Financial Liberalization and Inflationary Dynamics in the Context of Southern European Economies: An Open Economy Analysis

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Abstract

This paper essentially attempts to extend our initial closed-economy analysis on financial distortions and inflation into an open-economy framework. Three regressional analyses carried out by Haslag and Hein (1995), Haslag (1998) and Haslag and Koo (1999) have indicated a positive relationship between financial repression and inflation. This paper tries to provide a microeconomic foundation in explaining such a relationship. Specifically, we use an endogenous monetary growth model of a small open semi-industrialized economy with intermediate good imports and financial intermediaries subjected to “high” and mandatory cash reserves 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, just like in the closed economic environment, indicates a positive inflation-financial repression relationship irrespective of the risk aversion parameter and hence the specification of preferences. But the strength of the relationship obtained from the model is found to be much

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smaller in size than the corresponding empirical estimates.

Journal of Economic Literature Classification: E31, E44

Keywords: Inflation; Financial Markets and the Macroeconomy.

1 Introduction

The objective of this paper is to analyze the effects of financial distortions on the rate of inflation, in the context of four semi–industrialized small open Southern European economies — Greece, Italy, Portugal and Spain, over the period of 1980 to 1998. In particular we study the role of financial repression and seek for answers to the following question: What is the relationship between financial development and inflation? This paper essentially attempts to extend our initial closed-economy analysis on financial distortions and inflation into an open-economy framework. The motivation for such an extension is basically threefold: Firstly, the lack of in depth theoretical and associated numerical analysis, based on endogenous growth models, analyzing the effects and strength of financial repression on inflation and exchange rate, in the context of open economies. Couple of exceptions are Kang and Sawada (2000) and Kletzer and Kohli (2001). But the papers have their own limitations in that they ignore the importance of capital and intermediate good imports in production process and, also lacks any numerical analysis; and secondly, as Tables 1, 2 and 3 indicates, even though size of the FDI as a percentage of GDP is quite small in our chosen economies, the import of intermediate and capital goods, account for a major share of international trade in these economies and; thirdly the paper tries and investigates, if open economy assumptions can add to the strength of the relationship between inflation and repression. Recall the closed-economy model yielded much weaker inflation–repression relationship when compared to the simple

1See Section 2 for a detailed review of the available literature.
two variable regressions.

As can be observed from Tables 1 and 2 intermediate and capital goods as a percentage of both total trade and GDP are quite sizeable. The percentage of capital goods in total trade ranges between 26.68 percent (Greece) and 30.51 percent (Spain) and that of intermediate goods between 52.66 percent (Spain) and 60.18 percent (Italy). Besides, as can be observed from Table 1 the figures are comparable to other developed European economies as well. On the other hand, percentage of capital goods in GDP lies between 6.48 percent (Italy) to 16.41 percent (Greece) and that of intermediate goods between 16.45 percent (Spain) and 38.14 percent (Greece). As with the figures in Table 1 the percentages are quite comparable to four other industrialized economies. Note the calculations in Table 1 and 2 are based on the three digit Standard International Trade Classification. Based on a different tradeable goods classification\(^2\), Serven (1995) found comparable estimates of capital goods import as a percentage of total trade. The percentage of capital goods in total goods trade ranged between 14.90 percent (Italy) to 23.10 percent (Portugal)\(^3\). Table 3 indicates the change in the intermediate and capital goods import as percentages of total trade over the decade of 1980 and 1990. One interesting observation is that the percentages of intermediate goods import has gone down in the decade of 1990 compared to the decade of 1980, while the movements in the percentages for capital goods import is exactly the opposite, for all the economies tabulated.

The importance of trade in intermediate goods has been long recognized and probably, dates back to the findings of McKinnon (1966). McKinnon (1966) estimated that between 60 and 70 percent of world trade involved intermediate goods. In a different study analyzing transmission of business cycles, Costello and Praschnik (1993) too emphasized the role of intermediate and capital

\(^2\)The classification was based according to the commodity trade classification (COMTRADE) derived by GATT.

\(^3\)The figures correspond to the year 1983.
goods. Costello and Praschnick (1993) indicated that on average since 1970, 54 percent of the trade conducted by the United States, Germany, and Japan has been in intermediate goods, 28 percent of trade in capital goods and 16 percent in services. Given the importance of intermediate and capital goods in world trade, the noticeable absence observed in the treatment of intermediate and capital goods in theoretical open-economy analysis is perplexing. One possible reason for such an ignorance can perhaps be associated with the thought that including these goods into the analysis will in fact not significantly alter the general conclusions of the model. However, studies by Batra and Cass (1971), Serven (1995) and more recently Boileu (1999, 2002) suggests otherwise.

Batra and Cass (1971) theoretically demonstrated that when intermediate goods, serving purely as inputs in the production of final goods, are included into open-economy models, most of the traditional trade theorems might not hold “without additional provisions”. Further, they also find that if both intermediate and final goods are traded, “the pattern of trade may not be found appealing to trade theorems and will general be indeterminate”. Serven (1995) points out that in 1990, the capital goods comprised over 30 percent of U.S. imports. The author also indicates that in the same year, capital goods imports, represented on average, close to 30 percent of total imports for a sample of 82 developed and developing countries, which was almost 9 percent of the GDP. Hence, Serven (1995) indicates that the ignorance of capital good imports is thus bound to provide an “incomplete – and potentially misleading” – assessment of macroeconomic implications domestic policy changes. Carmichael, Këita and Samson (1999) also emphasizes the importance of good imports in the production process when analyzing business cycles with liquidity constraints for small open economy.

\(^4\)To be consistent with their theoretical modelling, the definition of intermediate goods in Costello and Praschnick (1993) encompassed both intermediate materials and primary products.
Table 1: Trade Composition of Imports of Goods and Services in European Economies (1985-2001)

<table>
<thead>
<tr>
<th></th>
<th>(Primary Goods)/ (Total Trade)</th>
<th>(Intermediate Materials)/ (Total Trade)</th>
<th>(Capital Goods)/ (Total Trade)</th>
<th>(Services)/ (Total Trade)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>37.04</td>
<td>15.95</td>
<td>30.51</td>
<td>16.5</td>
</tr>
<tr>
<td>Greece</td>
<td>42.79</td>
<td>12.44</td>
<td>26.68</td>
<td>18.09</td>
</tr>
<tr>
<td>Italy</td>
<td>46.65</td>
<td>17.03</td>
<td>26.91</td>
<td>9.41</td>
</tr>
<tr>
<td>Portugal</td>
<td>41.60</td>
<td>13.92</td>
<td>30.05</td>
<td>14.43</td>
</tr>
<tr>
<td>Belgiuma</td>
<td>48.64</td>
<td>9.71</td>
<td>22.86</td>
<td>18.78</td>
</tr>
<tr>
<td>France</td>
<td>41.32</td>
<td>10.87</td>
<td>27.84</td>
<td>19.97</td>
</tr>
<tr>
<td>Germany</td>
<td>42.08</td>
<td>10.87</td>
<td>26.24</td>
<td>20.81</td>
</tr>
<tr>
<td>UK</td>
<td>41.39</td>
<td>7.58</td>
<td>31.48</td>
<td>19.55</td>
</tr>
</tbody>
</table>

Source: www.sourceoecd.org.

Notes: Categorization based on SITC 2 and 3.

Trade in Services obtained from OECD Services data.

Total Trade is sum of trade in goods and trade in services.


More recently Boileu (1999, 2002) stresses on the role of capital goods in the form of equipments and machineries while analyzing the volatility of net-exports and terms of trade, in a standard two-country dynamic general equilibrium models. The author points out that trade in equipment accounted for half of the trade balance of G7 countries and most of its fluctuations over the 1971-1990 period. In summary all the above studies, in one way or another, emphasizes the important role of intermediate and capital goods, admits the ignorance of the treatment of the same in open-
economy models, and most importantly suggests the severity in implications of such omissions —
incomplete and misleading assessment of macroeconomic policy.

Table 2: FDI, Import of Intermediate Materials and Capital Goods in European Economies (1980-2001)

<table>
<thead>
<tr>
<th></th>
<th>FDI/ (Net FDI)/ GDP$^a$</th>
<th>(Intermediate Materials)/GDP</th>
<th>(Capital Goods)/GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>2.31</td>
<td>1.50</td>
<td>6.45</td>
</tr>
<tr>
<td>Greece</td>
<td>0.74</td>
<td>1.02</td>
<td>13.09</td>
</tr>
<tr>
<td>Italy</td>
<td>0.78</td>
<td>0.32</td>
<td>6.21</td>
</tr>
<tr>
<td>Portugal</td>
<td>1.81</td>
<td>1.51</td>
<td>11.97</td>
</tr>
<tr>
<td>Belgium</td>
<td>7.30</td>
<td>4.30</td>
<td>10.62</td>
</tr>
<tr>
<td>France</td>
<td>3.44</td>
<td>1.14</td>
<td>3.69</td>
</tr>
<tr>
<td>Germany</td>
<td>7.54</td>
<td>3.25</td>
<td>3.73</td>
</tr>
<tr>
<td>UK</td>
<td>14.79</td>
<td>2.24</td>
<td>4.38</td>
</tr>
</tbody>
</table>

Sources:
(1) www.worldinfigures.org.
(2) www.sourceoecd.org.


Based on previous observations and reasonings outlined in the first paper$^5$, financial repression is continued to be modelled by assuming that the commercial banks are obligated to maintain quite a “high” proportion of the deposits as reserves, and hence financial liberalization will be defined as a process of relaxing the reserve–ratio requirements. Realizing the importance of intermediate goods import in total imports, we build a model in this paper, that takes into account importance of the imports.

$^5$See Tables 2, 3 and 4.
intermediate goods in the production process. Thus unlike before the production structure would include the domestic capital which is rented directly from the households and the intermediate goods imported from abroad using loans available from the domestic banking sector. Following

Table 3: Import of Intermediate Materials and Capital Goods in European Economies

<table>
<thead>
<tr>
<th></th>
<th>(Intermediate Materials)/ (Total Goods Trade)</th>
<th>(Capital Goods)/ (Total Goods Trade)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>37.93</td>
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<td>11.65</td>
</tr>
<tr>
<td>UK</td>
<td>16.02</td>
<td>7.67</td>
</tr>
</tbody>
</table>

Source: www.sourceoecd.org.

Notes: Categorization based on SITC 2 and 3.

Karapatakis (1992) we assume that import of intermediate goods are constrained by loan availability. As observed by Karapatakis (1992), such an assumption is not arbitrary but is based on the following rationale: Given that foreign suppliers usually require prepayment for the foreign inputs, firms may not be willing to tie-up all their retained earnings trying to finance the imports. Thus, essentially we model the co-existence of the un-intermediated domestic capital and the intermediated
foreign intermediate good into the production structure.

Besides presenting an open-economy model with explicit roles for an imported intermediate good, the paper, as outlined before, also attempts to device a way to add to the strength of the relationship between inflation and repression and in this regard, imported capital goods are thought to be important. The intuition is based on the initial premise that financial repression would distort the mix between the intermediated foreign input and the un-intermediated domestic capital, and thus perhaps add meat to the inflation–repression relationship. As before, the consumers inhabiting the domestic economy will be assumed to have their preferences defined over consumption of a home-produced good and leisure. Besides the consumers, firms, and the financial intermediaries, we have the government which balances budget every period. We thus present a dynamic general equilibrium framework with consumers, firms, financial intermediaries and a government, in an attempt to study the effects of financial distortions on inflation and exchange rate movements. Besides the introduction, the paper has been arranged as follows: Section 2 provides a broad literature review on financial repression and corresponding issues of financial liberalization in the context of open economies. Section 3 and 4 outlines the basic structure and equilibrium and balanced growth path of the model, respectively and section 5 discusses the process of calibration. Section 6 deals with the inflationary dynamics of liberalizing the domestic financial sector, which in our case as already suggested at the onset, is portrayed in the form of a relaxation of the reserve–deposit ratio. Section 7 concludes and lays out the areas of future research.

2 Related Literature

In this section we lay out in detail the related literature, though very minimal, in the context of small open economies. The literature is of interest because even though all the studies stated below
do not directly relates to the process of financial liberalization, in the sense defined, most of them however analyzes the importance and associated macroeconomic impacts of reserve requirements.

One of the earliest theoretical contributions in this regard is that of Bacchetta and Caminal (1992). The authors analyze the effect of financial integration for two countries relying on the taxation of their domestic financial system. A two-country model with overlapping generations and explicit financial intermediation is used. Governments are assumed to derive revenues from seigniorage and set optimally, but non-cooperatively, the rate of inflation and the level of required reserves on bank deposits. They conclude that financial liberalization leads to lower reserve ratios, higher inflation rates and larger stocks of government debt. Further, when the liberalization is anticipated, governments may temporarily increase the reserve ratios before the liberalization occurs. Note the liberalization in this paper basically relates to the liberalization of the capital account, which in the process allows the domestic residents with an alternative source of investment in the form of foreign bonds.

Bacchetta (1992) analyzed the dynamic impact of joint liberalization of capital movements and of the domestic financial sector, in the context of a small open economy. The paper considered two experiments: first, a simultaneous liberalization of the domestic financial sector and of the capital account; second, a sequential liberalization of the domestic financial sector followed by a capital account liberalization. In each case, the analysis focussed on the evolution of savings, investment and capital account based on an overlapping generations model with a Hayashi (1982) type \( q \)-theory of investment involving cost of adjustment to capital stock. The model indicates that a likely outcome of a liberalization would be an initial net inflow followed by an outflow. The change in the long-run net asset position of the country is ambiguous and would depend critically on the initial conditions. The analysis also reveals that even when the financial sector is
liberalized first, the comparison between domestic and the world rate of interest will usually not indicate the direction of capital flows. The share prices are observed to overshoot post liberalization. Finally, the service payments of the public debt increase, with the increase usually being smaller for simultaneous liberalization. Moreover, a large initial public debt leads to smaller net capital flows in the long-run.

Espinosa (1995) analyzes inflationary and welfare consequences of multiple reserve requirements in the context of a small open economy. In particular, Espinosa (1995), uses a version of Sammuelson’s (1958) pure-exchange overlapping generations model, to verify the claim that, for a given deficit multiple reserve scheme leads to a lower rate of inflation than that would occur under a single reserve regime. Note the financial intermediaries in this model economy is not only subjected to a cash reserve requirement but is also obligated to hold a fraction of their deposits as interest bearing government bonds. The interest paid by the securities are however below the market rate. The intuition behind the adoption of multiple reserve requirements by governments across the world was basically twofold: On the one hand, the government would reduce the degree of monetization and hence inflationary pressures by “unloading” some government bonds on the commercial banks and on the other hand, it would also help the monetary authority to reduce the burden that a single reserve requirement presents on the commercial banks. In such a framework, the author derives conditions that introducing a multiple reserve requirement will both be welfare-enhancing and inflation-minimizing. The result was strikingly different from the contributions of Freeman (1987) and Drazen (1989). These authors indicated that the use reserve requirements as a means to help finance a government deficit is not justified on the efficiency grounds. Hence a direct policy implication of this consensus would be, therefore, to substitute this source of deficit finance by a non-distortionary tax. However, more recently, such a view has also been challenged by
Bhattacharya and Haslag (2001). Using a pure–exchange closed economy overlapping generations model, with intermediaries subjected to only cash reserve requirements, the authors find conditions under which a benevolent government may make some use of the inflation tax in conjunction with a lump-sum tax on the young but not so when the lump-sum tax is available on the old.

Dooley and Chinn (1995) studied the role of reserve requirements in discouraging capital inflows, in the context of both industrialized and developing countries. The analysis was based on an open economy macro model incorporating bank credit. The model suggested that high levels of reserve requirement was a perverse policy tool in the sense that they amplified the effects of monetary shocks in the foreign economy. However changes in reserve requirement could insulate a repressed financial market from international financial shocks. As an aside the model also suggested that traditional measures of capital mobility such as interest parity conditions or the scale of gross private capital flows are of no importance in assessing the openness of the repressed financial system.

Reinhart and Reinhart (1999) finds that foreign exchange intervention matched by changes in reserve requirements keeping money supply fixed influences the exchange rate both in the short and the long run. Similarly, De Gregorio, Edwards and Valdés (2000) study the effect of unremunerated reserve requirements on interest rates, real exchange rate and the volume and composition of capital inflows for Chile. They find that an increase in the interest rate differential, small effects on the real exchange rate and a significant effect on the composition of capital inflows. On the other hand, when reserve requirements are interpreted as tax on the depositor, Dooley and Kletzer (1994) show that changes in the stock of capital flight can increase or decrease welfare depending on the structure of distortionary taxes and subsidies on capital. Along similar lines, Espinosa, Smith and Yip (2000) find that appropriately selected barriers to capital movements can be used by relatively poorer countries to not only eliminate short run capital flow volatility, but also increase short and
long run economic development. The selected capital barriers if apt can also benefit all countries and increase the magnitude of the flows in the steady state.

Kang and Sawada (2000) presents an endogenous growth model which simultaneously incorporated the role of financial development, human capital investment, and external openness. The study indicated that financial development and trade liberalization increases the growth rate of the economy by enhancing the marginal benefits of human capital investment. Alternatively financial repression and an inward-oriented policy tends to result in lower human capital investment and hence growth by increasing the net marginal cost of investment. Additionally, financial repression and low real interest rate coincides with a low economic growth rate typifying the experiences of the Latin American countries in the early 1980s. The paper indicates that an expansionist government generally has the incentive to increase the growth rate of money supply, repress the financial sector, close the economy, and impose a high income tax rate to obtain increases in the seigniorage revenue and in turn expand its political hold over the economy. Unfortunately, the fall out of such repressive policies are higher inflation rate and a lower economic growth rate that will not be sustainable and ultimately spell political instability. Finally, the authors advocates openness and financial development as the basic requirements of sustainable economic development.

Kletzer and Kohli (2001) presents a growth model to analyze financial repression and exchange rate management in developing countries. The theoretical model links financial repression and its role in fiscal policy to exchange rate management as the government seeks to satisfy the intertemporal budget constraint and keep inflation under control. The model shows how in an economy without capital account convertability, financial liberalization without fiscal reforms can lead to a balance of payment crisis. The analysis which considers the interaction between optimizing households and firms in a monetary economy, articulates the relationship between exchange rate regimes,
fiscal policies and balance of payment problems. The model showed how the policy instruments of financial repression can in fact become tools of resisting exchange rate fluctuations and managing financial capital inflows with partial liberalization even as fiscal importance of financial repression diminishes with reform. The model when compared to the Indian experience of the 1990s, a period of increasing liberalization and financial reforms, indicates that these instruments were used as tools of exchange rate intervention under a managed float. Moreover, the model illustrates the importance of fiscal and financial reforms for the liberalization of the capital account. International financial integration tends to erode away the capacity of the government to tax financial intermediation for the purpose of generating resources for the government or to maintain an exchange rate peg inconsistent with rates of domestic credit creation. Under such circumstances capital account and financial liberalization can lead to financial crisis in the absence of fiscal reforms – a result corroborating the findings of Diaz-Alejandro (1985).

Shi (2002) extends the analysis of Espinosa (1991) and Bacchetta and Caminal (1992) by incorporating a production economy in the traditional exchange economy overlapping-generations model. The author, like Espinosa (1991) and unlike Bacchetta and Caminal (1992), considers a small open economy to examine the welfare implications of reserve requirement. The paper indicates that there exists conditions under which the effect of change in reserve requirement on welfare is ambiguous. The standard result of a negative relationship between welfare and reserve requirements obtained in the context of pure–exchange economy type models used by Freeman (1987), Drazen (1989) and Espinosa (1991) was thus brought into question.

Gomis-Porqueras (2003) considers a monetary growth model analyzing the role of multiple reserve requirements in the context of a small open economy. The model allows the government to impose different reserve requirements according to the origin of funds, which in turn can potentially
regulate capital inflows and reduce inflation tax that the domestic citizens are going to face. The author indicates that the relative strength of multiple reserve requirements imposed on the banking sector and the nature of the exchange rate regime can alter the response of long-run real activity to changes in the inflation rate. In particular, an increase in the steady state inflation rate stimulates long run activity when exchange rate is fixed and the reserve requirements faced by the households of the small open economy are relatively small. On the other hand, the steady state inflation rate is found to hamper long run real activity when reserve requirements are relatively high. Similarly when flexible exchange rate policies are in place, increases in steady state inflation rate is always impedes long run activity. The analysis also finds that multiplicity of equilibria seems to be more of a fall out of the exchange rate regime rather than the strength of the multiple reserve requirements. Finally, the paper also highlighted the importance of considering the degree of segmentation of the local credit market, i.e., the narrowness of the banking system for the foreigners and the domestic investors, when exploring the relationships between exchange rate regimes, the inflation rate and capital accumulation.

The above literature review indicates that most of the analysis, except for Reinhart and Reinhart (1994) and De Gregorio, Edwards and Valdés (2000), and to some extent Gomis-Porqueras (2003), involving reserve requirements in the context of an open economy is theoretical. The empirical results in Reinhart and Reinhart (1999) and Edwards and Valdés (2000) are based on reduced form econometric models and lack a theoretical–structural background based on strong microfoundations. On the other hand the theoretical model in the Gomis-Porqueras (2003) required numerical analysis as it could not be solved analytically. However, the numerical analysis is purely arbitrary and is not calibrated to any economy-specific data. Further, most of the theoretical models are pure-exchange type economies, Bacchetta and Caminal (1992) and Espinosa (1995), and the rest that
explicitly considers production structures ignores the importance of not only imported capital but also consumption goods. Two papers that are somewhat close to our analysis are by Kang and Sawada (2000) and Kletzer and Kohli (2001). However, these papers have their own limitations. The Kang and Sawada (2000) analysis is based on a social planner type endogenous growth model and does not explicitly model the financial intermediary and hence the source of financial repression. The financial repression in this essay is modelled by indicating that a fraction of savings is lost in the process of investment and this fraction is a decreasing function of the level of financial development. The paper though incorporates the role of human capital and its relation to the degree of openness, ignores the role of capital goods imports. Finally, the paper lacks any numerical analysis and makes restrictive assumptions regarding the rate of capital depreciation to obtain closed form solutions. On the other hand, the Kletzer and Kohli (2001) study which presents a growth model to analyze the effects of financial repression on exchange rate movements for developing countries, also, like Kang and Sawada (2000), ignores the role of capital goods imports. The model does not promise persistent growth of real variables in the steady-state and hence cannot be simultaneously used to study the inflationary and growth effects of financial liberalization, in the sense defined upfront. Moreover, the model is not explicitly tenable to numerical analysis either.

In such a backdrop we present an endogenous growth model of a small open economy relying on capital goods import, to analyze the effects of domestic financial market liberalization on inflation and exchange rate. The model explicitly accounts for a financial intermediary, subjected to “high” reserve requirements, and hence presents a more complete picture of a financially repressed macroeconomy. Note the model is populated by identical consumers, firms, and the government, with each solving their respective optimization problems. Besides given the structure of the model we are able to generate a framework that would lend itself to calibration based on country-specific data.
The need for calibration is essential not only to sign the relationship between financial repression and the critical macroeconomic variables of our concern but, also to measure the “strength” of the relation between the variables.

3 Economic Environment

We modify and extend the theoretical framework of Chari, Jones and Manuelli (1995, 1996), 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 small open semi-industrialized economic structure. Given that we are trying to analyze the importance of financial sector distortions on inflation and exchange rate movements, it is essential to model the banking system explicitly. Besides, realizing the importance of import of intermediate goods we allow for the co-existence of an intermediated input (imported intermediate goods) and the un-intermediated input in the production structure. In this regard the banking system plays a crucial role since the imported intermediate goods requirement are assumed to be completely financed through bank loans. Thus for the imported input to be used in the production process, consumers must place deposit in the banking system and firms must borrow these deposits in the form of loans to meet the cash requirements of the foreign suppliers. Assumptions of small open economy allows us to treat the foreign price as parametric. The domestic un-intermediated capital will be assumed to be rented directly from the households. We will denote the domestic capital by $k$ and the intermediated foreign input by $k^*$. 

Financial repression is modelled through the banks being 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 the home-produced consumption good will be assumed to be a credit good.\(^6\) Note that money is valued in this economy simply because the banks are obligated to hold a fraction of the deposits as cash reserves. The domestic consumption and investment goods are produced by the same technology. Since all goods in the domestic economy are perfect substitutes in the production side, they sell for the same nominal price.

The resource constraint in the model economy is given by

\[
c_t + i_{kt} + i_{ht} + x_t \leq F(k_t, k_t^*, n_t h_t), \tag{1}
\]

where \(p_t\) is the domestic price level; \(c_t\) is the consumption of domestic credit good; \(i_{kt}\) and \(i_{ht}\) are the domestic investment purchases in physical and human capital respectively; \(x_t\) denotes the exports of the small-open economy; \(k_t\) is the stock of domestic physical capital; \(k_t^*\) is the purchase of imported intermediate good; \(n_t h_t\) 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

\[
k_{t+1} \leq (1 - \delta_k) k_t + i_{kt} \quad \text{and} \quad h_{t+1} \leq (1 - \delta_h) h_t + i_{ht},
\]

where \(\delta_k\) and \(\delta_h\) are the depreciation rates.

Trading in the economy can be captured by the following sequence: At the beginning of each period, a securities market opens. The households receive their factor earnings (capital and labor) from the previous period, the net of tax principal and interest from their past savings, and any lump-sum transfers from the government. At this time, households make payments for the credit (consumption) goods and make savings decisions for the future. Note the only source of savings for the households are in the form of deposit contracts maturing in one period offered by the financial

\(^6\)Including an imported consumption good in the utility function of the individual does not alter the essence of the results obtained.
intermediaries. The deposits are used to make loans and acquire fiat money. The banks hold fiat money to satisfy a reserve requirement. We assume that no resources are required to operate the banking system.

On the production side, firms rent the domestic capital directly from the households but they must borrow cash from the financial intermediaries to purchase the imported intermediate good. This is because they start the period with no cash, since the free entry and exit in the perfectly competitive product market washes out all profits. The firm produces units of the domestic consumption and exportable good using a constant returns to scale production technology involving the un-intermediated domestic physical capital, human capital and the imported intermediate good as the three inputs.

The government taxes income and makes lump-sum transfer payments to the households. The government can finance the deficit in any period through seigniorage and issuing external debt. For the sake of simplicity and technical reasons outlined below, we assume that there are no domestic government bonds.

3.1 Consumers

We assume that there are large number of identical households that solves the following dynamic problem:

\[
V = \max_{c_{1t}, n_t^i, d_t, h_t, k_{t+1}} \sum_{t=0}^{\infty} \beta^t u(c_{1t}, 1 - n_t) \tag{2}
\]

\[
\text{s.t. : } d_t \leq \begin{cases} 
[p_t w_t n_t h_t(1 - \tau_t) + (1 - \tau_t)p_t r_t k_t] \\
[1 + (1 - \tau_t)R_{dt}]d_{t-1} - p_t c_t - \\
T_t - p_t i_{ht} - p_t i_{kt}
\end{cases} \tag{3}
\]
\begin{align*}
k_{t+1} &\leq (1 - \delta_k)k_t + i_{kt} \quad (4) \\
h_{t+1} &\leq (1 - \delta_h)h_t + i_{ht} \quad (5)
\end{align*}

with \(d_{t-1}, \tau_t, h_t, k_t, R_{dt}, w_t, r_t\) and \(p_t\) as given. Note \(\beta\) is the discount factor; \(u\) is the consumer’s utility; \(d_{t-1}\) 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 \(t\); \(\tau_t\) is the tax rate on income; \(T_t\) is the size of the transfer to the household delivered for use in period \(t\); \(w_t\) is the real wage rate and; \(r_t\) is the real rental of domestic capital. So consumers maximize their lifetime utility (equation (2)) subject to equations (3), (4) and (5), to determine a contingency plan for \(\{c_t, d_t, n^*_t, h_{t+1}, k_{t+1}\}_{t=0}^{\infty}\).

The consumer’s optimization problem can be written in the following recursive formulation.

\[
J(d_{t-1}, h_t, k_t) = \max_{n^*_t, d_t, h_{t+1}, k_{t+1}} \left\{ u\left(\frac{a_t}{p_t} - \frac{h_t}{p_t} - i_{ht} - i_{kt}, 1 - n_t\right) \right. \\
+ \beta J(d_t, h_{t+1}, k_{t+1}) \left. \right\} \quad (6)
\]

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

\[
d_t : \frac{u_1(c_t, 1 - n_t)}{p_t} - \beta J_1(d_t, h_{t+1}, k_{t+1}) = 0 \quad (7)
\]

\[
n^*_t : u_1(c_t, 1 - n_t) [w_t h_t (1 - \tau_t)] - u_2(c_t, 1 - n_t) = 0 \quad (8)
\]

\[
h_{t+1} : -u_1(c_t, 1 - n_t) + \beta J_2(d_t, h_{t+1}, k_{t+1}) = 0 \quad (9)
\]

\[
k_{t+1} : -u_1(c_t, 1 - n_t) + \beta J_3(d_t, h_{t+1}, k_{t+1}) = 0 \quad (10)
\]

Along with the following envelope conditions

\[
J_1(d_{t-1}, h_t, k_t) = u_1(c_t, 1 - n_t) \left[1 + (1 - \tau_t) R_{dt}\right] \quad (11)
\]

\[
J_2(d_{t-1}, h_t, k_t) = u_1(c_t, 1 - n_t) [w_t n_t (1 - \tau_t) + (1 - \delta_h)] \quad (12)
\]

\[
J_3(d_t, h_t, k_t) = u_1(c_t, 1 - n_t) [r_t (1 - \tau_t) + (1 - \delta_k)] \quad (13)
\]
In addition, a transversality condition is necessary to ensure the existence of the household’s present-value budget constraint. This terminal constraint can be interpreted as a “non-ponzi” condition in which the household cannot borrow against the sum of future deposits and domestic capital, at a rate higher than that can be repaid. Mathematically, the transversality condition is represented as

\[
\lim_{T \to \infty} \left[ \frac{d_T + k_T}{\prod_{t=0}^{T-1} (1 + (1 - \tau_t) R_t)} \right] \tag{14}
\]

where \( \pi \) is the gross rate of inflation. As such the date-\( t \) budget constraint of the household can be written in the form of an infinite horizon, present-value budget constraint.

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

\[
\frac{u_1(c_t, 1 - n_t)}{p_t} = \beta \frac{u_1(c_{t+1}, 1 - n_{t+1})[1 + (1 - \tau_{t+1}) R_{dt+1}]}{p_{t+1}} \tag{15}
\]

\[
\frac{u_1(c_t, 1 - n_t)}{u_2(c_t, 1 - n_t)} = \frac{1}{[w_t h_t (1 - \tau_t)]} \tag{16}
\]

\[
u_1(c_t, 1 - n_t) = \beta u_1(c_{t+1}, 1 - n_{t+1})[w_{t+1} n_{t+1} (1 - \tau_{t+1}) + (1 - \delta_h)] \tag{17}
\]

\[
u_1(c_t, 1 - n_t) = \beta u_1(c_{t+1}, 1 - n_{t+1})[r_{t+1} (1 - \tau_{t+1}) + (1 - \delta_k)] \tag{18}
\]

Equation (16) 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 (17) indicates that the marginal rate of substitution between consumption and leisure must be equal to the ratio of their prices. Equation (18) 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. Equation (19) is the efficiency condition for domestic physical 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 physical capital.

Moreover, from the above set of conditions, specifically (16), (18) and (19) it is easy to derive that arbitrage leads to equivalent real rates of return for the alternative investment choices available to the consumer.

\[
\left[ \frac{p_t(1 + (1 - \tau_{t+1})R_{dt+1})}{p_{t+1}} \right] = \left[ w_{t+1} + (1 - \delta_h) \right] = \left[ \tau_{t+1} + (1 - \delta_h) \right] \quad (19)
\]

### 3.2 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:

\[
\max_{L,d} \pi_{bt} = R_{Lt}L_t - R_{dt}d_t \quad (20)
\]

subject to:

\[
\gamma_t d_t + L_t \leq d_t \quad (21)
\]

where \( \pi_{bt} \) 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 \( \gamma_t \) 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

\[
R_{Lt}(1 - \gamma_t) - R_{dt} = 0 \quad (22)
\]
Simplifying, in equilibrium, the following condition must hold

\[ R_{Lt} = \frac{R_{dt}}{1 - \gamma_t} \]  

(23)

Reserve requirements thus tend to induce a wedge between the interest rate on savings and lending rates for the financial intermediary. Note, many countries impose a variety of obstacles to proper functioning of the intermediation system. Examples of such impediments include portfolio restrictions, taxes, and requirements that loans to favored sectors be made at interest rates below the market level (popularly called, Priority Sector Lending). To some extent these restrictions can be viewed a wedge between the interest rates goods producing firms pay banks and the rate banks ultimately receive on their loans. This can be easily incorporated in our model, by slightly reformulating the problem of the financial intermediaries.\(^7\) Given that in most of our model economies, interest rates were deregulated in the mid-1980, the reasons for including this wedge factor in our analysis was not very compelling.\(^8\) Moreover, a tax on the interest earnings of the banks introduces a similar type of wedge between the lending and borrowing rates as is obtained through the imposition of reserve requirements.

### 3.3 Firms

The firms rent the domestic un-intermediated capital, \(k\), directly from the households and purchases the foreign intermediate good, \(k^*\), using financing from the banks. Formally, the firms face the following problem:


\(^8\)See Bacchetta and Caminal (1992), for a detailed survey.
\[ W = \max_{k_t, k^*_t, (n_t h_t)} \sum_{i=0}^{\infty} \rho_t \left\{ (1 - \tau_t) \left[ p_t F(k_t, k^*_t, n_t h_t) - p_t w_t n_t h_t - p_t r_t k^*_t - R_{Lt-1} L_{t-1} \right] + L_t - e_t p^*_t i_{k^*_t} - L_{t-1} \right\} \] 

\[ \text{s.t. : (i) } e_{t-1} p^*_t - L_{t-1} \leq 0 \] 

\[ (ii) \quad k^*_t + 1 \leq i_{k^*_t} \] (25) (26)

where \( \rho_t \) is the subjective discount factor used by the firms; \( e_t \) is the nominal exchange rate at date-\( t \) and; \( p^*_t \) is the world price at date-\( t \). Note that the loan constraint, equation (25), implies that from the firm’s point of view, it may as well be renting the imported capital or intermediate goods from the bank itself, which in turn obtains them from the foreign suppliers on behalf of the firms. Moreover, the loans are strictly one period loans. Because of these assumptions, as pointed out by Chari, Jones and Manuelli (1995, 1996) and Basu (2001), the firm can be seen as facing a static problem; hence, one of the implications of the equilibrium conditions of this version of the model is that the choice of \( \rho_t \) is immaterial. Moreover, given that intermediate goods are goods which are used up in the production of other goods by the end of the period, we have the second constraint. Formally, implying that the depreciation rate is 100 percent.

The up-shot of the above static problem of the firm yields the following efficiency conditions:

\[ k_t : F_1(t) = r_t \] (27)

\[ k^*_t : (1 - \tau) F_2(t) = \left( \frac{e_{t-1} p^*_t - L_{t-1}}{p_t} \right) \left( \frac{p_{t-1} (1 + (1 - \tau_t) R_{Lt})}{p_t} \right) \] (28)

\[ (n_t h_t) : F_3(t) = w_t \] (29)

where \( F_i(t), i=1, 2, 3 \): denotes the marginal product the domestic capital, imported intermediate good and effective labor. As given by equations (27) and (28) respectively, the production
firm set their after-tax marginal products of the un-intermediated domestic capital and the inter-
mediated imported good equal to their respective after-tax real rentals. And equation (29) simply
states that the firm hires effective labor up to the point where the marginal product of effective
labor equates the real wage.

Note combining (19), (23), (27) and (28), we obtain the following relation between the marginal
products of the domestic capital and the imported capital good:

\[ [1 + (1 - \gamma_t) \left( 1 - \tau_t \frac{F_2(t)p_t}{e_{t-1}p_{t-1}} - 1 \right)] = \frac{p_t}{p_{t-1}} \left[ F_1(t)(1 - \tau_t) + (1 - \delta_k) \right] \] (30)

A close analysis of equation (30) reveals that increases in the financial repression parameter, \( \gamma \)
raises \( F_2 \) relative to \( F_1 \). So higher reserve requirements tend to distort the mix of domestic capital
and intermediate goods. The reason for this distortion is the financial repression that exists in the
economy in the form of non-interest bearing assets (cash reserves) in the portfolio of the financial
intermediaries. This requirement causes a wedge between the rental rates of the two type of assets,
which in turn distorts the capital mix.

### 3.4 Government

The government commits to a sequence \( \{T_t\}_{t=0}^\infty \) of transfers which are financed by a combination of
taxes, seigniorage and issuance of external debt. The government’s budget constraint, in nominal
terms, is

\[ T_t = m_t - m_{t-1} + \pi_t p_t F(k_t, k_t^*, n_t h_t) + e_t \left[ b_{t+1}^* - (1 + r_t^*) b_t^* \right] \] (31)

where \( b_t^* \) is the size of the domestic bond holding by foreigners at time \( t \); and \( r_t^* \) is the exogenously
given world nominal interest rate paid on the domestic bonds. To be consistent with perpetual
growth, we take the government transfer as a constant proportion of national income, in nominal
terms, i.e., \( T_t = \phi p_t F(k_t, k_t^*, n_t h_t) \). Notice that \( \phi \) is the parameter indicating the relative size of
the government in the economy. The government has at its disposal two tools of monetary policy, the reserve requirement and the rate of money growth, and the income-tax rate, the transfers and foreign public debt as the three tools of fiscal policy. We will assume that money evolves according to the policy rule \( m_t = \mu t m_{t-1} \), where \( \mu \) is the money growth rate.

Note a transversality condition is necessary to ensure the existence of the government’s present-value budget constraint. The government’s terminal constraint is interpreted as a non-ponzi condition in which the government cannot go on borrowing from the foreigners for ever. Formally, the transversality condition is represented as

\[
\lim_{T \to \infty} \frac{b^*_T}{\prod_{s=0}^{T-1} (1 + r^*_s)} = 0
\]  

(32)

A notable exception from the government budget constraint is the domestic government bonds, especially when government debt is an important source of finance in the four southern European economies of our choice. \(^9\) Besides being a simplification, bonds are ignored 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.

### 3.5 Balance of Payments

By definition, the Balance of Payments (\( BP \)) comprises of the Current and the Capital Accounts, denoted respectively by, \( CA \) and \( KA \). The \( CA \) includes the Trade Balance (\( TB \)) and the net debt service payments abroad, herein the services due to the foreign debt position of the model economy. The \( KA \) in turn captures the net foreign savings inflow into the economy. Formally, the \( BP, CA, \)

\(^9\) See Table 6, Chapter 1.
TB and the KA at any time period $t$ is given by the following expressions:

\[ BP_t = CA_t + KA_t \]  \hspace{2cm} (33)

\[ CA_t = TB_t - r_t^* \frac{b_t^*}{p_t^*} \]  \hspace{2cm} (34)

\[ TB_t = x_t - \frac{e_t^* p_t^* k_{t+1}^*}{p_t^*} \]  \hspace{2cm} (35)

\[ KA_t = \frac{(b_{t+1}^* - b_t^*)}{p_t^*} \]  \hspace{2cm} (36)

The nominal exchange rate will be determined according to the Purchasing Power Parity (PPP) condition, $P = e P^*$, and the net position of the foreign assets at steady state, $b^*$, will be deduced from the balance of payment equilibrium condition, $BP = 0$.

\[ x_t - \frac{e_t^* p_t^*}{p_t^*} k_{t+1}^* + \frac{[b_{t+1}^* - (1 + r_t^*) b_t^*]}{p_t^*} = 0 \]  \hspace{2cm} (37)

Without any loss of generality and maintaining consistency with perpetual growth, the exports of the economy, $x_t$, will be assumed to be a fixed fraction $\varphi$ of the domestic output. Further given that $p^*$ is parametrically given to the small-open economy, we set it to unitary without any loss of generality. Hence implying that the domestic price level and the nominal exchange rates are synonymous for the model economy with the PPP condition satisfied, i.e., $p_t = e_t^*$.

### 4 Equilibrium and Balanced–Growth Equations

An equilibrium in this model economy is a sequence of prices $\{p_t, e_t, w_t, r_t, R_{Lt}, R_{dt}\}_{t=0}^{\infty}$, allocations $\{c_t, n_t, k_t, h_t, ik_t^*, i_{kt_t}^*, i_{ht_t}\}_{t=0}^{\infty}$, stocks of financial assets $\{m_t, d_t\}_{t=0}^{\infty}$, exogenous sequences of $\{p_t^*, r_t^*\}_{t=0}^{\infty}$, and policy variables $\{\gamma_t, \mu_t, \tau_t, T_t, b_t^*\}_{t=0}^{\infty}$ such that:
1. The allocations and stocks of financial assets solve the household’s date–$t$ maximization problem, (2), given prices, exogenous and policy variables.

2. The stock of financial assets solve the bank’s date–$t$ profit maximization problem, (20), given prices, exogenous and policy variables.

3. The real allocations solve the firm’s date–$t$ profit maximization problem, (24), given prices, exogenous and policy variables.

4. The money market equilibrium condition: $m_t = \gamma_t d_t$ is satisfied for all $t \geq 0$.

5. The loanable funds market equilibrium condition: $e_{t-1} p_{t-1}^{*} k_{2t} = (1 - \gamma_{t-1})d_{t-1}$ where the total supply of loans $L_t = (1 - \gamma_t) d_t$ is satisfied for all $t \geq 0$.

6. The equilibrium condition in the external sector: $BP = 0$ holds, along with the PPP condition being satisfied.

7. The labor market equilibrium condition: $n_t^{r} h_t = (n_t h_t)^{d}$ for all $t \geq 0$.

8. The goods market equilibrium condition require: (1), $c_t + i_{kt} + i_{ht} + x_t = F(k_t, k_t^{*}, n_t h_t)$. is satisfied for all $t \geq 0$.

9. 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 conditions 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

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

(38)

where \( \psi \) and \( \sigma \) are preference parameters.

On the production side, a sufficient condition is that \( F(k, k^*, nh) \) is of Cobb-Douglas type. Specifically of the following form

\[
  Y = F(k_t, k^*_t, n_t h_t) = A(k_t)^{\alpha_1}(k^*_t)^{\alpha_2}(n_t h_t)^{1-\alpha_1-\alpha_2}
\]  

(39)

where \( A \) is a positive scalar, and \( \alpha_1, \alpha_2 \) and \( (1 - \alpha_1 - \alpha_2) \) are the elasticities of output with respect to domestic capital, imported capital or the intermediate good, and labor, respectively.

For the sake of tractability, we assume that the government has time invariant policy rules, which means the reserve–ratio, \( \gamma_t \), the money supply growth–rate, \( \mu_t \), and the tax–rate, \( \tau_t \), are constant over time.

For the above specifications and simplifications, we can show that the dynamics of the system converge to a balanced growth path.\(^{10} \) The economy is characterized by the following system of balanced growth equations:

\(^{10}\)See Benhabib and Perli (1994) and Ladron-de-Guevara, Ortigueira, and Santos (1994).
\[ g^\sigma \left( \frac{n^{(\alpha_1+\alpha_2)}}{1-n} \right) \frac{\theta}{(1-\tau)(1-\alpha_1-\alpha_2)} = \beta \frac{k^*}{c} \left( \frac{k^*}{k} \right)^{\alpha_2} \left( \frac{h^*}{k} \right)^{(1-\alpha_1-\alpha_2)} \]  

(40)

\[ g^\sigma = \beta [1 + (1-\tau)R_d] \]  

(41)

\[ g^\sigma = \beta [\omega n(1-\tau) + (1-\delta_k)] \]  

(42)

\[ g^\sigma = \beta [r(1-\tau) + (1-\delta_k)] \]  

(43)

\[ R_L = \frac{R_d}{1-\gamma} \]  

(44)

\[ w = (1-\alpha_1-\alpha_2)A \left( \frac{k^*}{k} \right)^{\alpha_2} n^{(-\alpha_1-\alpha_2)} \left( \frac{h}{k} \right)^{(1-\alpha_1-\alpha_2)} \]  

(45)

\[ r = \alpha_1 A \left( \frac{k^*}{k} \right)^{\alpha_2} n^{(1-\alpha_1-\alpha_2)} \left( \frac{h}{k} \right)^{(1-\alpha_1-\alpha_2)} \]  

(46)

\[ \frac{(1 + (1-\tau)R_L)}{\pi} = \alpha_2 (1-\tau) A \left( \frac{k^*}{k} \right)^{(\alpha_2-1)} n^{(1-\alpha_1-\alpha_2)} \left( \frac{h}{k} \right)^{(1-\alpha_1-\alpha_2)} \]  

(47)

\[ (g + \delta_k - 1) = \frac{i_k}{k} \]  

(48)

\[ (g + \delta_h - 1) = \frac{i_h}{k} \]  

(49)

\[ g \frac{k^*}{k} = \frac{\dot{L}}{k} \]  

(50)

\[ g = \frac{i_{k^*}}{k} \frac{k}{k^*} \]  

(51)

\[ \frac{\dot{L}}{k} = (1-\gamma) \frac{\dot{d}}{k} \]  

(52)

\[ \pi g = \mu \]  

(53)

\[ \pi = \varepsilon \]  

(54)

\[ \frac{\dot{m}}{k} = \gamma \frac{\dot{d}}{k} \]  

(55)

\[ \frac{c}{k} + \frac{i_k}{k} + \frac{i_h}{k} = (1-\varphi) A \left( \frac{k^*}{k} \right)^{\alpha_2} n^{(1-\alpha_1-\alpha_2)} \left( \frac{h}{k} \right)^{(1-\alpha_1-\alpha_2)} \]  

(56)

where \( \pi = \frac{\dot{m}_{t+1}}{m_t} \) is the steady-state level of inflation; \( \varepsilon = \frac{\dot{c}_{t+1}}{c_t} \) is the steady-state level of exchange rate depreciation of domestic currency; \( g = \frac{\dot{c}_{t+1}}{c_t} = \frac{i_{k_{t+1}}}{k_{t+1}} = \frac{i_{h_{t+1}}}{h_{t+1}} = \frac{k_{t+1}}{k_t} = \frac{h_{t+1}}{h_t} = \frac{\dot{d}_{t+1}}{d_t} \) is the balanced growth rate of the economy; \( \frac{c}{k}, \frac{i_k}{k}, \frac{i_h}{k}, \frac{\dot{m}}{k}, \) and \( \frac{k^*}{k} \) are the
long-run ratios of the respective parts of output relative to the size of the capital stock;\(^{11}\) \(\hat{d} (= \frac{d}{\hat{p}})\)
is size of real deposit; \(\hat{L} (= \frac{L}{\hat{p}})\) 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 a
non-linear system of seventeen equations in seventeen variables, \(g, \pi, \varepsilon, R_d, R_L, \frac{c}{k}, \frac{i_k}{k}, \frac{i_h}{k}, \frac{b}{k}, \frac{k^*}{k}, \frac{i_h^*}{k}, \frac{\hat{d}}{k}, \frac{\hat{L}}{k}, \frac{\hat{m}}{k}, w, r\) and \(n\) and can be solved given the values of the policy variables \(\mu, \tau\) and \(\gamma\), to
trace the long-run reaction of the system to a change in policy.

5 Calibration

In this section, using the system of equations at steady–state, we attribute values to the parameters,
several of them being country–specific. We select the parameter values for our benchmark model
using a combination of figures from previous studies and facts about the economic experience for

We follow the standard real business cycle literature in using steady–state conditions to establish
parameter values observed in the data. Some parameters are calibrated using country–specific
data, while others, without sufficient country–specific evidence over a long period, correspond
to prevailing values from the literature. This section reveals the general procedures used. The
country–specific calibrations are reported in Tables 4, 5 and 6. 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,

\(^{11}\)Recall \(x = \varphi A^{\alpha_1}(k^*)^{\alpha_2}(nh)^{(1-\alpha_1-\alpha_2)}\)
is, “based on the observation that about one–third of waking time (less personal care) is used for market labor by American households”\textsuperscript{12};

- $\sigma$: 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. It is important to realize that there is world–wide evidence suggesting that per capita leisure has increased steadily until the 1930s. Since then, and certainly for the post–war period, it has been approximately constant. Moreover, real wages (defined as real average hourly total compensation, including benefits and contributions for social insurance) have increased steadily in the post–war period. Taken together, these two observations imply that the elasticity of substitution between consumption and leisure should be near unity. These observations justify the choice of the log-utility specification.

- $(1 - \alpha_1 - \alpha_2)$: since the production function is Cobb-Douglas, this corresponds to the share of effective labor in income. $(1 - \alpha_1 - \alpha_2)$ 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 are 62.7 percent (Spain), 61.7 percent (Italy), 59.8 percent (Greece), and 53.0 percent (Portugal);

- $\delta_k$: 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); $\delta_k$: the depreciation rate of human capital. And without any loss of generality is assumed to be equal to $\delta_k$;

- $\beta$: the discount factor is set at 0.98.\textsuperscript{13}

\textsuperscript{12}For details see Kydland and Prescott (1982).
\textsuperscript{13}For details see Chari, Christiano and Kehoe (1994).
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 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);

- \( \pi \): 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);

- \( \gamma \): the annual reserve–deposit ratio lies between 0.137 (Italy) and 0.235 (Greece);

- \( \tau \): the tax rate, calculated as the ratio of tax-receipts to GDP, lies between 0.2274 (Greece) and 0.3625 (Italy);

- \( \frac{k^*}{Y} \): the ratio of the imported intermediate input to output ranges between 0.067 (Italy) and 0.146 (Greece).

- \( \varphi \): the ratio of exports to output ranges between 0.191 (Portugal) and 0.264 (Greece).

### 5.1 Some More Calibrated Parameters

The following set of parameters are reported in Tables 5 and 6.

- \( R_d \): the nominal rate of interest on deposits is solved from equation (41). We obtain two values of nominal interest rate for each country corresponding to the two alternative values of the relative risk aversion parameter \( \sigma \). For \( \sigma = 1 \), the nominal rate of interest lies between
16.85 percent (Spain) and 25.96 percent (Portugal) and between 20.69 percent (Spain) and 30.83 percent (Portugal) when $\sigma = 2$. Note the rate of interest is higher compared to what is reported in Table 5. This is however, a common feature of the endogenous growth models without uncertainty\(^{14}\):

- $R_L$: the nominal interest rate on loans is solved from equation (44), and like the rate of interest on the deposits has two values corresponding to the two alternative values of the relative risk aversion parameter $\sigma$. For $\sigma = 1$, the nominal interest rate on loan ranges between 19.62 percent (Spain) and 33.32 percent (Greece), and between 24.09 percent (Spain) and 38.44 percent (Portugal) when $\sigma = 2$. The nominal interest rates on loans are higher than observed, given that the calibrated interest rates on deposits are higher than the average values in the data;

- $k^*$: is the capital output ratio. The estimates are calibrated by using the country-specific investment output ratio and the equation of motion for the domestic-physical capital in steady state, that is, $(g + \delta k - 1)\frac{Y}{k} = \frac{i}{k}$. The country specific values are between 2.93 (Spain) and 4.22 (Greece);

- $\frac{k^*}{k}$: is the ratio of foreign intermediate goods to domestic capital is calibrated by using the ratio of the imported intermediate input to output and the country-specific capital-output ratio. The country specific values ranges between 0.02 (Spain and Italy) and 0.04 (Portugal);

- $\alpha_2$: is the share of foreign intermediate good in domestic output and is calibrated using equations (42), (43), (45), (46) and (47). Given that we have two alternative values for the interest rate on loans, corresponding to two different values of the risk-preference parameter,\(^{14}\)

\(^{14}\)For details see Chari, Manuelli and Jones (1995, 1996).
we also have two different values for the share of imported intermediate input in output. For \( \sigma = 1 \), the share ranges between 7.0 percent (Spain and Italy) and 14.0 percent (Portugal), and between 6.0 percent (Spain and Italy) and 12.0 percent (Portugal) when \( \sigma = 2 \). Note given \( \alpha_2 \) and \((1 - \alpha_1 - \alpha_2)\), we can easily calculate \( \alpha_1 \), the share of domestic physical capital in output. For \( \sigma = 1 \), the share ranges between 27.2 percent (Greece) and 33.0 percent (Portugal), and between 29.2 percent (Greece) and 35.0 percent (Portugal) when \( \sigma = 2 \);

- \( \frac{h}{k} \): the ratio of human to physical capital is calibrated from equations (42), (43), (45) and (46). Given alternative values for the share of imported intermediate input and domestic capital to output, for two alternative values of the risk preference parameter, we have two values for the ratio of human to physical capital. For \( \sigma = 1 \), the ratio ranges between 1.61 (Portugal) and 2.2 (Greece), and between 1.51 (Portugal) and 2.05 (Greece) when \( \sigma = 2 \);

- \( A \): the technology parameter, is calibrated from equations (43) and (46) and have two alternative values corresponding to the two alternative values of the risk preference parameter. For \( \sigma = 1 \), the \( A \) ranges between 0.69 (Greece) and 1.28 (Portugal), and between 0.79 (Greece) and 1.67 (Portugal) when \( \sigma = 2 \);

- \( \frac{i_k}{k} \): the ratio of the investment in physical capital to physical capital itself is calibrated from equation (48). The country specific value ranges between 0.0506 (Greece) and 0.0795 (Portugal);

- \( \frac{i_h}{k} \): The ratio of investment in human capital to domestic physical capital is calibrated from equation (49). Given that there are two alternative values for \( \frac{h}{k} \), corresponding to two alternative parameterization of the risk aversion parameter, we also have two alternative values for the ratio. The country specific value ranges between 0.1113 (Greece) and 0.1561 (Spain)
for $\sigma = 1$, and lies between 0.1037 (Greece) and 0.1508 (Spain) for $\sigma = 2$;

- $\xi_k$: the ratio of consumption to domestic capital is calibrated from the resource constraint of the economy given by equation (56). There are two values of $\xi_k$ corresponding to the two alternative values of the relative risk aversion parameter, $\sigma$. For $\sigma = 1$, the ratio ranges between 0.1039 (Portugal) and 0.1488 (Italy) and between 0.1706 (Greece) and 0.2193 (Portugal) when $\sigma = 2$;

- $\theta$: the value of $\theta$, the preference parameter for is obtained from equation (40). We obtain two values of the preference parameter for each country corresponding to two alternative values of the relative risk aversion parameter $\sigma$. For $\sigma = 1$, the parameter lies between 2.52 (Italy) and 6.01 (Portugal) and between 2.0 (Italy) and 3.70 (Portugal) when $\sigma = 2$;

- $\mu$: the annual money growth rate for the four economies, is calibrated using equation (53). The money growth rate parameter lies between 1.103, i.e., 10.30 percent (Spain) and 1.173 i.e., 17.3 percent (Greece);

Table 4: Calibration Parameters

<table>
<thead>
<tr>
<th></th>
<th>$(1 - \alpha_1 - \alpha_2)$</th>
<th>$i_k$</th>
<th>$g$</th>
<th>$\pi$</th>
<th>$\gamma$</th>
<th>$\tau$</th>
<th>$k^* / Y$</th>
<th>$\delta_k = \delta_h$</th>
<th>$\varphi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>0.627</td>
<td>0.2210</td>
<td>1.0254</td>
<td>1.0752</td>
<td>0.141</td>
<td>0.2553</td>
<td>0.069</td>
<td>0.050</td>
<td>0.205</td>
</tr>
<tr>
<td>Italy</td>
<td>0.617</td>
<td>0.2176</td>
<td>1.0193</td>
<td>1.0858</td>
<td>0.137</td>
<td>0.3625</td>
<td>0.067</td>
<td>0.052</td>
<td>0.219</td>
</tr>
<tr>
<td>Greece</td>
<td>0.598</td>
<td>0.2135</td>
<td>1.0186</td>
<td>1.1516</td>
<td>0.235</td>
<td>0.2774</td>
<td>0.146</td>
<td>0.032</td>
<td>0.191</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.530</td>
<td>0.2746</td>
<td>1.0295</td>
<td>1.1304</td>
<td>0.198</td>
<td>0.2773</td>
<td>0.132</td>
<td>0.050</td>
<td>0.264</td>
</tr>
</tbody>
</table>

Note: Parameters defined as above.
### Table 5: Calibration Parameters

<table>
<thead>
<tr>
<th></th>
<th>$R_d$</th>
<th>$R_L$</th>
<th>$\alpha_2$</th>
<th>$\frac{\mu}{k}$</th>
<th>$A$</th>
<th>$\frac{i_n}{k}$</th>
<th>$\frac{c}{k}$</th>
<th>$\theta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma = 1$</td>
<td>$\sigma = 2$</td>
<td>$\sigma = 1$</td>
<td>$\sigma = 2$</td>
<td>$\sigma = 1$</td>
<td>$\sigma = 2$</td>
<td>$\sigma = 1$</td>
<td>$\sigma = 2$</td>
<td>$\sigma = 1$</td>
</tr>
<tr>
<td>Spain</td>
<td>16.85</td>
<td>20.69</td>
<td>19.62</td>
<td>24.09</td>
<td>0.07</td>
<td>0.06</td>
<td>2.07</td>
<td>2.00</td>
</tr>
<tr>
<td>Italy</td>
<td>20.33</td>
<td>23.75</td>
<td>23.56</td>
<td>27.52</td>
<td>0.07</td>
<td>0.06</td>
<td>1.97</td>
<td>1.91</td>
</tr>
<tr>
<td>Greece</td>
<td>25.49</td>
<td>28.37</td>
<td>33.32</td>
<td>37.08</td>
<td>0.13</td>
<td>0.11</td>
<td>2.20</td>
<td>2.05</td>
</tr>
<tr>
<td>Portugal</td>
<td>25.96</td>
<td>30.83</td>
<td>32.36</td>
<td>38.44</td>
<td>0.14</td>
<td>0.12</td>
<td>1.61</td>
<td>1.51</td>
</tr>
</tbody>
</table>

Note: Parameters defined as above.

### Table 6: Calibration Parameters

<table>
<thead>
<tr>
<th></th>
<th>$\frac{k}{\bar{Y}}$</th>
<th>$\frac{k^*}{k}$</th>
<th>$\frac{i_n}{k}$</th>
<th>$\mu$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>2.93</td>
<td>0.02</td>
<td>0.0754</td>
<td>1.103</td>
</tr>
<tr>
<td>Italy</td>
<td>3.05</td>
<td>0.02</td>
<td>0.0713</td>
<td>1.107</td>
</tr>
<tr>
<td>Greece</td>
<td>4.22</td>
<td>0.03</td>
<td>0.0506</td>
<td>1.173</td>
</tr>
<tr>
<td>Portugal</td>
<td>3.14</td>
<td>0.04</td>
<td>0.0795</td>
<td>1.164</td>
</tr>
</tbody>
</table>

Note: Parameters defined as above.
6 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 modelled as banks being obligated to maintain a “high” reserve requirement, i.e., a high value of $\gamma$, in our case. In this sense, financial liberalization would imply a reduction in the size of the obligatory reserve requirement, $\gamma$, 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 system of equations the relationship obtained between the rate inflation and the policy variables, $\tau$, $\mu$, and $\gamma$ cannot be solved explicitly to obtain a reduced form. Hence, we adapt a first-order Taylor series approximation around the long-run averages of country-specific rate of inflation, to obtain explicit reduced-form solution for the steady-state rate of inflation.\textsuperscript{15}

Below in Table 7, using the calibrated parameters we report the values of the derivative of steady–state inflation with respect to the repression parameter, $\gamma$, evaluated at the long-run values of $\gamma$.

\textsuperscript{15}Given that the loss of information associated with the linearization process is a concern, higher order approximations were used. In all cases, eliminating the negative and possible imaginary roots, we were left with only solution for the steady-state inflation, which yielded quantitatively the same results as the first-order linearized solution.
Table 7: Inflation–Repression Relationship ($\frac{\delta \pi}{\delta \gamma}$)

<table>
<thead>
<tr>
<th></th>
<th>$\sigma = 1$</th>
<th>$\sigma = 2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>0.001</td>
<td>0.0006</td>
</tr>
<tr>
<td>Italy</td>
<td>0.001</td>
<td>0.0006</td>
</tr>
<tr>
<td>Greece</td>
<td>0.004</td>
<td>0.002</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.005</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Notes: Values evaluated at steady-states.

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 regressional coefficient reported in Table 1 of Chapter 2. Moreover, when the risk aversion parameter, $\sigma = 2$, a much weaker inflation–repression relationship is portrayed for all the economies.\footnote{Note given that $\pi g = \mu$ (equation (53)), growth is negatively related to financial repression for both $\sigma=1$ and $\sigma=2$.} The model is thus incapable of explaining the negative inflation-repression relationship observed in the data for Greece.

6.1 Policy Experiments

Once we obtained the reduced-form solution for the steady-state rate of inflation we carry out the financial liberalization policy experiment by increasing the reserve–deposit ratio, $\gamma$, in a phase-wise manner in the close interval of 0 to 0.99. Figures 1 through 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 for $\sigma=2$. The positive relationship stands out for all the economies for both $\sigma=1$ and $\sigma=2$. Note that the effect of the reserve requirement on inflation gathers momentum at higher values of the latter. This can be clearly seen from figures 9 to 16. The figures
plot the strength of the inflation-repression relationship for the value of the reserve requirement in the close interval of 0 to 0.99. Figures 9 to 12 indicates the effect on $\frac{\delta \pi}{\delta \gamma}$, for our chosen economies when $\sigma = 1$ and Figures 13 to 16 captures the same when $\sigma=2$.

7 Conclusion and Areas of Further Research

The objective of this paper is to analyze the effects of financial distortions on the rate of inflation, in the context of four semi–industrialized small open Southern European economies — Greece, Italy, Portugal and Spain, over the period of 1980 to 1998. In particular we study the role of financial repression and seek for answers to the following question: What is the relationship between financial development and inflation? This paper essentially attempts to extend our initial closed-economy general equilibrium model on financial distortions and inflation into an open-economy framework. The motivation for such an extension is basically threefold: Firstly, the lack of in depth theoretical and associated numerical analysis, based on endogenous growth models, analyzing the effects and strength of financial repression on inflation and exchange rate, in the context of open economies. Couple of exceptions are Kang and Sawada (2000) and Kletzer and Kohli (2001). But the papers have their own limitations in that they ignore the importance of capital and intermediate good imports in production process and, also lacks any numerical analysis ; and secondly, even though size of the FDI as a percentage of GDP is quite small in our chosen economies, the import of intermediate and capital goods, account for a major share of international trade in these economies and; thirdly the paper tries and investigates, if open economy assumptions can add to the strength of the relationship between inflation and repression. Recall the closed–economy model yielded much weaker inflation–repression relationship when compared to the simple two variable regressions.

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, just like in the case of the closed economy, the strength of the relationship derived from the model is way below when compared to the sizes of the regressional 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. Open-economy assumptions and introduction of imported intermediate goods do not change the essence of our results obtained in the closed-economy analysis.

Future research needs to be targeted in explaining the observed negative relationship between inflation and repression. However, before doing so one needs to understand if Greece is merely an exception. Moreover, one needs to look for ways to enhance the strength of the relationship between inflation and financial repression. As can be seen introduction of intermediated imported intermediate goods, rented at a higher cost as compared to domestic capital does not help much in this regard. The current paper can also be extended in at least two possible ways: (i) One can study the welfare implications of a lower reserve–deposit ratio; and (ii) Given that reserve requirements have tended to vary over time, it would be interesting to study the transitional dynamics of critical variables following financial liberalization, in the sense defined.

Selected References


Figure 1: Inflation-Repression Relationship for Spain

Figure 2: Inflation-Repression Relationship for Italy

Figure 3: Inflation-Repression Relationship for Greece
Figure 4: Inflation-Repression Relationship for Portugal

Figure 5: Inflation-Repression Relationship for Spain

Figure 6: Inflation-Repression Relationship for Italy
Figure 7: Inflation-Repression Relationship for Greece

Figure 8: Inflation-Repression Relationship for Portugal

Figure 9: Strength of Inflation-Repression Relationship for Spain
Figure 10: Strength of Inflation-Repression Relationship for Italy

Figure 11: Strength of Inflation-Repression Relationship for Greece

Figure 12: Strength of Inflation-Repression Relationship for Portugal
Figure 13: Strength of Inflation-Repression Relationship for Spain

Figure 14: Strength of Inflation-Repression Relationship for Italy

Figure 15: Strength of Inflation-Repression Relationship for Greece
Figure 16: Strength of Inflation-Repression Relationship for Portugal