Costly State Monitoring and Reserve Requirements

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The paper explores one *rationale* behind the existence of financial repression, with the latter being represented through the obligatory "high" reserve requirement for the banks. Using an overlapping generations production-economy-monetary model characterized by possibility of banking crisis, we try and answer, whether sizes of reserve requirements are related to probability of crisis. Results indicate that economies with higher probability of banking crisis should optimally choose higher income taxation. The correlation between optimal reserve requirements and probability of crisis is positive only when the social planner has exhausted his ability of income taxation. © 2005 Peking University Press

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1. INTRODUCTION

The paper explores one *rationale*, namely possibility of banking crisis, behind the existence of financial repression. We follow Drazen (1989), Bacchetta and Caminal (1992), Haslag and Hein (1995), Espinosa and Yip (1996), Haslag (1998) and Haslag and Koo (1999), by defining financial repression as a "high" reserve deposit ratio requirement. The study attempts to assay whether there exists a plausible explanation as to why the reserve requirements in some economies are higher than others. To put it alternatively, we analyze whether the "high" reserve requirements are a fall out of an welfare maximizing decision of the government, in an economy

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characterized by positive probability of banking crisis and tax evasion, and given that the government is assumed to have access to income taxation and seigniorage to finance its expenditure.[1] As an aside, we also study if higher reserve requirements can be associated with higher degrees of tax evasion.

Now the pertinent question here is - Why, if at all, would a government want to repress the financial system ? This seems paradoxical, especially when one takes into account the well documented importance of the financial intermediation process on economic activity, mainly via the finance-growth nexus.[2] In the words of Roubini and Sala-i-Martin (1992): One obvious reason, as to why the government would want to repress the financial sector, is motivated out of the fact that, "the financial sector is the potential source of "easy" resources for the public budget." Liberalization of the financial sector, often associated with the lowering of reserve requirements, can reduce inflation in the economy[3], and hence, lead to loss of government revenue through seigniorage. Thus, the process of liberalization clearly depends on the initial situation in the economy, in this case the position of the government budget. [4]

Besides, the fact that "high" reserve requirements enhance the size of the tax base and hence, is lucrative for the government to repress the financial system, an alternative line of thought is derived from the works of Cukierman, Edwards and Tabellini (1992) and Giovannini and De Melo (1993). Both these studies suggested that, countries with an inefficient tax systems and large costs involved in tax collection, would be more oriented towards the repression of the financial sector. Roubini and Sala-i-Martin (1995) addresses this issue in a formal fashion, using an endogenous growth framework. They indicated that, governments subjected to large tax-evasion will "choose to increase seigniorage by repressing the financial sector and increasing the inflation rates."

Di Giorgio (1999) presents an alternative perspective as to why reserve requirements in some countries are higher than others, in suggesting that the level of reserve requirements are related to the degree of financial development. Di Giorgio (1999) studies a simple productive economy with the process of financial intermediation characterized by a costly state verification problem (as in Townsend (1979); Gale and Hellwig (1985) and

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[1]In the economic framework, discussed below, the demand for money is a forced-demand, since banks are obligated to hold a "high" fraction of their deposits as cash reserves. Money is assumed to have no other role. In such an environment, the size of the reserve requirement decides the size of the seigniorage tax base, while the implicit tax rate is the money growth rate or the rate of inflation.

[2]See Roubini and Sala-i-Martin (1992), and the references cited there in.

[3]See Gupta (2005).

[4]See Drazen (1989) and Roubini and Sala-i-Martin (1995) for theoretical explanations regarding this link.

Williamson (1987)). As a regulatory policy, the banks are obligated to maintain mandatory reserve requirement on deposits. The level of costs associated to monitoring activity is interpreted as an indicator of the efficiency of the financial structure, since it is believed to reflect the existing legal environment, the organizational features and the functional structure of the intermediaries. The analysis indicates that when the cost of monitoring is negligible, the optimal reserve coefficient tends to zero. However, the paper derives a critical level of monitoring cost beyond which the optimal reserve requirement will be different from zero. The optimal reserve requirement is shown to be strictly increasing in the costs of verification of the state. This result is indicative of the fact that financially developed economies have low costs associated with the activities of the financial intermediaries (costs of information processing and project evaluation, as well as costs of monitoring borrowers) and thus, rationally should have optimal reserve requirements lower relative to economies with less efficient financial systems.

In this paper, besides incorporating the role of tax evasion, to test if at all degrees of tax evasion and "optimally chosen" reserve requirements are positively correlated across countries, we also investigate an alternative line of thought. We try to relate the sizes of reserve requirements, obtained from an welfare optimizing decision of the government, with the probability of banking crisis in an economy.

The rationale behind this is simple, and emerges from the structure of the model. The economic scenario can be laid out as follows: The production structure of the economy is characterized by a stochastic production function. The firms require bank loans to finance their input cost. However, when the firms project is unsuccessful, the probability of which is private information, the bank fails. The possibility of the firm hiding its true state is ruled out through the design of an optimal contract between the firms and the banks. Since, the deposits are insured the government needs to bailout the banks. Hence, higher the probability of banking crisis, higher the number of bailouts and the associated cost. In such a backdrop, we analyze whether, it is optimal for the government to choose higher reserve requirements for an economy with a higher probability of crisis. So what we ask is, if the high reserve requirements aim to discipline the banks and prevent them from lending out more in a relatively riskier environment. Obviously, as discussed before higher reserve requirements would yield higher government revenue. Given, that the government has access to both seigniorage and explicit taxation, we try to figure out the relative emphasis, an welfare maximizing social planner would put on the two instruments of revenue generation, in the presence of tax evasion and bank failure, and the associated bailout costs.

TABLE 1.

Seigniorage Revenue in some European Economies (1980-2002)

	Seigniorage (percentages of revenue)	Reserves/ Deposits (percentage)	Annual Inflation rate	Tax Evasion (percentage)
Spain	6.4^a	12.0	6.8	18.0
Greece	19.4^b	22.9	14.9	22.0
Italy	3.7^b	11.7	7.5	21.0
Portugal	6.0^c	17.5	12.2	18.0
Belgium	0.6^c	1.0	3.2	18.0
France	0.5^c	2.0	4.1	13.0
Germany	1.5^c	5.6	2.5	14.0
UK	0.6^c	1.7	5.2	11.0

Source: IFS – IMF International Financial Statistics.
Seigniorage has been calculated from lines 14a and 14c.
Also see notes to Table 1.
[a]: Excludes the year 2002.
[b]:Excludes the years 1998-2002.
[c]: Excludes the years 1999-2002.
See Section 7.

The remaining of the paper is organized as follows: Besides the introduction and conclusion, Section 2 discusses the motivation for our analysis and Section 3 is devoted to laying out the model formally. Section 4 and 5 lays out the equilibrium and the derivation of the optimal choices of the agents. Section 6 lays out the welfare criterion and Section 7 discusses the process of assigning calibration in detail, and Section 8 derives the optimal choice of policy instruments.

2. MOTIVATION

The motivation of trying to relate high reserve requirements with higher tax evasion and probability of banking crisis is, to some extent, data driven. Note for our analysis we use Greece, Italy, Portugal and Spain, which have traditionally had very high reserve requirements and higher degrees of tax evasion, and compare them with four other developed European economies. Table 1 portrays data from some major European economies and shows that seigniorage, has been traditionally an important source of public revenue in Italy, Spain, Greece, and Portugal, but is almost negligible for the other European Community (EC) countries.

As can be observed from the columns 2 and 3 of Table 1, the Southern European countries have been using both inflation and reserve–deposit ratio as instruments for seigniorage revenue generation. Column 4 of Table 1 reports the degree of tax evasion in eight European economies.[5] Clearly, there does seems to be a correlation, between the sizes of reserve requirements and tax evasion. Table 2 shows that the bank reserve ratios have increased significantly in three out of the four Southern European countries taken into consideration in the late 1980s but have come down over the next decade. Note in some ways Greece stands out to be an exception. Interestingly, the four economies of our concern have increased the reserve ratios while simultaneously deregulating their capital markets which were subjected to below market interest rates. Table 3 outlines the periods over which major interest rates were deregulated and credit ceilings were relaxed, in some of the important European economies. Tables 1, 2 and 3 vindicates the fact that the major means of financial repression in Greece, Italy, Portugal and Spain, during this period was via the "high" mandatory reserve requirements.

The fact that reserve requirements in these economies went up after the financial sector got marketized, leads us to our premise that high reserve requirements might be tied to possibilities of banking crisis. Where reserve higher reserve requirements chosen by the monetary authorities, post liberalization, might hint at the efforts of the authorities to maintain the financial health of the "newly" liberalized banking system, which over the years having operated under variety of regulations might not be immediately ready to meet up to challenges of a perfectly competitive market structure. It must, however, be noted that these economies are merely examples and have been chose since they fit the requirements of our modeling of financial repression. But, the analysis can be applied to any other economies that are subjected to "high" obligatory reserve requirements.

TABLE 2.

Bank Reserve Ratios

	Spain	Italy	Greece	Portugal
1980-1986	15.8	15.5	22.1	20.5
1986-1991	19.3	17.2	19.6	26.4
1992-1997	9.0	10.6	26.0	15.3
1998-2002	3.0	2.3	23.5	7.1
Source: See Table 1.				

The theoretical modeling in our paper is somewhat motivated out of Di Giorgio (1999). But unlike in the paper, we model the government budget

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[5]For details regarding the calculation of the degree of tax evasion, see section 7.

TABLE 3.

Interest Rate Liberalization and Credit Ceiling Relaxation Dates

Country	Interest Rate Liberalization	Credit Ceiling Relaxation
Spain	1984	1959-66
Italy	1980	1973-83
Greece	1980	1982-87
Portugal	1984	1978-91
Belgium	1986	Until 1978
France	1980	1958-85
Germany	1980	None
U.K.	1980	1964-71
Sources:Tables 3.4, 4.1 and 5.1 in Caprio, Honohan and Stiglitz (2001).		

constraint explicitly realizing that bank failures and bailouts, given deposits are insured, puts extra pressure on the budget and also allow for labor choice decisions in the model. Di Giorgio (1999) assumed that the cash reserves held by the banks serves the role of insuring the deposits. This in turn allows the intermediaries to repay their interest obligations even when the firm fails. However, we allow for deposit insurance explicitly, and compare the role of seigniorage and explicit taxation in the face of positive probability of banking crises and bailout obligations of the government. Thus, given that, we are interested in seeking for an optimal mix of policy instruments, the government would choose in order to meet the budgetary and bail out expenses, the need to explicitly model the government budget constraint is compelling.

Moreover, the production economy model is somewhat restricted in Di Giorgio (1999) in the sense that there does not exist a pure market for goods. This limitation of the model is handled by introducing labor-choices in the model. The labor decisions by the worker to earn wage provides the completeness to the demand decisions in the goods market. We however assume that there is only one factor of production, labor, and not capital as in Di Giorgio (1999), and the labor demand is constrained by the availability of loans.

3. ECONOMIC ENVIRONMENT

We study an economy with three types of agents: consumers, financial intermediaries and a consolidated government–monetary authority. Consumers are further categorized into two types: workers/depositors and entrepreneurs. The workers/depositors are endowed with one unit of labor

which they supply inelastically, with some probability, to the firms earning a specific wage. Labor income is allocated to savings and financing of consumption during retirement. The entrepreneurs, on the other hand, are endowed with a fixed amount of resources and have access to production technology. Financial intermediation plays the dual role of providing depositors with a safe way of transferring resources into the future, given that deposits are insured, and being the external source of finance to entrepreneurs. Moreover, given that the financial intermediaries are obligated to hold a fraction of their deposits as cash reserves, they enhance the inflationary tax base of the consolidated government. Note that, this assumption helps in generating the demand for money in the model. The consolidated government balances its budget on a period to period basis using revenue from income tax, seigniorage and deposit insurance.

The economy is affected by ex post moral hazard due to costly state verification. The outcome of the investment projects of the entrepreneurs, financed by bank loans, are private information; however, banks can observe the same outcome if they are willing to incur some monitoring costs. Monitoring costs will be assumed to be proportional to loans. As in Di Giorgio (1999), the assumption of a linear monitoring technology wants to capture the idea that it is more costly to monitor large borrowers in comparison to small ones. Implicitly, such an assumption emphasizes a positive correlation between borrower's size and the associated demand for bank loans. Note that the size of the cost of verification of state is also a 'proxy' for the efficiency of the financial system. A developed financial system can be rationally assumed to have a lower cost of state verification.

3.1. Agents' Behavior
3.1.1. Workers/Depositors, Entrepreneurs and Banks

Both workers/depositors and entrepreneurs and hence consumers within each class are a continuum with a population size normalized to one. They live for two periods and have positive endowments, labor in the case of the worker/depositor and a consumable good in case of the entrepreneur, when young but nothing when old. All workers/depositors and entrepreneurs have their preferences defined only over consumption when old.

All entrepreneurs are endowed with x units of perishable good.[6] The entrepreneurs also possess a simple stochastic linear technology. The identical production technology across the entrepreneurs can be formalized as follows:

$$y_{t+1} = \tilde{\beta}n_t{}^{\delta} \tag{1}$$

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[6]The positive endowment is required for technical reasons, mainly to solve explicitly for labor demand and wage rate. See below Section 5 for details.

with

$$\tilde{\beta} = \begin{cases} \beta, & \text{with probability q} \\ 0, & \text{with probability 1-q} \end{cases}$$

where y_{t+1} is level of output produced at time $t+1$; n_t is the labor requirement at time t; δ denotes the labor share and; $\tilde{\beta}$ is a random technology parameter and is independently and identically distributed across entrepreneurs. The technology is such that, by using one unit labor at time t, $\beta > 1$ units are produced at time $t+1$ with probability q, and 0 with probability $1-q$.

The worker/consumer is endowed with one unit of labor n which he can supply inelastically to the firms earning a real wage w in real terms, with a positive probability of ϕ. In the remaining $(1 - \phi_t)$ cases the worker/depositor cannot find employment and hence has no wage income. The labor supply decision is demand determined and is based along the lines of the lottery system outlined in Hansen (1985). The motivation for modeling the labor supply decision in this manner emerges from possible lack of loans to finance the entire labor supply in cases of very high reserve requirements. Note the probability, ϕ_t, of working full-time is in turn endogenously determined by the labor demand from the labor market equilibrium. Even though the production process is stochastic, since the firms borrow ahead to pay at the time of hiring, there is no further uncertainty to the wage income of the workers/depositors, once he ends up with a job. The consolidated government taxes the wage income at the rate of τ, but an exogenous fraction of $(1 - \alpha)$ is evaded by the workers/depositors.

The preferences of a worker/depositor born at time t are summarized by the following utility function and can be written as:

$$U_t^d = u(c_{t+1}^d) \tag{2}$$

where c_{t+1}^d denotes the consumption by an old agent born at time t. We assume that u is twice continuously differentiable, and strictly concave; formally, $u' > 0$, $u'' < 0$ and $\lim_{c \to 0}[u'(c)] = \infty$.

Defining r_{dt+1} as real interest rate paid by the banks on deposits, the budget constraint of the depositors can be explicitly laid out as follows:

$$d_t \leq (1 - \alpha\tau_t)(w_t\phi_t) \tag{3}$$

$$c_{t+1}^d \leq (1 + r_{dt+1})d_t \tag{4}$$

where d_t is the real deposits of the depositors. As is evident from the formulation of the young and old age budget constraints (3) and (4), the model

implicitly assumes the existence of unemployment insurance operated by the agents amongst themselves.

Let L and l be the nominal and real loans paid to any individual project that entrepreneurs can borrow from the banks, and n_t^d the demand for labor. Labor hiring is constrained by the available resources of financing:

$$w_t n_t^d = x + l_t \tag{5}$$

When the project succeeds the entrepreneurs repay the nominal interest rate on loans R_l, while nothing is paid back when the project fails. And given that deposits are insured and the banks are not able to meet the obligations of the depositors, the government needs to step in and bail out the banks.

The entrepreneur maximizes his expected profit, given by the following expression:

$$\max_L \Pi^e = q p_t [\beta \left(\frac{x + l_{t-1}}{w_{t-1}} \right)^\delta - \frac{(1 + R_{Lt})}{p_t} p_{t-1} l_{t-1}] \tag{6}$$

Note to ensure that the firms do borrow to produce rather than merely consuming their positive endowment x, we parameterize the model accordingly to ensure $\Pi^e > x$, holds under all possible circumstances.[7]

There is a finite number of competitive banks, which are price takers on their liabilities.[8] Banks collect deposits, keep a fraction, γ, as obligatory reserve requirements with the central bank and offer the remaining amount as loans to the entrepreneurs. From their balance sheet, we have

$$L_t \leq (1 - \gamma_t) D_t \tag{7}$$

where D is the nominal quantity of deposits. The level and conditions of intermediation activity are determined in the financial contract that we derive below.

3.1.2.   The Financing Contract

We will assume the entrepreneur and banks to be both risk neutral. The bank offers a contract to the entrepreneur establishing both the amount of the loan and its cost. Since the outcome of the project is private information of the borrower, the entrepreneur will always have the incentive to

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[7]See the Section on calibration for further details.

[8]As Di Giorgio (1999) points out this assumption is analogous to assuming that banks behave as Bertrand competitors when fixing the interest rate on deposits.

declare bankruptcy even if the project is in fact successful. The bank then accordingly specifies the contract such that when bankruptcy is declared monitoring will take place. As in Di Giorgio (1999), banks will optimally adopt a stochastic monitoring technology.

Let λ denote the probability of monitoring when bankruptcy is declared, and v be the punishment to the entrepreneur (in real terms) caught misreporting the production outcome. Using the revelation principle one can derive the optimal financial contract as the solution of the following problem:

$$\max_{R_L, L, \lambda, v} \Pi_B = q(1+R_{Lt})l_{t-1} + m_{t-1} - (1-q)\lambda c l_{t-1} - q(1+R_{dt})d_{t-1} - q\varepsilon_{t-1}d_{t-1} \tag{8}$$

subject to

$$l_{t-1} + m_{t-1} \ \leq \ d_{t-1} \tag{9}$$

$$m_{t-1} \ \geq \ \gamma_{t-1}d_{t-1} \tag{10}$$

$$qp_t\left[\beta\left(\frac{x+l_{t-1}}{w_{t-1}}\right)^{\delta} - \frac{(1+R_{Lt})}{p_t}p_{t-1}l_{t-1}\right] \ \geq \ p_t q \beta \left(\frac{x}{w_{t-1}}\right)^{\delta} \tag{11}$$

$$qp_t\left[\beta\left(\frac{x+l_{t-1}}{w_{t-1}}\right)^{\delta} - \frac{(1+R_{Lt})}{p_t}p_{t-1}l_{t-1}\right] \tag{12}$$

$$\geq \ qp_t[\beta\left(\frac{x+l_{t-1}}{w_{t-1}}\right)^{\delta} - \lambda v] \tag{13}$$

$$v \ \leq \ \beta\left(\frac{x+l_{t-1}}{w_{t-1}}\right)^{\delta} \tag{14}$$

$$0 \ \leq \ \lambda \leq 1 \tag{15}$$

where Π_B is the expected profit of the bank in real terms; c is the proportion of loans devoted to the monitoring activity; ε is the premium on deposit insurance; R_d is the nominal interest rate on deposits, m is the real quantity of cash reserves held by the banks; and p is the price level.

The constraints given by equation (9) to (13) respectively indicates the feasibility constraint, the mandatory cash reserves constraint, the participation constraint of the firm, the incentive compatibility constraint and the fact that the selected punishment abide by the principle of limited liability. (14) is obvious.

In the optimal contract (11) has to be binding implying that

$$\frac{(1+R_{Lt})^*}{1+\pi_t}l_{t-1} = \beta\left[\left(\frac{x+l_{t-1}}{w_{t-1}}\right)^\delta - \left(\frac{x}{w_{t-1}}\right)^\delta\right],$$

where $1+\pi_t = \frac{p_t}{p_{t-1}}$, the rate of inflation at period t. The incentive compatibility constraint (12) then requires that $\lambda v \geq \frac{(1+R_{Lt})^*}{1+\pi_t}l_{t-1}$. Since Π_B is a decreasing function of the probability of monitoring, banks will set λ at the minimum level such that (12) holds. This implies that $0 < \lambda^* < 1$ and that v is set at its maximum: from (13) $v^* = \beta\left(\frac{x+l_{t-1}}{w_{t-1}}\right)^\delta$. Assuming that revealing truthfully gives him the same expected profit, the entrepreneur does not misreport the production outcome and hence, (12) is binding as well. This results in $\lambda^* = \frac{l_{t-1}^*\left(\frac{(1+R_{Lt})^*}{1+\pi_t}\right)}{v^*}$. Given that banks are profit maximizers and $qR_L > c$, under all circumstances, they will lend all funds at their disposal hence (9) and (10) binds and we have, $l_{t-1}^* = (1-\gamma_{t-1})d_{t-1}$. Note to ensure that the banks lend all their available resources we parameterize the model accordingly to ensure $qR_L > c$, holds under all possible circumstances.[9]

Thus in summary, the optimal financial contract offered by the competitive bank, given $qR_L > c$, is:

(a) $l_{t-1}^* = (1-\gamma_{t-1})d_{t-1}$,

(b) $\frac{(1+R_{Lt})^*}{1+\pi_t}l_{t-1} = \beta\left[\left(\frac{(x+l_{t-1})}{w_{t-1}}\right)^\delta - \left(\frac{x}{w_{t-1}}\right)^\delta\right]$,

(c) $\lambda^* = \frac{l_{t-1}^*\left(\frac{(1+R_{Lt})^*}{1+\pi_t}\right)}{v^*}$, and

(d) $v^* = \beta\left(\frac{(x+l_{t-1})}{w_{t-1}}\right)^\delta$

n_{t-1}^*, w_{t-1}^* and $\frac{1+R_{Lt}}{1+\pi_t}$ is determined simultaneously from equation (5), the loan market equilibrium condition; the first order condition derived from equation (6) and; a linearized version of equation (11). Note we linearize around the steady-state value of the labor endowment, $\hat{n}$, which corresponds to the employment rates in respective economies, or put alternatively, one less the rate of unemployment.

3.2.   Government

The government has a fixed "purposeless" spending of g units (per young person) each period. The revenue needed to fund this expenditure and the bail out costs when a firm fails comes from the revenue raised by the two wings of the government: the treasury and the central bank. The former

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[9]See Section 7 for further details.

collects income taxes from the young workers/depositors, a fraction $(1-\alpha)$ of which is evaded. The latter controls the nominal stock of money, M, contributing to the government's revenue needs by new creating money and the reserve requirements. Formally, the government budget constraint in real per capita terms can be written out as follows:

$$g_t = \alpha \tau_t w_t \phi_t + \frac{M_t - M_{t-1}}{P_t} + q \varepsilon_t d_t - (1-q)(1+R_{dt+1})d_t - (1-q)d_t \quad (16)$$

Or,

$$g_t = \alpha \tau_t w_t \phi_t + \gamma_t (\frac{\mu_t}{1+\mu_t})d_t + q \varepsilon_t d_t - (1-q)(1+R_{dt+1})d_t - (1-q)d_t \quad (17)$$

Given that $M_t = (1+\mu_t)M_{t-1}$ and $M_t = \gamma_t D_t$, where μ_t is the growth rate of the nominal money stock. Note the first three terms respectively indicate the government revenue from tax, seigniorage and deposit insurance given that the project is successful with probability q, while the last two terms respectively shows the bail out expenditure for the government when the firm and hence the bank fails, and the cost incurred by the government in case the deposit insurance premium is subsidized, and not actuarially fair. Note an actuarially fair insurance would imply setting ε equal to the probability of failure, $1 - q$. Without any loss of generality we will assume that government expenses are proportional to expected labor income, i.e., $g_t = \kappa w_t \phi_t$.

4. EQUILIBRIUM

A valid perfect-foresight, competitive equilibrium for this economy is a sequence of prices $\{p_t, w_t, R_{dt}, R_{Lt}\}_{t=0}^{\infty}$, allocations $\{c_t^d, n_t, c_t^e\}_{t=0}^{\infty}$, stocks of financial assets $\{m_t, d_t, l_t\}_{t=0}^{\infty}$, and policy variables $\{\gamma_t, \mu_t, \tau_t, g_t\}_{t=0}^{\infty}$ such that:

• Taking the labor endowment, τ_t, g_t, β, γ_t, μ_t, p_t, w_t and r_{dt} the depositors optimal savings and consumption behavior is characterized by (3) and (4) ;
• Taking the endowment, τ_t, g_t, β, γ_t, μ_t, p_t, w_t and r_{dt} the entrepreneurs optimal behavior is characterized by (6);
• Banks maximize the return to deposits, taking, β, γ_{t-1}, ε_{t-1}, q, c and μ_{t-1} as given by (8);
• Goods, labor and money markets clear.
• The government budget constraint holds on a period-to-period basis.

5. OPTIMAL ALLOCATIONS

The profit maximization of the entrepreneur suggests that marginal product of labor is equal to the gross real interest rate on loans and hence yields the following condition:

$$\beta\delta \left(\frac{x + l_{t-1}}{w_{t-1}} \right)^{(\delta-1)} \frac{1}{w_{t-1}} = \frac{(1 + R_{Lt})^*}{1 + \pi_t} \tag{18}$$

Linearization of the binding-form of equation (11), yields:

$$\frac{(1 + R_{Lt})^*}{1 + \pi_t} = \hat{n}^{(\delta-1)} \frac{\beta}{w_{t-1}} \tag{19}$$

Realizing that $\phi_t = n_t^d$ and using (5), (17) and (18), n_t^*, the optimal level of labor hiring, is given by:

$$n_t^* = \hat{n} \tag{20}$$

Moreover using (5) and (19) w_{t-1}^* and the optimal real interest rate on loans $(1 + r_{Lt})^*$ $(= \frac{(1+R_{Lt})^*}{1+\pi_t})$ is given by the following expressions

$$w_{t-1}^* = \frac{x}{(1 - [(1 - \gamma_{t-1})(1 - \alpha\tau_{t-1})])} \frac{1}{\hat{n}} \tag{21}$$

$$(1 + r_{Lt})^* = \frac{\beta\hat{n}^\delta \left(1 - [(1 - \gamma_{t-1})(1 - \alpha\tau_{t-1})]\right)}{x} \tag{22}$$

The optimal choices of the worker/depositor can be derived directly from equation (5) and the budget constraints, and is given as follows:

$$d_t^* = (1 - \alpha\tau_t) \frac{x}{1 - (1 - \gamma_t)(1 - \alpha\tau_t)} \tag{23}$$

$$c_{t+1}^{d*} = (1 + r_{dt+1}^*)(1 - \alpha\tau_t) \frac{x}{1 - (1 - \gamma_t)(1 - \alpha\tau_t)} \tag{24}$$

Entrepreneurs consumption at time $t + 1$ is a random variable with the following distribution:

$$c_{t+1}^e = \begin{cases} \beta\hat{n}^{\delta-1}[\hat{n} - \delta(1 - \gamma_t)(1 - \alpha\tau_t)], & \text{with probability q} \\ 0, & \text{with probability 1-q} \end{cases} \tag{25}$$

where c_{t+1}^e is the consumption of the entrepreneur at period $t+1$.

$$\lambda^* = \frac{\delta}{\hat{n}}(1 - \gamma_{t-1})(1 - \alpha\tau_{t-1}) \tag{26}$$

Note that (14) is automatically satisfied.

Free entry in the banking industry implies zero profits in the sector. By substitution of equation (5) and the set of optimal choices derived from the financing contract, equations (21) and (25), we have:

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\begin{aligned}
(1 + r_{dt}^*) \;=\; & \left(\frac{\beta\hat{n}^\delta(1 - \gamma_{t-1})[1 - (1 - \gamma_{t-1})(1 - \alpha\tau_{t-1})]}{x}\right) \\
& + \frac{\gamma_{t-1}}{q(1 + \mu_{t-1})} - \left(\frac{1-q}{q}\right)c\frac{\delta}{\hat{n}}\frac{(1 - \gamma_{t-1})^2(1 - \alpha\tau_{t-1})}{1 + \mu_{t-1}} \\
& - \frac{\varepsilon_{t-1}}{1 + \mu_{t-1}}
\end{aligned}
\tag{27}
$$

Moreover, in steady-state the money market clearing condition implies that $\frac{p_t}{p_{t-1}} = \frac{1}{1+\mu_t}$.

6. THE WELFARE CRITERION

In this simple economy, the objective of a benevolent government-monetary authority is to maximize the social welfare. The social welfare can be defined as an weighted average of the expected utility of consumption of both depositors and entrepreneurs. Here we restrict ourselves to a stationary economy, with no growth. Note changes in government policy tools not only affect the return on deposits, but also the future consumption of the entrepreneurs. Given that the entrepreneurs are risk-neutral, they maximize their expected consumption. The steady-state level of welfare for all future generations is obtained by substituting the equilibrium decision rules into the agents utility function, to yield the following social welfare function:

$$
\begin{aligned}
\Omega \;=\; & \left\{ \theta u \left[\left(\left(\frac{\beta\hat{n}^\delta(1 - \gamma)[1 - (1 - \gamma)(1 - \alpha\tau)]}{x}\right) + \frac{\gamma}{1 + \mu} \right. \right. \right. \\
& \left. - \left(\frac{1-q}{q}\right)c\frac{\delta}{\hat{n}}\frac{(1 - \gamma)^2(1 - \alpha\tau)}{1 + \mu} - \frac{\varepsilon}{1 + \mu}\right) \left((1 - \alpha\tau)\frac{x}{1 - (1 - \gamma)(1 - \alpha\tau)}\right) \right] \\
& + (1 - \theta)\left[q\beta\hat{n}^{\delta-1}\left(\hat{n} - \delta(1 - \gamma_t)(1 - \alpha\tau_t)\right)\right] \right\}
\end{aligned}
\tag{28}
$$

where Ω is the steady-state social welfare, and; θ ($[1 - \theta]$) is the weight assigned to the welfare of the depositor (entrepreneur). The social planner maximizes Ω choosing τ, γ, $\mu = \pi$ given u, q, c, x, α, β, θ, δ and ε, to determine the optimal choices of the policy variables, subject to the set of inequality constraints: $\tau_{min} \leq \tau \leq 1$, $\gamma_{min} \leq \gamma \leq 1$, $\mu \geq \mu_{min}$ and the government budget constraint (16) evaluated at the steady state. For the rationale of assigned minimum values of τ, γ and μ, see below the section on calibration. A standard utility function of the following type is chosen for deriving the optimal values of the policy variables:

$$u(c_{t+1}) = \frac{c^{(1-\sigma)}}{1 - \sigma} \tag{29}$$

7. CALIBRATION

In this section we attribute values to the parameters, most of them being country–specific. The problem for the social planner is a non-linear constrained maximization problem, which cannot be solve analytically. Hence, assigning values to the parameters of the model is critical. We select the parameter values for our benchmark model using a combination of figures from previous studies and facts about the economic experience for our sample economies between 1980 and 1998. Note, unless otherwise stated, the source for all data is the IMF – International Financial Statistics (IFS).

- σ: The risk-aversion parameter in the utility function is set to 1.[10]

- q: The parameter measures the probability of success of the entrepreneurial project. Note q is tied with the probability of the success of the banks as well. In other words, the probability with which the production process fails is equivalent to the probability of a banking crisis. The probability of banking crisis for the economies of our concern, conditional on the fact that the financial markets were liberalized in these economies, over the period of 1980 to 1998, were derived using a methodology that closely mirrors the one outlined in the Demirgùç-Kunt and Detragiache (2001) study to obtain the probability of banking crises in our chosen set of economies. A multivariate logit model of the following type was fitted to the panel

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[10]The policy experiments were repeated for $\sigma = \frac{1}{2}$ and $\sigma = 2$, but the qualitative nature of our results stayed the same. Our analysis, thus, is not contingent upon the value of the risk aversion parameter. The results have not been tabulated to save space, however, they can be made available upon request.

data:

$$\log L = \sum_{t=1}^{T} \sum_{1}^{n} \left\{ P_{i,t} \log[F(\beta' X_{i,t})] + (1 - P_{i,t}) \log[1 - F(\beta' X_{i,t})] \right\} \quad (30)$$

Note the probability that a crisis will occur at a particular time in a particular country is hypothesized to be a function of a vector of n variables $X_{i,t}$, which includes the financial liberalization dummy, a constant and $n-2$ control variables. $P_{i,t}$ denotes the dummy variable that takes the value one when the $i - th$ country experiences a banking crises at time point t and zero otherwise. β is the vector of n unknown coefficients and $F(\beta' X_{i,t})$ is the cumulative probability density function calculated at $\beta' X_{i,t}$. Note to model F we use the logistic functional form. Thus it must be realized that the estimated coefficients do not indicate the increase in the probability of crises following one-unit increase in the corresponding explanatory variables as in standard linear regression models. Instead, the coefficients capture the effect of a change in an explanatory variable on $\log \frac{P_{i,t}}{1-P_{i,t}}$. Therefore the sign of the coefficient does indicate the direction of the change and the magnitude depends on the slope of the cumulative distribution function at $\beta' X_{i,t}$.

To construct the banking crises dummy we use the dates of banking crises reported in Demirgùç-Kunt and Detragiache (2001) and is reported in Table 4. The criteria used in the study to identify banking crises comprised of at least one of the following: "The ratio of non-performing assets to total assets in the banking system exceeded 10 percent; the cost of rescue operation was at least 2 percent of GDP; banking sector problems resulted in a large-scale nationalization of banks; extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees were enacted by the government in response to the crisis." In case the above set of criteria failed to identify the banking crises we followed a more stringent measure of banking crises as adapted by Ganapolsky (2003). Using monthly data on deposits a bank run was an episode where there was at least 5 percent reduction in total deposits during at least 2 months in a row and lasted until deposits started to recover again.

Given that in most countries the removal of interest rate controls were the centerpiece of the liberalization process, the financial liberalization variable is captured by a dummy (FINLIB) that takes the value 1 in a specific year and country if the interest rates have already been liberalized by then.

Demirgùç-Kunt and Detragiache (2001) points out that proxying financial liberalization by real interest rates in a panel data structure would be misleading and a hence a dummy variable needs to be assigned. To identify the years of financial liberalization the first year in which some interest rates were liberalized has been chosen as the date of interest rates liberalization for the countries in our sample and is reported in Table 3 and is repeated in Table 4 for the sake of convenience.

Using the criteria laid out above, Table 4 identifies dates of interest rate liberalization and the dates of banking crises for Spain, Italy, Greece and Portugal over the sample period of 1980-1998. However, using the same criteria, no crises could be identified over the same sample period for Belgium, France, Germany and U.K.

TABLE 4.

Interest Rate Liberalization and Banking Crisis Dates

Country	Interest Rate Liberalization	Banking Crisis
Spain	1984	1983
Italy	1980	1990-94 and 1997
Greece	1980	1983 and 1991
Portugal	1984	1986-89
Belgium	1986	None
France	1980	None
Germany	1980	None
U.K.	1980	None

Sources:

(a) Tables 3.4, 4.1 and 5.1 in Caprio, Honohan and Stiglitz (2001).

(b) Table 1 Ganapolsky (2003).

(c) Bayoumi (1993).

(d) Attanasio and Weber (1994).

(e) IMF- International Financial Statistics.

The control variables in the logistic regression can be broadly categorized into two sets. The first group captures macroeconomic developments that affects bank performance mainly through the level of non-performing loans and includes the rate of growth of real GDP (Growth), the change in external terms of trade (TOT Change), and the rate of inflation (Inflation). The real short-term interest rate (Real Interest Rate) is also introduced as a control variable because, whether financial markets are liberalized or not, banking sector problems are generally associated with high real interest rates. Following Demirgùç-Kunt and Detragiache (2001) we use rate

of interest on short-term government paper or a central bank rate as a measure the short-term interest rate.

The second group of control variables included define characteristics of the banking system, such as fragility to sudden capital outflows (M2/Reserves): measured by the ratio of M2 to foreign exchange reserves; liquidity (Cash/Bank): measured by the ratio of bank cash and reserves to bank assets; exposure to private sector (Private/GDP): measured by the ratio of loans to the private sector to GDP; and two-period lagged credit growth (Credit Growth$_{-2}$), which captures the fact that "high rates of credit expansion may finance an asset price bubble that, when it bursts, causes a banking crises." Finally, GDP per capita (GDP/CAP) is used to indicate the level of development of the country. Note the terms in the brackets correspond to the definition of the variables in the logistic model. The estimates of the multivariate logit model are reported in Table 5. Note except for the external terms of trade all the measurements follow Table 4.9 in Demirgùç-Kunt and Detragiache (2001). For the terms of trade we use the ratio of export to import price.

TABLE 5.

Calibration of Parameters

Countries	q	τ	UGE	α	ε	$\hat{n}$	(R_L)	$\mu = \pi$	$\frac{g}{y}$	γ	κ
Spain	0.74	25.5	22.3	0.82	0.10	0.8005	12.89	7.52	16.66	14.10	29.15
Greece	0.92	22.7	28.3	0.78	0.64	0.9122	22.96	15.16	14.55	23.50	25.89
Italy	0.87	36.3	26.2	0.79	0.20	0.8870	15.02	8.58	18.79	13.70	33.17
Portugal	0.64	27.7	22.3	0.82	0.10	0.9384	19.09	13.04	16.59	19.80	29.13
Belgium	1	42.1	21.5	0.82	0.03	0.8778	10.71	3.59	22.95	1.00	40.88
France	1	37.3	14.8	0.87	0.04	0.8927	10.01	4.54	23.24	2.00	40.76
Germany	1	31.8	16.8	0.86	0.05	0.8879	10.85	2.29	16.29	6.00	24.92
UK	1	32.9	12.3	0.89	0.04	0.9129	10.06	5.77	20.51	2.00	35.57
Note: Parameters defined as above.											

One observes the following facts from Table 5: (a) just like Demirgùç-Kunt and Detragiache (2001), the financial liberalization dummy is positively, though not significantly, correlated with the probability of banking crises. This suggests that financial liberalization is a factor leading to banking sector fragility; (b) The probability of banking crises tends to be associated with lower growth rates, adverse terms of trade changes, high real interest rates and high inflation; (c) the banking sector is found to be vulnerable to a speculative attack against currency. Besides, the liquidity measure and the exposure to the private sector tends to affect the probability of crisis in a positive (and significant) and negative manner, respectively; (d) a sudden

capital outflow is not found to enhance the possibility of a crisis; (e) finally, GDP per capita is significantly and negatively correlated to the probability of banking crises, suggesting that, other things equal, developing countries are more vulnerable to banking crises.

Once the multivariate logit model was estimated the probability of banking crisis at crisis dates were estimated by using the procedure outlined above and in Table 4.3 in Demirgùç-Kunt and Detragiache (2001). The probability of success ranges between 0.64 (Portugal) to 1.0 (Belgium, France, Germany and the U.K.).

• δ: The parameter measures the labor share in output. The value has been set to 0.6, for all the economies. A labor share of 60 percent is in conformity with the observed world average.[11]

• c: The parameter captures the proportional cost of monitoring. As Cooley and Nam (1998) points out that, in equilibrium, monitoring costs are incurred by financial intermediaries only when the entrepreneurs fail. Hence, these costs can be interpreted as costs of bankruptcy. We follow Cooley and Nam (1998) and set c at 10 percent.[12]

• x: The parameter measures the endowment of the entrepreneur and without any loss of generality is is set at 1.[13]

A second set of parameters is determined individually for each country. Here, we use averages over the whole sample period to find values that do not depend on the current business cycle. These parameters are listed in Table 6, along with q.

• $\frac{g}{y}$: The parameter measures the government expenditure to GDP ratio, defining the size of the government. Note, we use the ratio of central government outlays to GDP Note the country-specific values ranges between 14.55 percent (Greece) to 22.95 percent (Belgium).

• R_L: The parameter measures the nominal interest rate on loans. The country specific values lies between 10.01 percent (France) and 22.96 percent (Greece).

• $\pi = (\mu)$: The parameter measures the annual inflation rate and lies between 3.59 percent (Belgium) and 15.16 percent (Greece)

• UGE: The parameter measures the size of the underground economy as a percentage of GDP. The values are obtained from Schneider and

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[11]See Zimmermann (1997). Further an alternative value of $\delta =0.7$ was also used while conducting the policy experiments. qualitative nature of our results stayed the same.

[12]Varying c does not change our results qualitatively.

[13]The qualitative nature of our results remain unchanged with alternative choices of x, as long as $x>0$.

Klinglmair (2004) and lies between 12.3 percent (France) to 28.3 percent (Greece).

• τ: The parameter measures the taxes paid as a percentage of the GDP. The country-specific values lies between 22.2 percent (Greece) to 42.1 percent (Belgium).

• α: The parameter measures the fraction of reported income. Note the calibrated value of the parameter hinges critically on the measurements of the size of the underground economy. The following method was used

$$\frac{TE}{Y} = UGE \times \tau \tag{31}$$

where $\frac{TE}{Y}$ is tax evasion as a percentage of GDP.

We have assumed that the effective average tax rate is the same in the official and the underground economy. Given that

$$(1 - \alpha) = \frac{\frac{TE}{Y}}{\left[\frac{TE}{Y} + \tau\right]} \tag{32}$$

The country-specific parameters lie between 0.78 (Greece) and 0.89 (U.K.), which implies that for Greece 22 percent of the taxes are evaded and for that of U.K. the value is 11 percent.

• γ: The parameter measures the reserve-deposit ratio and lies between 1.0 percent (Belgium) and 23.5 percent (Greece).

• ε: The annual deposit insurance premium is obtained from Demirgùç-Kunt and Sobaci (2001). Note for France and U.K. the deposit insurance is not mandatory and available by demand. We set it at the average of the values of Belgium and Germany. Otherwise the country-specific values lies between 0.03 percent (Belgium) to 0.64 percent (Greece).

• $\hat{n}$: The parameter measures the employment-rate, in the sense that it is one less the average rate of unemployment. The country-specific values lies between 80.05 percent (Spain) and 93.84 percent (Portugal). The figures imply that Spain has an unemployment-rate of 19.95 percent where as the average unemployment-rate for Portugal is 6.16 percent.

A third set of parameters are calculated from the model using the country specific data. The parameters are also reported in Table 6.

• β: The technology parameter, is set at 5, given that $\beta > 1$. Such a choice of β ensures that $q(1 + R_L) > c$ and $\Pi^e > x$. Formally, the two conditions imply that $\beta > \frac{1}{1+\mu} \frac{c}{q} \left(\frac{x}{\hat{n}^\delta [1-(1-\gamma)(1-\alpha\tau)]} \right)$ and $\beta > \frac{x}{q\hat{n}^{\delta-1}[\hat{n}-\delta(1-\gamma_t)(1-\alpha\tau_t)]}$,

respectively. Note if the latter holds so would the former condition. To ensure that β is defined we set the lower limits of γ, τ and μ at 1.0 percent, 22.7 percent and 3.6 percent. Moreover $\hat{n}$ and q are set to 0.8005 and 0.64, with $c=0.1$ and $\delta=0.6$. These values correspond to the lowest values of the corresponding parameter observed in the data for these 8 economies. In some sense we carry out a change in location of the policy parameters. It must be realized we are more interested in analyzing the movements in the policy parameters rather than their absolute value.

item κ: The parameter captures the ratio of the government expenditure to the wage bill and is given by $\frac{\frac{g}{y}}{\frac{w\phi}{y}}$. Note $\frac{w\phi}{y}$ is given by $\frac{\delta}{\frac{1+R_L}{1+\pi}}$. The country-specific values lies between 24.92 percent (Germany) to 40.88 percent (Belgium).

TABLE 6.

Optimal Policy Variables ($c = 0.1, \varepsilon = \bar{\varepsilon}$)

Countries	$\theta = 0$			$\theta = 0.25$			$\theta = 0.5$			$\theta = 0.75$			$\theta = 1.0$		
	τ	μ	γ	τ	μ	γ	τ	μ	γ	τ	μ	γ	τ	μ	γ
Spain	22.7	∞	100.0	67.1	3.6	100.0	68.0	3.6	92.7	71.6	13.6	7.3	69.9	3.6	1.0
Greece	22.7	35.1	100.0	43.8	3.6	100.0	44.7	3.6	92.8	47.7	3.6	27.2	46.3	3.6	1.0
Italy	35.4	∞	100.0	58.5	3.7	100.0	59.9	3.6	88.6	64.3	33.5	9.0	62.2	3.6	1.0
Portugal	76.1	3.6	100.0	76.1	3.6	100.0	79.1	3.6	70.4	80.1	3.7	1.7	80.0	3.6	1.0
Belgium	22.7	37.6	100.0	35.2	20.3	99.9	44.6	7.9	90.8	22.7	132.5	47.9	22.8	∞	27.9
France	22.7	35.4	100.0	31.7	22.2	100.0	22.7	39.6	92.0	22.7	127.3	46.6	43.5	∞	6.6
Germany	22.7	7.2	100.0	25.1	4.4	100.0	22.7	7.3	97.3	22.7	18.7	42.2	22.7	110.5	12.8
U.K.	22.7	23.8	100.0	37.3	3.6	100.0	23.7	24.5	92.8	22.7	77.0	44.2	22.7	∞	19.3
Notes: Optimal values derived from constrained optimization.															
All values are in percentages.															
See also Table 5.															
See Table 4.3 in Caprio, Honohan, Stiglitz (2001).															

8. OPTIMAL POLICY DECISIONS

The constrained optimization of the objective function given by equation (27), yields the optimal values of the decision variables, τ, μ and γ. The deposit-insurance premium is fixed at the country-specific levels observed in the data.[14] The results corresponding to different weights (θ) are reported in Table 7. The following observations can made:

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[14]See Table 6 for the values of the deposit-insurance premia.

• There is quite a lot of variability within and across countries. The movements in the money growth rates and the reserve requirements follows no specific pattern. The results does not overwhelmingly vindicate our hypothesis that countries with higher probability of crisis should have higher reserve requirements.

• Except for the extreme case when the social planner values only the welfare of the entrepreneur, the economies with higher probability of crisis, namely Spain, Greece Italy and Portugal, have higher income tax rates than that of Belgium, France, Germany and the U.K., which have relatively lower (zero) probability of bank failures. Moreover, for the former set of economies the tax rates are positively correlated with the probability of bank failures.

• When the social planner assigns higher weight to the producers relative to the depositor/worker, the optimal reserve requirements are at unity. Such observations, in some sense, corroborate our findings for the endowment economy.

TABLE 7.

A Counterfactual Experiment ($c = 0.1$)

	$\theta = 0$			$\theta = 0.25$			$\theta = 0.5$			$\theta = 0.75$			$\theta = 1.0$		
Countries	τ	μ	γ	τ	μ	γ	τ	μ	γ	τ	μ	γ	τ	μ	γ
Average-Economy	22.7	17.9	100.0	28.9	9.8	100.0	22.8	19.1	93.7	22.7	51.9	44.1	22.70	∞	17.1
Average-Economy	22.7	19.9	100.0	26.0	15.8	100.0	33.1	7.5	94.4	22.7	58.3	45.1	22.7	∞	18.6
Average-Economy	22.7	56.9	100.0	47.7	3.6	100.0	48.8	3.6	89.4	51.4	3.6	20.9	50.6	3.6	1.0
Average Economy	36.4	∞	100.0	51.2	3.6	100.0	50.1	8.6	89.4	55.1	3.6	20.9	54.3	3.6	1.0
Notes: Optimal values derived from constrained optimization.															
All values are in percentages.															
See also Table 5.															

    To better understand the movements in the optimal policy variables, we decided to look into the average economy – an economy constructed with the average values of the the parameters of the eight countries considered in our sample. We start off by examining the case with tax evasion is set at the lowest level observed (corresponding to U.K.) and there is no probability of banking crisis, that is α=0.89 and q=1.0. And then compare the economy with the following three scenarios of the same average-economy: (a) α=0.83 and q=1.0; (b) α=0.89 and q=0.90, and; (c) α=0.83 and q=0.90. Note a value of α=0.83 and a value of q=0.90 correspond to the averages of the eight economies. The comparison between the baseline average economy

and (a), allows us to evaluate the importance of tax evasion on the sizes of policy parameters, most importantly on the reserve requirements and test if at all there exists a positive relationship between reserve requirements and tax evasion. The comparison with (b) enable us to assess the importance of bank failure on reserve requirements and other policy variable. The experiment in (c) and the comparison with the baseline economy helps us in outlining the importance of both tax evasion and higher probability of crisis, separately and simultaneously, on the policy variables. The results are reported in Table 8.

TABLE 8.

A Counterfactual Experiment $(c = 0.1, \tau = \overline{\tau})$

	$\theta = 0$		$\theta = 0.25$		$\theta = 0.5$		$\theta = 0.75$		$\theta = 1.0$	
Countries	μ	γ	μ	γ	μ	γ	μ	γ	μ	γ
Average-Economy	5.7	100.0	5.7	100.0	6.0	94.3	16.6	37.9	186.9	7.0
Average-Economy	8.5	100.0	8.5	100.0	9.1	94.4	24.9	39.3	∞	9.5
Average Economy	47.7	100.0	47.7	100.0	48.5	98.8	58.0	87.9	∞	32.3
Average-Economy	∞	100.0	145.4	100.0	141.7	98.8	∞	97.2	∞	97.0

Notes: Optimal values derived from constrained optimization.
All values are in percentages.
See also Table 5.

Qualitative nature of the movements of the policy variables are the same as is observed for the eight countries. Moreover, comparing rows 1 and 2 and then 3 and 4 of Table 8 provide us with distinct evidence that higher degrees of tax evasion imply non-decreasing reserve requirements. However, as can be seen from both rows 3 and 4, when compared to 1 and 2, except when $\theta = 0$, higher probability of crisis yields higher income tax rates. Comparison between rows 3 and 4 indicates that when higher degrees of tax evasion is coupled with higher probability of crisis, tax rates are clearly higher. Interestingly, except when the social planner weigh the welfare of the entrepreneur more than the worker/depositor, comparing rows 1 and 2 with 3 and 4 indicates that economies with no probability of bank failures tends to have higher reserve requirements than economies with positive probability of crisis — a result completely opposite to our initial hypothesis. In summary, the experiments suggest that when controlled for other parameters economies with higher probability of crisis will have higher tax rates, except when the planner values the producer only.

Finally, in Table 9 we control for the tax rate and fix it at the economy wide average of 32.0 percent, for the experiments in rows 1 and 2, and at

zero for rows 3 and 4. The intuition of such an experiment can be believed to be a sequential movement of the treasury and the monetary wings of the planner — the treasury moves first and arbitrarily fixes the tax rate and then the monetary authority optimally chooses the money growth rates and the reserve requirement to meet the deficit. Or alternatively, the economy can be viewed as having exhausted its ability to tax. In Table 9 we compare the baseline economy corresponding to α=0.89 and q=1.0 with α=0.83 and q=1.0 in rows 1 and 2. In rows 3 and 4 when τ[15] is set at zero we compare the cases of q=1.0 with q=0.90. Clearly, comparison between rows 1 and 2 suggest that higher degrees of tax evasion would imply higher reserve requirements, except when the planner values the welfare of the producer more than the consumers. However, money growth rates are consistently higher in row 2, with higher tax evasion. Moreover, comparison between rows 3 and 4 indicates that optimal money growth rates are always higher except for θ=1.0, while reserve requirements stays the same except when the social planner values the welfare of the depositor/worker more than the producer.

9. CONCLUSION

The paper tries to explore two *rationale* behind the existence of financial repression. We assay whether there exists a plausible explanation as to why the reserve requirements in the some economies namely, Greece, Italy, Portugal and Spain, are relatively higher compared to other developed European economies. For this, we develop an overlapping generation production-economy monetary model with a possibility of banking crisis.

The results from the model can be summarized as follows: (a) When the government is allowed to choose its full-range of instruments namely, the tax-rate, the reserve-requirement and the money growth rate, the social planner will always optimally choose a higher tax-rate for economies with positive probability of crisis; (b) The tax rates for these economies are positively correlated with the probability of crisis; (c) There is no clear-cut evidence that countries with positive probability of crisis will have optimally higher reserve requirements; (d) In the extreme case, when the social planner puts the entire weight on the entrepreneur, or values the welfare of the entrepreneur more than that of the depositor/worker, the reserve requirements are set optimally at the 100 percent level, irrespective of the size of probability of bank failures. The model however indicates, that when we

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[15]Note in this case β=29, to ensure that the firm produces and the bank lends.

control for the country-specific parameters of the model, higher tax evasion and higher probability of crisis do correspond high reserve requirements.

Thus to summarize, the model tends to suggest that the "high" reserve requirements are more a fall-out of the seigniorage motive of the social planner and does not correspond to a welfare maximizing objective in the presence of positive probability of crisis, given the availability of an alternative distortionary instrument (income-tax, in our case). To put it alternatively, if we were to assume that the social planner of an economy (say our hypothesized behavior corresponding to that of the government of Spain, Italy, Greece and Portugal) with positive probability of crisis was choosing the "higher" reserve requirements to accommodate for the bailout costs of the bank failures — our model shows that such a policy is not compatible with a welfare maximizing objective. From the policy perspective, economies with positive probabilities of banking crisis and hence larger bailout pressures on the government budget, should rely more on direct income taxation rather than implicit taxes.

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