Stabilization Policy in A Two Country Model and The Role of Financial Frictions

Ester Faia†
Universitat Pompeu Fabra

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Abstract

This paper provides a quantitative assessment of the role of financial frictions on the optimal choice of exchange rate regimes for a two country model. To analyze such a question I use a two country model with trade on consumption and investment goods, sticky prices and borrowing constraints on investment and compare different exchange rate arrangements. When simulating the economy under a foreign productivity slowdown or a foreign monetary tightening a regime of floating exchange rate delivers good stability properties - as opposed to hard pegs or managed exchange rates. The reason lies in the fact that external shocks induce devaluation pressures and that borrowing constraints on investment aggravate the trade-off between currency and financial stabilization. This result is robust to the introduction of debt denominated in foreign currency. This benchmark helps to rationalize the experiences of the Gold Exchange Standard and of the European Monetary System. On the other side, an economy which experiences shocks which are mainly originated domestically might benefit from pegging the interest rate to the one of the foreign economy. Furthermore, the paper analyzes credibility shocks - i.e. shocks to exchange rates expectations - and shows that under fixed exchange rates they can be as disruptive as any external shock.

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1 Introduction

“For the major countries and regions (the United States, the Euro area, and Japan) where unrestricted capital mobility is the established norm, and where pursuit of a common monetary policy

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†Ester Faia, Department of Economics, Universitat Pompeu Fabra, Ramon Trias Fargas 25-27, Barcelona, Spain. E-mail: ester.faia@upf.edu.
appears unlikely to be consistent with the key goals of macroeconomic stability, floating exchange rates will, and should, continue to prevail”. Michael Mussa

A long standing literature has studied the optimal choice of exchange rate regimes between two countries in terms of their relative stabilization properties under different settings. However firm financing constraints have been often neglected despite the fact that important historical experiences, such as the Gold Exchange Standard and the European Monetary System, have thought the importance of the trade-off between financial stability and currency stabilization. This paper fills the gap along two directions. First, it presents an account of the two mentioned historical examples. Secondly, it calibrates an artificial economy with two country which trade on consumption and investment goods and which are characterized by borrowing constraints on investment. Simulations of the model under a variety of shocks and quantitative analysis show the ability of such a model to rationalize the mentioned episodes.

To fix ideas, the model is calibrated on data for industrialized economies. However, this analysis is more general and can be applied to a variety of cases where two (or more) countries face the problem of choosing their monetary and exchange rate arrangement under financial instability.

During the Gold Exchange Standard period several countries were forced to exit the system of pegged exchange rate due to the financial distress generated by the Great Depression. While remaining in the system many countries experienced high destabilization of output and investment as a consequence of their efforts to maintain the parity with the gold. Indeed, during the Gold Exchange Standard period, the volatility of output for the U.S. economy, the UK and the three main European countries - i.e. France, Germany and Italy - was about two times the one under the floating exchange rate period - i.e. which dates from the 1971 on. This might seem to imply that systems with hard pegs might be the only responsible for such experiences. However, more recently similar episodes were experienced by some countries which belonged to the European Monetary System - i.e. thereafter EMS -, a system of managed exchange rate with rigid bands. In particular in the 1992, Italy and the U.K. were forced to exit the system because of their inability to maintain their exchange rate inside the bands without severely affecting the real and financial side of their national economies. Several authors and commentators have argued that the element which induced the declining spiral during the EMS system was the German unification which acted as an external idiosyncratic shock for the countries which belonged to the EMS. However the severity of the spiral has to be imputed more likely to the to the exacerbation induced by the financial distress.

*Prima-facie*, those episodes would seem to substantiate the claim by Mussa quoted above. To see if this claim has theoretical support, the paper calibrates an artificial economy for two large economies characterized by imperfect financial integration in the bond market, adjustment costs on capital, sticky prices in an imperfectly competitive framework and trade in both consumption and

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1 Speech held at Jackson Hole, Wyoming in the symposium on “Global Opportunities and Challenges”.


investment goods. The introduction of sticky prices is particularly helpful when comparing different monetary arrangements where monetary policies follow endogenous policy rules. To this economy, otherwise similar to those analyzed in some of the recent open-economy-macro literature\(^2\), I add borrowing constraints on investment associated with balance sheet effects in both countries. To this purpose I follow in particular the structure proposed in the closed economy by Carlstrom and Fuerst (1998) and Bernanke, Gertler and Gilchrist (1998) which assume heterogeneity between borrowers and lenders and formalize a costly state verification contract in the general equilibrium\(^3\). Doing so adds realism to the model and moves a step forward towards integrating the analysis of the domestic and the international transmission mechanisms. To analyze different monetary arrangement I use a device common to the open economy literature which consists in using a Taylor type rule with a coefficient on exchange rates with values ranging from zero to infinity\(^4\).

To mimic more closely the episodes cited above I perform the following experiments. I simulate the calibrated economy under two different regimes - i.e. hard pegs versus floating - and assuming alternatively a negative productivity and monetary policy shock generated in the foreign country. It has indeed been argued that during the Gold Exchange Standard countries which belonged to the pegged exchange rates system had imported the productivity slowdown and the monetary tightening generated abroad. I then repeat the experiments by comparing floating with managed and pegged exchange rates. This helps to analyze the situation of systems like the EMS. I find that, under realistic degrees of financial and trade integration, floating exchange rates deliver good stability property and insulate from foreign shocks. The intuition of this result being as follow. Under fixed or managed exchange rates an external shock with devaluation pressures forces the monetary authority to raise interest rates with a consequent increase in the cost of loans. The presence of borrowing constraints on investment exacerbates the tightening effect generating financial distress and destabilization. To show the impact of borrowing constraints on investment I compare the economy with and without agency costs on lending activity. In the model without borrowing constraints on investment floating exchange rates are also superior to fixed exchange rates as business cycle smoothing devices. However the differences in the volatilities of variables between the two regimes is significantly lower in this case.

A monotone relation exists among the three regimes considered - i.e. floating, hard peg and managed exchange rates - in terms of their stabilization property. Managing the exchange rates is less destabilizing than hard pegging but more than letting the currency to float.

To test the robustness of the predictions I consider other shocks and different assumptions about the degree of financial openness.

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\(^2\)See among many others V. V. Chari, P. Kehoe and E. McGrattan (2000).

\(^3\)Several equivalent or closely related formulations have been proposed in closed economy. See for instance N. Kiyotaki and J. Moore (1997), T. Cooley and K. Nam (1998), T. Cooley and V. Quadrini (1999a, 1999b).

When considering a negative productivity shock originated in the home country the business cycle properties of the three regimes are much closer and floating exchange rates become somehow more destabilizing. The intuition being as follows. The decrease in investment opportunities due to the technology slowdown generates an increase in the interest rate and in the cost of loans. The amplifying effect of borrowing constraints strongly improves financial conditions under floating exchange rates. On the contrary under fixed or managed exchange rates the monetary authority counteracts the increase in the interest rate in order to stabilize the currency thereby dampening the beneficial effect. This is consistent with the traditional theory on the choice of exchange rate regimes for which the superiority of floating exchange rates with respect to other regimes is mainly associated with external shocks. However the explanation of such result in the present setting and the transmission mechanism between the two countries is widely enriched by the presence of the credit channel.

To analyze the effects of financial openness I simulate the economy assuming that loans to investment are denominated in foreign currency. A peculiar feature of pegged exchange rate systems is the proliferation of debt in foreign currency. During the Gold Exchange Standard several countries which pegged their currency with the dollar had experienced a strong increase of private debt in dollar denomination. Similarly during the EMS countries like Italy had seen a strong increase of the fraction of loans in DM. It is then natural to ask whether a system of floating exchange rates by allowing for devaluations might bring destabilizing effects associated with the increase in the cost of the loans denominated in foreign currency. Simulations of the model with foreign denominated debt show that the volatilities of all variables is indeed higher under floating exchange rates. Nevertheless volatilities under floating exchange rates remain lower than the ones under fixed exchange rates.

Finally the paper explores the effects of a credibility shock - i.e. a shock to exchange rate expectations. An important potential threat to a system of pegs comes from the emergence of devaluation expectations. A credibility shock is modelled as temporary - or permanent - shock to future expectations of exchange rates in the loglinear version of the uncovered interest rate parity. An increase in the future expectations of exchange rates generates a decrease of nominal interest rates through the uncovered interest rate parity. Under fixed exchange rates the monetary authority needs to counteract to devaluation expectations by increasing the interest rate. Through this way is depresses the increase in investment demand.

The present work is related to the literature on optimal choice of exchange rate regimes that started with the works of M. Friedman (1953) and R. Mundell (1960, 1961a,1961b,1963). Recently a considerable literature has studied the performance of different monetary policy rules and exchange rate regimes in an open economy models with explicit microfoundations. Most of the

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existing literature on this topic concentrates attention on stabilization of the exchange rate⁶ and trade balance and uses frameworks that lack markets for capital goods and frictions on investment decisions⁷.

The paper is organized as follows: section 2 shows the theoretical model, section 3 describes the calibration procedure, section 4 reports the results of the simulation experiments. Section 6 brings conclusions.

1.1 Historical Episodes of Financial Instability Under Regimes of Pegged Exchange Rate

History witnessed several episodes of financial destabilization associated with regimes of pegged exchange rates. A complete account of such examples is reported in Eichengreen (1998). Here I will explore two of them which are more closely related to the present analysis.

*The Gold Exchange Standard and The Financial Instability of the Great Depression.* In analyzing cross-country comparison, Kindelberger (1973) emphasized that countries remaining on the Gold Exchange Standard after the 1931 experienced stronger depressions than countries which abandoned the pegged system⁸. This is one of the many testimonies brought to stress the importance of the international dimension of the Great Depression.

The Gold Exchange Standard System established the parity of each currency in terms of the others by determining the value of each currency in terms of the value of gold. The parity between the value of each currency and the value of the gold was determined inside the Gold Bullion Standard. Such a monetary system established that paper money with legal course was convertible at a given price with amounts of gold which were above a certain minimum level. The system lasted roughly from the 1890 to the 1930 even tough several countries had entered the Gold Exchange System later and left it earlier. Associated with the Gold Exchange Standard is a period of great destabilization associated with important financial turbulences.

A first important assessment in evaluating the destabilizing effects of the Gold Exchange Standard as a system of pegged exchange rates stems from comparing volatilities of output gaps under the mentioned period with the ones prevailing during the floating exchange rate period. Historical annual data on GDP for the U.S. economy, the U.K. and the three main European countries - i.e. France, Germany and Italy - are available in A. Maddison (1995) starting from the 1820 and ending in 1994. I calculate standard deviations of Hodrick - Prescott filtered log GDP for

the following periods: the Gold Standard period\textsuperscript{9} - i.e. 1890 to 1930 - and the floating exchange rates - i.e. 1973 to 1994. Table (1) shows output gap volatilities for the U.S., the U.K., Germany, France and Italy. According to those data output gap volatilities were much higher during the period of the Gold Exchange Standard than in the latest period of floating exchange rates.

The strong destabilization of the Gold Standard emerged with the occurrence of a strong financial crisis that hit several countries in the 1929. Several empirical studies documented that national economies in various part of the world were characterized by declining GDP, investment, commodity and stock prices, increasing spread on loans and rising unemployment. On the international markets central bank in various countries tried hard to defend the parities imposed by the Gold Exchange Standard and this implied in several occasions an increase of discount rates that deepened the financial instability. Figure (1) to (2) show the behavior of CPI-Indices and Stock Indices for three economies, the US, the UK and Germany. Data range from 1920 to 1940 and are taken from the Global Financial Dataset. The data displayed in the figures are differences from the Hodrick-Prescott trend. Commodity and stock price deflation marks the first half of the twenties and the 1929. In addition figure (3) shows the exchange rate between UK and the US - i.e. data are also taken from Global Financial Dataset. Apart from two big devaluations, UK-US exchange rates have been maintained strongly anchored to the parity during the recession periods.

The European Monetary System. The financial turmoil experienced by several countries which belonged to the European Monetary System -i.e. thereafter EMS - is another example of financial instability associated with pegged exchange rate regimes. One main difference with the previous example resides in the fact that the EMS is a systems of managed exchange rates inside bands. Nevertheless it shares many features with the Gold Exchange Standard.

It has often been argued that the main cause of distress during the EMS came from the idiosyncratic shock generated by the German unification 1989. The increase in government expenditure faced by the German government was financed through budget deficits and was accompanied by an increase in the interest rates. The various economies linked by the exchange rate bands to the DM imported such an increase in interest rates hence experiencing increases in the cost of the loans. The most immediate effects of high interest rates were a decrease in industrial profitability, banking weakness and high unemployment. The situation was precipitated also by the fact that from the 1989 and until the beginning of the 1990 some countries moved from wide to strict bands. One of those countries was Italy which was indeed one of the countries most severely affected by the exchange rate and financial crisis.

Figure (4) and (5) show the money market interest rate to three months and the lending rate.

\textsuperscript{9}The Gold Standard started in Great Britain in 1821. Several other countries joined later the system. Since most of the countries joined between the 1870 and the 1900, the starting date of the Gold Standard is usually taken as the 1880.
to enterprises\textsuperscript{10} for Germany and Italy during the period 1990-1992. The money market to three months is the most closest proxy for the interest rate set by the monetary authority. It is evident that the German money market rate had increased after the German unification. Due to the enforcement of the strict bands money market rates in Italy had followed the trend of the German ones. Lending rate to enterprises had increased in both countries and the external finance premium -i.e. the difference between the lending rate and the money market - had widened. Eichengreen (1998) also documents that markets in Italy were alarmed by the increase in debt service both in the 1990 and the 1992. Italian lending rates started to decrease only with the exit of Italy from the EMS. To corroborate the thesis of the strict link between worsening of financial conditions and exchange rate pegs it is worth noticing that the exchange rate between the DM and the Lira was maintained stable until the 1992 when Italy exit the EMS - i.e. see figure (6).

2 The Model

There are two countries of equal size. In both economies population is divided into two groups. The “workers” are infinite lived agents that choose consumption and leisure, invest in bank deposits and in international bonds and own firms of a monopolistic sector that sets prices facing adjustment costs and produces different varieties of final goods. “Entrepreneurs” are finite lived agents that choose consumption, invest in capital goods and act as producers in a competitive sector that produces an intermediate homogenous good and is subject to an idiosyncratic risk of default. In order to pay for the capital investment the entrepreneurs seek a loan while facing borrowing constraints.

There are two sectors of firms in both economies. The wholesale producers produce a homogenous good in a competitive fashion assembling capital and labor with a constant return to scale technology. The monopolistic sector differentiates the homogenous goods and sets prices a’ la Rotemberg. Monopolistic producers face domestic and foreign demand for their products, but do not engage in international price discrimination. A competitive intermediary gets money from households’ deposits and offers loans to the firms in the competitive sector. Since the idiosyncratic risk of default is not observable the intermediary charges an external finance premium to recover the cost of monitoring.

Let $s^t = \{s_0, ..., s_t\}$ denote the history of events up to date $t$, where $s_t$ denotes the event realization at date $t$. The date 0 probability of observing history $s^t$ is given by $\rho_t$. The initial state $s^0$ is given so that $\rho_0 = 1$. Henceforth, and for the sake of simplifying the notation, let’s define the operator $E_t\{\cdot\} \equiv \sum_{s_{t+1}} \rho(s_{t+1}|s^t)$ as the mathematical expectations over all possible states of nature conditional on history $s^t$.

\textsuperscript{10} Data are taken from the MTN dataset of the European Central Bank. Given the short period considered data are kept in levels.
2.1 Workers’ Behavior in Home and Foreign Country

Workers’ Behavior. Workers are infinite lived agents who consume, work and hold non-monetary assets in the form of deposits in banks that pay a gross return at the end of the period and in the form of international bonds. Workers’ utility is increasing, concave and separable over consumption and leisure. Workers’ utility in each country, \( s = H, F \), is given by:

\[
E_0 \sum_{t=0}^{\infty} \beta^t [U_s(C_t) - V_s(N_t)]
\]

where \( N \) denotes the number of hours worked by the representative agent, and \( V \) is increasing, convex and differentiable, and \( C \) is a Dixit-Stiglitz-Spence aggregator. Their budget constraint read like this:

\[
C_t + B_t^e e_t^e + D_t \leq \frac{W_t}{P_t} N_t + T_t + \Upsilon_t + R_{t-1}^F e_t^e B_{t-1}^e + R_{t-1} D_{t-1}
\]

where \( W_t N_t \) is nominal labor income, \( D_t \) is the quantity of deposits, expressed in units of domestic consumption index, that pay \( R_t D_t \) one period later, \( B_t^e \) is the quantity of real international bonds that pay \( R_t^F B_t^e \), and \( e^e = \frac{e^F}{e^R} \) is the real exchange rate, while \( e^r \) is the nominal exchange rate. \( T_t \) are government transfers and \( \Upsilon_t \) are the real profits from the monopolistic sector. The following optimality conditions hold:

\[
U_{c,t} \frac{W_t}{P_t} = -U_{n,t}
\]

\[
U_{c,t} = \beta R_t E_t \{U_{c,t+1}\}
\]

\[
U_{c,t} = \beta R_t^F E_t \left\{ \frac{e_{t+1}^F}{e_t^F} \right\}
\]

Equation (3) gives the optimal choice of labor supply. Equation (4) is the Euler condition with respect to home deposits. Equation (5) is the Euler condition with respect to the foreign security.

Arbitrage condition and accumulation of assets. Due to imperfect capital mobility and/or in order to capture the existence of intermediation costs in foreign asset markets workers pay a spread between the interest rate on the foreign currency portfolio and the interest rate of the foreign country. This spread is proportional to the (real) value of the country’s net foreign asset position:

\[
\frac{R_t^F}{R_t^F} = -\zeta (e_t^F B_t^e)
\]

where \( \zeta > 0, \zeta' > 0 \). As shown in Schmitt-Grohe and Uribe (2001) and Benigno (2002) this assumption is also useful in order to maintain the stationarity in the model. Aggregating the
budget constraints of the workers and substituting for (6) we obtain the following law of motion for the accumulation of bonds:

\[ e_t^k B_t^k \leq R_t^k (e_t^k B_{t-1}^k) + \left[ Y_t + \frac{W_t}{P_t} N_t \right] - [D_t - R_{t-1} D_{t-1}] - C_t \]  

(7)

**Workers in the Foreign Region.** I assume throughout that all goods are traded, that both countries face the same composition of consumption bundle and that the law of one price holds. Foreign workers face an allocation of expenditure and wealth similar to the one of the workers of the domestic region except for the fact that they do not pay an additional spread for investing in the international portfolio.

The efficiency condition for bonds’ holdings will read as follow:

\[ U_{c^*,t} = \beta R^*_t E_t \{ U_{c^*,t+1} \} \]  

(8)

The return on deposits and international securities are clearly equalized by arbitrage condition.

After substituting equation (6) into equation (5) and imposing an arbitrage condition on the international securities held by domestic and foreign residents we obtain the following relation:

\[ E_t \left\{ \frac{U_{c,t+1}^*}{U_{c,t}^*} \right\} = -E_t \left\{ \frac{U_{c,t+1}}{U_{c,t}} \frac{e_t^*}{e_t^* (e_t^* B_t^k)} \frac{\zeta}{\zeta (e_t^* B_t^k)} \right\} \]  

(9)

who states that marginal utilities across countries are equalized up to the spread for the country risk. Equations (9) plays the role of an uncovered interest rate parity whose deviations are justified by the presence of the country spread.

### 2.2 The Entrepreneurs in Home and Foreign Region

Entrepreneurs consume, invest in capital markets and run production in the competitive unit. In each period they rent to firms in the competitive unit the existing capital stock that they own and finance investment in new capital. To finance the purchase of new capital they need to acquire a loan from a competitive intermediary that raises funds through deposits.

The return on capital is subject to an idiosyncratic shock, \( \omega^j \). At the beginning of each period the entrepreneur observes the aggregate shock. Before buying capital, the entrepreneur goes to the loan markets and borrows money from the intermediary by making a contract which is written before the idiosyncratic shock is recognized. For the relationship with the lender is subject to an agency cost problem the Entrepreneur needs to pay an external finance premium on the loan. Finally I assume that Entrepreneurs are risk neutral and they have a probability of dying \( \xi^{11} \).

**Consumption and Investment Decisions.** Each Entrepreneur chooses a sequence \( \{ C_t^e, I_t, K_t, L_t \}_{t=0}^{\infty} \) to maximize:

\[ 11 \text{See also Kiyotaki and Moore (1997) and Carlstrom and Fuerst (1998).} \]
\[ E_0 \sum_{t=0}^{\infty} (\zeta \beta)^t C_t, \quad \zeta \beta \leq \beta \] (10)

subject to the following sequence of constraints:

\[ Z_t K_{t-1} + L_t + \Theta_t = C_t^e + Q_t I_t + R_t^L L_{t-1} \] (11)
\[ K_t = (1 - \delta) K_{t-1} + I_t - \frac{\Phi}{2} \left( \frac{I_t}{K_t} - \delta \right)^2 K_{t-1} \] (12)

Equation (11) is the Entrepreneurs’ budget constraint in units of final goods. Wealth is derived from rental income \( Z_t K_t \) for production, new loans \( L_t \), and a transfer of wealth, \( \Theta_t \), from old agents. The presence of the transfer \( \Theta_t \) assures that aggregate net wealth are different from zero in the steady state\(^\text{12}\). Expenditure is allocated in final good consumption \( C_t^e \), investment \( I_t \) (where \( Q_t \) is the real price of new capital) and in the service of the predetermined loan debt, \( R_t^L L_{t-1} \). The term \(-\frac{\Phi}{2} \left( \frac{I_t}{K_t} - \delta \right)^2 K_{t-1}\) in the constraint (12) indicates that, when investing in capital, entrepreneurs face adjustment costs.

Let’s define \( \{ \lambda_t, \xi_t \}_{t=0}^{\infty} \) as the sequence of Lagrange multipliers on the constraints (11) and (12) respectively. The first order conditions of the above problem read as follows:

\[ \lambda_t = 1 \] (13)
\[ \lambda_t = \zeta E_t \{ R_t^L \lambda_{t+1} \} \] (14)
\[ \xi_t \left[ 1 - \Phi \left( \frac{I_t}{K_t} - \delta \right) \right] = \lambda_t Q_t \] (15)
\[ \xi_t = \zeta E_t \left\{ Z_{t+1} \lambda_{t+1} + \xi_{t+1} \left( 1 - \delta + \frac{\Phi}{2} \left( \frac{I_{t+1}}{K_{t+1}} - \delta \right)^2 - \Phi \left( \frac{I_{t+1}}{K_{t+1}} - \delta \right) \frac{I_{t+1}}{K_{t+1}} \right) \right\} \] (16)

Equation (13) simply states that, due to risk neutrality, the marginal utility of additional real income is constant. Equation (14) is the Euler efficiency condition on the loan holding. Equations (15) and (16) are the efficiency conditions on capital investment.

**Loans demand.** In the current period domestic Entrepreneurs need to finance an investment value \( Q_t K_t \). To this end they employ existing collateral \( NW_t \) and resort to external funds via a financial intermediary. The amount of capital investment that needs to be financed is therefore, in real terms, \( Q_t K_t - NW_t \). Hence:

\(^{12}\)This assumption is needed for the correct definition of the contract.
\[ L_t^k = (1 - \xi)(Q_t K_t^\ell - NW_t^\ell) \] (17)

**Return on assets.** Let’s define \( E_t \{ R_{t+1}^k \} \) as the expected aggregate return on capital investment\(^{13}\). To derive an expression for the aggregate return on capital we first substitute (13) into (14) to obtain \( E_t \{ R_t^k \} = \zeta^{-1} \). Then substituting the latter and equation (15) into (16) and imposing arbitrage condition between the expected return on the loans and the one on capital, we obtain the following equation for the return on capital:

\[
E_t \{ R_{t+1}^k \} = E_t \left\{ \frac{Z_{t+1} + Q_{t+1} \left( 1 - \delta + \frac{\Phi}{2} \left( \frac{I_{t+1}}{K_{t+1}} - \delta \right)^2 - \Phi \left( \frac{I_{t+1}}{K_{t+1}} - \delta \right) \frac{I_{t+1}}{K_{t+1}} \right)}{Q_t} \right\} (18)
\]

**Aggregate net wealth accumulation.** Aggregation in this model is feasible considering that the fraction of entrepreneurs that remains alive in every period is equal to the constant \((1 - \zeta)\). To derive aggregate net wealth we substitute (12), (17) and (18) into (11). After aggregating the net wealth accumulation of the economy reads as follows:

\[
NW_t = \zeta [R_t^k Q_{t-1} K_{t-1} - R_t^L (Q_{t-1} K_{t-1} - NW_{t-1}) - \Theta_t] \] (19)

**Aggregate Consumption.** In order to derive the aggregate consumption function it is worth to notice that the probability of dying for the entrepreneurs corresponds, by law of large numbers, to the fraction of entrepreneurs that die in each period. The population is held steady by the birth of a new entrepreneur for each dying one. Under those assumption entrepreneurs behave as permanent income consumers since they consume a constant fraction, \(\zeta\), of their end of period wealth, \(NW_t\), net of the transfers to the new born:

\[
C_t^e = \zeta (NW_{t-1} - \Theta_t) \] (20)

### 2.3 The Loan Contract Between the Entrepreneurs and the Financial Intermediary

A financial intermediary collects money from deposits, pools resources and supplies loans to the entrepreneurs facing an incentive problem due to asymmetric information. The asymmetric information in this economy arises from the fact that firms observe the idiosyncratic shock but banks can do so only at some cost, \(\mu\). The financial contract follows the tradition and assumes the form of an optimal debt contract a’ la Gale and Hellwig (1983). I introduce financial frictions in the general equilibrium following the strategy of Bernanke, Gertler and Gilchrist (1998), Carlstrom and Fuerst (1998), Cooley and Nam (1998).

\(^{13}\)The expected value is taken with respect to the idiosyncratic shock.
The basic properties of the contract are the incentive compatibility property - i.e. when the return to investment is above the cut-off value which determines the default states entrepreneurs repay a fixed amount, \( R_t^L \) - and the maximum recovery property - under the default states the bank monitors the investment activity and repossess the assets of the firm.

For the time being each individual variable carries an index \( j \).

**Default space.** Default occurs when the return from the investment activity if lower than the amount that needs to be repaid. Hence the cut-off value is determined by the following zero profit condition - i.e. participation constraint to the borrower:

\[
\varpi(j) \equiv \frac{R_{t+1}^L L_t(j)}{R_{t+1}^k Q_t K_t(j)}
\]  

(21)

**The optimal debt contract.** The contract maximizes the capital expected income for the entrepreneur which is defined as follows:

\[
\Gamma(\varpi) R_{t+1}^k Q_t K_t(j) = \int_\varpi^\infty (\omega(j) R_{t+1}^k Q_t K_t(j) - R_t^L L_t(j)) dF(\omega)
\]  

(22)

With \( \Gamma'(\varpi) > 0 \). The participation constraint for the bank states that the expected return from the lending activity must equal the return paid on the deposits to workers/lenders. Expected return form the lending activity is given by:

\[
G(\varpi(j)) R_{t+1}^k Q_t K_t(j) = \int_\varpi^\infty (1 - \mu) \omega(j) R_{t+1}^k Q_t K_t(j) dF(\omega) + \int_\varpi^\infty R_t^L L_t(j) dF(\omega)
\]  

(23)

With \( G'(\varpi(j)) > 0 \). The return paid on deposits is given by \( R_t L_t(j) \).

Hence the contract specifies the optimal cut-off value, \( \varpi(j) \), and the amount of loan, \( L_t(j) \), which solve the following maximization problem:

\[
Max \Gamma(\varpi(j)) R_{t+1}^k Q_t K_t(j)
\]  

(24)

subject to

\[
G(\varpi(j)) R_{t+1}^k Q_t K_t(j) = R_t(Q_t K_t(j) - NW_t(j))
\]  

(25)

Let’s define \( \chi_t \) as the lagrange multiplier on (25). First order conditions to this contract read as follows:

- \( K_t(j) \):

\[
\Gamma(\varpi(j)) R_{t+1}^k Q_t + \chi_t [G(\varpi(j)) R_{t+1}^k Q_t - R_t Q_t] = 0
\]  

(26)

- \( \varpi(j) \):

\[
\Gamma'(\varpi(j)) R_{t+1}^k Q_t K_t(j) + \chi_t G'(\varpi(j)) R_{t+1}^k Q_t K_t(j) = 0
\]  

(27)
Merging (26) and (27) gives the following relation between the return on capital and the return on deposits:

\[ \frac{R_{t+1}^k}{R_t} = \rho(\varpi(j)) \]  

(28)

where the external finance premium is given by:

\[ \rho(\varpi(j)) = \left[ \frac{G'(\varpi(j))\Gamma(\varpi(j))}{\Gamma'(\varpi(j))} - G(\varpi(j)) \right]^{-1} \]  

(29)

With \( \rho'(\varpi(j)) > 0 \). Notice that the cut-off value, \( \varpi(j) \), can be written as function of the leverage ratio, \( LV_t = \frac{Q_t K_{t+1}(i)}{NW_t(j)} \):

\[ \varpi(j) \equiv \frac{R_{t+1}^k}{R_t^k} \frac{Q_t K_t(j)}{NW_t(j)} - 1 \]  

(30)

Hence the external finance premium is also a positive function of the leverage ratio.

2.4 Production Sectors in Home and Foreign Country

The Competitive Sector. There is a competitive sector owned the entrepreneurs. The sector produces a homogenous good, hiring capital and labor and assembling them according to a return to scale technology, \( Y = AN^\alpha K^{1-\alpha} \). The optimal demand for capital (and labor) is determined by minimization of total production cost subject to a constant return to scale production function. Merging the optimality conditions on the production factors one gets the following expression for the real marginal cost of production that holds in a period by period basis:

\[ mc_t = \frac{1}{A_t} \left( \frac{W_t}{\alpha P_t} \right)^\alpha \left( \frac{Z_t}{(1 - \alpha)} \right)^{1-\alpha} \]  

(31)

The monopolistic competitive sector. Each firm in this sector has monopolistic power in the production of its own variety, \( i \), and therefore has leverage in setting the price. In so doing it faces a quadratic cost equal to:

\[ \kappa_t(i) = \frac{\theta}{2} \left( \frac{P_{H,t}(i)}{P_{H,t-1}(i)} - 1 \right)^2 \]  

(32)

where the parameter \( \theta \) measures the degree of nominal price rigidity. The higher \( \theta \) the more sluggish is the adjustment of nominal prices. In the particular case of \( \theta = 0 \) prices are flexible. The problem

\[ \frac{1}{mc} \frac{W}{P} = (1 - \alpha) \frac{Y}{N}; \frac{1}{mc} \frac{Z}{K} = \alpha \frac{Y}{K} \]

where \( mc \) is the shadow price of production, i.e. the real marginal cost evaluated at the home currency.

\[ \]
of each domestic monopolistic firm is the one of choosing the sequence \( \{ P_{H,t}(i) \}_{t=0}^{\infty} \) in order to maximize expected discounted real profits \( \Theta_t \equiv P_{H,t}(i)Y_t(i) - MC_t - \pi_t(i) \).

\[
Max E_0 \sum_{t=0}^{\infty} \beta^t \frac{\Theta_t}{P_{H,t}}
\]

subject to the constraint:

\[
Y_t(i) = \left( \frac{P_{H,t}(i)}{P_{H,t}} \right)^{-\varepsilon} (X^W_t)
\]

where \( X^W_t \equiv X_{H,t} + X_{H,t}^* \) is world demand for the domestic intermediate variety \( i \). The first order condition with respect to prices reads as follows:

\[
0 = \frac{P_{H,t}(i)^{-\varepsilon}}{P_{H,t}} X^W_t \left( 1 - \varepsilon \right) + \varepsilon m_{Q_t} \left( \frac{P_{H,t}(i)}{P_{H,t}} \right)^{-1} - \theta \left( \frac{P_{H,t}(i)}{P_{H,t-1}(i)} - 1 \right) \frac{1}{P_{H,t-1}(i)} \]

\[
+ \beta \Theta_t \left\{ \left( \frac{P_{H,t+1}(i)}{P_{H,t}(i)} - 1 \right) \frac{P_{H,t+1}(i)}{P_{H,t}(i)^2} \right\}
\]

Notice that the lagrange multiplier \( m_{Q_t} \) plays the role of the real marginal cost of production. For convenience it is also useful to rewrite the above pricing condition in terms of individual producer’s relative price and inflation. Let’s define \( \tilde{\pi}_H \equiv \frac{P_{H,t}(i)}{P_{H,t-1}} \) as the relative price of domestic variety \( i \) and \( \pi_{H,t} \equiv \frac{P_{H,t}}{P_{H,t-1}} \) as the gross domestic producer inflation rate. The above condition can be rewritten as:

\[
0 = X^W_t \tilde{\pi}_{H,t}^{-\varepsilon} \left( 1 - \varepsilon \right) + \varepsilon m_{Q_t} - \theta \left( \frac{\pi_{H,t}}{\tilde{\pi}_{H,t}} - 1 \right) \frac{\pi_{H,t}}{\tilde{\pi}_{H,t-1}} \]

\[
+ \beta \theta \left( \frac{\pi_{H,t+1}}{\tilde{\pi}_{H,t}} - 1 \right) \frac{\pi_{H,t+1}}{\tilde{\pi}_{H,t}^2}
\]

### 2.5 Demand Aggregation

The final good \( X \) is obtained by assembling domestic and imported intermediate goods via the Armington aggregate production function:

\[
X_t = \left( (1 - \alpha)^{\frac{1}{\delta}} X_{H,t}^{\frac{\alpha}{\delta}} + \alpha^{\frac{1}{\delta}} X_{F,t}^{\frac{\alpha}{\delta}} \right)^{\frac{\delta}{1 - \delta}}
\]

where \( X_{H,t} \equiv \left( \int_0^1 X_{H,t}(i)^{\frac{1}{\delta}} di \right)^{\frac{\delta}{1 - \delta}} \) and \( X_{F,t} \equiv \left( \int_0^1 X_{F,t}(i)^{\frac{1}{\delta}} di \right)^{\frac{\delta}{1 - \delta}} \) are composite aggregates of domestic and imported intermediate goods respectively. The composite final good can be then
used for consumption and investment. Optimal demand for each variety of the final good are given by\(^{15}\):

\[
X_{H,t}(i) = \left( \frac{P_{H,t}(i)}{P_{H,t}} \right)^{-\varrho} X_{H,t} ; \quad X_{F,t}(i) = \left( \frac{P_{F,t}(i)}{P_{F,t}} \right)^{-\varrho} X_{F,t} \tag{39}
\]

\[
X_{H,t} = (1 - \alpha) \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} X_t ; \quad X_{F,t} = \alpha \left( \frac{P_{F,t}}{P_t} \right)^{-\eta} X_t \tag{40}
\]

where \( P_{H,t} \equiv \left( \int_0^1 P_{H,t}(i) \omega(i) d\omega \right)^{\frac{\varrho}{\varrho - 1}} \), \( P_{F,t} \equiv \left( \int_0^1 P_{F,t}(i) \omega(i) d\omega \right)^{\frac{\varrho}{\varrho - 1}} \), \( P_t \equiv \left[ (1 - \alpha) P_{H,t}^{1 - \eta} + \alpha P_{F,t}^{1 - \eta} \right]^{\frac{1}{1 - \eta}} \) are the respective price indices.

### 2.6 The Equilibrium Conditions

The total net supply of bonds will satisfy

\[
B_t^* = 0 \tag{41}
\]

Market clearing for domestic variety \( i \) must satisfy:

\[
Y_t(i) = X_{H,t}(i) + X_{H,t}^*(i) + \zeta_t(i) + U_t(i)K_t(i) \tag{42}
\]

\[
= \left( \frac{P_{H,t}(i)}{P_{H,t}} \right)^{-\varrho} \left( 1 - \alpha \right) X_t + \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} \alpha X_t^* \right] + \zeta_t(i) + U_t(i)K_t(i)
\]

for all \( i \in [0, 1] \) and \( t \). Where \( U_t(i) = \mu \int_0^1 \omega(i) dF(\omega) \})R_{t+1}^kQ_tK_t(i) \) and represents the deadweight loss due to the presence of monitoring costs.

Market clearing in the final good sector implies:

\[
X_t = C_t + I_t + C_t^* \tag{43}
\]

\[
X_t^* = C_t^* + I_t^* + C_t^{**} \tag{44}
\]

Finally the real demand for loan has to be equal to the real supply of loans (for both countries):

\[
D_t = L_t = Q_tK_t - NW_t \tag{45}
\]

\[
D_t^* = L_t^* = Q_t^*K_t^* - NW_t^* \tag{46}
\]

\(^{15}\)Optimal demands are derived solving the following maximization: \( \{X_{H,t}(i), X_{F,t}(i)\}_{i=0}^{\infty} \) to maximize \( P_tX_t - \int_0^1 P_{H,t}(i)X_{H,t}(i) di - \int_0^1 P_{F,t}(i)X_{F,t}(i) di \).
2.7 Monetary Policy Rules

There is an active monetary policy. The monetary authority sets the short term nominal interest rate by reacting to endogenous variables. I consider the general class of the Taylor rules of the following form:

\[ R_t^m = \left( \frac{\pi_t}{\pi} \right)^{\varpi_{\pi}} \left( \frac{\xi_t e}{e} \right)^{\varpi_{\xi}} M_t \]  \hspace{1cm} (46)

where \( R_t^m = R_t \frac{P_{t+1}}{P_t} \), \( \varpi_{\pi} \) is the weight the monetary authority puts on the deviation of inflation from the target \( \bar{\pi} \), \( \varpi_{\xi} \) is the weight that the monetary authority puts on the deviation of the exchange rate from the target level and \( M_t \) is a monetary policy shock that evolves according to \( M_t = M_{t-1}^{M} + \varepsilon_t^M \). A regime of pure floating exchange rate is identified by the case \( \varpi_{\xi} = 0 \). I then consider managed exchange rate regimes identified by a Taylor rule of the form (46) in which \( \varpi_{\xi} > 0 \). Finally I identify a regime of pure peg with the following monetary rule:

\[ R_t^m = R_t^{\pi^*}. \]  \hspace{1cm} (47)

The monetary authority of the foreign country always follows a Taylor rule of the form (46).

When analyzing temporary monetary policy shocks I assume some degree of interest rate smoothing and one period investment delays. Those assumptions help to recover the lack of persistence which typically characterizes those shocks.

3 Calibration

The two country are assumed to be symmetric in preference and technology specifications. Time is taken to be measured in quarters.

Preferences. I set the discount factor \( \beta = 0.99 \), so that the annual interest rate is equal to 4 percent. The parameter on consumption in the utility function is set equal to one while the one on labor is set equal to three. I set the degree of openness at \( \gamma = 0.15 \) that is consistent with the US-Europe case. The elasticity of substitution between domestic and foreign goods \( \eta \) equal to 1.5 as in Backus, Kehoe and Kydland (1994). Following Schmitt-Grohe and Uribe (2002) and consistently with Lane and Milesi-Ferretti (2002) I set the elasticity of the spread on foreign bonds to the net asset position equal to 0.000742.

Technology. The share of capital in the production functions \( \alpha = 0.3 \), the quarterly depreciation rate \( \delta = 0.025 \), the steady state mark-up value 1.2. Loglinearizing the pricing conditions for the monopolistic sector yields a typical Phillips curve. The coefficient of the marginal cost in the Phillips of the model is given by \( \frac{\partial \pi}{\partial \mu} \). Given the assigned value for the mark-up and consistently with estimates by Sbordone (1998), I set \( \theta = 17.5 \). The elasticity of the price of capital with respect
to investment output ratio 0.5 to generate a volatility of investment higher than the volatility of consumption.

**Financial frictions parameters.** In order to parametrize the financial contract I make the following assumptions on the primitive parameters. I set the volatility of the idiosyncratic shock equal to 0.28, the probability of the firm being alive next period equal to 0.973, and the monitoring cost equal to 0.12. Given those values the contract yields an external finance premium in steady state of 330 basis points, a business failure rate, \( F(\bar{\omega}) \), of 5.4 percent, a ratio of capital to net worth of 2.1 and an elasticity of the external finance premium with respect to the leverage ratio \( \rho(.) = 0.05 \). The values for the primitive parameter of the contract are consistent with data in industrialized countries, like U.S. and Europe.

**Monetary policy parameters:** I fix the weight on inflation in the Taylor rule at \( \omega_\pi = 1.5 \) and vary the parameters on exchange rate depending on the regime considered.

**Exogenous shocks:** The persistence of technology shock is set equal to 0.9. The persistence of the monetary shock is set to zero. Volatility is calibrated so as to match volatilities of variables for industrialized countries.

The equilibrium of the model is characterized as the solution of the system of expectation difference equations of the loglinearized form\(^{16}\).

### 4 Fixed Versus Floating Exchange Rates

The historical episodes considered showed the severity of the trade-off between exchange rate stabilization and domestic financial stability. Financial destabilization occurs in particular when a country operating under strict exchange rate parity or bands imports a negative productivity shock or monetary policy tightening. I will now use the model described so far to answers the following questions. Which exchange rate regime is more destabilizing when entrepreneurs suffer of borrowing constraints? In answering these questions I will stress the importance of financial frictions by comparing the models with and without borrowing constraints. I will start by analyzing the effects on the home economy of negative productivity and monetary policy shocks generated in the foreign country.

**Monetary policy tightening in the Foreign Country.** Friedman and Schwartz had argued that during the Gold Exchange Standard several countries had imported deflations generated by

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\(^{16}\) The loglinearized system can be described by a general homogenous matrix equation:

\[
E_t \sum_{i=-m}^n A_i X_{t+i} = 0, t \geq 0
\]

where \( m \) is the number of leads, \( n \) is the number of lags, \( A_i \) are the structural coefficient matrices, and \( A_n(n = 1) \) is not full-rank. I apply the solution method developed by Anderson and Moore (1985) which enables us to deal with possibly singular systems, unlike the Blanchard-Khan (1980).
monetary tightening and/or productivity slowdown occurred at an international level. Similarly during the EMS countries like Italy had imported the monetary policy tightening implemented by the Bundesbank to contain inflationary pressure.

Figure (7) shows the impulse response functions of the home country variables in a model with agency costs to a monetary tightening in the foreign country - i.e. volatility of the shock has been calibrated to generate volatilities for output and other variables consistent with those of industrialized countries - under both floating and fixed exchange rate regimes. Under fixed exchange rate regimes almost all macroeconomic variables, apart from exchange rate and trade balance show higher persistence and volatility. When the home economy is hit by a negative external shock that generates devaluation pressures the domestic monetary authority reacts by increasing the nominal interest rate. The increase in the nominal interest rate generates an increase of the real interest rate under sticky prices. The increase of the real interest rate raises the cost of loans thereby reducing asset prices and the value of net worth offered as collateral. As a consequence the external finance premium increases thereby exacerbating the decrease in the demand for loans, investment and employment. Under floating exchange rates instead the unfavorable effects of the external shock are absorbed by the movements in the exchange rates. Table (2) shows volatilities of several variables. All of them except for the terms of trade are higher the fixed exchange rate regime.

To appreciate the contribution of the agency costs I show results for the same experiment in the model with a zero external finance premium. Figure (8) shows the impulse response functions for such a scenario. As it can be seen all variables are much less destabilized although floating exchange rates still dominate fixed exchange rates as business cycle smoothing devices. An increase in the foreign interest rates under pegged exchange rates has still the effect of reducing domestic investment, however now the depression is less pronounced. This is confirmed by the volatilities too, as from table (2), which show that the difference in terms of stabilization properties between fixed and floating regimes is now lower.

**Productivity Shock in the Foreign Country.** Several authors argued that the Great Depression was ignited by a productivity slowdown. It is then instructive to consider the effects on the home economy of a worsening of investment opportunities in the foreign country.

Figure (9) shows the impulse response functions of the home country variables in a model agency costs to a negative technology shock in the foreign country under both floating and fixed exchange rate regimes. Under fixed exchange rate regimes almost all macroeconomic variables, apart from exchange rate and trade balance show a higher persistence and volatility. A productivity and output slowdown in the foreign country generate a reduction of imports from the home country hence a reduction of domestic inflation. In addition under pegged exchange rates the home monetary authority imports an increase in nominal interest which again under sticky prices
induces an increase in the real interest rate and in the cost of the loans. The general worsening of investment opportunities in the domestic economy also depresses output and employment. Table (3) shows volatilities under different regime and across models. Once again volatilities are higher under fixed than floating exchange rate regimes. The introduction of agency costs deepens the financial and real destabilization mostly under pegged exchange rates.

It has been often argued in the traditional mundellian theory on the choice of exchange rate regimes that the superiority of floating exchange rate regimes with respect to fixed is mostly associated with shocks that are generated abroad. So it is compelling to test the performance of the model under home country shocks. The model is indeed compatible with the traditional theory.

*Productivity Shock in the Home Country.* Figure (10) shows the impulse response functions of the home economy in the model with financial frictions to a positive technology shock in the home country under both, floating (solid curves) and fixed (dashed curves) exchange rate regimes. The beneficial effect coming from an improvement of investment opportunities is higher under floating than under fixed exchange rates. Under floating exchange rates a positive technology shock generates a decrease in the real interest rate and in the cost of loans improving financial conditions. Instead under fixed exchange rates the monetary authority counteracts the reduction of the interest rate in order to stabilize the currency and reduces the beneficial effect.

*Financial exposure.* A peculiar feature of pegged exchange rate systems is the proliferation of debt in foreign currency. During the Gold Exchange Standard several countries which pegged their currency with the dollar had experienced a strong increase of private debt in dollar denomination. Similarly during the EMS countries like Italy had seen a strong increase of the fraction of loans in DM. It is then natural to ask whether a system of floating exchange rates by allowing for devaluations might bring destabilizing effects associated with the increase in the cost of the loans denominated in foreign currency.

To test the above hypothesis I repeated the experiments of the negative productivity and monetary policy shocks in the foreign country by assuming that the all debt is denominated in foreign currency. The volatility of investment in this case is much higher under floating exchange rates but it remains below the one under fixed exchange rate - i.e. which did not change significantly. As for the volatility of output, it slightly increased under floating exchange rates but it also remains lower than the one under fixed.

*Credibility Shock.* The 1992 EMS crisis was not only a financial crisis but an exchange rate crisis too. During the course of the 1990 and the 1992 exchange rate markets in various countries began to realize that the cost of sustaining the bands were too high, hence expected exchange rate started to signal credibility problems. The success in maintaining a stable exchange rate in previous years had endogenously induced firms in several countries to increase the fraction of loans in foreign currency (namely in DM). Hence expectations of devaluations became even more disruptive than
the efforts to sustain the exchange rate bands.

An important potential threat to a system of pegs comes from the emergence of devaluation expectations. A credibility shock is modelled as temporary - or permanent - shock to future expectations of exchange rates in the loglinear version of the uncovered interest rate parity. Figure (12) shows impulse responses to such a shock. An increase in the future expectations of exchange rates generates a decrease of nominal interest rates through the uncovered interest rate parity. Under fixed exchange rates the monetary authority needs to counteract to devaluation expectations by increasing the interest rate. Through this way is depresses the increase in investment demand.

4.1 Managed versus Fixed versus Floating Exchange Rates

As argued before the EMS system can be more reasonably classified as managed exchange rate systems with wide bands from the 1979 to 1986 and strict bands from 1987 to 1992. It is then natural to ask the question to as whether a system of managed exchange rate regimes by allowing more flexibility might be the natural candidate in easing up the trade-off between exchange rate and financial stabilization. Hence I analyze now the effects of a monetary policy tightening in the foreign country by comparing three different regimes: floating, hard pegs (as before) and managed exchange rates. Managed are identified with a monetary policy rule which reacts with a coefficient of 0.5 to deviations of exchange rates from the target. A monotone relation emerges among the three regimes with the floating exchange rates being the leading vehicle for insulation to foreign shocks and pegs still remaining as the worst regime in the terms of stabilization properties.

Figure (11) shows the impulse response function to a monetary tightening in the foreign country under the three alternative regimes. As it stands clear impulse responses for managed exchange rate always lie between the ones for floating and the ones for pegged exchange rates. From table (2) it can also be seen that the volatilities of variables under managed exchange rates always lie between the ones under floating and the ones under pegged exchange rates.

5 Conclusions

The theory on the choice of exchange rate regimes has often neglected financial stability considerations even though several historical episodes hints at the importance of the trade-off between currency stabilization and financial markets stability. This paper addresses the issue of policy stabilization in terms of optimal choice of exchange rates regimes and the transmission mechanism of shocks in a two country model where national economies are characterized by financial distress associated with borrowing constraints on investment. Financial stability can be a concern for the policy makers as long as the presence of financial frictions can impact the overall stability of the economy. In presence of agency costs, movements in real interest rates due to management of the
exchange rates have a large impact on investment and net worth which are an important determinant of the business cycle. Hence the insulation property of the Mundellian theory can gain important insights from the addition of financial consideration. A clear ranking is identified in this paper among different monetary regimes in terms of persistence in the patterns of the impulse response and of volatilities of variables. Hence the stabilization analysis show that the presence of financial frictions adds an extra burden mostly under fixed exchange rate regimes.

The results obtained here also suggest the importance of further exploration in the direction of introducing financial consideration in the open economy context. Further research is indeed needed to analyze for instance the impact on the economy and on the current account dynamic of borrowing constraints for firms which operate in the import markets or for banks which diversify their liability portfolio in international markets.

References


Table 1: **Output gap volatilities for the Gold Standard and the Floating Exchange Rate Period. Annual Data, Hodrick Prescott de-trended.**

<table>
<thead>
<tr>
<th>Output Gap Volatilities</th>
<th>USA</th>
<th>UK</th>
<th>France</th>
<th>Germany</th>
<th>Italy</th>
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<tbody>
<tr>
<td>Gold Standard (1890-1932)</td>
<td>2.3198</td>
<td>3.5</td>
<td>4.3951</td>
<td>2.89</td>
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<td>Floating Exchange Rate Regime (1973 - 1994)</td>
<td>0.9740</td>
<td>2.4</td>
<td>0.632</td>
<td>0.8831</td>
<td>0.8412</td>
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Table 2: **Foreign monetary policy shock. Volatilities under different regimes. It also compares the model with financial frictions, \( \psi = 0.05 \), and without, \( \psi = 0.05 \).**

<table>
<thead>
<tr>
<th>Exchange Rate Regime</th>
<th>Floating</th>
<th>Floating</th>
<th>Fixed</th>
<th>Fixed</th>
<th>Managed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>( \psi = 0.05 )</td>
<td>( \psi = 0 )</td>
<td>( \psi = 0.05 )</td>
<td>( \psi = 0 )</td>
<td>( \psi = 0 )</td>
</tr>
<tr>
<td>Output</td>
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<td>0.64</td>
<td>2.23</td>
<td>1.50</td>
<td>1.74</td>
</tr>
<tr>
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<td>7.25</td>
<td>1.39</td>
<td>5.95</td>
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<tr>
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<td>1.18</td>
<td>3.51</td>
<td>2.15</td>
<td>2.74</td>
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<td>1.26</td>
<td>1.27</td>
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<tr>
<td>Terms of trade</td>
<td>0.66</td>
<td>0.71</td>
<td>0.0022</td>
<td>0.0008</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Table 3: **Foreign productivity shock. Volatilities under different regimes. It also compares the model with financial frictions, \( \psi = 0.05 \), and without, \( \psi = 0.05 \).**

<table>
<thead>
<tr>
<th>Exchange Rate Regime</th>
<th>Floating</th>
<th>Floating</th>
<th>Fixed</th>
<th>Fixed</th>
<th>Managed</th>
</tr>
</thead>
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<tr>
<td>Variables</td>
<td>( \psi = 0.05 )</td>
<td>( \psi = 0 )</td>
<td>( \psi = 0.05 )</td>
<td>( \psi = 0 )</td>
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<td>1.61</td>
<td>1.53</td>
<td>1.53</td>
<td>1.61</td>
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Figure 1: CPI-Index between 1920 and 1940 for US, UK and Germany.
Figure 2: Stock Market Indeces from 1920 to 1940 for US, UK and Germany.

Figure 3: UK-US Exchange Rate from 1920 to 1940.
Figure 4: Levels for money market interest rate to three months and lending rate to enterprises for Germany: period 1990 to 1992.

Figure 5: Levels for money market interest rate to three months and lending rate to enterprises for Germany: period 1990 to 1992.
Figure 6: Exchange rate between Italy and Germany. Period 1989 to 1992.
Figure 7: Impulse responses to negative foreign monetary policy shock in the model with financial frictions. Floating exchange rates (solid line) versus fixed (dashed line).
Figure 8: Impulse responses to negative foreign monetary policy shock in the model without financial frictions. Floating exchange rates (solid line) versus fixed (dashed line).
Figure 9: Impulse responses to negative foreign productivity shock in the model with financial frictions. Floating exchange rates (solid line) versus fixed (dashed line).
Figure 10: Impulse responses to negative domestic productivity shock in the model with financial frictions. Floating exchange rates (solid line) versus fixed (dashed line).
Figure 11: Impulse responses to negative foreign monetary policy shocks in the model with financial frictions under three alternative regimes: floating, managed and fixed exchange rates.
Figure 12: Impulse responses to a shock to devaluation expectations in the model with financial frictions. Floating versus fixed exchange rates.