analysis is provided that supports the basic tenets of the model.

Table 1

Country	Year personal accounts introduced	Percent of Retirement Benefit from Personal Account after Reform for Average Worker	Voluntary Participation Choice / Notes
Chile	1981	96.25%	New workers must join new system; current workers may choose between systems.
Switzerland	1982	62.87%	No.
U.K.	1986	n.a	Yes. Due to voluntary participation, problems with private pension administration, and rollbacks of the scheme, the U.K. is treated as a nonreforming country in our study.
Peru	1991	62.33%	Yes.
Australia	1992	71.69%	No.
Argentina	1993	62.98%	Yes.
Colombia	1993	32.51%	Yes, workers are allowed to switch back and forth every three years.
China	1995	n.a.	No. No unified national social security system. Implementation of reforms varies widely with substantial discretion by local government. Therefore, China is treated as a nonreforming country in our study.
Mexico	1995	98.87%	No.
Uruguay	1995	22.96%	Employees over 40 years old can choose, those under 40 years old and new workers must join new system.
El Salvador	1996	90.97%	All new and young workers must join new system. Older workers must remain with old system. Workers between 36 and 55 (men) / 50 (women) years old may choose.
Bolivia	1997	100.00%	No.
Hungary	1997	37.96%	No.
Denmark	1998	79.54%	No.
Kazakhstan	1998	100.00%	No.
Poland	1998	44.96%	Yes.
Sweden	1998	17.73%	Workers born before 1938 stay with old system; those born after 1953 switch to new system; gradual transition from old to new system for workers born between 1938 and 1953.
Croatia	1999	31.48%	Workers between age of 40 and 50 at the time of reform can opt into the new system. Older workers remain in old system, younger workers must participate in new system.
Costa Rica	2000	7.92%	No.
Bulgaria	2000	24.39%	All workers born after 1959 must participate in the new system.
Hong Kong	2000	n.a.	No. Country is not sovereign self-governing state. Therefore, country is not modeled and not included in our dataset.

Nicaragua	2000	100.00%	System implementation suspended in 2005 and prior public pension system restored.
Dominican Republic	2001	83.81%	No.
Ecuador	2001	22.96%	System implementation pending legal decision on constitutional grounds.
Latvia	2001	57.53%	All workers born after July 1st 1971 must participate in new system. Participation is voluntary for older workers.
Russian Federation	2001	26.71%	All workers born after 1966 must participate in new system.
Estonia	2002	55.65%	All workers born after 1982 must participate in the new system.
Lithuania	2003	25.99%	Yes.
Slovakia	2003	39.68%	Full implementation in 2005. All workers entering the labor force in 2005 or later must participate in the new system. Existing workers could opt into the new system before June 30 th 2006.

Source: Authors' model based on rules of each country's pension system as published in *Social Security Programs Throughout the World*. Some countries have instituted reforms, but were not modeled or included in the empirical investigation because of lack of other data. Hong Kong is not an independent self-governing country and hence our political economy model does not apply. For Denmark, our data refers to the 1998 reform creating "SP 'Special Pension Savings'" Personal Accounts. However, our model calculation of the benefits from personal accounts in Denmark includes both the "SP" scheme and the preexisting "ATP 'Ordinary Supplementary Pension'" employment-related mandatory defined contribution scheme dating back to 1964.

Figure 1
Size of Reforms Relative to Per-Capita Income at the Time of Reform

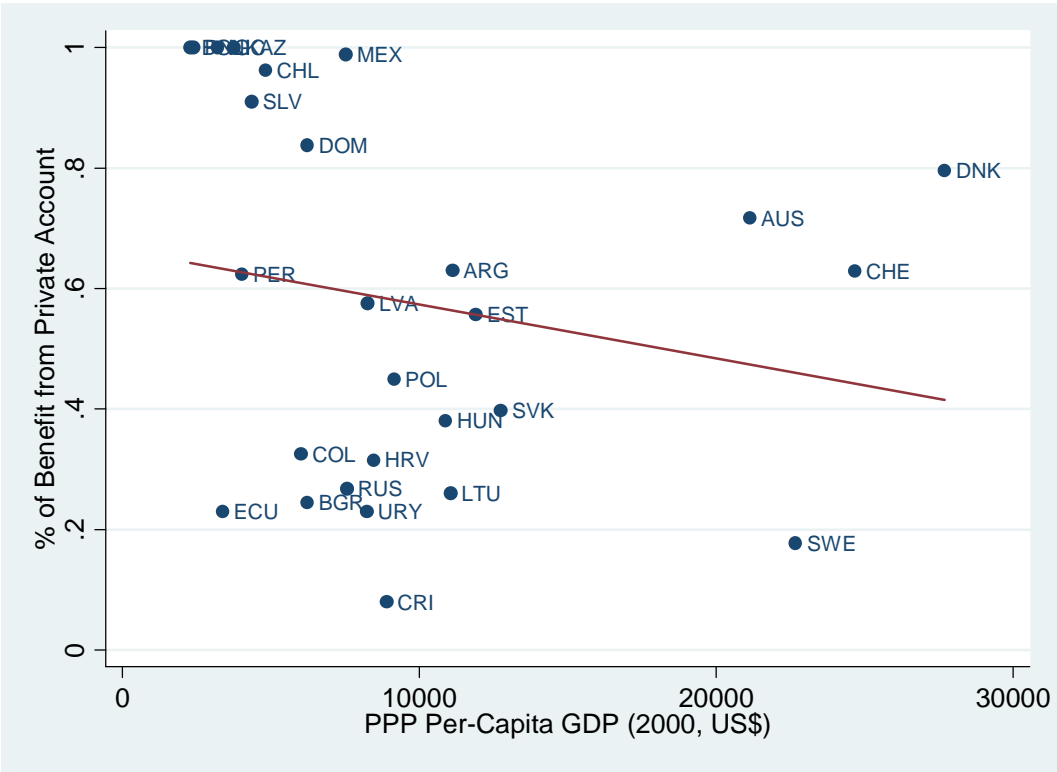
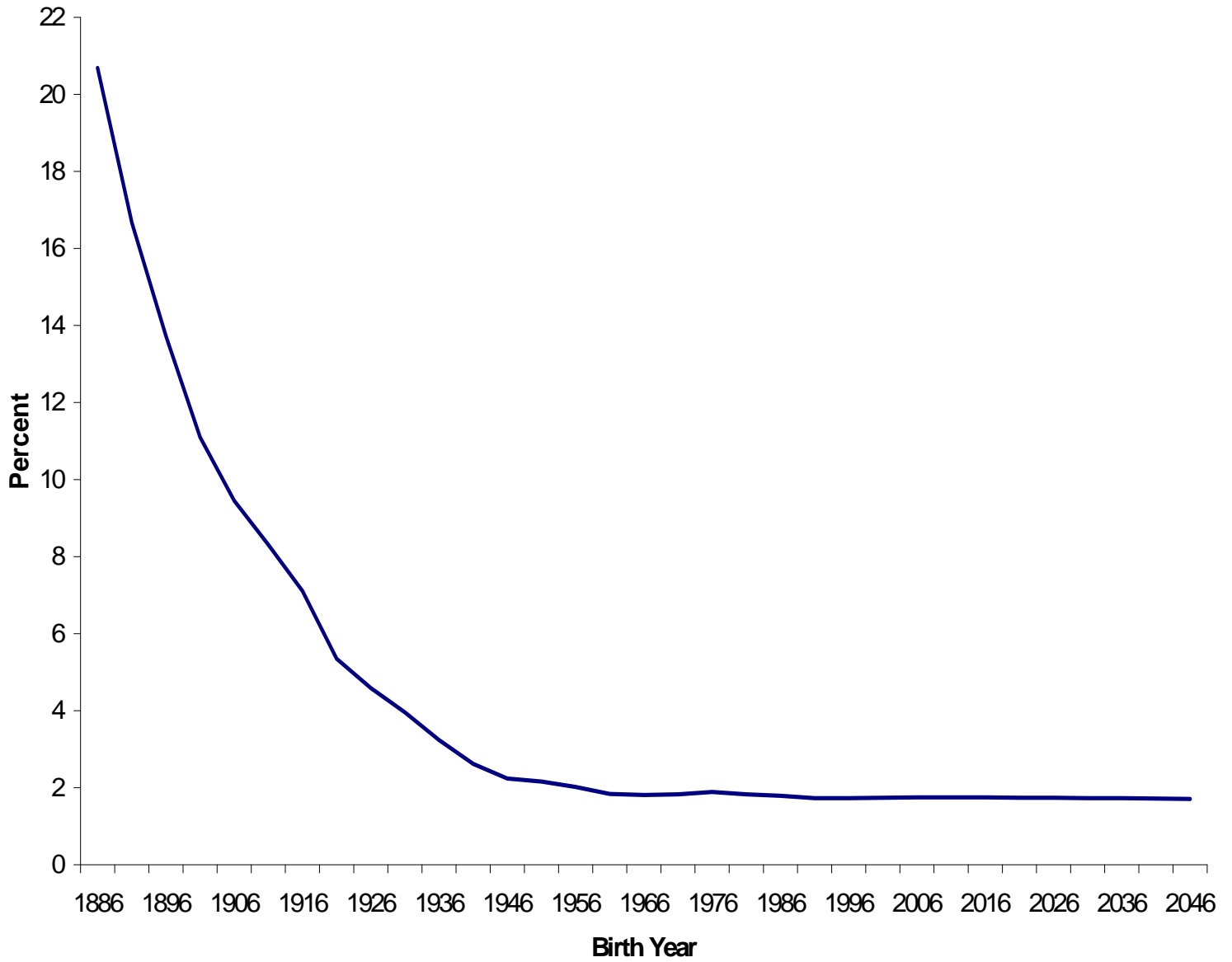


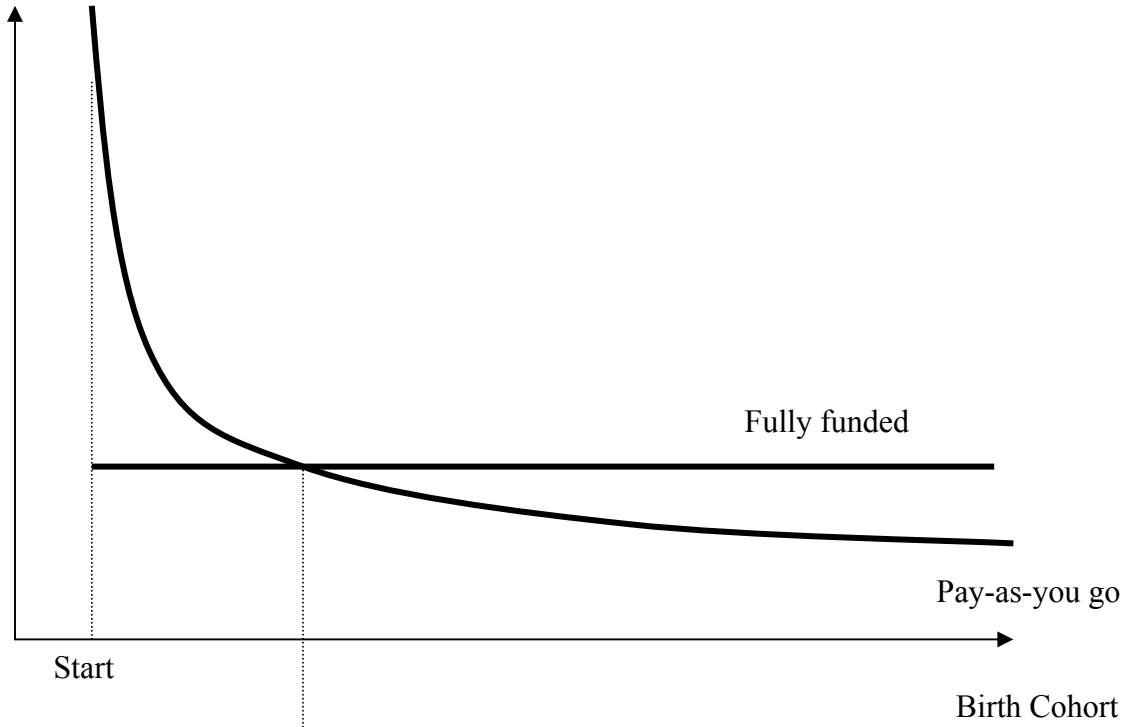
Figure 2
Effective Real Rates of Returns to the U.S. Public Pension System



Source: Dean R. Leimer, "Cohort-Specific Measures of Lifetime Net Social Security Transfers," ORS Working Paper No. 59, Social Security Administration, 1994.

Figure 3
Dynamics of Pay-as-you-go vs. Funded System with a Constant Tax Rate

Panel A: Effective Rates of Return



Panel B: Monetary Windfalls

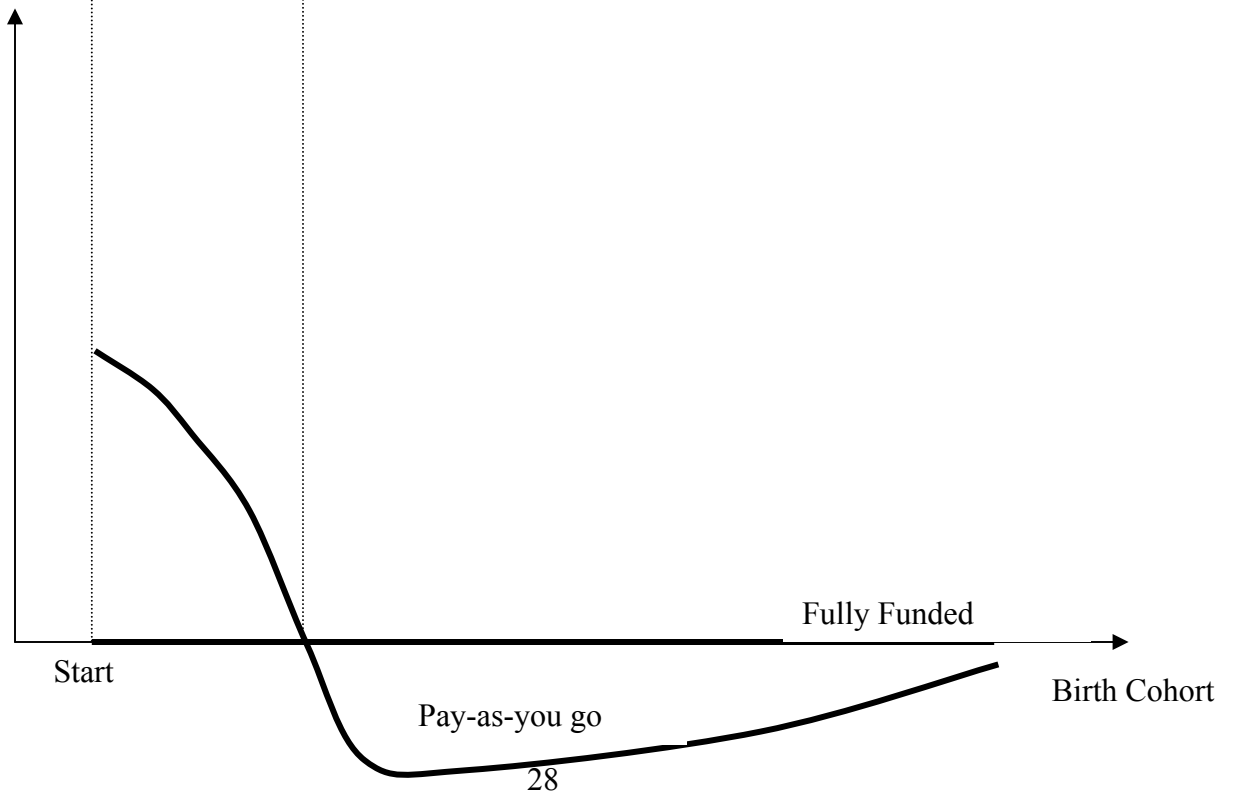


Figure 4
Private Credit as a Percent of GDP

(Reform dates shown as short vertical lines)

Bolivia, Chile, Colombia, and Peru

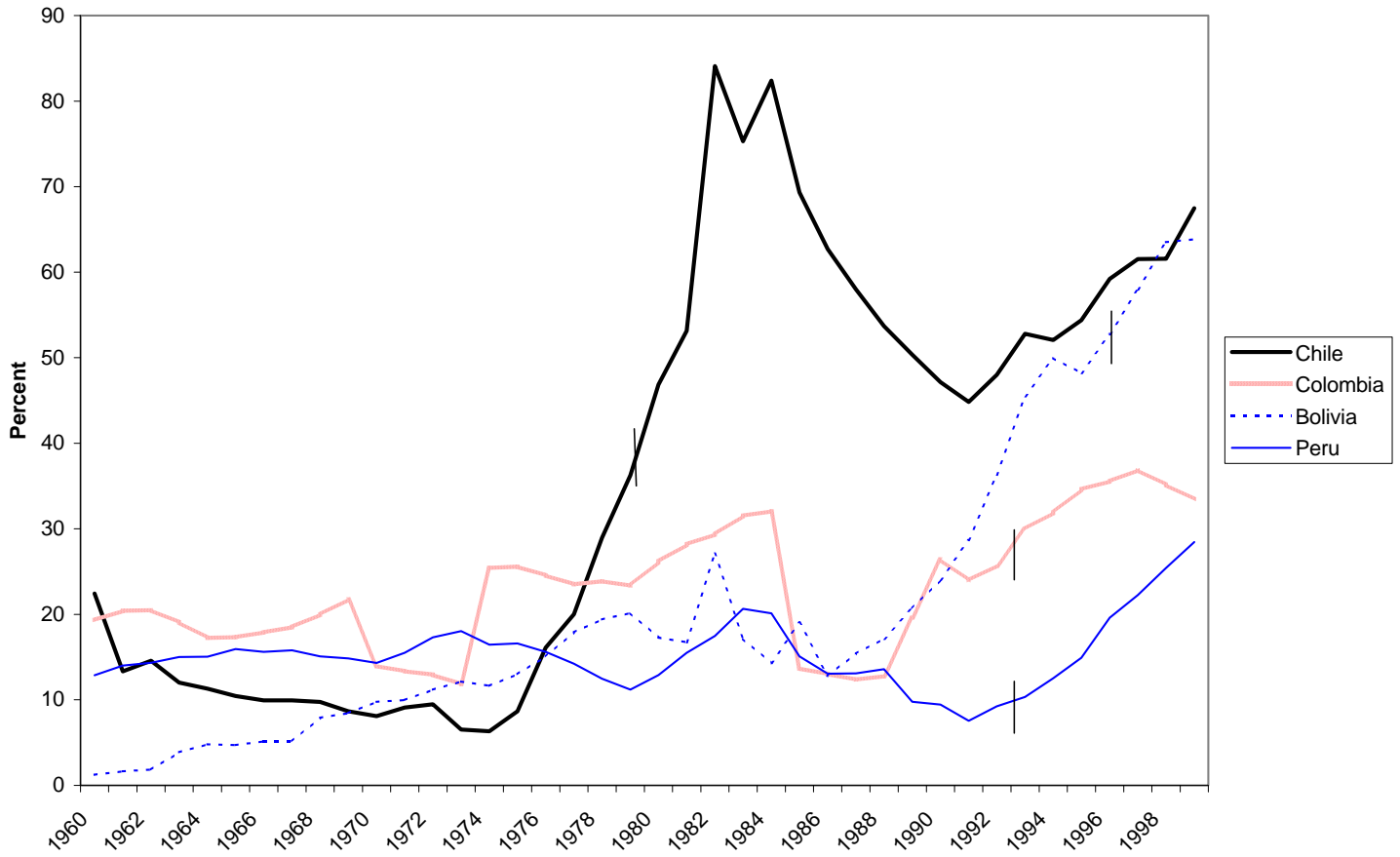


Figure 4 (Continued)
Private Credit as a Percent of GDP

Argentina, El Salvador, Mexico and Uruguay

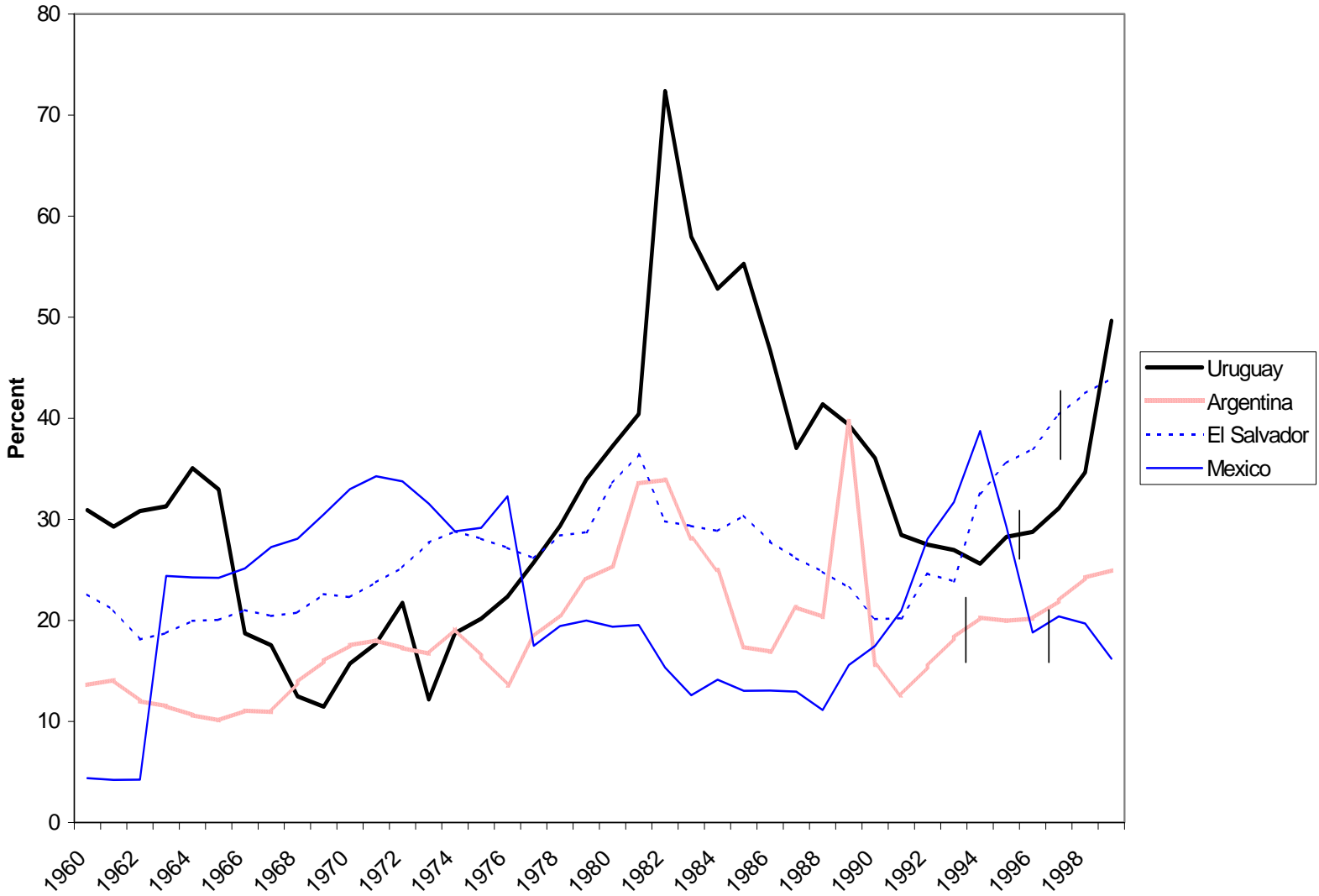


Figure 4 (Continued)
Private Credit as a Percent of GDP

Hungary, Kazakhstan, Poland

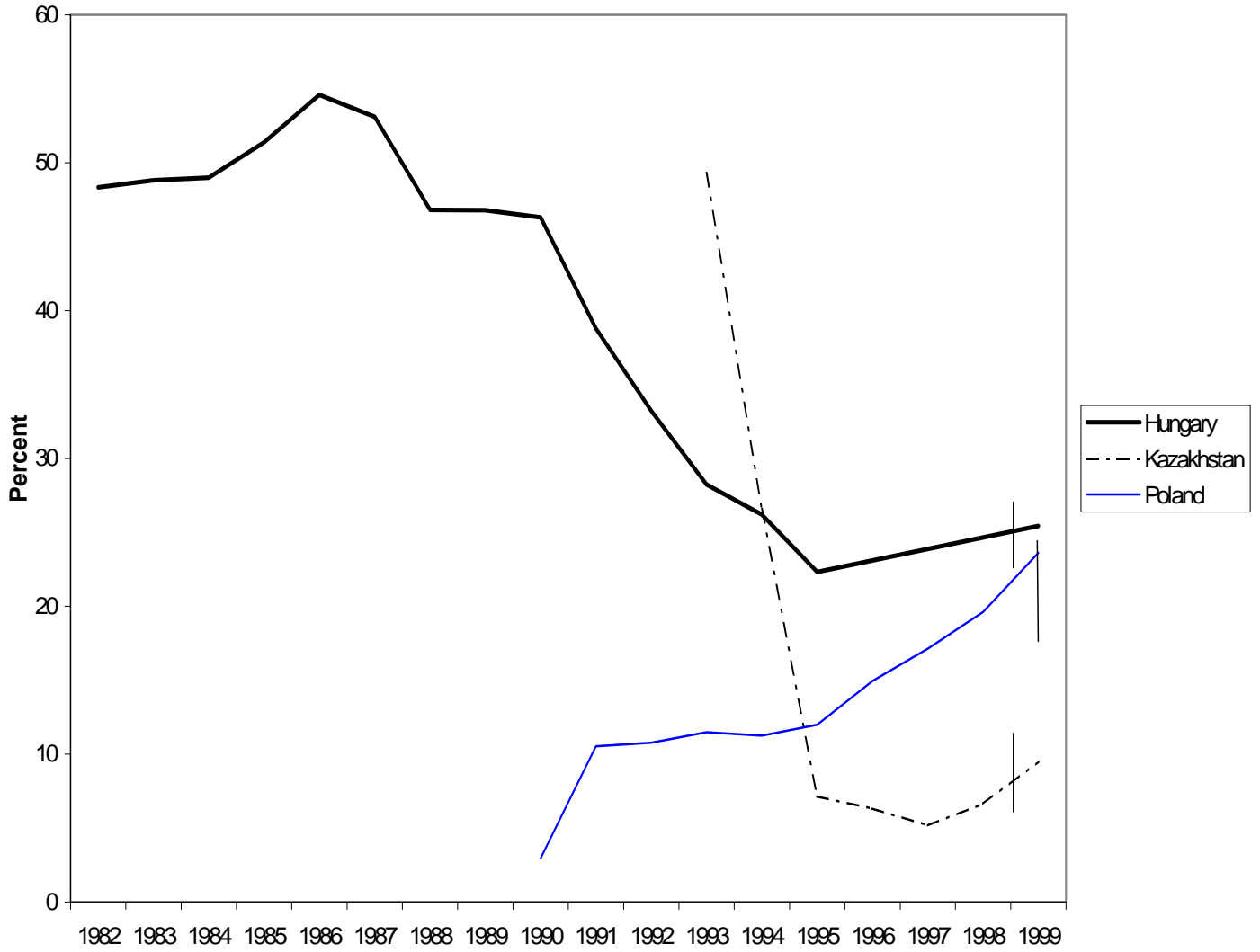


Figure 4 (Continued)
Private Credit as a Percent of GDP

Australia, Sweden, Switzerland, U.K.

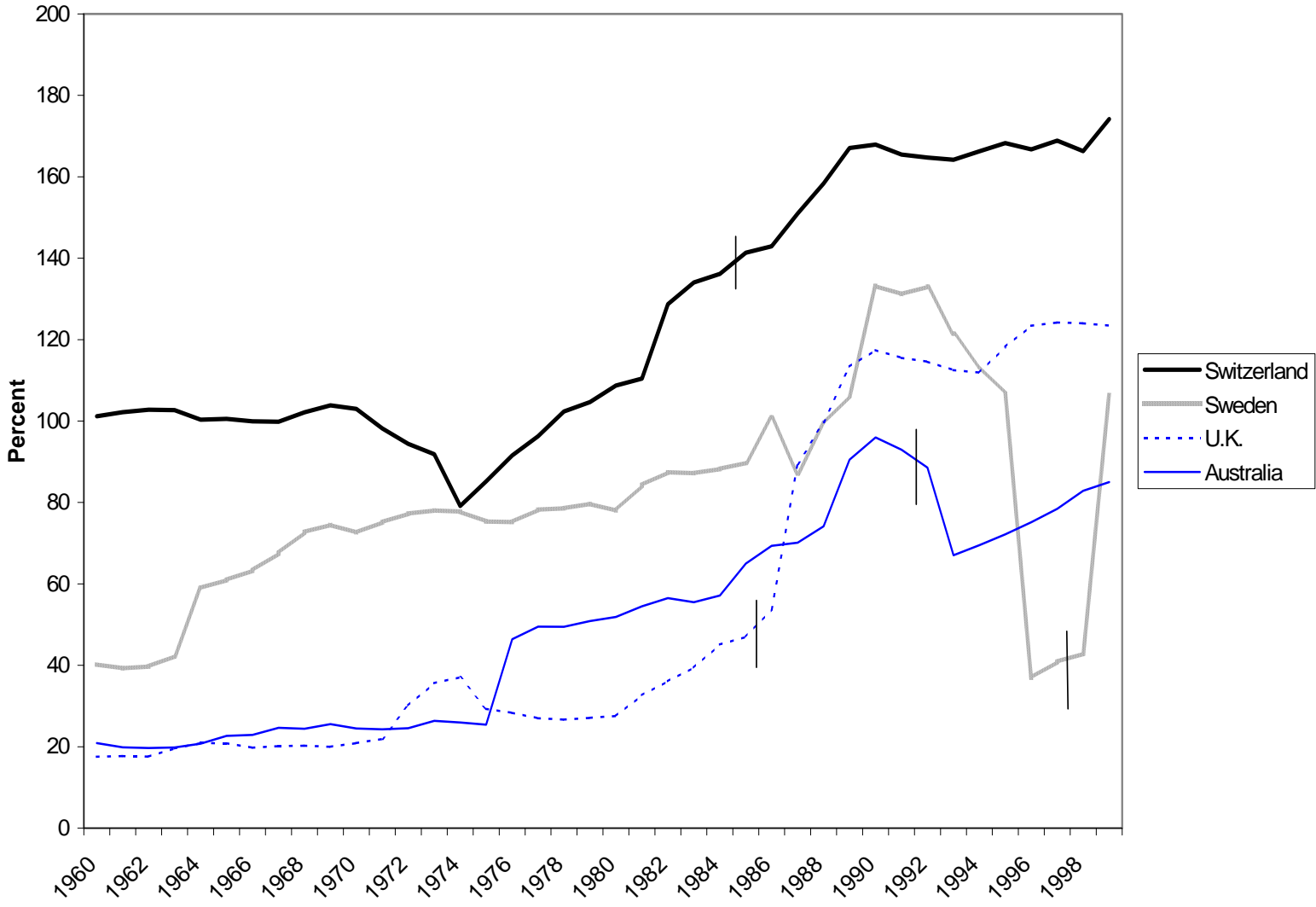


Table 2
Past and Projected Worker-Retiree Ratios

	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
High-Income Countries at time of their Reform										
Australia	3.6	3.5	3.3	2.9	2.5	2.2	1.9	1.7	1.6	1.6
Denmark	2.9	2.9	2.6	2.3	2.1	2.0	1.8	1.6	1.5	1.5
Hong Kong	4.2	4.3	4.2	3.5	2.8	2.0	1.5	1.3	1.2	1.1
Sweden	2.4	2.4	2.2	2.0	1.9	1.7	1.6	1.5	1.4	1.4
Switzerland	3.0	2.9	2.6	2.3	2.1	1.8	1.5	1.3	1.3	1.3
United Kingdom	2.6	2.6	2.5	2.3	2.1	2.0	1.7	1.6	1.5	1.5
Medium-Income Countries at time of their Reform										
Croatia	2.5	2.4	2.5	2.4	2.1	1.9	1.8	1.7	1.7	1.6
Hungary	2.8	2.9	2.8	2.6	2.3	2.1	2.1	2.0	1.8	1.6
Poland	3.4	3.4	3.6	3.2	2.7	2.2	2.1	2.1	2.0	1.8
Uruguay	2.9	3.0	3.1	3.1	3.0	2.8	2.6	2.5	2.3	2.1
Poorer Countries at time of their Reform										
Argentina	3.7	3.8	3.9	3.8	3.6	3.4	3.2	3.0	2.8	2.4
Bolivia	7.2	7.2	7.4	7.4	7.2	7.0	6.6	6.1	5.4	4.8
Chile	5.5	5.2	4.8	4.4	3.9	3.3	2.8	2.5	2.3	2.2
China	5.8	5.6	5.4	5.0	4.1	3.7	3.0	2.4	2.1	2.0
Colombia	6.2	6.2	6.2	6.0	5.5	4.9	4.2	3.7	3.2	2.9
Costa Rica	6.9	6.6	6.3	5.8	5.1	4.2	3.5	3.0	2.7	2.5
Domenica Rep.	7.9	7.5	7.3	6.9	6.1	5.2	4.3	3.6	3.2	2.8
Kazakhstan	5.3	4.3	4.9	4.9	4.4	3.6	3.2	3.1	3.1	2.9
El Salvador	6.7	7.3	7.6	7.5	7.4	7.3	6.7	5.5	4.3	3.4
Mexico	7.7	7.6	7.2	6.7	5.9	5.1	4.4	3.9	3.2	2.8
Nicaragua	8.9	9.4	9.9	9.7	8.7	7.8	6.8	5.8	4.9	4.1
Peru	7.0	7.0	7.0	6.7	6.1	5.5	4.8	4.1	3.5	3.0

Source: Data provided by Robert Palacios, WB

Figure 5
Size of Reforms Relative to Projected Population aged 65 and older in 2025

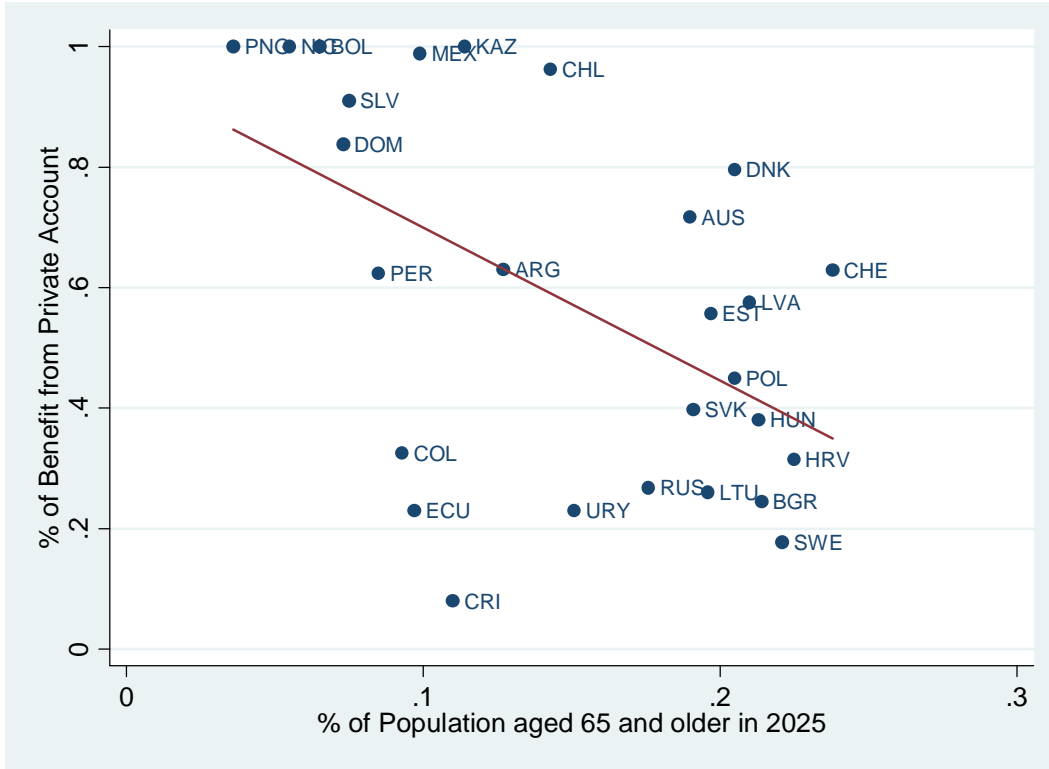
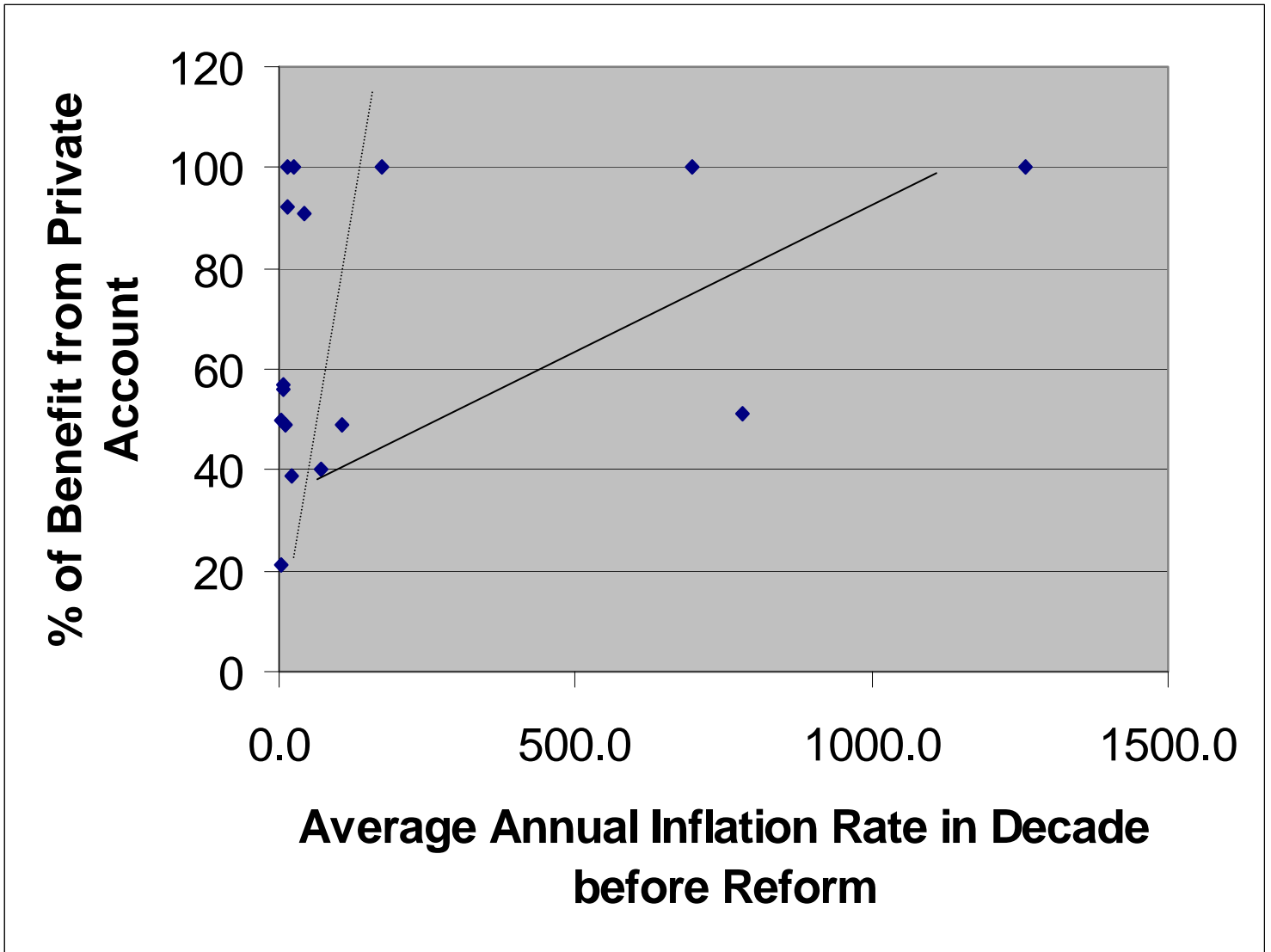


Table 3
5-Year Moving Average Annual Rates for Preceding Five Years
(Year of Reform shown in parentheses for each country)

	1975	1980	1985	1990	1995	1998
<i>High-Income Countries at time of their Reform</i>						
Australia (1992)	8.1	11.6	9.0	7.8	3.0	2.0
Denmark (1990)	8.7	9.9	9.5	4.3	2.1	2.0
Hong Kong, China (2000)	n.a.	n.a.	n.a.	n.a.	n.a.	6.6
Sweden (1998)	7.4	9.7	10.3	5.6	5.8	1.1
Switzerland (1985)	7.1	2.9	4.4	2.1	3.9	0.8
United Kingdom (1986)	9.6	15.7	9.6	5.3	4.6	3.0
<i>Medium-Income Countries at time of their Reform</i>						
Croatia (2002)	n.a.	n.a.	n.a.	353.8	570.9	25.2
Hungary (1998)	n.a.	5.3	7.2	10.7	25.5	20.7
Poland (1999)	n.a.	5.3	34.7	71.5	149.5	21.6
Uruguay (1996)	58.2	60.3	44.2	71.0	76.4	29.2
<i>Low-Income Countries at time of their Reform</i>						
Argentina (1994)	38.3	227.6	268.1	863.3	505.1	1.8
Bolivia (1997)	21.7	10.1	352.0	2414.3	13.4	8.6
Chile (1981)	198.7	150.4	22.4	20.3	17.5	7.7
China (1995)	n.a.	n.a.	n.a.	n.a.	10.4	10.3
Colombia (1993)	14.9	23.7	22.9	24.0	26.6	20.9
Costa Rica (1999)	11.5	8.0	38.0	16.2	18.6	15.8
Dominican Republic (2001)	8.9	9.6	11.5	30.2	23.1	7.8
El Salvador (1998)	5.6	13.2	13.7	23.3	15.7	7.5
Kazakhstan (1998)	n.a.	n.a.	n.a.	n.a.	n.a.	423.3
Mexico (1997)	10.3	19.1	56.1	82.0	16.3	22.6
Nicaragua (2000)	n.a.	14.9	30.1	3357.6	2096.3	n.a.
Peru (1993)	9.1	43.9	84.1	878.6	1607.4	12.4

Figure 6

Size of Reforms Relative to Inflation Risk



{update with newest list and our calculated % of benefit value }

Table 4
Political and Civil Rights

	Year Reformed	<u>Freedom Index Two-Years Before Reform</u>			% of Benefit From Private Account
		Political Rights	Civil Liberties	Total Score	
<i>Countries with Stronger Records of Political and Civil Rights Two Years Before Reform</i>					
Australia	1992	1	1	1	57
Denmark	1990	1	1	1	56
Sweden	1998	1	1	1	21
Switzerland	1985	1	1	1	50
United Kingdom	1986	1	1	1	49
Costa Rica	2001	1	2	1.5	n.a.
Hungary	1997	1	2	1.5	39
Poland	1999	1	2	1.5	49
Uruguay	1996	2	2	2	40
Argentina	1994	2	3	2.5	51
Dominican Republic	2001	2	3	2.5	n.a.
<i>Countries with Weaker Records of Political and Civil Rights Two Years Before Reform</i>					
Colombia	1993	2	4	3	100
El Salvador	1998	3	3	3	100
Nicaragua	2001	3	3	3	n.a.
Croatia	1998	4	4	4	n.a.
Mexico	1997	4	4	4	91
Peru	1993	3	5	4	100
Chile	1981	6	5	5.5	100
Kazakhstan	1997	6	5	5.5	100
Bolivia	1997	6	6	6	92
China	1995	7	7	7	n.a.
Hong Kong, China	2000	n.a.	n.a.	n.a.	n.a.

{Update with the most recent reforming countries; make reform dates consistent}

Table 5
Durability of Government

	Year Reformed	Years Since Last Regime Change (or 1900, whichever came last)	% of Benefit from Private account
<i>Highly Durable Governments (50+ years)</i>			
Costa Rica	2001	101	Na
Australia	1992	92	57
United Kingdom	1986	86	49
Switzerland	1985	85	50
Sweden	1998	81	21
Denmark	1990	75	56
<i>Less Durable Governments (< 50 years)</i>			
China	1995	46	Na
Colombia	1993	36	100
Bolivia	1997	15	92
El Salvador	1998	14	100
Argentina	1994	11	51
Nicaragua	2001	11	Na
Uruguay	1996	11	40
Chile	1981	8	100
Poland	1999	8	49
Croatia	1998	7	Na
Hungary	1997	7	39
Kazakhstan	1997	6	100
Dominican Republic	2001	5	Na
Hong Kong, China	2000	0	Na
Mexico	1997	0	91
Peru	1993	0	100

{Update with the most recent reforming countries; make dates consistent}

Source of Column 3: The Polity IV Project

Larger reforms tend to happen in countries with less durable governments. A less durable government creates more uncertainty in the inter-generational c

Appendix A

Countries in Dataset Listed by Historic Instability			
(Countries in Bold reformed their state pension systems as of 2003)			
<i>No Instability (0)</i>	Low (1)	Low-Moderate (2)	Moderate (3)
Australia	Armenia	Albania	Bolivia
Bangladesh	Azerbaijan	Algeria	Bulgaria
Botswana	Bahrain	Austria	Burkina Faso
Canada	Belarus	Belgium	Dominican Republic
Costa Rica	Burundi	Benin	El Salvador
Haiti	Cameroon	Central African Rep.	France
Israel	Chad	Colombia	Greece
Jamaica	China	Congo	Guyana
Laos	Cote d'Ivoire	Cyprus	Hungary
Lebanon	Dem. Rep. Congo	Denmark	Iran
New Zealand	Egypt	Ethiopia	Latvia
Niger	Equatorial Guinea	Gabon	Mexico
Oman	Estonia	Germany	Panama
Papua New Guinea	Finland	Ghana	Philippines
Saudi Arabia	Georgia	Guinea	Poland
Sierra Leone	Honduras	Italy	Venezuela
Switzerland	Ireland	Kyrgyzstan	
United Kingdom	Japan	Lithuania	High (4)
United States	Jordan	Madagascar	Czech Republic
Vietnam	Kazakhstan	Mali	Ecuador
Zimbabwe	Kuwait	Morocco	Guatemala
	Mauritania	Netherlands	Paraguay
	Mauritius	Nicaragua	Peru
	Norway	Pakistan	Romania
	Portugal	Republic of Korea	Slovakia
	Moldova	Russian Fed.	Spain
	Senegal	Rwanda	
	South Africa	Sudan	Very High (5+)
	Sweden	Tunisia	Brazil
	Syria	Ukraine	Chile
	Thailand		Croatia
	Togo		Slovenia
	Trinidad and Tobago		Turkey
	Turkmenistan		Uruguay
	Uzbekistan		Argentina
	Yemen		

Appendix B

Modeling the share of pension payments attributable to the personal accounts

Social security reforms differ by extent. Some countries, like Chile, have replaced their entire pension system with private accounts, while other countries have chosen to retain significant elements of their existing public pension systems and use private accounts as a supplementary source of retirement income. The decision to introduce any private account component, regardless of size, into an existing social security system, is a significant event that entails substantive changes to the country's legal, regulatory, and political environment. Hence, we use the dichotomous reform variable as the object of analysis in our probit and hazard model analysis. However, to analyze what factors affect the extent of reform, we need an accurate measure of the magnitude of reform, which will be used in our tobit model. Therefore, we construct a model of the future share of pension payments that will be derived from the privatized portion of the social security system. This produces a scaled reform variable that ranges from 0 to 1, with 1 indicating that 100% of future pension payments in that country will come from private accounts. We utilize a scaled variable, rather than a raw figure such as the average value of private account payouts, because we wish to control for differences in expectations between countries on the magnitude of employment income replaced in retirement. A drawback of this approach is that our measure of reform may not accurately capture effective revaluations of pension systems, where a privatized reform is accompanied by broad changes in the intended income replacement rate of the pension system. Construction of such a replacement rate-sensitive measure would require comprehensively modeling all non-reforming countries' existing pension systems, which is a task outside the scope of this paper.

We model all countries with private account reforms in our dataset. First, we obtain the complete published rules of the private account system and the complementary public pension system. In particular, we obtain the contribution rates to the private and public pension system,

the retirement age, and the payout formulas used for the public pension system. Next, we obtain detailed data on the income distribution of the country, and life expectancy by gender. We use income distribution data to construct country wages by income percentile, and then model contributions into a private account for a typical worker of a given income percentile. At retirement, the worker's private account, with compounded returns, is used to buy an annuity. The cost of the annuity is actuarially calculated based on the country-specific life table. The annual value of the annuity is the yearly income attributable to the private account component of the pension system. We add to this the annual value of the public component of the pension system, as determined by the rules of the country's public pension system, to obtain the total annual income available to the worker at retirement. The percentage of this total value which is derived from the private account component is the scaled reform variable, which ranges from 0 for no reform to 1, representing 100% reforms with all retirement income derived from the private accounts. Note that as contribution rates may differ by income, we perform this calculation at different income percentiles for each country, and obtain the average scaled reform percentage, which corresponds closely to the percentage of income derived from private accounts for the median wage earner.

A simplified structural representation of our modeling process is given by:

$$\frac{\text{ANNUAL VALUE OF PRIVATE COMPONENT}}{\text{NPV of \$1 ANNUITY}} = \frac{\sum_{t=0}^T [(INCOMEX\%_t \times PRIVATE\tau_t) (1 + R)^{T-t}]}{\text{NPV of \$1 ANNUITY}}$$

Where:

PRIVATE τ = Private account contribution tax rate

INCOMEX% t = Annual labor income at the Xth percentile of wages in period t

R = Real rate of return on private account funds, set to 3%

T = Labor Income Periods till Retirement Age (assuming working life begins at age 20)

Note that our modeling process differs by country due to structural differences such as the country's tax rates on retirement income (if any), contribution ceilings, floors, and caps, guaranteed minimum income plans, and the like. Two major pension system features and their modeling decisions are given below:

Redistributive Payments

Many countries explicitly include redistributive elements in their pension systems. These often take the form of a minimum pension guarantee or other old-age transfers. These transfers are financed by the government, and thus are excluded from calculations of the private system's share of overall pension payments, even when the transfer is paid out 'through' the private system. In general, redistributive elements will decrease the share of pensions attributable to the private system when the income distribution of the country is such that a large number of workers will likely qualify for redistributive payments.

Voluntary Participation / Switching Between Systems

Under some systems, workers have a choice of participating in the new system or old system, or even of switching between new and old systems at certain times. Generally, this choice of participation is limited by age group, so older workers have the ability to opt-in while younger workers generally must switch to the new system. For simplicity, for all reforms that include age-related opt-outs, we assume that the system is fully transitioned to younger workers when modeling private system payouts. However, for reforms that give workers the ability to continuously choose which system to participate in, we model the NPV of each system choice for a representative worker of that income group, and have the worker choose the system which offers them the higher NPV at that point in time.

The spreadsheets used in calculating each country's scaled reform variable are available on request from the authors.

Appendix C

VARIABLES	(1) Probit	(2) Tobit	(3) Hazard
Instability	0.214** (0.100)	0.149* (0.0843)	0.200* (0.111)
WDI: Annual Per Capita PPP GDP in 1,000s (Inter/Expolated)	-0.0546 (0.0356)	-0.0365 (0.0335)	-0.106** (0.0463)
WDI: Annual % of Population 65+	-0.117 (0.0926)	-0.118 (0.0814)	
UN Projected Population 65+ in 2025, Percent of Total Pop	0.187*** (0.0652)	0.147** (0.0641)	
Historic Democracy	0.0904** (0.0370)	0.0718** (0.0328)	
WDI: Domestic Credit to Private Sector, Percent of GDP	-0.0136** (0.00618)	-0.0105* (0.00573)	-0.0104 (0.00788)
Constant	-1.549*** (0.325)	-1.101*** (0.394)	
WDI: Annual Interpolated and Extrapolated Life Expectancy			0.122*** (0.0411)
Observations	117	117	3445
r2_p	0.240	0.155	
R-squared	.	.	.

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix D

Variable	Description / Source
Instability	Based on the DURABLE variable from the Polity IV Project: Political Regime Characteristics and Transitions, 1800-2006 database. DURABLE is a country by year level observation that indicates the number of years since the last regime change in that country. <i>Instability</i> measures the number of times, since the creation of that country's public pension system, that DURABLE reaches 5. Thus, <i>Instability</i> is higher for countries with frequent regime changes.
WDI: Annual Per Capita PPP GDP in 1,000s (Inter/Expolated)	Based on NYGDPPCAPPKD from the World Development Indicators 2005 database from the World Bank. Annual Per-Capital Purchasing Power Parity GDP, in \$1,000s of dollars. Due to data continuity problems, data is interpolated and extrapolated when necessary to ensure a balanced panel for estimates.
WDI: Annual % Of Population 65+	Obtained from SPPOP65UPTOZS from the World Development Indicators 2005 database from the World Bank. Percentage of the country's total population in that year who are aged 65 years and older.
UN Projected Population 65+ in 2025, Percent of Total Population	Obtained from World Population Prospects, the 2004 Revision, Medium Variant. United Nations Population Division.
Historic Democracy	Based on the POLITY2 variable from the Polity IV Project database. POLITY2 is a country by year level observation that ranges from +10 (strongly democratic) to -10 (strongly autocratic). <i>Historic Democracy</i> is the average historical POLITY2 score for the period between the creation of that country's public pension system, and the year of reform or the year 2003, whichever comes first.
WDI: Domestic Credit to Private Sector, % of GDP	Based on FSASTPRVTGDZS from the World Development Indicators 2005 database from the World Bank. <i>Domestic Credit to Private Sector</i> refers to financial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable that establish a claim for repayment. For some countries these claims include credit to public enterprises. <i>Domestic Credit to Private Sector</i> is divided by country's GDP and expressed as a multiple of GDP.
WDI: Annual Interpolated and Extrapolated Life Expectancy	Based on SPDYNLE00IN from the World Development Indicators 2005 database. SPDYNLE00IN is a country by year observation indicating that country's current life expectancy at birth. Due to data continuity problems, we interpolate and extrapolate this variable to form a continuous series.

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