

University of Connecticut

Department of Economics Working Paper Series

Financial Liberalization and Inflationary Dynamics

Rangan Gupta

University of Connecticut and University of Pretoria

Working Paper 2005-31

July 2005

341 Mansfield Road, Unit 1063
Storrs, CT 06269-1063
Phone: (860) 486-3022
Fax: (860) 486-4463
<http://www.econ.uconn.edu/>

Abstract

The paper analyzes the effects of financial liberalization on inflation. We develop a monetary and endogenous growth, dynamic general equilibrium model with financial intermediaries subjected to obligatory "high" cash reserves requirement, serving as the source of financial repression. When calibrated to four Southern European semi-industrialized countries, namely Greece, Italy, Spain and Portugal, that typically had high reserve requirements, the model indicates a positive inflation-financial repression relationship irrespective of the specification of preferences. But the strength of the relationship obtained from the model is found to be much smaller in size than the corresponding empirical estimates.

Journal of Economic Literature Classification: E31, E44

Keywords: Inflation; Financial Markets and the Macroeconomy

This is a revised version of the second chapter of my dissertation at the University of Connecticut. I am particularly grateful to my major advisor Christian Zimmermann for many helpful comments and discussions. All remaining errors are mine.

1 Introduction

The primary objective of this paper is to analyze the effect of financial liberalization on the rate of inflation using a closed economy monetary endogenous growth model. Secondly, in order to quantify the effects of financial liberalization on inflation, we calibrate the dynamic general equilibrium model to four southern European economies — Greece, Italy, Portugal and Spain, over the period of 1980–1998.¹ Financial repression can be broadly defined as a set of government legal restrictions, like interest rate ceilings, compulsory credit allocation and high reserve requirements, that generally prevent the financial intermediaries from functioning at their full capacity level.

It is important to emphasize that there exists a relatively large literature — both theoretical and empirical, concerned with the role of financial intermediation, growth and inflation. However, the literature has observed a specific dominant trend, namely development of theoretical frameworks that cannot be calibrated or simple linear regression models with no microfoundations². The departure of our analysis from this literature lies in the development of a theoretical framework that can be calibrated. The need for calibration is essential not only to sign the relationship between financial repression and inflation but, also to measure the “strength” of the relation between the two critical variables of our concern. Moreover, the “strength”, when compared to the simple regression coefficients between inflation and financial repression, would also tell us about the performance of the dynamic general equilibrium model in their ability to replicate the data. And would simultaneously, help us realize the modifications, if at all, we need to make to our existing general equilibrium model for making better policy prescriptions.

We follow Drazen (1989), Bacchetta and Caminal (1992), Haslag and Hein (1995), Espinosa and Yip (1996), Haslag (1998) and Haslag and Koo (1999) in using the “size” of obligatory reserve requirements held by commercial banks as the metric for the degree of financial repression. It must be realized that nothing should prevent our existing general equilibrium analysis to be used in studying other developing economies subjected to a repressed financial structure, mainly through the imposition of “high” reserve requirements. The four European economies chosen are, hence, merely examples of countries that matches the assumptions of our model. Our choice of the sample is vindicated by observations that can be made from Tables 1 and 2.

Table 1, along with sizes of reserve requirements and annual rate of inflation, outlines the periods over which major interest rates were deregulated and credit ceilings were relaxed in some important European economies. Clearly, economies with higher average reserve requirements are observed to experience higher average rate of inflation. Besides this, an interesting feature stands out, while on one hand, the capital markets were being deregulated, the required bank reserves were much higher in Greece, Italy, Portugal and Spain, when compared to Belgium, France, Germany and the U.K. Moreover, as Table-2 indicates, while financial liberalization was in process, with interest rates being determined by the market, the bank reserve ratios increased significantly in the late 1980s, in three out of the four Southern European countries of our concern.

[INSERT TABLE 1 HERE]

[INSERT TABLE 2 HERE]

[INSERT TABLE 3 HERE]

In order to evaluate the relationship between inflation and financial repression for our economies we run a simple two-variable regression analysis between inflation and the reserve–deposit ratio. The results are reported in Table-3. Note that except for Greece the data indicates a positive relationship between inflation and financial repression. Further, except for Spain the positive relationship between inflation and the financial repression parameter is significant. The negative relationship in Greece is an exception, especially when one realizes that the positive relationship between the reserve requirements and inflation has been well documented in the empirical literature.³

The paper is structured as follows: Besides the introduction and the conclusion, Section 2 and 3 outlines the basic structure, equilibrium and balanced growth path of the model. Section 4 discusses the process of calibration. And, Section 5 deals with the inflationary dynamics of liberalizing the domestic financial sector, which in our case, is portrayed in the form of a relaxation of the reserve–deposit ratio.

2 The Economic Environment

We modify the theoretical framework of Chari, Jones and Manuelli (1995), Haslag (1998) and Haslag and Young (1998) used to analyze inflation-growth correlations in the context of developed economies to suit the requirements of a financially repressed semi-industrialized economic structure. We make the relevant assumption that in our model economy the firms own the capital but the entire investment need of the firms are loan-financed, given that the equity markets in semi-industrialized economies are far from being developed and incapable of providing investible funds for the firms. The households own the firms. Moreover, we assume that the banks are obligated to hold a “high” fraction of their deposits as fiat currency in order to serve as an easy source of seigniorage revenue for the government. We consider an infinitely-lived representative agent model with no uncertainty and complete markets. The economy is populated by four types of decision makers: households, banks, firms, and the government. In this model, there is only one type of consumption good, called the credit goods. The credit good and the investment good, are produced by the same technology. Explicitly modeling the financial intermediaries, obligated to maintain “high” reserve requirements, we assume that all the investment is financed through bank deposits.

The resource constraint in the model economy is given by

$$c_t + i_{kt} + i_{ht} \leq F(k_t, n_t h_t), \quad (1)$$

where c_t is the consumption of credit goods; i_{kt} and i_{ht} are the investment expenditures in physical and human capital respectively; k_t is the stock of physical; $n_t h_t$ denotes effective labor, given that n_t is the hours of labor and h_t is the stock of human capital; and F is the production function. Physical and human capital evolve according to the following processes, respectively $k_{t+1} \leq (1 - \delta_k)k_t + i_{kt}$ and $h_{t+1} \leq (1 - \delta_h)h_t + i_{ht}$, where δ_k and δ_h are the depreciation rates.

Events in the economy can be captured by the following sequence: Each period is divided into three sub-periods. At the start of the period individuals enter into the credit market, consumers make their savings decision, and firms borrow money. Financial intermediaries offer deposit contracts to households, maturing in one period. The deposits are used to make loans and acquire fiat money. The banks hold fiat money to satisfy a reserve requirement. Note that money is valued in this economy simply because the banks are

obligated to hold a fraction of the deposits as cash reserves. We assume that no resources are required to operate the banking system. During the medium third of the period is when production and purchasing decisions are undertaken. It is assumed that each firm and household has several ‘members’ so that they may simultaneously be on both supply and demand sides of a market. At the end of the period wages, dividends, the principal and interest from the deposit contracts, and any lump-sum transfers from the government are distributed and loans are repaid.

On the production side, firms own all the capital but they must borrow cash from the financial intermediaries to invest in capital. This is because they start the period with no cash, all retained earnings is assumed to have been distributed as dividends. The firm produces units of the consumption good using a constant returns to scale production technology involving physical capital and the human capital as the two inputs. Since all the three goods (c, i_k, i_h) available in a period of time are perfect substitutes on the production side, they all sell for the same nominal price p_t .

The government makes lump-sum transfer payments to the households and finance the same in any period only through seigniorage. For the sake of simplicity we ignore taxes⁴ from the government budget constraint, however, for technical reasons outlined below, we assume that there are no government bonds.

2.1 Consumers

Explicitly the activities consumers in the three periods can be outlined as follows. Consumers start off by making their saving decisions, in the form of deposits, at the beginning of the period. Consumers are assumed to work and consume in the middle period. Income from labor, returns from the savings, dividends and lump-sum transfer if any are received at the end of the period. We assume that there is a large number of identical households that solve the following problem:

$$V = \max_{c_{1t}, n_t^s, d_{t+1}, h_{t+1}} \sum_{t=0}^{\infty} \beta^t u(c_{1t}, 1 - n_t) \quad (2)$$

$$s.t. : d_t \leq \begin{Bmatrix} [p_t w_t n_t h_t] + [1 + R_{dt}] d_{t-1} \\ -p_t c_t - -p_t i_{ht} \\ +\pi_{ft} + T_t \end{Bmatrix} \quad (3)$$

$$h_{t+1} \leq (1 - \delta_h) h_t + i_{ht} \quad (4)$$

with d_{t-1} , h_t , R_{dt} , w_t and p_t as given. Note β is the discount factor; u is the consumer's utility; d_t is the deposits in the banking system; h_t is the stock of human capital at the beginning of period t ; R_{dt} is the nominal interest rate paid on deposits at the end of period t ; T_t is the size of the transfer to the household delivered for use in period t ; w_t is the real wage rate; π_{ft} is the dividend earning received at the end of period t . So consumers maximize their lifetime utility (equation (28)) subject to equations (29) and (30), to determine a contingency plan for $\{c_t, d_t, n_t^s, h_{t+1}\}_{t=0}^{\infty}$.

$$J(d_{t-1}, h_t) = \max_{n_t^s, d_t, h_{t+1}} u\left(\frac{a_t}{p_t} - \frac{d_t}{p_t} - i_{ht}, 1 - n_t\right) + \beta J(d_t, h_{t+1}) \quad (5)$$

where $a_t = [p_t w_t n_t h_t] + [1 + R_{dt}] d_{t-1} + T_t$. The upshot of the dynamic programming problem are the following first order conditions:

$$d_t : \frac{u_1(c_t, 1 - n_t)}{p_t} - \beta J_1(d_t, h_{t+1}) = 0 \quad (6)$$

$$n_t^s : u_1(c_t, 1 - n_t)[w_t h_t] - u_2(c_t, 1 - n_t) = 0 \quad (7)$$

$$h_{t+1} : -u_1(c_t, 1 - n_t) + \beta J_2(d_t, h_{t+1}) = 0 \quad (8)$$

Along with the following envelope conditions

$$J_1(d_{t-1}, h_t) = \frac{u_1(c_t, 1 - n_t)[1 + R_{dt}]}{p_t} \quad (9)$$

$$J_2(d_{t-1}, h_t) = u_1(c_t, 1 - n_t)[w_t n_t + (1 - \delta_h)] \quad (10)$$

In addition, a transversality condition is necessary to ensure the existence of the households's present-value budget constraint. The household's terminal constraint is interpreted as a non-ponzi condition in

which the household cannot borrow against future deposits at a rate greater than can be repaid. Formally, the transversality condition is represented as

$$\lim_{T \rightarrow \infty} \left[\frac{d_T}{\prod_{s=0}^{T-1} [1 + R_{ds}]} \right] \quad (11)$$

Using the first order conditions along with the envelope conditions, the consumer's problem yields the following set of efficiency conditions.

$$\frac{u_1(c_t, 1 - n_t)}{p_t} = \beta \frac{u_1(c_{t+1}, 1 - n_{t+1})[1 + R_{dt+1}]}{p_{t+1}} \quad (12)$$

$$\frac{u_1(c_t, 1 - n_t)}{u_2(c_t, 1 - n_t)} = \frac{1}{w_t h_t} \quad (13)$$

$$u_1(c_t, 1 - n_t) = \beta u_1(c_{t+1}, 1 - n_{t+1})[w_{t+1} n_{t+1} + (1 - \delta_h)] \quad (14)$$

Equation (12) is the efficiency condition for consumption. On the left hand side is the marginal cost of consuming one less unit of the consumption good and on the right-hand side is the marginal benefit obtained from future savings. Equation (13) indicates that the marginal rate of substitution between consumption and leisure must be equal to the ratio of their prices. Equation (14) is the efficiency condition for human capital. The left hand side of the equation is the marginal cost while the right hand side indicates the stream of future benefit adjusted for the depreciation from the investment in human capital.

Moreover, from the above set of conditions, specifically (12) and (14), it is easy to derive that arbitrage leads to equivalent real rates of return for the alternative investment choices available to the consumer.

$$\left[\frac{p_t(1 + R_{dt+1})}{p_{t+1}} \right] = [w_{t+1} n_{t+1} + (1 - \delta_h)] \quad (15)$$

2.2 Financial Intermediaries

At the start of the period the financial intermediaries accept deposits and make their portfolio decision, loans and cash reserves choices, with a goal of maximizing profits. At the end of the period they receive their interest income from the loans made and meets the interest obligations on the deposits. Note the intermediaries are constrained by legal requirements on the choice of their portfolio (that is, reserve requirements), as well as by feasibility. Given such a structure, the intermediaries obtains the optimal choice for L_t by solving

the following problem:

$$\max_{L,d} \pi_{bt} = R_{Lt}L_t - R_{dt}d_t \quad (16)$$

$$s.t. \quad : \quad \gamma_t d_t + L_t \leq d_t \quad (17)$$

where π_{bt} is the profit function for the financial intermediary at time t , and $m_t \geq \gamma_t d_t$ defines the legal reserve requirement. m_t is the cash reserves held by the bank, L_t is the loans, and γ_t is the reserve requirement ratio. The reserve requirement ratio is the ratio of required reserves (which must be held in form of currency) to deposits.

To gain some economic intuition of the role of reserve requirements, let us consider the solution of the problem for a typical intermediary. Free entry, drives profits to zero and we have

$$R_{Lt}(1 - \gamma_t) - R_{dt} = 0 \quad (18)$$

Simplifying, in equilibrium, the following condition must hold

$$R_{Lt} = \frac{R_{dt}}{1 - \gamma_t} \quad (19)$$

Reserve requirements, thus, tend to induce a wedge between the interest rate on savings and lending rates for the financial intermediary.

2.3 Firms

Each firm maximizes the discounted stream of dividend payments where the dividends are discounted by their value to the owners of the firms, the consumers, that is the additional utility that can be obtained in the next period. The firm utilizes current capital stock (k_t) and effective labor, i.e., ($n_t h_t$), to produce a single final good (Y_t) which can be allocated to investment demand (i_{kt}) and consumption goods (c_t). Next, we assume that producers are capable of converting bank loans (L_t) into fixed capital formation such that: $p_t i_{kt} = p_t l_t$; and l_t ($= \frac{L_t}{p_t}$) is the loan in real terms. We also assume that the production transformation schedule is linear so that the technology applies to both capital formation and consumption good production. The firm owns all the capital but uses financing from the bank to purchase all its investment requirement for future production process since it starts every period without any cash in hand.

The sequence of events in a more rigorous fashion can be outlined as follows: Firms begin the period with capital stock k_t . They enter into the credit market in order to borrow the cash that they will use for payments later in the period. In the middle of the period firms hire workers in a competitive labor market. The ‘producer’ part of the firm carries out the production and selling aspects of the good while the ‘purchaser’ part of the firm buys new capital in the goods market. At the end of the period the firm uses the earnings to repay the loans and pays workers. Residual earnings are the profits (or losses) of the firm and are returned to the consumers as dividends. The dynamic optimization problem of the firm can be summarized as follows:

$$\max_{k_{t+1}, (n_t h_t)} \sum_{i=0}^{\infty} \left[\beta^{i+1} \frac{u_1(c_{t+i+1}, 1 - n_{t+i+1})}{p_{t+i}} \right] \pi_{ft+i} \quad (20)$$

$$k_{t+1} \leq (1 - \delta_k)k_t + i_{kt} \quad (21)$$

$$p_t i_{kt} = p_t l_t \quad (22)$$

where $\pi_{ft} = [p_t F(k_t, n_t h_t) - p_t w_t n_t h_t - p_t(1 + R_{Lt})l_t]$ is the profit function of the representative firm. Here $\left[\beta^{i+1} \frac{u_1(c_{t+i+1}, 1 - n_{t+i+1})}{p_{t+i}} \right]$ is the marginal utility of the shareholder of a dollar received at the end of the $t + i$ th period. The reason we have the subscript $t + i + 1$ appearing here, is that a dollar at the end of the period $t + i$ cannot be used until the following period. Since each firm is too small to affect the average consumption or leisure of the consumers, through its action, this term is treated as a constant during the firms optimization problem. The firm’s problem can be written in the following recursive formulation.

$$\Psi(k_t) = \max_{nh, k'} \left\{ \left[\beta \frac{u_1(c_{t+1}, 1 - n_{t+1})}{p_{t+1}} \right] \left\{ \begin{array}{l} p_t F(k_t, n_t h_t) - p_t w_t n_t h_t \\ -p_t(1 + R_{Lt})(k_{t+1} - (1 - \delta_k)k_t) \end{array} \right\} + \left[\beta^2 \frac{u_1(c_{t+2}, 1 - n_{t+2})}{p_{t+2}} \right] \Psi(k_{t+1}) \right\} \quad (23)$$

The upshot of the above dynamic programming problem are the following first order conditions.

$$k_{t+1} : \left[\beta \frac{u_1(c_{t+1}, 1 - n_{t+1})}{p_{t+1}} \right] (1 + R_{Lt})p_t = \left[\beta^2 \frac{u_1(c_{t+2}, 1 - n_{t+2})}{p_{t+2}} \right] \Psi'(k_{t+1}) \quad (24)$$

$$(n_t h_t) : F_2(t) = w_t \quad (25)$$

And the following envelope condition.

$$\Psi'(k_t) = p_t[F_1(t) + (1 + R_{Lt})(1 - \delta_k)] \quad (26)$$

Optimization, leads to the following efficiency condition, besides (25), for the production firm.

$$\left[\frac{u_1(c_{t+1}, 1 - n_{t+1})}{p_{t+1}} \right] (1 + R_{Lt})p_t = \left\{ \begin{array}{c} \beta \left[\frac{u_1(c_{t+2}, 1 - n_{t+2})}{p_{t+2}} \right] p_{t+1} \\ \{F_1(t+1) + (1 + R_{Lt+1})(1 - \delta_k)\} \end{array} \right\} \quad (27)$$

Equation (27) provides the condition for the optimal investment decision of the firm. The firm compares the cost of increasing investment in the current period with the future stream of benefit generated from the extra capital invested in the current period. And equation (25) simply states that the firm hires effective labor up to the point where the marginal product of effective labor equates the real wage. Note, $F_j(t)$, $j = 1, 2$, denote the marginal product of capital and labor, respectively.

Traditionally in growth theory the firm rents the capital directly from the households. Hence it is not usual to have the firm own the capital stock and borrow loans to finance its investment expenditures. Given that our concern is financial repression and we model the financial intermediaries explicitly, the path of loans become important and thus calls for a dynamic firm problem.

2.4 Government

The government commits to a sequence $\{T_t\}_{t=0}^{\infty}$ of transfers which are financed by seigniorage. The government's budget constraint, in nominal terms, is

$$T_t = m_t - m_{t-1} \quad (28)$$

The government has at its disposal two tools of monetary policy, the reserve requirement and the rate of money growth, and the transfer as the sole tool of fiscal policy. We will assume that money evolves according to the policy rule $m_t = \mu_t m_{t-1}$, where μ is the money growth rate.

As discussed above a notable exceptions from the government budget constraint are taxes and government bonds. Though taxes are ignored for simplicity, bonds are left out for a technical reason. In a world of no uncertainty incorporating government bonds in either the consumer or bank problem would imply plausible multiplicity of optimal allocations of deposits or loans and government bonds. Since the arbitrage conditions

would imply a relative price of one between deposits or loans and government debt. One way to incorporate government bonds is to have the financial intermediaries hold government bonds as part of obligatory reserve requirements. Or alternatively, assume that there exists a fixed ratio of government bonds to money. The conclusions of our analysis remains unchanged following such alternative specifications with the former merely inflating the repression parameter.

3 Equilibrium and Balanced–Growth Equations

An equilibrium in this model economy is a sequence of prices $\{p_t, w_t, R_{Lt}, R_{dt}\}_{t=0}^{\infty}$, allocations $\{c_t, n_t, i_{kt}, i_{ht}\}_{t=0}^{\infty}$, stocks of financial assets $\{m_t, d_t\}_{t=0}^{\infty}$, and policy variables $\{\gamma_t, \mu_t, T_t\}_{t=0}^{\infty}$ such that:

1. The allocations and stocks of financial assets solve the household's date- t maximization problem, (2), given prices and policy variables.
2. The stock of financial assets solve the bank's date- t profit maximization problem, (16), given prices and policy variables.
3. The real allocations solve the firm's date- t profit maximization problem, (20), given prices and policy variables.
4. The money market equilibrium conditions: $m_t = \gamma_t d_t$ is satisfied for all $t \geq 0$.
5. The loanable funds market equilibrium condition: $p_t i_{kt} = (1 - \gamma_t) d_t$ where the total supply of loans $L_t = (1 - \gamma_t) d_t$ is satisfied for all $t \geq 0$.
6. The goods market equilibrium condition require: (1), $c_t + i_{kt} + i_{ht} = F(k_t, n_t)$. is satisfied for all $t \geq 0$.
7. The labor market equilibrium condition: $n_t^s h_t = (n_t h_t)^d$ for all $t \geq 0$.
8. The government budget is balanced on a period-by-period basis.

To study the long-run behavior of the model, we use the solutions to the maximization problems of the consumer, financial intermediary and the firm together with the equilibrium condition to calculate the

balanced growth equations. Along a balanced growth path output grows at a constant rate. In general for the economy to follow such a path, both the preference and the production functions must take on special forms. On the preference side, the consumer, when faced with a stationary path of interest rates must generate a demand for constant growth in consumption. The requirement is

$$u(c_t, 1 - n_t) = \begin{cases} \frac{[c_t(1-n_t)^\psi]^{1-\sigma}}{1-\sigma} & \text{for } \sigma \neq 1, \\ \log c_t + \psi \log(1 - n_t) & \text{for } \sigma = 1. \end{cases} \quad (29)$$

where ψ and σ are preference parameters

On the production side, a sufficient condition is that $F(K, nh)$ is of Cobb-Douglas type. Specifically of the following form

$$Y = F(k_t, n_t h_t) = A k_t^\alpha (n_t h_t)^{1-\alpha} \quad (30)$$

where A is a positive scalar, and α and $(1 - \alpha)$ are the elasticities of output with respect to capital and labor, respectively.

For the sake of tractability, we assume that the government has time invariant policy rules, which means the reserve-ratio, γ_t , and the money supply growth-rate, μ_t , are constant over time. The economy is characterized by the following system of balanced growth equations:

$$g^\sigma \pi = \beta A (1 - \alpha) \frac{(1 - n)}{n^\alpha} \left(\frac{h}{k} \right)^{(1-\alpha)} \frac{k}{c} \frac{1}{\psi} \quad (31)$$

$$g^\sigma \pi = \beta [1 + R_d] \quad (32)$$

$$g^\sigma = \beta [wn + (1 - \delta_h)] \quad (33)$$

$$w = A (1 - \alpha) n^{(1-\alpha)} \left(\frac{h}{k} \right)^{-\alpha} \quad (34)$$

$$R_L = \frac{R_d}{1 - \gamma} \quad (35)$$

$$1 + R_L = \frac{\alpha \beta A n^{(1-\alpha)} \left(\frac{h}{k} \right)^{(1-\alpha)}}{g^\sigma - \beta (1 - \delta_k)} \quad (36)$$

$$(g + \delta_k - 1) = \frac{i_k}{k} \quad (37)$$

$$(g + \delta_h - 1) = \frac{i_h}{k} \frac{k}{h} \quad (38)$$

$$\frac{i_k}{k} = \frac{\hat{L}}{k} \quad (39)$$

$$\frac{\hat{L}}{k} = (1 - \gamma) \frac{\hat{d}}{k} \quad (40)$$

$$\pi g = \mu \quad (41)$$

$$\frac{\hat{m}}{k} = \gamma \frac{\hat{d}}{k} \quad (42)$$

$$\frac{c}{k} + \frac{i_k}{k} + \frac{i_h}{k} = An^{(1-\alpha)} \left(\frac{h}{k} \right)^{(1-\alpha)} \quad (43)$$

where $\pi = \frac{p_{t+1}}{p_t}$ is the steady-state level of inflation; $g = \frac{c_{t+1}}{c_t} = \frac{i_{kt+1}}{i_{kt}} = \frac{i_{ht+1}}{i_{ht}} = \frac{k_{t+1}}{k_t} = \frac{h_{t+1}}{h_t} = \frac{\hat{d}_{t+1}}{\hat{d}_t} = \frac{\hat{L}_{t+1}}{\hat{L}_t} = \frac{\hat{m}_{t+1}}{\hat{m}_t} = \frac{(w_{t+1}h_{t+1})}{(w_th_t)}$ is the balanced growth rate of the economy; $\frac{c}{k}$, $\frac{i_k}{k}$, $\frac{i_h}{k}$ are the long-run ratios of the respective parts of output to the capital stock; $\hat{d}$ ($= \frac{d}{p}$) is size of real deposit; $\hat{L}$ ($= \frac{L}{p}$) is size of real loans; $\hat{m}$ is the real money holdings by the banks to meet the cash reserve requirements; and n is the balanced growth level of labor supply. This is a non-linear system of thirteen equations in thirteen variables: g , π , R_d , R_L , $\frac{c}{k}$, $\frac{i_k}{k}$, $\frac{i_h}{k}$, $\frac{h}{k}$, $\frac{\hat{d}}{k}$, $\frac{\hat{L}}{k}$, $\frac{\hat{m}}{k}$, w and n , can be solved given the values of the policy variables μ and γ , to trace the long-run reaction of the system to a change in policy.

4 Calibration

The next step in the analysis is to choose values for the parameters of the model. The values come from either *a priori* information or so that various endogenous variables, along the models balanced growth path, match the long run values observed in the data for Greece, Italy, Portugal and Spain. The parameters that needs to be calibrated can be grouped under the following three categories:

Preference: β , ψ , and σ .

Production: A , α and δ_k , δ_k .

Policy: γ , μ .

The country-specific calibrations are reported in Table 4. Note unless otherwise stated, the source for all data is the IMF – International Financial Statistics (IFS).

A first set of parameter values is given by numbers usually found in the literature. These are:

- n : following Zimmermann (1997), the share of time devoted to market activities, is set to 0.3, except for Portugal, for which n is set to 0.18 using the findings of Correia, Neves and Rebelo (1995). As

Zimmermann (1997) points out, the value used here, for Italy Spain and Greece, is, “based on the observation that about one-third of waking time (less personal care) is used for market labor by American households.”

- σ : the relative risk aversion parameter is set to 1 and then to 2, to show that the inflation–repression relationship is qualitatively unaffected for the choice of different values to the risk aversion parameter.
- α : since the production function is Cobb-Douglas, this corresponds to the capital income share. α for Spain, Italy and Greece is derived from Zimmermann (1997) and the value for Portugal is obtained from Correia, Neves and Rebelo (1995). the values range between 37.3 percent (Spain) and 47 percent (Portugal);
- δ_k : the depreciation rate of physical capital for Spain, Italy and Greece is derived from Zimmermann (1997) and the value for Portugal is obtained from Correia, Neves and Rebelo (1995). The values range between .032 (Greece) and .052 (Italy); δ_h : the depreciation rate of human capital. And without any loss of generality is assumed to be equal to δ_k ;
- β : the discount factor is set at 0.98.⁵

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, which are also listed in Table 4, are:

- $\frac{i_k}{Y}$: is the physical capital investment output ratio and ranges between 0.214 (Greece) and 0.275 (Portugal);
- g : the annual gross growth rate in per capita Gross Domestic Product (GDP) ranges between 1.0186, i.e., 1.86 percent (Greece) to 1.0295, i.e., 2.95 percent (Portugal);
- π : the annual gross rate of inflation lies between 1.0752, i.e., 7.52 percent (Spain) and 1.1516 , i.e., 15.16 percent (Greece);
- γ : the annual reserve–deposit ratio lies between 0.137 (Italy) and 0.235 (Greece);

The following parameters are determined from the balanced growth paths to match long-run averages of the endogenous variables of the model.

- A : the technology parameter, is calibrated from equations (33) and (34) and have two values corresponding to the two alternative values of the risk preference parameter. For $\sigma = 1$, the A ranges between 0.32 (Greece) and 0.55 (Portugal), and between 0.40 (Greece) and 0.73 (Portugal) when $\sigma = 2$;
- ψ : the value of ψ , the preference parameter for is obtained from equation (31). We obtain two values of the preference parameter for each country corresponding to two alternative values of the relative risk aversion parameter σ . For $\sigma = 1$, the parameter lies between 3.25 (Greece) and 7.26 (Portugal) and between 2.35 (Greece) and 4.32 (Portugal) when $\sigma = 2$;
- μ : the annual money growth rate for the four economies, is calibrated using equation (41). The money growth rate parameter lies between 1.103, i.e., 10.30 percent (Spain) and 1.173 i.e., 17.3 percent (Greece). Note, this would require the average values of the annual growth rate and rate of inflation for the individual countries.

It must be noted that to obtain the value for A we need to solve for the R_d , R_L and $\frac{h}{k}$ using equations (32), (35) and, (33), (34), (36), respectively. Similarly, for ψ , we need to pin down the values of $\frac{c}{k}$, which is obtained from the resource constraint, given by equation (43). This in turn requires the values for $\frac{i_k}{k}$ and $\frac{i_h}{k}$, which are in turn derived from equations (37) and (38) respectively. The values of these endogenous variables of the model, obtained from the long-run balanced growth path and used to obtain A and ψ have been reported in Table 5, and are as follows:

[INSERT TABLE 4 HERE]

[INSERT TABLE 4 HERE]

5 Financial Liberalization and Inflationary Dynamics

We are now ready to analyze the effects of financial liberalization in our benchmark model. Note, financial repression has been modeled as banks being obligated to maintain a “high” reserve requirement, i.e., a high value of γ , in our case. In this sense, financial liberalization would imply a reduction in the size of the obligatory reserve requirement, γ , and hence allowing the financial intermediaries to loan out a larger fraction of their deposits as loans to fulfill the investment requirement of the firms.

Due to the non-linearity of the system of equations, the relationship obtained between the rate inflation and the policy variables, μ , and γ cannot be solved explicitly to obtain a reduced-form solution. Hence, we plot the implicit function, specifying the relationship between inflation and reserve requirements, given the other policy parameters.

Figures 1 through 8, depicts the policy experiment, where we increase the reserve–deposit ratio, γ , in a phase–wise manner in the closed interval of 0 to 0.99. Figure 1 through Figure 4 depicts the relationship between the rate of inflation and the reserve–deposit ratio, when $\sigma = 1$. And Figures 5 through 8 plots the inflation–repression relationship $\sigma = 2$. The positive relationship stands out for all the economies for both $\sigma = 1$ and $\sigma = 2$. As is evident from the Figures 1 through 8, the effect of the reserve requirement on inflation tend to gather momentum at higher values of the latter, but is otherwise weak.

[INSERT FIGURES 1 THROUGH 8 HERE]

In Table 6, using the calibrated parameters we report the values of the derivative of steady–state inflation with respect to the repression parameter, γ , evaluated at the country-specific average value of γ . The values are obtained by using the Implicit-Function Theorem.

[INSERT TABLE 6 HERE]

Note both for $\sigma = 1$ and $\sigma = 2$ the value of the derivative always indicates a positive inflation–repression relationship. However, the value of the derivatives indicate values way less than the sizes of the simple regression coefficient reported in Table 3. Moreover, when the risk aversion parameter, $\sigma = 2$, a much weaker inflation–repression relationship is portrayed for all the economies. This is understandable since, the

inverse of the degree of relative risk aversion measures the elasticity of savings (deposits) with respect to interest rate. Given the interest rate on loans, as reserve requirement is reduced, the interest rate on deposits increases and the supply of deposits and hence loans responds more in the case of the lower value of the relative risk aversion parameter. With relatively more loans generated with $\sigma=1$ as compared to the case of $\sigma=2$, there is comparatively, higher investment, higher growth and lower inflation, for the former case.⁶ The model is thus incapable of explaining the negative inflation-repression relationship observed in the data for Greece.

6 Conclusion and Areas of Further Research

The paper analyzes the effects of removal of financial distortions on the rate of inflation, in the context of four semi-industrialized Southern European economies — Greece, Italy, Portugal and Spain, over the period of 1980 to 1998. The analysis is carried out by developing a monetary and endogenous growth dynamic general equilibrium model, involving proper microfoundations for the behavior of agents in the economy. The uniqueness of our study lies in the departure from regression analyses lacking microfoundations, or theoretical models that cannot be calibrated.

We represent financial repression through the obligation of the commercial banks to maintain a “high” proportion of the deposits as reserves. The model predicts a positive relationship between inflation and financial repression, as observed in the data for three (Spain, Italy, and Portugal) of the four economies. The results are in accordance with the widely available empirical evidence on inflation and reserve-ratio. However, the model fails to explain the negative effects of reserve requirements on inflation for Greece. Moreover, the strength of the relationship derived from the model is way below when compared to the sizes of the regression coefficient in the two-variable regression between inflation and financial repression. The relationship tends to become even weaker with the increase in the degree of risk aversion. In terms of policy the model proposes liberalization of the domestic financial sector, but indicates that the effect might be marginal on inflation.

Future research needs to be targeted to realize if the case of Greece is merely an aberration. Moreover, it

might be interesting to analyze whether addition of portfolio and capital adjustment costs can add meat to the strength of the relationship between inflation and reserve requirements. Moreover, it would be interesting to analyze the open economy version of the current model, and try to figure out whether the results of the closed economy still continues to hold.

References

- [1] Bacchetta, Philippe., and Caminal, Ramon., 1992. ‘Optimal Seigniorage and Financial Liberalization’, *Journal of International Money and Finance*, 11, 518–538.
- [2] Chari, V V., Manuelli, Rodolfo E., and Jones, Larry E., 1995. ‘The Growth Effects of Monetary Policy’, *Quarterly Review*, Federal Reserve Bank of Minneapolis, 19, 18–32.
- [3] Correia, Isabel., Neves, João C., and Rebelo, Sergio., 1995. ‘Business Cycles in a Small Open Economy’, *European Economic Review*, 39, 1089–1113.
- [4] Demirgüç-Kunt, Ash., and Detragiache, Enrica., 2000. ‘Financial Liberalization and Financial Fragility’ in Gerard, Caprio., Patrick, Honohan., and Joseph E. Stiglitz (ed.). ‘Financial Liberalization – How far, How Fast?’, Cambridge University Press, Cambridge.
- [5] Drazen, Allan., 1989 ‘Monetary Policy, Seigniorage, and Capital Controls in an Open Economy’, in M. de Cecco and A Giovannini (ed.). *An European Central Bank?* Cambridge University Press, Cambridge.
- [6] Espinosa, Marco., and Yip, Chong K., 1996. ‘An Endogenous Growth Model of Money, Banking, and Financial Repression’, Working Paper, 96-04, Federal Reserve Bank of Atlanta.
- [7] Haslag, Joseph H., 1998. ‘Monetary Policy, Banking and Growth’, *Economic Inquiry*, 36, 489–500.
- [8] Haslag, Joseph H., and Hein, Scott E., 1995. ‘Does it Matter how Monetary Policy is Implemented?’, *Journal of Monetary Economics*, 35, 359–386.
- [9] Haslag, Joseph H., and Koo Jahyeong., 1999. ‘Financial Repression, Financial Development and Economic Growth’, Working Paper, 99-02, Federal Reserve Bank of Dallas.
- [10] Haslag, Joseph H., and Young, Eric R., 1998. ‘Money Creation, Reserve Requirements, and Seigniorage’, *Review of Economic Dynamics*, 1, 677–698.

- [11] Honohan, Patrick., 2001. ‘How Interest Rates Changed under Liberalization: A Statistical Review’ in Gerard, Caprio., Patrick, Honohan., and Joseph E. Stiglitz (ed.). ‘Financial Liberalization – How far, How Fast?’, Cambridge University Press, Cambridge.
- [12] Roubini Nouriel and Sala-i-Martin Xavier., 1992. ‘Financial Repression and Economic Growth’, Journal of Development Economics, 39, 5–30.
- [13] Wyplosz, Charles., 2001. ‘Financial Restraints and Liberalization in Postwar Europe’ in Gerard, Caprio., Patrick, Honohan., and Joseph E. Stiglitz (ed.). ‘Financial Liberalization – How far, How Fast?’, Cambridge University Press, Cambridge.
- [14] Zimmermann, Christian., 1997. ‘Technology Innovations and the Volatility of Output: An International Perspective’, CREFE Working Paper, 34.

Notes

¹The choice of the sample period is to maintain uniformity with respect to definitions of data. Note while, Italy, Portugal and Spain joined the the European Monetary Union in 1998, Greece got included in 2002.

²See Roubini and Sala-i-Martin (1992), for a detailed survey regarding both theoretical and empirical models.

³See, for example, Haslag and Hein (1995), Haslag (1998), and Haslag and Koo (1999).

⁴Our results are not affected qualitatively with the inclusion of taxes.

⁵For details see Chari, Christiano and Kehoe (1994).

⁶Note, given, equation (41), growth is negatively related to the financial repression parameter.

Table 1: **Financial Facts in European Economies (1980-2002)**

	Reserves/ Deposits (percentage)	Annual Inflation rate	Interest Rate Liberalization	Credit Ceiling Relaxation
Spain	12.0	6.8	1984	1959-66
Greece	22.9	14.9	1980	1982-87
Italy	11.7	7.5	1980	1973-83
Portugal	17.5	12.2	1984	1978-91
Belgium	1.0	3.2	1986	Until 1978
France	2.0	4.1	1980	1958-85
Germany	5.6	2.5	1980	None
UK	1.7	5.2	1980	1964-71
Source: IFS – IMF International Financial Statistics. Inflation is the percentage change in the GDP Deflator. Deposit has been calculated from lines 24 and 25. Sources: Tables 3.4, 4.1 and 5.1 in Caprio, Honohan and Stiglitz (2001).				

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.				

Table 3: Inflation-Repression Correlation Coefficients (1980-1998)

	c_0	c_1
Spain	0.062 (3.25)	0.097 (0.82)
Greece	0.30 (6.53)	-0.62** (-3.29)
Italy	.013 (0.30)	.53* (1.75)
Portugal	0.041 (0.78)	0.45* (1.81)
Notes: Data source: IFS-IMF International Financial Statistics. Regression results emerge from the following equation: $\pi_t = c_0 + c_1\gamma_t + \epsilon_t.$ where π: Rate of inflation, γ: Reserve-deposit ratio, $c_i, i = 0, 1$: regression coefficients, $\epsilon \sim N(0, \sigma^2)$. Inflation is the percentage change in the GDP Deflator. Deposit has been calculated from lines 24 and 25. Numbers in the parentheses indicates the t-ratios. ** significant at 1 percent level. * significant at 10 percent level.		

Table 4: **Calibration Parameters**

	α	$\frac{i_k}{Y}$	A		$\delta_k=\delta_h$	ψ		g	π	γ	μ
			$\sigma = 1$	$\sigma = 2$		$\sigma = 1$	$\sigma = 2$				
Spain	0.373	0.2210	0.42	0.54	0.050	5.01	3.00	1.0254	1.0752	0.141	1.103
Italy	0.383	0.2176	0.40	0.49	0.052	4.72	3.11	1.0193	1.0858	0.137	1.107
Greece	0.402	0.2135	0.32	0.40	0.032	3.25	2.35	1.0186	1.1516	0.235	1.173
Portugal	0.470	0.2746	0.55	0.73	0.050	7.26	4.32	1.0295	1.1304	0.198	1.164
Note: Parameters defined as above.											

Table 5: **Steady-State Values of Endogenous Variables**

	R_d		R_L		$\frac{h}{k}$		$\frac{i_h}{k}$		$\frac{c}{k}$		$\frac{i_k}{k}$
	$\sigma = 1$	$\sigma = 2$	$\sigma = 1$	$\sigma = 2$	$\sigma = 1$	$\sigma = 2$	$\sigma = 1$	$\sigma = 2$	$\sigma = 1$	$\sigma = 2$	
Spain	12.55	15.36	14.61	17.88	1.93	1.98	0.1455	0.1493	0.0773	0.1648	0.0754
Italy	12.96	15.14	15.02	17.54	1.85	1.89	0.1319	0.1348	0.0750	0.1392	0.0713
Greece	19.69	21.92	25.74	28.65	1.87	1.91	0.0946	0.0967	0.0813	0.1394	0.0506
Portugal	18.78	22.28	23.42	27.78	1.39	1.44	0.1105	0.1145	0.0739	0.1629	0.0795
Note: Endogenous variables defined as above.											

Table 6: **Inflation–Repression Relationship** ($\frac{\delta\pi}{\delta\gamma}$)

	$\sigma = 1$	$\sigma = 2$
Spain	0.017	0.006
Italy	0.017	0.005
Greece	0.019	0.007
Portugal	0.033	0.011
Note: Values evaluated at average value of γ .		

Figure 1: Inflation Repression Relationship for Spain

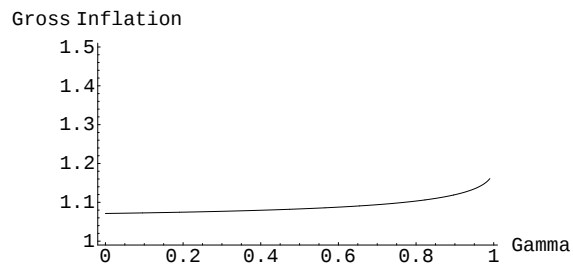


Figure 5: Inflation Repression Relationship for Spain

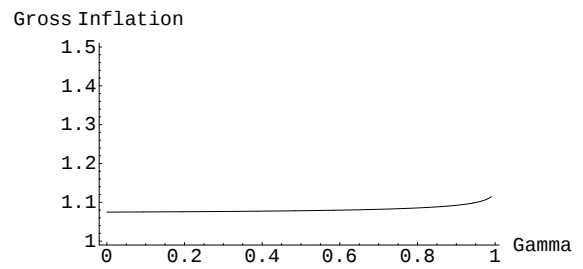


Figure 2: Inflation Repression Relationship for Italy

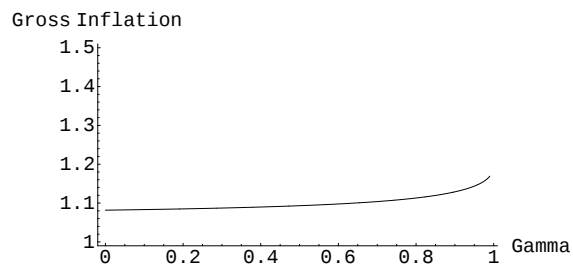


Figure 6: Inflation Repression Relationship for Italy

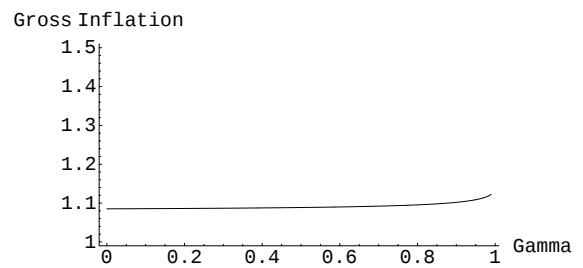


Figure 3: Inflation Repression Relationship for Greece

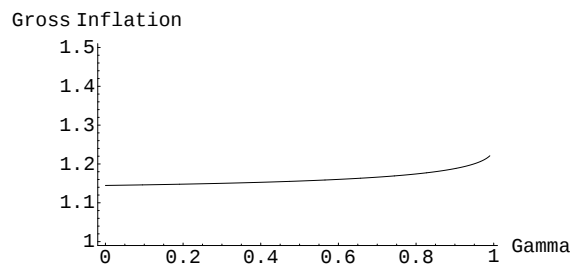


Figure 7: Inflation Repression Relationship for Greece

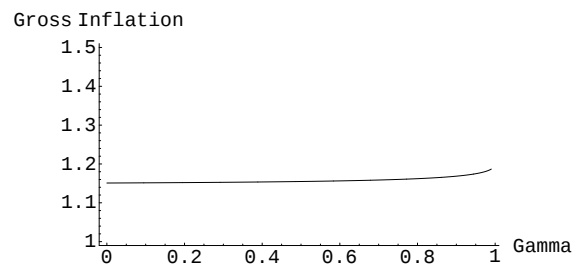


Figure 4: Inflation Repression Relationship for Portugal

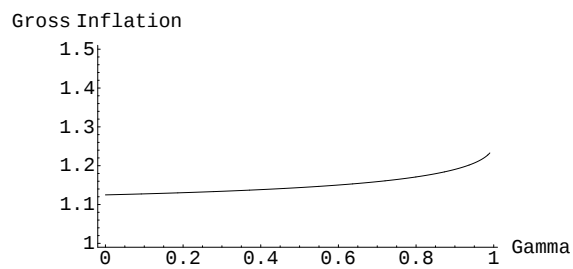


Figure 8: Inflation Repression Relationship for Portugal

