Public and Private Insurance
Cross country evidence and a model

Giuseppe Bertola* and Winfried Koeniger**

Preliminary draft, August 24, 2008

Abstract

Insurance provision differs across developed countries both in terms of total amounts expended, and of whether it is supplied via public schemes or private contractual arrangements. We propose a model where insurance is limited by the need to elicit unobservable effort; entails implementation costs that may differ for public and private entities; and tends to be more desirable when liquidity constraints reduce the scope of self-insurance. We characterize how the model's parameters bear on the absolute (public and private) and relative (public vs. private) dimensions of insurance provision patterns, and seek support for our assumptions and modeling approach using data on the cost of public insurance administration and the actuarial fairness of private insurance markets.

*Università di Torino and CEPR. ** Queen Mary, University of London, and IZA. We thank Luigi Bocola for useful comments. This research is part of a project funded by Università di Torino (ex 60%).

1 Introduction

Developed countries differ widely as to whether insurance is publicly provided or based on private contracts, and also differ in terms of total public and private insurance expenditures. Scandinavian countries rely much more on public than on private insurance; the difference between public and private insurance expenditures is smaller for Anglo-Saxon countries; and both of these groups of countries spend more than Mediterranean countries, where private *and* public insurance expenditures are low. In this paper we interpret these facts in a model with government redistribution as well as insurance market imperfections.

As pointed out by Eaton and Rosen (1980) and Varian (1980), redistribution can be beneficial ex ante in the presence of labour income risk; Low and Maldoom (2004) have recently extended that perspective to a setting with endogenous leisure choice and precautionary effects on labour supply. Similar insights are relevant to recent studies that calibrate models with incomplete markets and linear tax-transfer schemes.[1] In dynamic equilibrium models with financial market imperfections, redistribution can significantly increase welfare (Floden and Linde, 2001), particularly when borrowing is constrained (Hansen and Imhoroglu, 1992).

We revisit these findings in a stylized framework, focusing on informational issues in order to analyze the rationale for public policies along the lines of, for example, Agell (2002) and Bertola (2004). In general, the implementation of public policies, motivated by insurance concerns, entails efficiency costs. Here, we highlight three determinants of public and private insurance provision. Firstly, public and private insurance entail transaction costs, which play a role similar to that of administration costs in the tax design research surveyed by Slemrod (1999). Secondly, all insurance is limited by moral hazard, where the extent of this problem depends on the public or private provision of insurance. Thirdly, we consider interactions with the loans market imperfections that previous research has shown to be relevant to the desirability of redistribution (Hansen and Imhoroglu, 1992; Bertola and Koeniger, 2007). We find that borrowing constraints make redistribution more beneficial in our model, under plausible parametric assumptions. As a result, the

[1] Another strand of literature has investigated the optimal design of redistribution in dynamic settings with incomplete markets. See the survey by Kocherlakota (2005), and Shimer and Werning (2005)'s recent study about the optimal design of unemployment insurance if consumers have access to a savings technology.

determinants of insurance in our model provide an empirically useful perspective on the insurance configurations across countries, both along the *absolute* (both public *and* private) and *relative* (public *vs.* private) dimensions.

We then proceed to investigate how the cross-country evidence may be interpreted from that perspective. For this purpose, it is important to consider that observable differences of insurance configurations and other market imperfections across countries reflect not only underlying exogenous differences but also endogenous policy choices. The literature has proposed historically determined legal traditions (La Porta et al., 2008) or culture (Fernandez, forthcoming) as exogenous shifters, has entertained the possibility of multiple equilibria when the motivation and effects of policies feed back on each other (Hassler et al., 2003), and has emphasized that accounting for country-specific circumstances is essential for the purpose of detecting the effects of endogenous policies (Rodrik, 2005). Cross-country heterogeneity of policy choices is not exogenous and, to the extent that it is driven by deeper factors, these factors may well bear on outcomes directly.

In this paper, we take a first step towards understanding the cross-country differences by providing descriptive evidence on how observed insurance outcomes are associated with the determinants suggested by our model. We analyze how much of the observed insurance outcomes can be explained by available data for developed countries on mark-ups in the private insurance sector; on the cost of running public social protection schemes; and on the stringency of borrowing restrictions. The evidence is supportive of our theoretical perspective in that insurance is scarcer where it appears more expensive, both across countries and between public and private schemes.

The rest of the paper is structured as follows. In Section 2 we discuss the empirical facts which motivate the model. In Section 3 we set up a simple static insurance problem, in which individuals decide how much effort to allocate to avoid bad contingencies. We characterize the optimal insurance choice and discuss pros and cons of private vs. public provision of insurance. In Section 4 we extend the model to two periods and show how borrowing constraints affect intratemporal insurance provision. In Section 5 we return to the facts and interpret them in light of the model, and we conclude in Section 6.

2 Some facts

Figure 1 motivates our analysis plotting the size of public insurance programs against expenditures on private (non-life) insurance. Scandinavian countries devote about 20% of GDP to *public* social insurance expenditures, which absorb less than 15% of GDP in Anglo-Saxon countries such as the US or UK.[2] *Private* (non-life) insurance expenditures in the US or UK are about 5% of GDP, which is twice as high as in Scandinavian countries.[3] So, both groups of countries may well provide comparable levels of insurance through different mixes of public/private insurance provision. But since other countries (such as Italy, Japan, Greece, and South Korea) spend little on both public and private insurance, across all OECD countries the correlation between public and private insurance is insignificant: the correlation coefficient, reported in Table 1, is actually positive 0.13. As usual, observed outcomes can form a shapeless cloud when their variation is driven by two or more factors which have opposite effects on the outcomes.

To disentangle the underlying supply and demand differences across countries, we will set up a simple model to derive predictions for the main determinants of insurance expenditure, and then revisit the facts from the model's perspective. A clue to the relevance of other factors is offered by the correlation of insurance expenditures with data on loan-to-value (LTV) ratios reported by Jappelli and Pagano (1994, Table 1, column 3). Table 1 displays its correlation with public and private insurance expenditures. Thus, factors shaping borrowing and lending (such as LTVs) appear empirically related to those that shape the supply and demand of insurance. This motivates consideration of intertemporal aspects in the theoretical model.

[2]The empirical indicator includes (i) incapacity-related benefits (care services, disability benefits, benefits accruing from occupational injury and accident legislation, employee sickness payments); (ii) health (in- and out-patient care, medical goods, prevention); (iii) family (child allowances and credits, childcare support, income support during leave, sole parent payments); (iv) active labour market policies (employment services, training youth measures subsidised employment, employment measures for the disabled); (v) unemployment (unemployment compensation, severance pay, early retirement for labour market reasons); housing (housing allowances and rent subsidies); and (vi) other social policy areas (non-categorical cash benefits to low-income households, other social services; i.e. support programmes such as, food subsidies).

[3]The data, sourced from the Social Expenditure Database and Insurance Statistics Yearbook of the OECD, are three-year averages for 1996-1998. We chose 1996-1998 for reasons of data quality and comparability across countries. The time-series variation is rather noisy due to measurement problems, especially for the private insurance data.

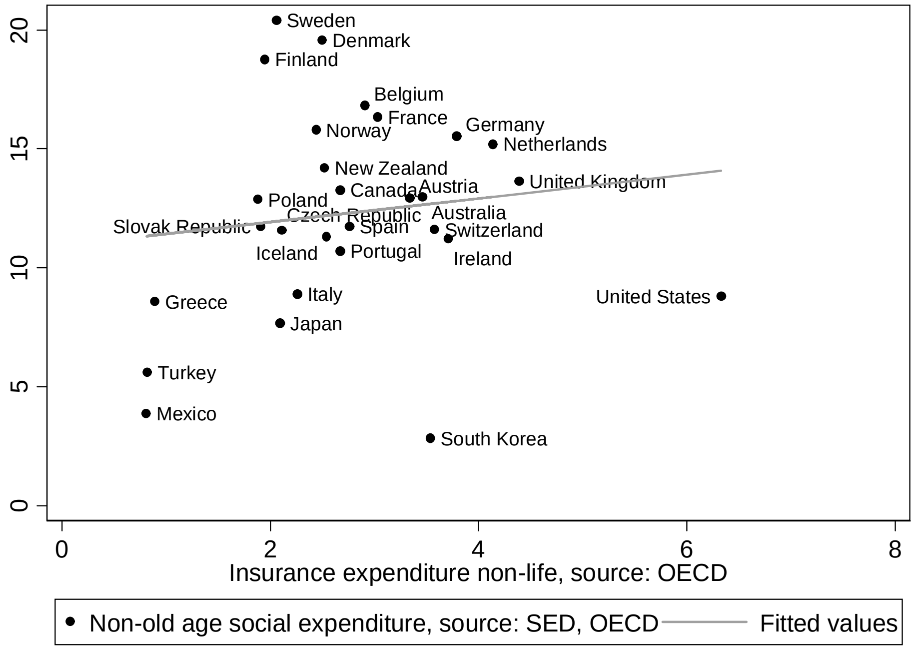

Figure 1: Public and private insurance across OECD countries, % of GDP. Note: Public insurance is measured as social expenditure other than pension and survivorship payments (source: OECD, Social Expenditures Database); private insurance is measured as total premiums paid, excluding life insurance (source: OECD, Insurance Statistics Yearbook); both are 1996-98 averages of GDP percentages.

	social exp.	non-life ins.	LTV
public social expenditure	1	.	.
non-life insurance expenditure	0.134 (0.498)	1	.
loan-to value (LTV) ratio	0.776 (0.000)	0.371 (0.082)	1

Table 1: Correlations between public insurance, private insurance and credit market development. Note: P-values in brackets.

3 A model

In this section we discuss the model set up and characterize the optimal effort and insurance.

3.1 The set-up

We consider an economy populated by a continuum of risk-averse individuals.

Uncertainty. Consumers have uncertain labour income w_j, where the realization of uncertainty is indexed by j. For simplicity and without loss of qualitative generality we focus on a two-state specification of uncertainty, with $j = b, g$ indexing the "bad" and "good" realization. The probability with which each of these states occurs depends on the individual's effort.

Effort. Effort is unobservable. The probability of a "good" income realization $p(\epsilon)$ depends positively on effort, $p'(\epsilon) > 0$, but effort provision is costly to the individual. This cost is $k(\epsilon)$ where we assume that $k'(\epsilon) > 0$.

Government insurance. To characterize the trade-off facing public policy, it is convenient to suppose that no private insurance is available. This may reflect private agents' limited enforcement power as well as their inability, possibly due to privacy laws, to verify the income realization. If the government may instead gather relevant information, it will be able to address that source of market failure. Like private firms, however, governments face implementation costs, and even though we suppose that realizations can be observed perfectly, effort remains the individuals' private information. Thus, governments cannot provide costlessly the insurance that markets fail to deliver, and government insurance needs to trade-off consumption stability and efficiency.

The government provides insurance by taxing consumers in the good state and paying benefit income in the bad state. We assume that consumers in the good state are taxed at a linear tax rate τ and consumers in the bad state receive benefit payments b. For a given tax rate and *ex-ante* identical individuals, the benefit payments are determined by the government budget constraint where

$$\chi p(\epsilon)\tau w_g = (1 - p(\epsilon))b \ , \tag{1}$$

where $0 < \chi < 1$ captures the government administration costs of operating the transfer scheme (approximated in the empirical exploration below by data on the administrative cost of public insurance).

3.2 Consumption and optimal effort

We start by characterizing insurance choices in a single period. To prepare the stage for treatment of intertemporal decisions, in the individual's budget set we allow for accumulated assets, a, and for the income accrued at an exogenous rate r on those assets. The consumer makes no saving decisions in the (final) period, and chooses effort to maximize

$$\max_{\epsilon} \left[p(\epsilon)u(c_g) + (1 - p(\epsilon))u(c_b) - k(\epsilon)\right]$$

knowing that $c_g = (1 - \tau)w_g + a(1 + r)$ if the realization of uncertainty is favorable, $c_b = w_b + b + a(1 + r)$ otherwise. The first-order condition

$$p'(\epsilon)\left[u(c_g) - u(c_b)\right] = k'(\epsilon) \ , \tag{2}$$

characterizes a maximum if $p''(\epsilon)\left[u(c_g) - u(c_b)\right] - k''(\epsilon) < 0$.

Intuitively, equation (2) equates the marginal benefit $p'(\epsilon)\left[u(c_g) - u(c_b)\right]$ to the marginal cost $k'(\epsilon)$ of effort provision. The marginal benefit is increasing in the stakes $X \equiv u(c_g) - u(c_b)$. Totally differentiating (2), we find that effort is increasing in the stakes,

$$\frac{d\epsilon}{dX} = \frac{p'(\epsilon)}{k''(\epsilon) - p''(\epsilon)X} > 0,$$

as long as the second-order condition is satisfied (so that the denominator is positive).

3.3 Optimal government insurance

The government cannot observe effort but knows that consumers choose it according to (2). The tax rate τ is chosen so as to maximize ex ante welfare of a representative consumer

$$\max_{\tau} \left[p(\epsilon)u(c_g) + (1 - p(\epsilon))u(c_b) - k(\epsilon)\right]$$

subject to the government budget constraint (1). As shown in the Appendix, the condition for the optimal government insurance is

$$u'(c_g) = \chi \xi u'(c_b) \ , \tag{3}$$

where

$$\xi = 1 + \frac{p'(\epsilon)}{p(\epsilon)\left(1 - p(\epsilon)\right)} \tau \frac{\partial \epsilon}{\partial \tau} < 1. \tag{4}$$

Intuitively, the efficiency costs of government insurance, both in terms of effort crowding out ($\xi < 1$), and in terms of administration cost ($\chi < 1$) imply that in the optimum marginal utility is larger in the bad than in the good state. The parameters ξ and χ have the same role in equation (3): public insurance may be low because the government administration is inefficient, or because the moral-hazard problem is severe.

Consider a parameterized example where $p(\epsilon) = \nu\epsilon$ and $k(\epsilon) = \psi\epsilon^2/2$, with $\nu > 0$, $\psi > 0$, so that $p'(\epsilon) = \nu$, $p''(\epsilon) = 0$, $k'(\epsilon) = \psi\epsilon$ and $k''(\epsilon) = \psi$. Equation (2) then implies that optimal effort is

$$\epsilon = \frac{\nu}{\psi} X \ ,$$

where $X \equiv u(c_g) - u(c_b)$. Moreover, we have[4]

$$\tau w_g = \frac{\chi u'(c_b) - u'(c_g)}{\chi u'(c_b) u'(c_g)} X \left(1 - \frac{\nu^2}{\psi} X\right)^2 ,$$

[4] $\xi = 1 + \frac{\nu}{\nu\epsilon(1-\nu\epsilon)} \tau \frac{\partial \epsilon}{\partial \tau}$, and in the optimum $\frac{\partial \epsilon}{\partial \tau} = -\frac{\nu}{\psi} \frac{u'(c_g) w_g}{1 - \nu\epsilon}$. Hence, $\xi = 1 - \frac{\nu^2}{\psi\nu\epsilon(1-\nu\epsilon)^2} \tau u'(c_g) w_g$. Inserting expression (4) for ξ into (3), we find that the optimum tax revenue is

$$\tau w_g = \frac{u'(c_b) - u'(c_g)}{u'(c_b) u'(c_g)} \frac{\psi\nu\epsilon\left(1 - \nu\epsilon\right)^2}{\nu^2} \ .$$

Using our explicit solution for ϵ, we get the expression in the text.

where c_j, $j = b, g$, and X are functions of τ. The equation shows that the optimal tax revenue, τw_g, depends not only on the difference of *marginal* utilities but also on the difference of *absolute* utilities, X. The reason is that government insurance needs to balance the benefits of insurance, $u'(c_b) - u'(c_g) > 0$ for strictly concave utility functions, with the reduction in the tax base due to lower effort exertion, which depends on X. Accordingly, the effects of X on tax revenues may be positive or negative and, as shown in the next section's numerical analysis, benefit payments are a non-monotonic function of taxes.

3.4 Public vs. private insurance provision

Let us now derive optimal insurance in private insurance markets so that we can compare it with optimal government redistribution. Although private markets generally are not able to provide complete insurance against labour income risks, they may provide some insurance. Suppose that consumers can enter a contract that binds them to pay a premium $\pi\sigma$ in the good state and to receive σ units of resources in the bad state. The insurance industry breaks even when

$$\zeta p(\epsilon)\pi = 1 - p(\epsilon), \text{ or } \pi = \frac{1 - p(\epsilon)}{p(\epsilon)} \frac{1}{\zeta}, \tag{5}$$

where $\zeta < 1$ captures insurance implementation costs or other deviations from actuarially fair insurance due to lack of competition in insurance markets. The $1/\zeta$ ratio is the loading factor of insurers, and we will refer to it as the *mark-up* of private insurance provision.

If consumers purchase an insurance amount σ (which may affect the premium π) so as to solve

$$\begin{aligned} &\max_{\sigma} [p(\epsilon) u \left(w_g + a(1+r) - \pi(\sigma)\sigma\right) \\ &+ (1 - p(\epsilon)) u \left(w_b + a(1+r) + \sigma\right) - k(\epsilon)], \end{aligned}$$

the break-even condition (5) plays the same role as the government budget constraint in the redistribution problem analyzed above. Similar derivations imply that insurance satisfies the condition

$$u'\left(c_g\right) = \zeta \mu u'\left(c_b\right), \tag{6}$$

where

$$\mu \equiv \frac{1 - p(\epsilon)}{1 - p(\epsilon) + \pi'(\sigma)\sigma}. \tag{7}$$

If insurance is priced so as to take into account the negative effect of insurance expenditures on effort provision ($d\epsilon/d\sigma < 0$), then (5) implies that

$$\pi'(\sigma) = -\frac{p'(\epsilon)}{p(\epsilon)\zeta}\frac{d\epsilon}{d\sigma} > 0,$$

and the expression in (7) is smaller than unity.

Expenditures on private insurance are smaller if premiums are not actuarially fair ($\zeta < 1$). Private insurance expenditure is also smaller if insurers take the effect of individual insurance expenditures on effort into account, so that $\pi'(\sigma) > 0$ and $\mu < 1$.

Comparison of the optimality conditions for the government in (3) and the private sector in (6) highlights two reasons why government provision of insurance may be more efficient than the insurance market's equilibrium.

First, the relative efficiency of private insurance administration, as indexed by ζ/χ, may be smaller than unity. The government may offer better insurance if it has lower implementation costs, for example because it is less costly to verify income states (if the cost of verifying the income state is prohibitively costly for private insurers, $\zeta \to 0$, then no private insurance is available and, as shown above, it is optimal for the government to provide some insurance) or because private pricing of insurance is marked up by monopoly power. If $\zeta/\chi < 1$, the model predicts more government insurance and less private insurance expenditures.

Second, the government may be better able to internalize the effect of insurance on effort. Indeed, atomistic private insurers may over-insure consumers, if they do not have information about the total insurance expenditures (Pauly, 1974). In this case, $\pi'(\sigma) = 0$ and $\mu = 1$ for private insurers, while $\xi < 1$ in the government's optimal provision of insurance improves efficiency. It is possible that $\mu/\xi > 1$, in which case a government's administrative advantage (as indexed by $\zeta/\chi < 1$) need not imply that government insurance expenditures are higher than private ones.

The relative size of the effort-motivated wedges defined in (4) and (7) feature complex interactions of various effects when private and public insurance coexist.[5] Keeping in mind that differences in μ/ξ and in ζ/χ have similar implications, and that a large variety of factors may be relevant to the trade-off between public and private insurance in reality, in what follows we will focus on observable proxies of the administration efficiency parameters ζ and χ.[6] Before we bring this perspective to bear on the data, however, we will extend the model to analyze the role of borrowing constraints, which will prove crucial to interpret the cross-country patterns documented in the previous section.

4 Intertemporal distortions

We now show how borrowing constraints influence the insurance motive. As they shift resources to the future, they may be expected to exacerbate the moral hazard problem for older people, who have less at stake. For the purpose of assessing the qualitative robustness of this effect, we treat both the interest rate and borrowing limits as exogenous, and we rule out private insurance to simplify the analysis.

The timing of consumer decisions. In the first period consumers are born without resources. They then make a decision how much effort to exert in the first period. The effort influences the probability of receiving high or low income from labour and insurance markets. Consumers then decide (subject to a liquidity constraint) how much to borrow or save in terms of a riskless financial asset and choose effort for the second period. After the draw of labour income in the second period all the remaining resources are consumed.

The second period. More assets are carried to the second period when the borrowing constraint is tighter. Thus, we investigate the implications of that constraint for government redistribution

[5] If $\pi'(\sigma) > 0$, insurers take the effect of insurance on premiums into account. Then public and private insurance interact with each other in complex ways, as government redistribution affects the severity of moral hazard problem in private insurance markets. In general, there are no clear analytic results, as this interaction depends on higher-order derivatives of $k(\epsilon)$ and $p(\epsilon)$.

[6] Among other factors, politico-economic interactions may imply that government schemes are also exploited for redistribution purposes across *ex ante* heterogenous groups of agents. In a reduced-form sense we capture this "inefficiency" by the parameter χ but further research could flesh out these interactions in more detail.

by comparative statics methods. Differentiating (2) with respect to a, we find

$$\frac{\partial \epsilon_2}{\partial a} = \frac{\partial \epsilon_2}{\partial X}\frac{\partial X}{\partial a} = \underbrace{\frac{p'(\epsilon)(1+r)}{k''(\epsilon) - p''(\epsilon)X}}_{>0}\underbrace{\left[u'(c_g) - u'(c_b)\right]}_{<0},$$

if utility is strictly concave. Hence, borrowing constraints decrease effort in the second period. Whether this reduces government redistribution, however, depends on the redistribution schedule (3). In general, the shape of $k(\epsilon)$ and $p(\epsilon)$ influences the response of effort to taxes, and the severity of the moral-hazard problem. To isolate the role of utility's functional form in determining optimal government redistribution, consider the parameterized example studied in the previous section, where $p'(\epsilon) = \nu$ and $k'(\epsilon) = \psi\epsilon$. Then, the revenues raised by taxation at rate τ are given by

$$\tau w_g = \frac{\chi u'(c_b) - u'(c_g)}{\chi u'(c_b) u'(c_g)} X \left(1 - \frac{\nu^2}{\psi} X\right)^2,$$

and higher-order derivatives of the utility function are relevant because, on the right hand side of this expression, not only the stakes X but also *marginal* utilities in the two states are affected by government redistribution. If $u'''(.) > 0$, as is realistic in light of precautionary savings behavior, the higher consumption afforded by a larger stock of assets reduces the difference in marginal utilities and, to the extent that this strengthens the impact of redistribution on effort, tends to decrease the optimal tax rate.

The first period. The consumer problem of the first period also features a saving choice. Consumption in the first period is given by

$$\begin{aligned} c_{1g} &= (1-\tau)w_{1g} - a_{1g} \text{ with probability } p(\epsilon_1), \\ c_{1b} &= w_{1b} + b_1 - a_{1b} \text{ with probability } 1 - p(\epsilon_1) \end{aligned}$$

where the subsidy b satisfies the government's budget constraint in period 1,

$$\chi p(\epsilon_1)\tau w_{1g} = (1 - p(\epsilon_1))b_1. \tag{8}$$

We show in the Appendix that optimal effort in the first period is given by

$$X_1 p'(\epsilon_1) = k'(\epsilon_1) \tag{9}$$

and that optimal government redistribution is determined by

$$u'\left((1-\tau)w_{1g} + M\right) - (\xi_1 \chi \lambda_b - \lambda_g) = \xi_1 \chi u'\left(w_{1b} + b_1(\tau) + M\right)\ , \tag{10}$$

where M is the binding borrowing limit, λ_j, $j = b, g$, are the shadow prices of the constraint in the bad and good state, and the stakes in the first period X_1 and ξ_1 are defined in the Appendix. As long as shocks are at least partly temporary, strict concavity of utility implies that the borrowing constraint is less binding in the good state so that $0 \leq \lambda_g < \lambda_b$. If $\xi_1 \chi \lambda_b > \lambda_g$, borrowing constraints strengthen the insurance motive as they transfer resources from the good to the bad state in which the constraint is more binding. If $\xi_1 \chi = 1$, the government redistributes until marginal utility in the bad state and good state are equal, in which case $\lambda_b = \lambda_g$ endogenously. If $\xi_1 \chi < 1$ redistribution will not be full and, if $\xi_1 \chi \lambda_b < \lambda_g$, there may be even *less* redistribution than without borrowing constraints. In this case, redistribution is so inefficient that the cost of the tighter borrowing limit due to taxation in the good state outweighs the benefit of relaxing the borrowing constraint by $\xi_1 \chi < 1$ units in the bad state.

How do laxer borrowing constraints affect redistribution in the first period? Totally differentiating (9), we show in the Appendix that

$$\frac{d\epsilon_1}{dM} = \underbrace{\frac{p'(\epsilon_1)}{k''(\epsilon_1) - X_1 p''(\epsilon_1)}}_{>0} \underbrace{(\lambda_g - \lambda_b)}_{<0} < 0. \tag{11}$$

Borrowing constraints raise effort in the first period, because finding oneself in the bad state has higher cost if borrowing constraints restrict self-insurance. But while this level effect is unambiguous, it is unclear whether effect reacts more or less strongly to changes in the stakes: when borrowing constraints are tighter, effort may be more or less sensitive to the costliness of failure, depending on high-order derivatives of $u(.)$, $k(\epsilon)$ and $p(\epsilon)$. Thus, intertemporal market imperfections may or may not reduce moral-hazard problems, and may or may not make it easier for public schemes to supply insurance without reducing productive efficiency. We proceed to illustrate these interactions numerically for plausible parametric assumptions.

4.1 Numerical illustration

We have been able to show analytically that borrowing constrained individuals provide more effort when young, and less effort when old. If this makes it easier for the government to redistribute intratemporally, through channels similar to those relevant in models where hidden assets interfere with the social planner's desire to offer insurance (see, e.g., Cole and Kocherlakota, 2001), more redistribution can be optimal.

Government redistribution, however, not only offers insurance against idiosyncratic events by improving welfare of risk-averse individuals. It also reduces the incentive to exert effort, and thus may increase the incidence of borrowing constraints ex post as the shadow price of the constraint falls in the amount of feasible consumption. To assess the strength of this effect in our simple model, we now provide a numerical example.

Preferences. We assume CRRA utility $u(c) = \left(c^{1-\gamma} - 1\right)/(1-\gamma)$, where γ denotes the coefficient of relative risk aversion.

Effort. We assume a quadratic cost of effort $\psi\epsilon^2$ and a probability of the good state $p(\epsilon) = 1 - \exp(-\epsilon)$ which ensures that the probability is a differentiable, strictly concave, increasing and continuous function of effort ϵ, bounded in the interval $[0, 1]$ for effort levels $\epsilon \in [0, \infty[$. We set the exogenous efficiency-cost parameter $\chi = 1$, without loss of generality.

Parameter values. All parameter values for our numerical example are summarized in Table 2. The table reports annual rates which are converted to values for a ten-year period length in the numerical solution.

Borrowing constraints. We will compare the equilibrium in which consumers cannot borrow at all, $M/(1 + r) = 0$, with the equilibrium in which consumers can borrow up to 40% of gross

Parameter values	*Explanation*
$\beta = 0.96$	Annual discount factor; for decade period 0.66
$r = 0.02$	Annual real interest rate; for decade period 0.22
$\gamma = 2$	Risk aversion
$\psi = 0.5$	Effort cost
$\chi = 1$	Efficiency parameter
$\alpha = 1.018$	Annual income growth factor; for decade period 1.2
$w_g = 1$	Pre-tax income if realization is good
$w_b = 0.5$	Pre-tax income if realization is bad

Table 2: Parameter values for the numerical example.

income w_b in the bad state, $M/(1+r) = 0.2$. This is well below the solvency constraint w_b/r.

Numerical algorithm. The numerical solution proceeds backwards. At every τ grid point, we proceed as follows:

Step 1: Guess b_1 and $b_2(y_1)$, where y_1 denotes net resources in period t and the second-period subsidy is such as to satisfy the government's budget constraint across individuals who experience the same first-period realization (see the Appendix for details).

Step 2: Specify functions $c_{g,2}(y_2, a_2(y_1))$ $c_{b,2}(y_2, a_2(y_1))$ and find the optimal $a_2^*(y_1)$ and $\epsilon_2^*(y_1)$.

Step 3: Use $\epsilon_2^*(y_1)$ in the government budget constraint to update $b_2(y_1)$. Restart with step 2 until convergence. Retrieve $b_2^*(y_1)$ and update y_2.

Step 4: Compute the two-period utility in period 1 conditional on the income draw. Find the optimal ϵ_1^*.

Step 5: Use ϵ_1^* in the government budget constraint to update b_1. Restart with step 4 until convergence. Retrieve b_1^*.

Step 6: Use b_1^* to update y_1. Restart at step 2 until convergence.

Within each period, there are two schedules: $\epsilon(b)$ in the consumers problem and $b(\epsilon)$ in the government budget constraint. The rational expectations equilibrium is located at the intersection of the two schedules where consumers base their choices on benefit policies that are by construction consistent with resource constraints.[7] We now illustrate the numerical solution graphically.

[7] Note that the equilibrium effect of the effort ϵ on b and thus net income y complicates the solution since we condition on y, when solving for the optimal policies after the income draw has realized.

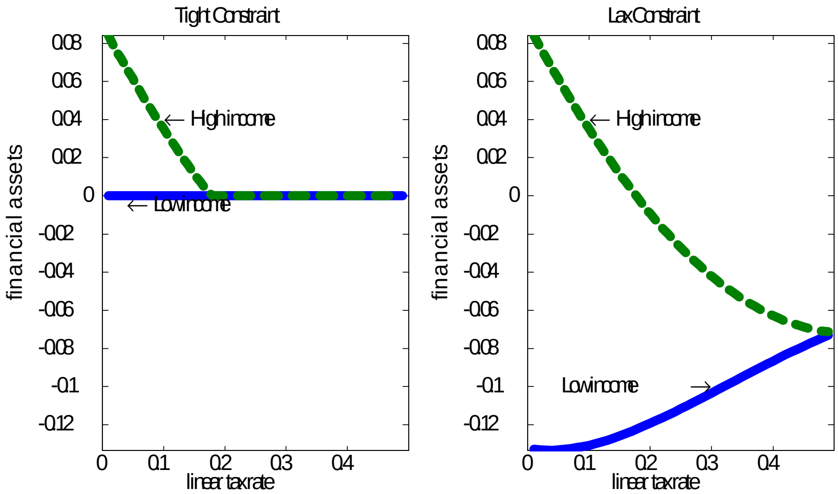

Figure 2: Financial assets as a function of the tax rate. Notes: Graphs differ due to the respective income draw in the first period and two different borrowing limits M: tight constraint ($M/(1+r) = 0$), lax constraint ($M/(1+r) = 0.2$).

Results. We first show how the incidence of the borrowing constraint depends on government redistribution. This is crucial to understand effort and ultimately *optimal* government redistribution. In the figures, we focus on the first period, where the interactions between intratemporal insurance and intertemporal constraints are most interesting.

Figure 2 displays the financial asset position as a function of the linear tax rate τ which is applied to each period's income, and also determines subsidies via the government's budget constraint (see the Appendix). The left panel shows the function for a tight borrowing constraint whereas the right panel shows the function for lax constraints. Within each panel the solid graph shows financial assets for the bad income draw and the dashed graph shows financial assets for the good income draw. The figure shows that consumers with a bad income draw would like to borrow to smooth consumption. In the left panel they are borrowing constrained, however, so that $a_{1b} = 0$. With a laxer constraint instead, consumers with a bad draw borrow up to a quarter of gross labour income in the bad state, $a_{1b} = -0.13$.

The figure further shows that redistribution reduces the differences in the financial asset position across different income states. There are two reasons for this: (i) the income states within a period are less different if more is redistributed. Indeed for $\tau = 0.5$, there is full redistribution for

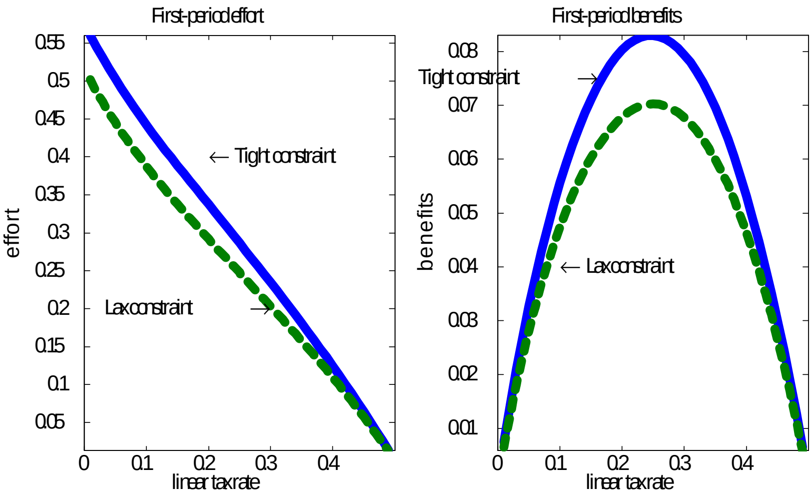

Figure 3: Effort and benefits in the first period as a function of the tax rate. Notes: Graphs differ due to two different borrowing limits M: tight constraint ($M/(1+r) = 0$), lax constraint ($M/(1+r) = 0.2$).

the chosen parameter values; (ii) intertemporal differences in income become smaller. Since we have assumed positive income growth and impatient consumers, redistribution does not eliminate borrowing fully in our example with lax constraints.[8]

The left panel of the figure illustrates how government redistribution can lower the cost of borrowing constraints for consumers with a bad income draw (as the borrowing motive decreases), at the cost of tightening the constraints in the good state.

Let us now comment on the implications of redistribution and borrowing constraints on effort and transfers in the first period. The left panel of Figure 3 shows how effort in the first period depends on redistribution with lax and with tight borrowing constraints. Not surprisingly, more redistribution reduces effort. More interestingly, as shown analytically in the previous subsection, consumers with binding borrowing constraints have less resources available in the first period which alleviates the moral-hazard problem.[9] The benefit schedules in the right panel of the figure show that the government can thus redistribute more to constrained consumers. Both schedules peak

[8] With lax constraints, the financial asset position in both income states is about $a_{1b} = -0.07$ if $\tau = 0.5$. Full redistribution eliminates the precautionary saving motive by reducing income differences across states. Moreover, the probability $p(\epsilon)$ is always smaller than 0.5 so that the variance of labour income approaches zero as effort falls.

[9] Results, which are not reported, also show that effort of constrained consumers is lower in the second period (as shown analytically in the previous subsection). Consumers with binding borrowing constraints have more resources available in the second period which exacerbates the moral-hazard problem.

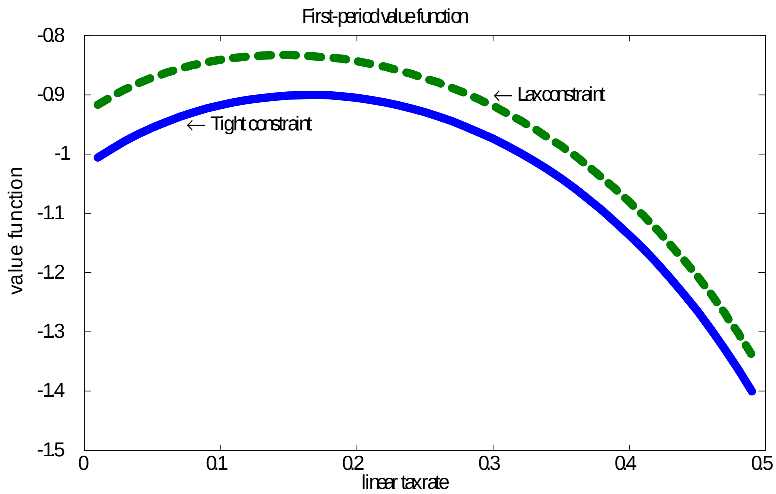

Figure 4: Value function and tax rate. Notes: Graphs differ due to two different borrowing limits M: tight constraint $(M/(1+r) = 0)$, lax constraint $(M/(1+r) = 0.2)$.

at a tax rate between 0.25 and 0.3 and have a non-monotonic "Laffer-curve" shape.

After these positive results, we now ask the normative question what the optimal tax rate should be in the environment with and without borrowing constraints. Since all consumers are identical ex ante, we use the "representative" value function of a consumer which is plotted in Figure 4, for lax and tight borrowing constraints. Not surprisingly, the value function shifts up with a laxer constraint. Furthermore note that the tax rates which maximize the respective value function are well below the tax rates at which the Laffer curve peaks. The optimal tax rate is $\tau^* = 0.17$ if there is a tight borrowing constraint and it falls to $\tau^* = 0.13$ if this constraint is relaxed.

The numerical example thus confirms the intuition that optimal redistribution is lower if borrowing constraints are laxer. In terms of the analytical results in the previous subsection, we have shown that for plausible parameter values and functional forms of $u(.)$, $p(\epsilon)$ and $k(\epsilon)$, intertemporal distortions increase optimal intratemporal insurance.

5 A structural interpretation of the facts

We now return to the public and private insurance expenditures data displayed in Figure 1.[10] We try to make further progress to understand the cross-country variation by controlling for differences in the determinants suggested by our model: the cost of public or private insurance across countries, and restrictions in credit access.

Data are available for the administrative cost component of public social expenditure from Eurostat, the tax administration cost per net revenue collections and the ratio of gross written premiums over gross claims, both available from the OECD. Figure 5 plots public insurance expenditures against the two measures for the public administration cost from Eurostat and the OECD.[11] The two measures for administration costs are highly positively correlated and deliver similar results. More interestingly, public social expenditures tend to be lower in countries where administration absorbs a larger share of social policy's costs or tax revenues: the bivariate correlations are -0.36 and -0.31, respectively for the two measures of administration costs, with p-values of 0.13 and 0.15. For most of the further analysis we focus on the results for the OECD tax administration measure due to the larger country sample.

Similarly, Figure 6 shows that private non-life insurance expenditures tend to be lower in countries where the insurance industry absorbs more of the premia before paying claims.[12] Across all countries, the correlation between private insurance expenditures and the markup is -0.34 with a p-value of 0.07.

While these observations are realizations of politico-economic equilibria and could be driven by

[10] Summary statistics of the data are in the Appendix.

[11] The tax administration cost is the average for the years 2000 to 2002 in OECD (2004), Table 17. Concerning social expenditures, the Eurostat Esspros classification disaggregates administrative costs within social expenditures. These data are only available across EU member countries. Eurostat aggregate social expenditures data are very similar to the OECD data used in Figure 1 (the correlation is 0.94).

[12] This absorption approximates the model's administration efficiency if a break-even condition holds for the insurance industry, as in equation (5). The law of large numbers implies that, if claims equal premiums and earned interest, then insurance is actuarially fair. We use three-year averages for 1996-1998 of data on premiums and claims contained in the OECD Insurance Yearbook, country tables C.2.1.3 and H.2. Unfortunately, there is no information on the interest earned on the assets of the insurance companies. These would need to be added to the gross premiums since premiums are typically paid well before the period which is covered by insurance and in which claim payments are made. If this earned interest is roughly constant across countries, however, our simpler measure is still informative about cross-country differences in the markup. Since the OECD Insurance Yearbook does not contain data for claims in the US, we use the mark-up factor of 1.18 based on the analysis of Brown and Finkelstein (2007) for the US long-term care market.

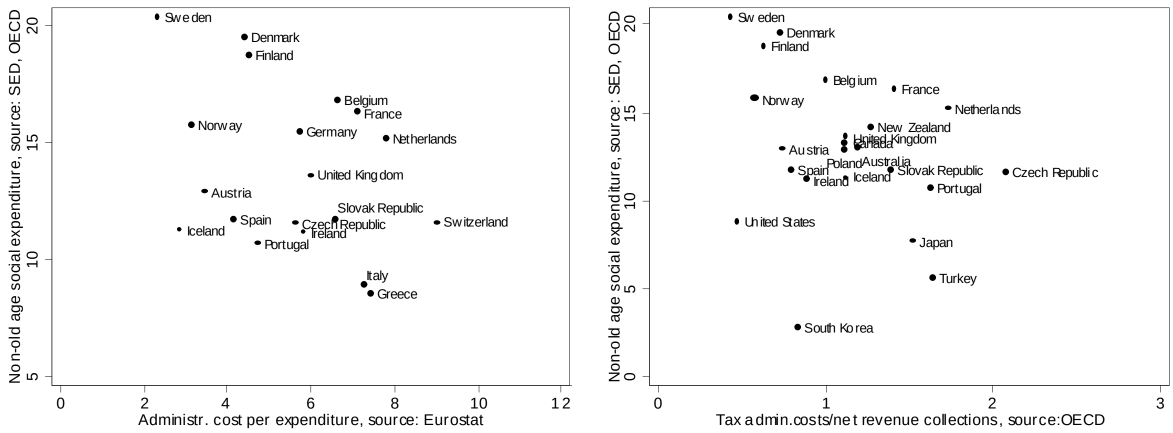

Figure 5: Public and private insurance and their costs. Notes: vertical axes: expenditure data in percent of GDP as in Figure 1; horizontal axes: administration costs of public social expenditure or tax collection (source: Eurostat and OECD, 2004).

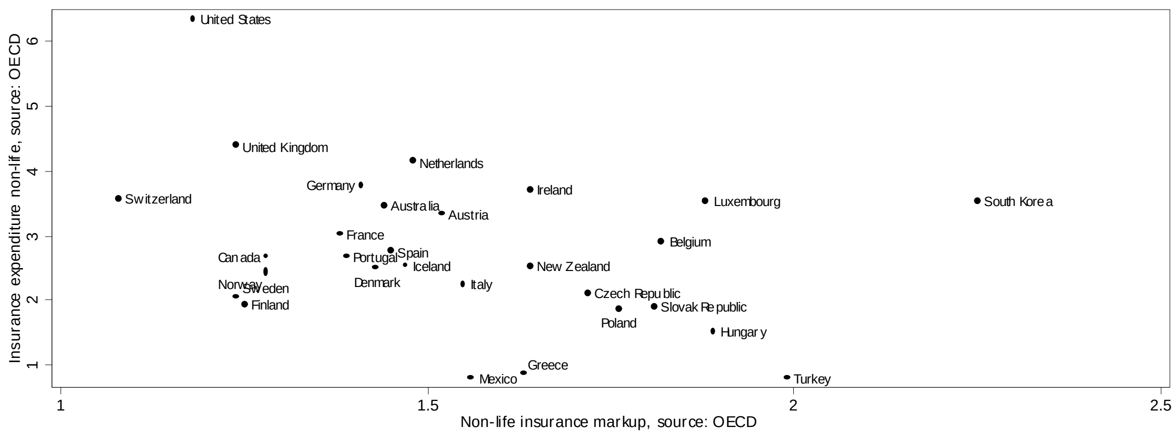

Figure 6: Private insurance and their costs. Notes: vertical axes: expenditure data in percent of GDP as in Figure 1; horizontal axes: ratio of private non-life insurance premia over paid claims (source: OECD).

	admin. cost	markup	LTV
tax administration cost	1	.	.
markup for non-life insurance	0.364 (0.088)	1	.
loan-to value (LTV) ratio	-0.396 (0.093)	-0.736 (0.000)	1

Table 3: Correlations between tax administration cost, private insurance markup and loan-to-value ratio. Note: P-values in brackets.

a vast variety of possible cross-country differences, the negative associations of the data displayed in Figures 5 and 6 suggest that some of the data variation may indeed be driven by supply-side differences across countries: as public or private insurance provision becomes more costly, equilibrium expenditures fall if demand is sufficiently elastic. The low public and private insurance expenditures in Mediterranean countries like Italy or Greece are associated with relatively high administration costs of public insurance (about 8% of the expenditures) and high markups (about 50%) in the private insurance market. Scandinavian and Anglo-Saxon countries both have lower markups than most countries (about 25-30%) but Scandinavian countries also have rather low administration costs per public expenditure (less than 4%) whereas this cost is higher, about 6%, in Anglo-Saxon countries like the UK.

Recalling the strong association between the LTV ratio and public insurance in Table 1, Table 3 shows that the LTV ratio (an index of credit market efficiency) is negatively correlated with the insurance industry's markup (an index of the insurance industry's efficiency), indicating that common supply-side features may be driving both. We also see in Table 3, however, that markups in private insurance markets are not strongly correlated with public administration costs. Hence, the supply side of available insurance opportunities differs across countries in interesting ways.

To detect the relative importance and different role of these variables, we show how the relationship between public and private insurance displayed in Figure 1 is altered by controlling for such theoretically relevant covariates. We first investigate the relationship between public or private insurance expenditure and the three supply-side determinants separately, before we consider all three determinants together.

As discussed in Section 2, the correlation between public and private insurance expenditures is

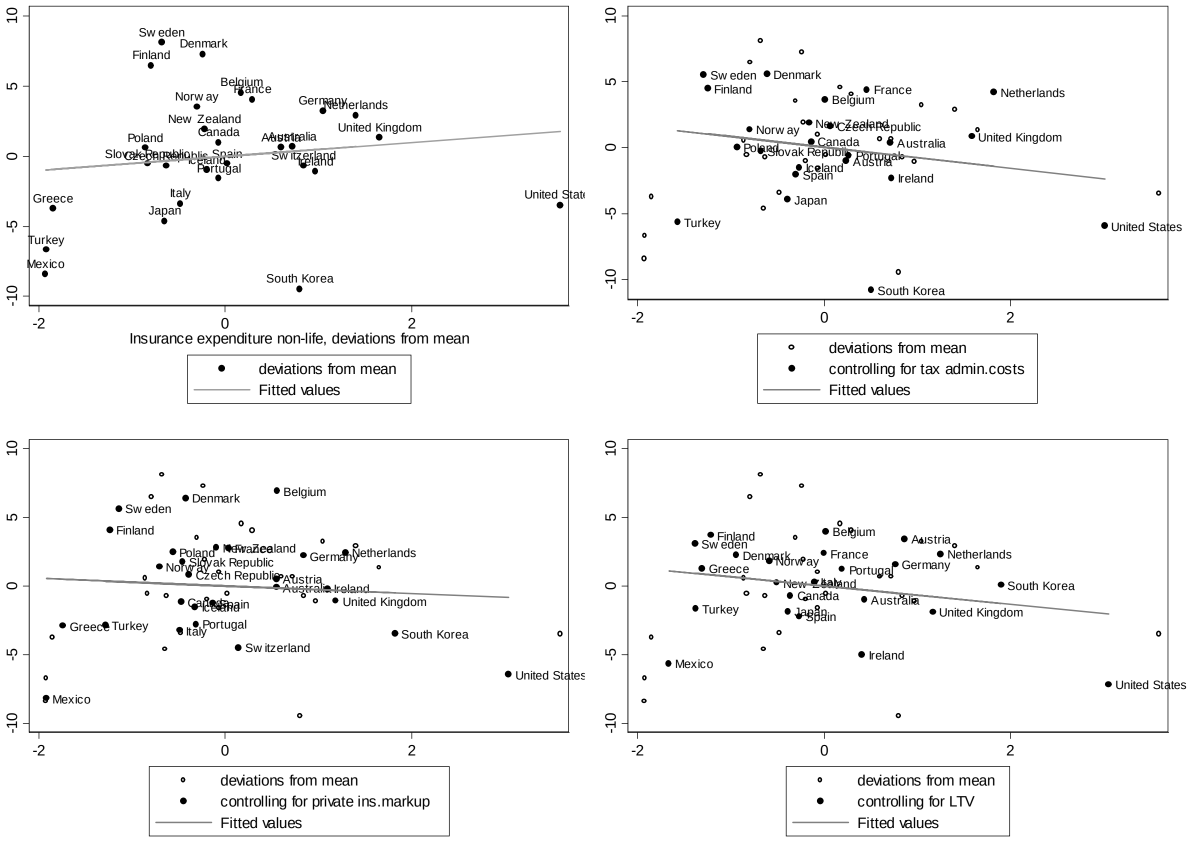

Figure 7: The relationship between public and private insurance after controlling for insurance costs and borrowing restrictions. Note: see notes of previous figure for definitions and sources.

insignificant, and slightly positive overall. The upper left panel of Figure 7 shows this in the upper left panel, which plots public and private insurance expenditures against each other in terms of deviations from the sample mean (i.e. residuals from a regression on a constant). The other panels of Figure 7 explore the explanatory power of the three supply-side indicators by plotting residuals from regressions of public and private insurance on each in turn (regressions also include a constant; in each panel, the first panel's deviations from means are also plotted as hollow circles, for reference and to help gauge fit). The upper right and lower panels show that controlling for either public or private insurance cost indicators or the LTV indicator changes the slope of the regression line relating public and private insurance expenditures. This confirms the empirical relevance of these determinants highlighted by our model. The remaining negative association between the variation of public and private insurance expenditures is not explained by these supply-side determinants and consistent with a demand-side interpretation.

After establishing the importance of each of our supply-side determinants, we show in the left panel of Figure 8 the private and public-insurance expenditure residuals of regressions on all three supply-side indicators together. The slope is negative (the correlation is -0.55 with a p-value of 0.018) and remains consistent with a demand-side interpretation. Quantitatively, a 1 percentage-point increase in private insurance above the mean prediction is associated with a 1.5 percentage-point fall of public insurance below the mean prediction. Moreover, insurance expenditures in Mediterranean and Scandinavian countries (while still lower and higher, respectively, than the predicted value) are no longer very different. The remaining differences may be explained by other determinants, such as tighter or looser family relationships, which could fulfil some of the insurance needs if private and public insurance vehicles are very inefficient. In theory, of course, the family is not an efficient insurance provider because of its small size but the available monitoring technology in a family may be quite efficient. The right panel of Figure 8 shows that when we add an indicator for average household size to the regression, the fit improves strongly, and the association between the residuals remains negative (the correlation is -0.90 with a p-value below 0.01).[13]

[13] The indicator is average household size (in persons), variable A7341, in the EUSI database provided by GESIS. It is based on Eurostat data, complemented with additional household-survey sources for some countries. See http://www.gesis.org/en/social_monitoring/social_indicators/Data/EUSI/

We have further complemented these data for some countries using data from the respective statistical offices (see the notes to figure 8).

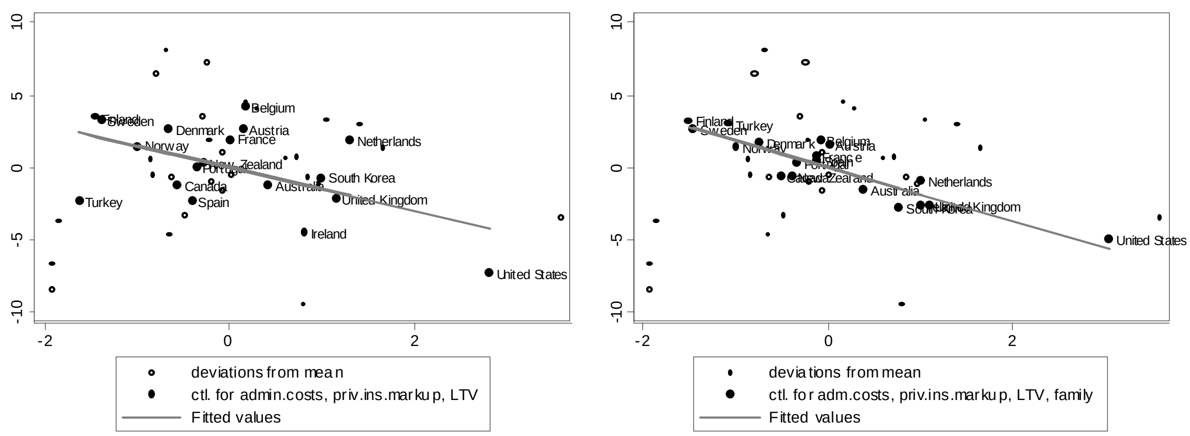

Figure 8: Relationship between public and private insurance after controlling for their costs and for financial market and family structure. Note: "Family" is average household size, 1996-1998; source: EUSI database complemented with data from the Australian Bureau of Statistics , Statistics Canada, Statistics Korea, Statistics New Zealand and data for Turkey from the Statistical Yearbook of the Economic Commission for Europe. See previous figures for other definitions.

In terms of our model, unobserved heterogeneity across countries along other dimensions could still cloud the relationship between public and private insurance. Differences in moral hazard across countries (driving differences in μ/ξ in the model) matter for insurance provision, and may be related to different attitudes towards effort exertion across cultures (Algan and Cahuc, 2006; see Fernandez, forthcoming, for a survey).[14] We view the tight fit of the figure's right panel as suggestive evidence for the relevance of our model's perspective, albeit limited by degrees of freedom and possible endogeneity, and of family networks as an empirically relevant alternative source of insurance.[15]

[14] Interestingly, our results are robust if we insert indicators for civicness or trust across countries using data from Algan and Cahuc (2006). Since the sample size is reduced by five countries and the added indicators are not significant, we do not present these results for brevity.

[15] We have experimented with a number of indicators of theoretically relevant and possibly exogenous features, such as gross wage inequality, which tends to elicit more effort at any given level of redistribution at the same time as it makes borrowing constraints more costly (to the extent that transitory gross income shocks are larger). None have proved better than household size as additional explanatory variables for the residuals shown in the left panel of Figure 8.

6 Conclusion and further research

We argue that patterns of private and public insurance provision across countries depend on differences in the absolute and relative efficiency of public and/or private administration. Our analysis offers a novel interpretation of existing evidence and earlier modelling perspectives, and suggests that countries should improve private insurance markets if they reduce public social expenditures, as stronger international competition may force them to do.

Of course, many other dimensions of public policy are relevant to the problem we analyze. If inefficient private provision of insurance is due to imperfect competition, this could be corrected by regulatory reforms rather than by government insurance provision. Moreover, better sharing of information among insurers or "no-double-insurance" clauses could help to address market inefficiencies without direct involvement of the government in the supply of insurance. And while we have treated borrowing constraints as an exogenous feature of the financial market's supply side, more pervasive redistribution may make it less harmful to be excluded from further borrowing, increase the attractiveness of default, and endogenously reduce the maximum borrowing consistent with repayment (Krueger and Perri, 1999). Co-variation of borrowing restrictions and redistribution thus may be interpreted from either equilibrium's perspective. Time-series and individual-level data may help disentangle the causes and consequences of borrowing constraints and redistribution but are currently not available for many countries on a comparable basis. Moreover, one would like to measure actual insurance using data on consumption rather than insurance expenditures. We are not aware of available data on an internationally comparable basis which would allow us to address these issues.

Appendix

I. **Derivation of equation (3).**

The government chooses a tax rate τ which maximizes

$$\max_{\tau} \left[p(\epsilon)u(c_g) + (1-p(\epsilon))u(c_b) - k(\epsilon)\right]$$

subject to the budget constraint (1). The optimality condition is

$$\begin{aligned} & p(\epsilon)u'(c_g)\frac{\partial c_g}{\partial \tau} + (1-p(\epsilon_1))u'(c_b)\frac{\partial c_b}{\partial b}\frac{\partial b}{\partial \tau} \\ = \quad & \left[k'(\epsilon) - p'(\epsilon)X\right]\frac{\partial \epsilon}{\partial \tau} \ . \end{aligned}$$

The right-hand side of this equation is equal to zero if consumers choose effort optimally (see (2)), so that the first-order condition simplifies to

$$p(\epsilon)u'(c_g)w_g = (1-p(\epsilon))u'(c_b)\frac{\partial b}{\partial \tau}, \tag{12}$$

where (1) implies that

$$\begin{aligned} \frac{\partial b}{\partial \tau} &= \frac{p(\epsilon)}{1-p(\epsilon)}\chi w_g + \frac{p'(\epsilon)}{\left[1-p(\epsilon)\right]^2}\tau\chi w_g\frac{\partial \epsilon}{\partial \tau} \\ &= \left[1 + \frac{p'(\epsilon)}{p(\epsilon)\left(1-p(\epsilon)\right)}\tau\frac{\partial \epsilon}{\partial \tau}\right]\frac{p(\epsilon)}{1-p(\epsilon)}\chi w_g \ . \end{aligned}$$

Hence, insurance has an efficiency cost (the second term in square brackets is negative) because effort falls as more insurance is provided, $\partial\epsilon/\partial\tau < 0$. Formally,

$$\begin{aligned} \frac{\partial \epsilon}{\partial \tau} &= \frac{\partial \epsilon}{\partial X}\frac{\partial X}{\partial \tau} \\ &= -\frac{p'(\epsilon)}{k''(\epsilon) - p''(\epsilon)X}\left[u'(c_g)w_g + u'(c_b)\frac{\partial b}{\partial \tau}\right] \\ &< 0 \ . \end{aligned}$$

Using (12), we know that *at the optimum*

$$\frac{\partial \epsilon}{\partial \tau} = -\frac{p'(\epsilon)}{k''(\epsilon) - p''(\epsilon)X} \frac{u'(c_g)w_g}{1 - p(\epsilon)} \ .$$

Substituting in the explicit expression of $\partial b/\partial \tau$, we can rewrite (12) as

$$\frac{u'(c_g)}{\chi \xi} = u'(c_b) \ ,$$

where

$$\xi = 1 + \frac{p'(\epsilon)}{p(\epsilon)\,(1 - p(\epsilon))} \tau \frac{\partial \epsilon}{\partial \tau} < 1.$$

II. Derivation of equations (9) and (10).

The government redistributes maximizing

$$\max_{\tau} \{p(\epsilon_1)u((1-\tau)w_{1g} - a_{1g}) + (1 - p(\epsilon_1))u(w_{1b} + b_1(\tau) - a_{1b}) - k(\epsilon_1)$$
$$+\beta E_{\epsilon_2,\epsilon_1}\left[u(c_2) - k(\epsilon_2)\right]\},$$

and the first-order condition is

$$p(\epsilon_1)u'(c_{1g})w_{1g} = (1 - p(\epsilon_1))u'(c_{1b}) \frac{\partial b_1}{\partial \tau} \ .$$

The effect on savings is second-order if saving decisions are unconstrained so that the insurance choice in the first period depends entirely on the marginal utilities in the good and bad state in that period and the analysis is analogous to the second period. Defining

$$\begin{aligned} V_{1b} \ \equiv \ & u(c_{1b}) \\ & +\beta p(\epsilon_2)\left[u((1-\tau)w_{2g} + a_{1b}(1+r)) - k(\epsilon_{2b})\right] \\ & +\beta(1 - p(\epsilon_2))\left[u(w_{2b} + b_{2b}(\tau) + a_{1b}(1+r)) - k(\epsilon_{2b})\right] \end{aligned}$$

and

$$
\begin{aligned}
V_{1g} \quad \equiv \quad & u(c_{1g}) \\
& +\beta p(\epsilon_2)\left[u((1-\tau)w_{2g}+a_{1g}(1+r))-k(\epsilon_{2g})\right] \\
& +\beta(1-p(\epsilon_2))\left[u(w_{2b}+b_{2g}(\tau)+a_{1g}(1+r))-k(\epsilon_{2b})\right]
\end{aligned}
$$

maximization of

$$V_0 = p(\epsilon_1)V_{1g} + (1-p(\epsilon_1))V_{1b} - k(\epsilon_1)$$

yields the first-order condition for optimal effort in the first period:

$$\underbrace{[V_{1g}-V_{1b}]}_{X_1}p'(\epsilon_1) = k'(\epsilon_1)\ .$$

Hence, the analysis of static insurance provision in the first period is analogous to the second period as long as saving decisions are unconstrained. Savings are used to smooth resources over time and insurance smooths resources across states.

Note that we have assumed that benefits in the second period condition on the draw in the first period (each group of consumers has its own budget constraint). This simplifies the model since interactions between consumers with different draws in the first period through the government budget constraint are eliminated.

For interactions between intertemporal and intratemporal smoothing to arise, the saving choice needs to be constrained. Suppose that consumers are always at the constraint the first period, so that $a_{1j} = -M$. The government then solves

$$\max_{\tau,\ \epsilon_1} V_0$$

subject to the government budget constraint (8). The first-order condition is

$$
\begin{aligned}
& -p(\epsilon_1)u'\left((1-\tau)w_{1g}+M\right)w_{1g}+(1-p(\epsilon_1))u'\left(w_{1b}+b_1(\tau)+M\right)\frac{\partial b_1}{\partial \tau} \\
& +p(\epsilon_1)\left[u'(c_{1g})-\beta(1+r)E_{\epsilon_{2g}}u'(c_2|a_{1g})\right]\frac{\partial c_{1g}}{\partial \tau}|_{a_{1g}=-M} \\
& +(1-p(\epsilon_1))\left[u'(c_{1b})-\beta(1+r)E_{\epsilon_{2b}}u'(c_2|a_{1b})\right]\frac{\partial c_{1b}}{\partial \tau}|_{a_{1b}=-M} \\
= \;& 0\,.
\end{aligned}
$$

With a binding borrowing constraint the second and third line are no longer zero. In this case,

$$
u'(c_{1j})=(1+r)\beta E_{\epsilon_{2j}}\left[u'(c_2|c_{1j})\right]+\lambda_j\;,
$$

where λ_j is the strictly positive shadow price. Substituting in the respective shadow price into the first-order condition, we have

$$
\begin{aligned}
& -p(\epsilon_1)u'\left((1-\tau)w_{1g}+M\right)w_{1g}+(1-p(\epsilon_1))u'\left(w_{1b}+b_1(\tau)+M\right)\frac{\partial b_1}{\partial \tau} \\
& +p(\epsilon_1)\lambda_g\frac{\partial c_{1g}}{\partial \sigma_1}|_{a_{1g}=-M}+(1-p(\epsilon_1))\lambda_b\frac{\partial c_{1b}}{\partial \sigma_1}|_{a_{1b}=-M} \\
= \;& 0\,.
\end{aligned}
$$

As the government redistributes from the good to the bad state in period 1 it also changes the intertemporal inequality of resources in both states. In the bad state, transfers add resources so that more consumption in the present can be afforded: $\partial c_{1b}/\partial\tau|_{a_{1b}=-M}=\partial b_1/\partial\tau$. In the good state instead, taxes reduce current consumption, $\partial c_{1g}/\partial\tau|_{a_{1g}=-M}=-w_{1g}$. Hence, the optimality condition for insurance in the first period simplifies to

$$
\begin{aligned}
& p(\epsilon_1)w_{1g}\left[u'\left((1-\tau)w_{1g}+M\right)+\lambda_g\right] \\
= \;& (1-p(\epsilon_1))\frac{\partial b_1}{\partial \tau}\left[u'\left(w_{1b}+b_1(\tau)+M\right)+\lambda_b\right]\;.
\end{aligned}
$$

Using the government budget constraint (8) to determine $\partial b_1/\partial\tau$, we get

$$u'\left((1-\tau)w_{1g}+M\right)-(\xi_1\chi\lambda_b-\lambda_g)=\xi_1\chi u'\left(w_{1b}+b_1(\tau)+M\right) \ ,$$

where

$$\xi_1=1+\frac{p'(\epsilon_1)}{p(\epsilon_1)\left(1-p(\epsilon_1)\right)}\tau\frac{\partial\epsilon_1}{\partial\tau}<1.$$

III. Derivation of equation (11).

Using the definitions of V_{1g} and V_{1b} above, we totally differentiate the stakes in the first period $V_{1g}-V_{1b}$ with respect to the borrowing limit:

$$\begin{aligned} d\left[V_{1g}-V_{1b}\right] &= u'(c_{1g})\left(-\frac{\partial a_{1g}}{\partial M}\right)dM+\beta(1+r)E_{\epsilon_{2g}}\left[u'(c_2|a_{1g})\right]\frac{\partial a_{1g}}{\partial M}dM \\ &\quad -\left[u'(c_{1b})\left(-\frac{\partial a_{1b}}{\partial M}\right)dM+\beta(1+r)E_{\epsilon_{2b}}\left[u'(c_2|a_{1b})\right]\frac{\partial a_{1b}}{\partial M}dM\right]. \end{aligned} \tag{13}$$

This expression disregards the effects through changes in the optimal second-period effort level, which are of second order by the envelope theorem, and also abstracts from any equilibrium effects on the disposable resources in the first period. If the borrowing constraint binds upon realization j, then $\partial a_{1j}/\partial M=-1, a_{1j}=-M$, and

$$u'(c_{1j})-(1+r)\beta E_{\epsilon_{2j}}\left[u'(c_2|a_{1j}))\right]=\lambda_j>0.$$

Inserting these relationships in (13) yields

$$d\left[V_{1g}-V_{1b}\right]=\left[\lambda_g-\lambda_b\right]dM. \tag{14}$$

Equation (9) then implies that

$$\frac{d\epsilon_1}{dM}=\frac{p'(\epsilon_1)}{k''(\epsilon_1)-(V_{1g}-V_{1b})\,p''(\epsilon_1)}\frac{d\left[V_{1g}-V_{1b}\right]}{dM} \ .$$

IV. Descriptive statistics.

Summary statistics for the data we use are displayed in the following table.

	Observ.	Mean	Std. Dev.	Min	Max
Public social exp. / GDP	28	12.30	4.33	2.83	20.4
Public admin.cost/social exp.	20	5.46	1.80	2.32	9.01
Tax admin. costs/net revenue collections	24	1.12	0.429	0.43	2.08
Non-life insur. premiums/GDP	30	2.74	1.15	0.81	6.33
Markup (non-life prem./claims)	28	1.55	0.27	1.08	2.25
Loan-to value (LTV) ratio	23	72.91	16.62	30	95
Household size	29	2.63	0.35	2	3.17

Table 4: Summary statistics. Notes: See main text and figure legends for definitions and sources.

References

Agell, Jonas (2002): "On the Determinants of Labour Market Institutions: rent seeking vs. social insurance," *German Economic Review*, vol. 3, 2002.

Algan, Yann and Pierre Cahuc (2006): "Civic Attitudes and the Design of Labour Market Institutions: Which Countries Can Implement the Danish Flexicurity Model?", IZA Discussion Paper No. 1928.

Bertola, Giuseppe (2004):"A pure theory of Job Security and Labour Income Risk," *Review of Economic Studies*, vol. 71, 43-61.

Bertola, Giuseppe, and Winfried Koeniger (2007): "Consumption Smoothing and Income Redistribution," *European Economic Review,* vol. 51, 1941-1958.

Brown, Jeffrey R. and Amy Finkelstein (2007): "Why is the Market for Long-Term Care Insurance so small?," *Journal of Public Economics*, vol. 91, 1967-1991.

Cole, Harold, and Narayana Kocherlakota (2001): "Efficient Allocations with Hidden Income and Hidden Storage," *Review of Economic Studies*, vol. 68, 523-542.

Eaton, Jonathan and Harvey S. Rosen (1980): "Optimal Redistributive Taxation and Uncertainty", *Quarterly Journal of Economics*, vol. 95, 357-364.

Fernandez, Raquel (forthcoming): "Culture and Economics," Forthcoming in Palgrave Dictionary of Economics.

Floden, Martin and Jesper Linde (2001): "Idiosyncratic Risk in the United States and Sweden: is there a role for government insurance?", *Review of Economic Dynamics*, vol. 4, 406-437.

Hassler, John, José V. Rodríguez Mora, Kjetil Storesletten, and Fabrizio Zilibotti (2003): "The Survival of the Welfare State", *American Economic Review*, vol. 93, 87-112.

Jappelli, Tullio and Marco Pagano (1994): "Saving, Growth, and Liquidity Constraints," *Quarterly Journal of Economics*, vol. 109, 83-109.

Kocherlakota, Narayana R. (2005): "Advances in Dynamic Optimal Taxation", World Congress of the Econometric Society, mimeo.

Krueger, Dirk and Fabrizio Perri (1999): "Risk sharing: private insurance markets or redistributive taxes?," Staff Report 262, Federal Reserve Bank of Minneapolis.

La Porta, Rafael, Florencio Lopez-de-Silanes and Andrei Shleifer (2008): "The Economic Consequences of Legal Origins," NBER Working Paper No. 13608.

Low, Hamish and Daniel Maldoom (2004): "Optimal Taxation, Prudence and Risk-Sharing", *Journal of Public Economics*, vol. 88, 443-464.

OECD (2004): *Tax Administration in OECD Countries: Comparative Information Series*, Paris, OECD.

Pauly, Mark V. (1974): "Overinsurance and Public Provision of Insurance: The Roles of Moral Hazard and Adverse Selection," *Quarterly Journal of Economics*, vol. 88, 44-62.

Rodrik, Dani (2005): "Why We Learn Nothing from Regressing Economic Growth on Policies," working paper, Harvard University, mimeo.

Shimer, Robert and Ivan Werning (2005): "Liquidity and Insurance for the Unemployed", Federal Reserve Bank of Minneapolis, Research Department Staff Report 366.

Slemrod, Joel (1990): “Optimal Taxation and Optimal Tax Systems”, *Journal of Economic Perspectives*, vol. 4, 157-178.

Varian, Hal R. (1980): “Redistributive Taxation as Social Insurance,” *Journal of Public Economics*, vol. 14, 49-68.