Capital Flows and Financial Intermediation in a Small Open Economy: Business Cycles with Neoclassical Banks

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Abstract

This paper studies the business cycle implications of exogenous fluctuations in foreign capital inflows driven by world-interest-rate changes in a small open economy with a 'neoclassical' banking system. Banks are the only domestic agents with access to international capital markets. They intermediate capital flows by borrowing abroad and lending to domestic firms and households in a competitive credit market. Firms demand credit to finance their working capital while households use credit to smooth consumption over time. Banks, firms, and households all choose optimally their positions in financial assets. Calibrating different versions of the model to the Argentine economy for 1970-1999, quantitative results indicate that a demand for working capital is not enough to break the neutrality of business cycles to interest-rate shocks. Only when the banks' supply of funds is not infinitely elastic, the model produces a volatility of domestic credit consistent with actual statistics. The standard small-open-economy RBC model, even when augmented to include neoclassical banks and working capital, is unable to reproduce the kind of output swings associated with capital outflows that are observed in actual economies.

Keywords: capital flows, small open economies, business cycles, financial intermediation, interest rate.

JEL Classification Code: E32, E44, F32, F41

1 Introduction

This paper investigates the quantitative importance of exogenous fluctuations in capital inflows for the business cycles of a small open economy (SOE). Both, the cost of international financing and international capital flows are crucial for the macroeconomic performance of emerging economies. In the 90's several developing countries faced sudden capital outflows with devastating consequences for their real economies. After the 1994 Mexican devaluation and the Russian default and Asian crises in 1997-1998, many countries experienced how the capital inflows that shrank interest rates and fuelled economic expansions at the beginning of the 90's, then flew out giving rise to deep recessions, unemployment, and financial turmoil. Figure 1 shows the 3-months Argentinean interest rate, and a GDP index for the period 1982-1999. The contemporaneous correlation between the two variables is equal to -0.781. A similar pattern seems to relate interest rate and output in other developing counties like Mexico and Brazil. It is not less surprising the existent co-movement between bank loans and GDP (see Figure 2), which have a correlation equal to 0.64.

Event though referring to interest-rate shocks and capital flows as if they were completely independent of domestic *economic* developments may sound unrealistic, there are reasons to believe so under some circumstances. On one hand, there are several *non-economic* domestic factors (e.g. political events) that affect country-specific risk premiums. The recent winding path of the Argentine bond returns which were moving in accordance with the political turmoil in the country is a clear example. On the other hand, both the financing conditions and the availability of external financial capital in emerging countries are, to a large extent, independent of *any* domestic event. This hypothesis has been supported by Calvo et al. (1993; 1996). Studying the capital inflows to Latin America at the beginning of the 90's, Calvo et al. (1993; 1996) conclude that much of these inflows were driven by factors external to the region such as the macroeconomic stance in the developed economies and changes in the regulation of their capital markets.[1] Similarly, Corbo and Hernández (2001) indicate

[1]Following these inflows the countries in the region observed decreasing interest rates (for an example,

that the size of overall capital flows depend on factors internal to industrial economies, while the distribution of the flows among developing countries hinges on country specific factors. Furthermore, Calvo and Mendoza (2000) demonstrate how likely is an scenario where international investors take portfolio decisions following the 'market' rather than assessing countries' fundamentals. Therefore, contagion effects might also produce large capital flows in globalized markets regardless the undergoing conditions in a particular country.

In the standard small-open-economy RBC model (as in Mendoza 1991), a change in the international interest rate affects production through the supply of factor inputs. First, labor supply decisions are subject to intertemporal substitution. Second, a change in bond prices makes households variate their consumption path and reallocate their savings between physical capital and international bonds. In this framework, Mendoza (1991) shows the neutrality of this model with respect to interest-rate fluctuations when it is calibrated to the Canadian economy.[2,3] Correia et al. (1995) finds the same results for the Portuguese economy using another version of this RBC model.

To add a mechanism through which interest-rate disturbances become a source of macroeconomic volatility, Neumeyer and Perri (2001) propose modifying the standard model to introduce a demand for working-capital. Since firms have to pay for the use of factors of production before getting their sale proceeds, the interest rate is part of the cost of employing inputs. The effect of interest-rate shocks on production is the same as the one that Christiano (1991) and Christiano and Eichenbaum (1992) introduce to explain the liquidity effect induced by money inflows in a close economy. On the one hand, a change in the domestic interest rate (due to a liquidity effect in one case and to an international interest-rate shock in the other) affects input supplies through both assets and intertemporal substitu-

see Figure 1)

[2]The utility index in Mendoza (1991) rules out the intertemporal substitution in labor.

[3]Following a non-standard procedure where a model economy is used to back out the shocks consistent with the actual evolution of the (model) endogenous variables, Blankenau et al. (2001) find that world-interest-rate shocks are important to explain Canadian business cycles.

tion. On the other hand, the demand for inputs is also affected, since the interest rate becomes part of the cost of employing factors of production.

Neumeyer and Perri (2001) assume that firms fund their production process directly placing bonds in free-access world capital markets, so that working capital is modelled as a factor of production coming directly from overseas. A subtle analysis of the nature of working capital reveals that its introduction in a macroeconomic model may deserve a deeper analysis. First, working capital is associated with a short-term loan, the typical financial service banks offer to firms, and not with a long-term international bond. Second, these loans are monitoring-intensive and so less plausible to be granted by institutions different from domestic banks.

The banking system is a central element of the process of financial intermediation in most developing economies, and domestic capital markets play an almost insignificant role in the borrow-lending process of these emerging economies.[4] Beck et al. (1999) show that while private bonds market capitalization is around 4% of the GDP, total private credit from financial intermediaries is equal to 20% of the GDP in low and lower-middle income countries. In high income countries these ratios rise to 20% and 60%, respectively.

This paper studies the business fluctuations of a SOE in which a neoclassical banking system intermediates the inflows of foreign capital and firms have to finance their working capital. The model provides an analytical framework to study the interactions between the financial and non-financial sectors in emerging economies.

Although in a frictionless Arrow-Debreu economy, the form of financial intermediation is inessential for real variables, the banking literature maintains that there exist a broad array of issues which render essential the role of banks (see Freixas and Rochet, 1997). These issues give rise to two paradigms to model the role of banks: the industrial organization approach and the asymmetric approach. The former approach, which considers that banks provide differentiated services whose tangible counterparts are the financial transactions,

[4]This fact has been early documented by Gurley and Shaw (1960). They also observed that in the earlier stages of financial development, commercial banking is the main form of intermediation.

is used in the paper. The transformation of financial securities and the exclusive access to international financial markets give the reasons for banks to exist in the model. Under the asymmetric information approach banks overcome the informational asymmetries that preclude the existence of complete markets.[5] Although the validity of the informational approach is not neglected, the paper is aimed at exploring the role of financial intermediaries under the industrial organization approach. The model can be considered as a benchmark to compare the dynamic properties of other models where the financial system becomes the mechanism to solve informational problems.

Banks are modelled following Freixas and Rochet (1997, chap. 3). The banking sector is perfectly competitive and banks face two constraints, a financial or balance sheet constraint, and a technology constraint (Sealey and Lindley, 1977). The technological constraint dictates that real resources must be used up in the process of granting a loan. Banks produce loans employing labor and capital along with specific 'banking skills'. Banks maximize profits and their revenues come from the intermediation margin. The balance sheet constraint assures that what banks lend in the domestic credit market is what they borrow from abroad. Thus, financial decisions are not independent from production decisions but they are made jointly.

Banks issue an internationally traded bond and the proceeds are lent to other agents in the economy: firms and households. Firms must pay 'a fraction' of the factors of production they employ before realizing their sales and hence have a demand for working capital. Households use bank loans to smooth consumption and to change the stock of capital they are renting to firms and banks. Thus, from the standpoint of households, bank loans play the role international bonds do in the standard model.

The main findings of the paper can be summarized as follows. First, adding working capital needs to the RBC model of small open economies is not enough to break the neutrality of business cycles to interest-rate shocks. Second, only when the supply of credit is not

[5]In a work in progress, Oviedo (2002) appeals to the asymmetric information approach to discuss the role of aggregate-credit risk and banking crises in the business cycles of emerging countries.

infinitely elastic, the model produces a volatility of domestic finance consistent with actual statistics. Also, the standard small-open-economy RBC model, even when augmented to include neoclassical banks, is unable to reproduce the effects that capital outflows have in actual economies.

Several papers have studied the relationship between financial intermediaries and firms in Macroeconomics employing the industrial organization approach. King and Plosser (1984) modify the RBC model to add a banking sector which provides transaction services to study money-output correlations. Contrary to King and Plosser (1984) where banking services are another input of the production function, in this paper they are treated as working capital. In Díaz-Giménez et al. (1992) banks intermediate among agents of a closed economy. Households borrow from banks to finance the purchases of houses and they lend to banks to save for retirement. The banks in Díaz-Giménez et al. (1992) use real resources to produce both deposits and loans and operate a constant return technology so that interest-rate spreads are independent of the resources being intermediated. Inasmuch as banking skills are an input in fixed supply used by the financial industry in the model of section 2, the interest-rate spread depends on the level of loans. This technology guarantees that the model has a well defined steady state and no other assumption is required in this regard. Agénor (1997) introduces banks in a model of SOE to study the effect of an increase in the risk premium on international markets induced by a contagion effect. However banks are modelled as a costless technology and the interest-rate margin arises only due to the imposition of reserve requirements.

The rest of the paper proceeds with other three sections. Section two presents the model and section three contains its quantitative properties. The model is calibrated to Argentina for the period 1970-1999, in order to evaluate the importance of the banking system and the demand for working capital for the business cycles of that economy. The final section contains concluding remarks.

2 The Model

Consider a small open economy with three type of agents: banks, firms and households. They interact in four competitive markets: labor, capital, loans, and goods. The economy grows at a constant and exogenous rate, γ, determined by a standard labor augmenting technological change. Therefore, non-price variables, except labor, are detrended accordingly.

2.1 The Household Problem

The representative household (RH) has an infinite life and wants to maximize its objective function

$$E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, 1 - n_t^s) \tag{1}$$

where c_t represents consumption and n_t^s the labor supplied by the household; the time endowment is normalized to one and household's leisure is the time not spent working, i.e. $1 - n_t^s$. The instantaneous utility function is continuously differentiable and concave. $\beta \in (0, 1)$, is the intertemporal discount factor and E_0 indicates expectations as of time t=0, conditional on the information set Ω_0^h.[6] The household faces the following flow budget constraint:

$$\begin{aligned} &w_t n_t^s + r_{k,t} k_t^s + \pi_{b,t} + \pi_{y,t} + (1+\gamma) L_{h,t+1}^d = \\ &c_t + i_t \left[1 + H\left(\frac{k_{t+1}^s}{k_t^s} \right) \right] + L_{h,t}^d (1 + r_{L,t}) \end{aligned} \tag{2}$$

The RH's total income in the left hand side of eq. (2) is given by the sum of labor and property income. Labor income depends on the wage rate, w_t, and the labor services supplied. Property income has three components. First, the net financial income coming from net interest earnings on household loans, $(1 + r_{L,t}) L_{h,t}^d$. Second, as the RH is the owner

[6]The true discount factor, B, is different from β since the latter also depends on γ and preference parameters (see section 3.1).

of both banks and firms, it receives profits from these two sectors, $\pi_{i,t}$ (i=b, y). Third, the RH also counts on income coming from renting capital k_t^s at the rental rate $r_{k,t}$.

The RH uses of income in the right-hand-side of eq. (2) are purchases of consumption and investment goods, i_t, including installation costs, $(H(\cdot)i_t)$. Excesses of expenditures over income are covered increasing the demand for bank loans.

While perfect competition will make firm profits equal to zero, bank profits will fluctuate over the business cycle. This is because banking skills are in fixed supply. Investment (net of adjustment costs) and the law of motion of the household's capital stock are defined by:

$$i_t = (1+\gamma)k_{t+1}^s - k_t^s(1-\delta) \tag{3}$$

where δ is the depreciation rate. Except at the steady state, adjusting the stock of capital is costly. The convex function $H(\cdot)$ represents the adjustment costs.

To avoid an infinite level of household debt, the no-Ponzi game condition is imposed:

$$lim_{t\to\infty} \quad E_0 \frac{k_t^s - L_{h,t}^d}{\prod_{v=0}^{t-1}(1+r_{L,v})} \geq 0 \tag{4}$$

Initial conditions for the capital stock and household loans, $L_{h,0}, k_0$, respectively, complete the description of the RH's problem.

The RH's Optimality Conditions

The RH chooses the contingent sequences $\{c_t, n_t^s, L_{h,t+1}^d, k_{t+1}^s\}_{t=0}^{\infty}$, so as to maximize eq. (1) subject to eqs. (2) to (4), and the initial conditions $L_{h,0}, k_0$. The RH's information set at at time t is Ω_t^h and includes the historic values of all variables until time $t-1$ and the value of the state variables at time t. The latter are, $L_{h,t}^d$, k_t^s, and also z_t and r_t, which are the economywide productivity shock and international interest rate, respectively.

The following optimality conditions, along with eq. (2), characterize the optimal RH's decision process for $t = 0, \ldots \infty$

$$-\frac{u_n(c_t, 1-n_t^s)}{u_c(c_t, 1-n_t^s)} = w_t \tag{5}$$

$$(1+\gamma)u_c(c_t, 1-n_t^s) = \beta E_t\Big[u_c(c_{t+1}, 1-n_{t+1}^s)(1+r_{L,t+1})\Big] \tag{6}$$

$$(1+\gamma)u_c(c_t, 1-n_t^s)P_t^q = \beta E_t\Big[u_c(c_{t+1}, 1-n_{t+1}^s)(P_{t+1}^k + r_{k,t+1})\Big] \tag{7}$$

where P_t^q and P_t^k are given by:

$$P_t^q = 1 + H_t + H_t'\frac{1}{k_t}i_t \tag{8}$$

$$P_t^k = (1-\delta)(1+H_t) + (1+\gamma)H_t'\frac{k_{t+1}^s}{k_t^{s2}}i_t \tag{9}$$

P_t^q is the Tobin's Q, and it represents the consumption value-cost of a marginal unit of new capital. P_t^k is the ex-rental value of a marginal unit of installed capital.[7] The transversality condition indicates that:

$$lim_{t\to\infty} \quad \beta^t\, E_0\, u_c(c_t, n_t^s)(k_t^s - L_{h,t}^d) = 0$$

Eq. (5) equates the marginal rate of substitution of consumption for leisure to the wage rate. Eqs. (6) and (7) characterize the optimal saving behavior. The former governs the accumulation of bank debt over time. The optimal borrowing behavior indicates that the RH borrows from the bank until the benefit in terms of actual utility, equals the discounted expected cost of borrowing. This cost is the future utility that will be resigned to repay the loan.

The left hand side of eq. (7) designates the (gross) utility cost of installing a new unit of capital. The right hand side shows the expected discounted benefits, in utility terms, of doing that. These benefits have two components: the future rental income from an extra unit of capital, $(r_{k,t+1})$, and the future (after depreciation) value of that unit of capital, P_{t+1}^k. The latter includes the benefits from future reductions in adjustment costs as it can be seen in eq. (9).

[7] By construction, either at the steady state or in the absence of capital adjustment costs, P^q=1 and P^k=1-δ.

2.2 Firms

The representative firm (RF) faces an atemporal problem. It wants to maximize its profits choosing a combination of labor, capital, and working capital, given input prices, the final output price (normalized to one), and the interest rate on bank loans. Working capital is required since the RF must pay a 'fraction' of the labor services before selling its output. The RF takes supply decisions in the output market and demand decisions in input and loan markets.

The RF's objective function is:

$$\pi_{y,t} = e^{z_t} f(k^d_{y,t}, n^d_{y,t}) - r_{k,t} k^d_{y,t} - w_t n^d_{y,t}(1 + \varphi r_{L,t}) \tag{10}$$

where f is an increasing and concave production function; $k^d_{y,t}$, and $n^d_{y,t}$ are the capital and labor services demanded by the firm; φ is the fraction of labor costs paid in advance. This specification of the working capital demand allows for $0 \leq \varphi \leq 1$ rather than imposing $\varphi = 1$ because when $\varphi = 1$ the amount of working capital demanded would be incompatible with the amount of total credit available in developing economies. For example, when $\varphi = 1$, if the share of income paid to labor is equal to 60% of the output, so is the working capital to output ratio. And working capital loans are only one component of the demand for credit. Adding the households' stock of loans would return the ratio of credit to GDP of a net debtor country that could be easily as high as 100%, a fact that is not observed in emerging economies.[8]

The term e^{z_t} is a productivity shock with z_t given by:

$$z_t = \rho_z \, z_{t-1} + \varepsilon_{z,t} \tag{11}$$

where $\varepsilon_{z,t}$ is a zero mean, i.i.d. process with $Var[\varepsilon_z] = \sigma^2_{\varepsilon_z}$.

The FOC's of the RF's problem are standard: for each input, the marginal revenue product is equal to its unit cost, which in the case of labor includes *financing* costs:

$$e^{z_t} f_{n_y}(k^d_{y,t}, n^d_{y,t}) = w_t(1 + \varphi r_{L,t}) \tag{12}$$

[8]Recall the ratios from Beck et al. (1999) mentioned in the introduction

$$e^{z_t} f_{k_y}(k^d_{y,t}, n^d_{y,t}) = r_{k,t} \tag{13}$$

In this economy, firms borrow the following amount of working capital:

$$L^d_{y,t} \equiv n^d_{y,t}\, w_t\, \varphi \tag{14}$$

At each date t, the RF observes prices $r_{L,t}$, w_t, and $r_{k,t}$, and chooses the amount of labor and capital services according to eqs. (12) and (13). Condition (12) illustrates how interest-rate disturbances impact production.[9] A rise in $r_{L,t}$ depresses the gross cost of employing labor and induces firms to raise labor demand and production. Since φ=0 in the standard RBC small-open-economy model, the interest rate has no effect on the demand side of input markets and any variation in the output level arises from changes in the supply side of these markets.

2.3 Banks

The representative bank (RB) is the only domestic agent borrowing and lending in international capital markets. Its balance sheet constraint dictates that the RB lends at home what it borrows from abroad. On the other hand, a technological constraint arises because the production of loans imposes administrative costs to the banks. These costs are modelled as requirements of capital, labor, and banking skills. A typical commercial bank hires labor (tellers, managers, etc.) and capital (computers, buildings, ATM's, etc.) for their operations. It also employs the "bankers" whose services are supplied inelastically and are invariant over the business cycle.

Distinguishing between financial and administrative costs is useful for understanding the model dynamics. Therefore, the RB's profit maximization program is presented as a two-stage problem. In the first step, the RB solves for a cost function which returns the minimum (administrative) cost per level of loans, L_t. In the second step, observing both

[9] Although $r_{L,t}$ is the domestic interest rate, it is going to be shown later that $r_{L,t}$ is positively correlated with the international market rate, r_t.

the market rate for its bonds and the market loan rate, the bank decides on the optimal supply of financing.

The cost function depends on the production function of loans which is given by:

$$L_t = e^{z_t} g(k^d_{b,t}, n^d_{b,t}, x) \tag{15}$$

where e^{z_t} is the economy-wide productivity shock discussed before; $k^d_{b,t}$ and $n^d_{b,t}$ are the capital and labor demanded by banks; and x is the banking specific factor. The financial intermediation technology, $g(\cdot)$, is a continuous and concave function. For any L_t, one can solve for the *conditional* factor demands, and from there for the bank cost function. Factor demands are conditional on the level of financing, returning the optimal $n_{b,t}$ and $k_{b,t}$ given factor prices and L_t. The bank cost function, BCF_t, can be written as:

$$BCF_t = BCF(L_t, w_t, r_{k,t}, r_{L,t}) = \widetilde{k}^d_{b,t} r_{k,t} + w_t \widetilde{n}^d_{b,t} \left(1 + \varphi r_{L,t}\right)$$

where a "∼" over a variable denotes the conditional factor demand, i.e. $\widetilde{n}^d_{b,t} = n_b(w_t, r_{k,t}, L_t)$ and $\widetilde{k}^d_{b,t} = k_b(w_t, r_{k,t}, L_t)$. The cost function incorporates the fact that the bank must also pay labor services in advance. The working capital demanded by banks is:

$$L^d_{b,t} \equiv \widetilde{n}^d_{b,t}\, w_t\, \varphi \tag{16}$$

The RB maximizes the profit function

$$\pi_{b,t} = (r_{L,t} - r_t) L_t - BCF_t$$

where r_t is the international interest rate, that evolves according to:

$$r_t = \rho_0 + \rho_r\, r_{t-1} + \varepsilon_{r,t} \tag{17}$$

$\varepsilon_{r,t}$ is a zero mean, *i.i.d.* process with $Var(\varepsilon_{r,t}) = \sigma^2_{\varepsilon_r}$.

The optimal level of bank loans is determined maximizing $\pi_{b,t}$ with respect to L_t. At the optimal L_t, the intermediation spread is equal to the marginal administrative cost,

$$r_{L,t} - r_t = \frac{\partial BCF_t}{\partial L_t} \tag{18}$$

For an alternative interpretation of eq. (18), notice that the marginal revenue, $r_{L,t}$, is equal to the marginal cost. The marginal cost is the sum of the marginal financial cost, r_t, and the marginal administrative cost, $\frac{\partial BCF_t}{\partial L_t}$.

The optimal L_t determines: the bank's net position in international capital markets through the balance sheet constraint, $b_t = L_t$; the capital and labor demanded through the conditional factor demands; and the demand for working capital given the optimal amount of labor demanded.

A critical element of this model is that the RB's marginal cost function has a finite elasticity.[10] Eq. (18) shows that the marginal administrative costs imposes a wedge between the domestic and international interest rate. When the marginal administrative costs curve is flat, i.e. $\partial BCF_t/\partial L_t$ is constant, the interest rate spread $r_t - r_{L,t}$ is independent of L_t. The domestic rate, $r_{L,t}$, will rise in exactly the same magnitude as a given rise in r_t.

This is no longer the case when banks operate a decreasing returns technology. When the marginal administrative cost curve has a finite elasticity, i.e. $\partial BCF_t/\partial L_t$ is increasing in L_t, the financial system acts as a buffer when the economy is hit by a world-interest-rate shock. In this case, a rise in the international rate shifts the credit supply curve up and to the left, and for the same demand for loans, the equilibrium domestic rate rises less than its international counterpart.

The described banking technology endows the model with a well defined steady state without requiring other assumptions typically used in the literature for this purpose.[11] Because of the described loan production process, the domestic interest rate is an endogenous variable and the economy always reaches a steady-state which is independent of the initial conditions.[12] For example, if the economy starts with an L_0 lower than the steady state

[10]Discussing the effect of implicit bank bailouts on financial crises, Burnside et al. (2001) *assume* an intermediation technology like the one discussed in the text.

[11]See the review in Schmitt-Grohé and Uribe (2002).

[12]This contrasts with the assumptions behind the open economy version of the RBC model where both the interest rate factor $1 + r$ and the discount factor β are given from the standpoint of the small open economy.

value of L, the equilibrium domestic rate is lower than its steady state value. This induces an intertemporal substitution in consumption that raises the demand for loans, which in turns moves the domestic interest rate up towards its *unique* steady state value. A similar reasoning explains why if the economy starts with an L_0 higher than its steady state value, the economy will converge to exactly the same stationary equilibrium.

2.4 The Competitive Equilibrium

The competitive equilibrium of the described economy is: a sequence of state contingent allocations for each household $\{c_t,\ n_t^s,\ k_{t+1}^s,\ L_{h,t}^d\}_{t=0}^{\infty}$; a sequence of contingent allocations for each firm, $\{n_{y,t}^d,\ k_{y,t}^d,\ L_{y,t}^d\}_{t=0}^{\infty}$; a sequence of contingent allocations for each bank $\{n_{b,t}^d,$ $k_{b,t}^d,\ L_{b,t}^d,\ L_t^s\}_{t=0}^{\infty}$; and a sequence of nonnegative contingent prices $\{r_{L,t},\ r_{k,t},\ w_t,\ P_t^q,\ P_t^k\}_{t=0}^{\infty}$ such that,

1. The allocation $\{c_t,\ n_t^s,\ k_{t+1}^s,\ L_{h,t+1}^d\}_{t=0}^{\infty}$ solves the representative household's problem, i.e. it maximizes its expected lifetime utility, eq. (1), subject to: a) the resource and time constraints; b) the no Ponzi scheme condition; and c) the initial conditions for household loans and capital; d) the fixed factor x and the subsequent bank's profits ; e) the sequence of nonnegative contingent prices.

2. The allocation $\{n_{y,t}^d,\ k_{y,t}^d,\ L_{y,t}^d\}_{t=0}^{\infty}$ gives the maximum firm profits in every period given the sequence of prices.

3. The allocation $\{n_{b,t}^d,\ k_{b,t}^d,\ L_{b,t}^d,\ L_t^s\}_{t=0}^{\infty}$ gives the bank its maximum profits in every period taken as given the sequence of prices, and observing the balance sheet constraint, $b_t = L_t$.

4. The following four markets clear in every period:

   Capital services:

$$k_t^s = k_{y,t}^d + k_{b,t}^d$$

Labor services:

$$n_t^s = n_{y,t}^d + n_{b,t}^d$$

Loans:

$$L_t = L_{y,t}^d + L_{b,t}^d + L_{h,t}^d$$

Final goods:

$$e^{z_t} f(k_{y,t}^d, n_{y,t}^d) + L_{h,t+1}^d - L_{h,t}^d(1 + r_{L,t}) = c_t + (1 + H_t)i_t$$

3 Numerical Analysis

The model is first calibrated according to the Argentine national accounts and also using standard parameter values in the literature. It is then log-linearized around its non-stochastic steady state to compute impulse response functions and second moment statistics.

The functional forms of the utility index in eq. (1) and the production functions for firms and banks in eqs. (10) and (15) are as follows.

$$u(c_t, 1 - n_t) = \frac{\left(c_t - \frac{\nu}{\mu} n_t^{\mu}\right)^{1-\sigma}}{1 - \sigma} \tag{19}$$

$$e^{z_t} f(k_{y,t}, n_{y,t}) = e^{z_t}\, A_y\, k_{y,t}^{\alpha}\, n_{y,t}^{1-\alpha} \tag{20}$$

$$L_t = e^{z_t}\, A_b\, k_{b,t}^{\alpha\xi}\, n_{b,t}^{(1-\alpha)\xi}\, x^{1-\xi} \tag{21}$$

The RH has an isoelastic instantaneous utility index and σ is the risk aversion parameter. The argument of the utility index is the one introduced by Greenwood et al. (1988). Thus, employment decisions are taken to be independent of consumption-saving decisions, and labor supply decisions are free of any intertemporal substitution effect. Both production functions are Cobb Douglas and A_y and A_b are scaling factors; α and $\alpha\xi$ are the share of output paid to capital in the good and financial industries, respectively. Considering that x is a specific type of labor, the share of all types of labor is given by $1 - \alpha\,\xi$.

The cost of adjusting the stock of capital is given by:

$$H\left(\frac{k_{t+1}}{k_t}\right) = h_1 \left\{ \exp\left[h_2(1+\gamma)\left(\frac{k_{t+1}}{k_t} - 1\right)\right] + \exp\left[-h_2(1+\gamma)\left(\frac{k_{t+1}}{k_t} - 1\right)\right] - 2 \right\}$$

where h_1 and h_2 are parameters defining the size of this cost.

The model is consistent with trend growth under the following circumstances. First, the productivity of the fixed factor x also grows at the rate γ. Second, preferences specified in eq. (19) implicitly mean that because of the existence of some kind of home production, the disutility of working also grows over time. Greenwood et al. (1995) show that an economy with home production is observationally equivalent to another without home production but with different preferences.

3.1 Model Calibration

Because working capital is an intermediate input used in production, the value of final output is different from output itself in the model economy. In the calibrated economy, banks output is equal to 0.9% of national output. Argentinean National Accounts indicate that the financial industry output is equal to 4% of GDP (in the period 1993-1999). However, banks' output in the model comprises of just a fraction of the services the financial system provides in the actual economy.

Argentina has grown at 2.6% per year during the last 25 years, so γ=0.026 on annual basis. As for the interest rates, r is initially set equal to 6.5% on annual basis. Beck et al. (1999) database defines the interest rate margin as the ratio of net interest income and total assets. They estimate that the Argentinean banks interest margin is equal to 4.25%, and this is taken to be the value of administrative costs at the non-stochastic steady state.

The parameter σ is set equal to 2; μ is set equal to 1.45 as in Mendoza (1991), and it implies that ν=6.15. Eq. (6) implies that β is equal to 0.981 on quarterly basis. Therefore, the true subjective discount factor, B, solves $B(1+\gamma)^{(1-\sigma)} = 0.981$ and implies B=0.987. The share of the good industry paid to labor, including its financial costs, α, is equal to 0.40. The parameter ξ is set equal to 0.50; considering the factor x as specific labor, total labor share in the financial industry then rises to 0.8, which is consistent with the fact that the financial industry is (relatively) more labor intensive than the rest of the economy. Under this assumption, the share of the fixed factor in the national income is equal to 0.43%. For simplicity, $x = 1$.

For y denoting national income, Argentinean national accounts indicate that c/y=0.79, and i/y=0.20. As it is standard in the business cycle literature, it is assumed that 20% of the time is employed in market activities (n=0.2). The specifications detailed above and the model equations in steady state have the following implications. The ratio L/y takes different values depending on the value of φ.[13] In the benchmark model φ is set to 0.5, so that 50% of the labor cost must be financed in advance. Under this assumption L_h/y=0.56 and L_y/y=0.35. The implied annual capital output ratio is k/y=2.6 and δ=0.052 on annual basis; 0.4% of the labor and capital are employed in the financial industry; and r_k=16.33% is the annual rate of return on capital.

The autocorrelation coefficient of productivity is chosen so that the model reproduces the output persistence of the Argentinean economy. The persistence parameter ρ_r in the international interest-rate process is fixed to 0.9. Two standard deviations for the quarterly interest rate are considered, σ_r=1.00% and 3.00%.

3.2 Numerical Results

The quantitative exercises are aim to address the following questions. To what extent do working capital needs magnify the real effects of model interest-rate fluctuations? How do these effects depend on the statistical properties of the productivity and interest-rate shocks hitting the economy? And how important is the buffer-effect induced by the operation of a costly banking system?

To see how other models are nested in the discussed one, first notice that as the interest rate margin, $r_{L,t} - r_t$, approaches zero, banks' output becomes negligible and therefore

[13]Compare two similar economies that only differ in the composition of the demand of the credit market. Given the same supply of loans, to clear the loan market at the same domestic interest rate, the economy with a lower φ must have a higher stock of household debt to compensate the lower demand for working capital.

domestic agents obtain financing placing bonds in the world capital market. On the other hand, when the parameter φ is set equal to zero, there is no need for working capital and the loan market clears when the stock of loans demanded by households equals the banks' credit supply. Therefore, when $r_{L,t} - r_t = \varphi = 0$, the model becomes the basic small-open-economy RBC model.

3.2.1 Impulse Response Functions

Interest-Rate Shocks and Capital Flows. The introduction of a banking system into the RBC model of SOE's adds new transmission mechanisms. Consider the effect of a rise in the international interest rate that could follow a policy of tight money in developed economies or a change in the foreigners' perception of the riskiness of domestic businesses. In the standard RBC model of a SOE as well as in this paper's model, the typical income and substitution effect cause a fall in consumption and investment expenditures and a shortening of the current account deficit. The income effect arises because the shock augments the debt burden in a debtor country; the substitution effect follows a (relatively) more expensive actual consumption which makes the representative household to raise its savings. Investment expenditures fall because an optimal portfolio reallocation indicates that it is profitable to reduce the stock of debt and to cut down the stock of physical capital.

As in Neumeyer and Perri (2001), the introduction of working capital adds a demand effect on factor inputs. Since the interest rate is part of the (gross) cost of hiring labor, higher financing costs induce firms to slow down their production, cutting down their demand for labor and their supply of output. Therefore, output falls more in an economy in which firms demand financial services as an intermediate input than in an economy where all transactions take place simultaneously.

Adding a domestic costly-operated banking system can append an attenuating effect to this interest-rate-driven recession. This is shown in Figure 4 where solid lines represent the banking economy and dashed lines the economy under direct financing. The impulse response functions follow a one percent rise in the world interest rate and illustrate the buffer effect induced by banks. The interest-rate shock adds to the financial costs of the banking system and banks restrain their supply of credit. The domestic credit market clears at a higher interest rate and at a lower amount of loans. Inasmuch administrative costs are increasing in the amount of financing, the domestic interest rate rises less than the world interest rate. In other words, higher financing costs are partially compensated with lower administrative costs. While the effect of the shock persists, the quantity and value of resources allocated to the financial industry are lower than their steady-state counterparts.

The importance of this attenuating effect is going to depend on: a) the interest-rate elasticity of the supply of loans (affected by the value of the parameter ξ); and b) the share of administrative costs in the domestic rate.

To understand the role of the value of ξ, recall that $L_t = e^{z_t} A_b k_{b,t}^{\alpha\xi} n_{b,t}^{(1-\alpha)\xi} x^{1-\xi}$ and consider two special cases, $\xi = 1$ and $\xi = 0$. When ξ=1, input x (which has been normalized to one) becomes useless and the technology to produce loans has constant returns. The supply of loans is infinitely elastic at the interest rate that exactly compensates the unitary administrative cost of financing. In this case, a rise in the financial cost of the banks, i.e. a higher international interest rate, shifts up the supply of loans by the magnitude of the interest-rate increase. The opposite case happens when $\xi = 0$ since the supply of loans becomes perfectly inelastic and the domestic interest rate is demand-determined. As the production of loans is proportional to the amount of the fixed factor x, a given amount of the latter implies a unique level of loans which does not depend on the interest rate $r_{L,t}$. On the other hand, for $0 < \xi < 1$, the elasticity of the loans supply is inversely related to the value of ξ as it is shown in Figure 3.

As for the share of administrative costs in the domestic rate, other things held constant, the larger the interest-rate margin, the higher the dampening effect shown above. A larger interest-rate margin is equivalent to a larger component of administrative costs in the domestic interest rate. Hence, shocks affecting the financial marginal cost of the banking system have a lower impact on the domestic rate.

When banks intermediate in the loan market, $r_{L,t}$, and not r_t, is the relative price of future consumption. Since r_t rises more than $r_{L,t}$, the economy without banks observes a larger adjustment in the level of consumption and a larger reallocation of savings. The supply of capital and the demand for labor falls more in the non-intermediated economy. Thus the recession following a capital outflow is milder in the banking economy due to the dampening effect performed by bank administrative costs. The fall in consumption and output is approximately twice as large in the economy under direct financing.

Productivity Shocks. Now consider the (one-percent) productivity shock depicted in Figure 5, where dashed lines identify the non-intermediated economy. The existence of the banking system breaks the separation between consumption and investment decisions that is present in the standard SOE-RBC model. The shock makes firms demand more capital. The Tobin's q rises above 1. This induces households to accumulate capital. In the standard model, the trade balance becomes coutercyclical when the pro-borrowing effect dominates the pro-saving effect.[14] However, since the interest rate is constant in that model, the price of future consumption does not induce any additional effect on intertemporal decisions.

This is not longer the case in the model of section 2. For instance, investment and consumption decisions place a higher demand for loans and induce an equilibrium rise in the domestic interest rate. This causes other equilibrium adjustments in the banking economy that are similar to those that follow an interest-rate disturbance and which were discussed above: intertemporal consumption substitution; reallocations of assets; adjustment in the level of production.

The importance of the differences between these two economies is going to depend, again, on the slope of the supply of financing and on the share of administrative costs in the domestic interest rate, as well as on the importance of financial costs of the firms. In Figure 5 the domestic rate falls by less than 0.1% on impact and the dynamics of the two

[14]The pro-borrowing effect arises because the economy wants to produce more when productivity is high and this requires, among other things, more capital. The pro-saving effect is given by the consumption-smoothing behavior: agents are better off if consumption is higher not only when productivity is high, but in all the remaining periods

economies are quite similar, something that is going to be explored quantitatively next.

3.2.2 Quantitative Comparisons

For the quantitative study of the volatilities induced by the above shocks under alternative setups, models' statistics are compared to those of the Argentinean economy. Some actual business cycles statistics are reported in Table 1.[15]

The analysis is carried out in three steps. First, banks are ruled out and the non-intermediated economy is tested under two scenarios: a) the economy is only hit by productivity shocks; b) both productivity and interest-rate disturbances drive business cycles. In the second step, the quantitative importance of the banking system is studied under two interest-rate processes. Third, alternative specifications of the production of loans show that to reconcile the model predictions with the actual volatility of loans, the supply of credit should have a higher slope than in the benchmark model. Two additional quantitative exercises are performed next. One studies the effect of introducing capital controls which are modelled as reserve requirements, and the other explores the significance of productivity shocks that only hit the financial sector.

Interest-Rate Shocks under Direct Financing. The simulations reported in Table 2 were performed setting the innovations to productivity so that the model reproduces the (average) Argentinean output volatility, computed from the last two editions of the national accounts: i.e. σ_{ε_z}=1.26. Similarly, ρ_z is equated to 0.74 to imitate the actual output autocorrelation; the adjustment cost parameters h_1 and h_2 are both equal to 3.4,

[15]It should be noted that the Argentinean national accounts (NA's) have several deficiencies. One problem is the truncation of the series. Macroeconomics series have small number of observations with a maximum of 80, on quarterly basis (20 years). Series bases change very often. The last edition of the NA's measure macroeconomic variables at 1993 prices and its sample goes from 1993.1 to the present. However, this edition has several differences with the NA's at 1986 prices. Moreover, these two editions show differences with the NA's at 1970 prices. Given these deficiencies, it has been opted to report the business cycles statistics that arise from each of these series instead of reporting single figures.

to reproduce the relative volatility of investment.[16]. To make the role of banks negligible, the intermediation margin is reduced (to 0.5%) but not completely eliminated so that the model still has a well defined steady state.

As Table 2 shows, moderate interest-rate perturbations do not have a large impact on output fluctuations or on the investment-saving correlation. This is the neutrality of interest-rate shocks discussed by Mendoza (1991), neutrality that seems to remain invariant under the existence of working capital. When the volatility of the interest rate is risen from 1% to 3%, except for investment expenditures and the trade balance which become significatively more volatile, all other variables have approximately the same volatility and autocorrelation coefficients. Moreover, the response of hours to interest-rate disturbances seems to indicate that firms' financial needs have a negligible effect on the labor market, where precisely one expects to see the source of additional repercussion of interest-rate shocks on production.

To explain how the neutrality of interest-rate disturbances is invariant to the introduction of working capital, notice that the firms' gross cost of a unit of labor is equal to $w_t(1+\varphi r_{L,t})$. For $\hat{z} \equiv d\ \ln(z)/dt$, the log-linear version of a change in this cost is $\hat{w}_t+\frac{\varphi r_L}{1+\varphi r_L}\hat{r}_{Lt}$. For $\varphi = 0.5$ and r_L=10.75%, the coefficient of $\hat{r}_{L,t}$ is equal to 0.05. Thus *a 20% rise* in $r_{L,t}$ is equivalent to an exogenous 1% rise in the wage rate. Therefore, the negligible relevance of the changes in the cost of financing on the demand side of the labor market is explained by the relatively small coefficient of $\hat{r}_{L,t}$.

A disruptive result of the economy under direct financing is the volatility of household loans. This is the dimension in which the model without banks perform worst and which hints at an alternative setup. The slope of the credit supply is the natural element to consider in this regard.

Banks versus Direct Financing. Table 3 compares the intermediated with the non-intermediated economy, the former subject to interest disturbances of different size. The results under direct financing are reproduced from Table 2. The characteristic of the exoge-

[16]See eq. (3) and notice that the convexity of the adjustment cost function rises with h_1 and h_2

nous stochastic processes and the adjustment cost parameters are the same as above, while administrative costs are equal to 4.25%.

The neutrality of the economy to interest-rate disturbances seems to vanish when the banking sector is considered explicitly. While output becomes 8.4% more volatile when the standard deviation of interest rate is equal to 1%, the *absolute* volatility of investment and consumption are quite similar. On the other hand, when the standard deviation of interest-rate shocks is raised to 3% in the banking economy, the simulations results are quite the same, exception made for the domestic interest rate and the investment-saving correlation. This correlation is higher in the intermediated economy because the financial system breaks the standard separation between consumption and investment decisions.

Working Capital and the Supply of Loans. The simulations above show that the introduction of the banking system raises the volatility of output. The next question is then, to what extent the results depend on the existence of a demand for working capital in the market for loans? This and the importance of the slope of the supply of financing are explored here. The exercise is performed setting σ_{ε_z}=1.26% and ρ_z=0.7 so as to reproduce the actual output behavior when the economy is only hit by productivity disturbances. The value of the adjustment cost parameters are h_1= h_2=3.2 to reproduce the actual (average) volatility of investment.

In Table 4 ξ is set equal to 0.9 and 0.5, respectively. As shown in Figure 3, the lower the value of ξ, the higher the slope of the supply of funds. The model produces similar results in terms of the volatility of its variables for four different values of φ, showing the robustness of the results to alternative values of this parameter. This confirm that working capital needs are unable to enlarge the response of output to interest-rate disturbances. Varying the value of φ demands a re-calibration of the model. Particularly, there are noticeable changes in the credit market.[17] When φ=0.01 (ruling out the demand for working capital), $\frac{L_h}{y}$=1.04 and $\frac{L_y}{y}$=0; on the other hand, when φ=0.75, $\frac{L_h}{y}$=0.32 and $\frac{L_y}{y}$=0.45. When the

[17] See footnote 13.

banking system operates a technology that is "close" to a constant return one, i.e. ξ=0.9, the differences between alternative values of the parameter φ are less noticeable, except for household loans. As the credit supply becomes flatter (ξ is rising), the fluctuations of the international interest rate are becoming the only source of variation of the domestic rate.

The volatility of household loans which took extremely large value under the absence of banks, is now in line with actual data when ξ is set equal to 0.5. This suggests that diminishing returns in the financial industry is important to account for the kind of volatility that financial variables, like the stock of loans and the interest rate, have in practice.

4 Concluding Remarks

The standard RBC model of a SOE predicts that interest-rate shocks are unable to produce significative output variance. Thus, neither country-specific (international free rate plus risk premium) interest rates nor their concomitant capital flows would be an important determinant of business cycles in actual economies. However there is a remarkable contrast between this prediction and the recent events in Latin America and Asia. The prediction also contrasts with the emphasis that macroeconomic forecasts for emerging countries put on international financial variables.

The paper evaluated the extent to which the introduction of working capital and a neoclassical banking system may close the gap between theoretical predictions and the actual developments in developing countries. The premise is that working capital is a short-term loan typically provided by commercial banks, and whose production requires the employment of factor inputs. More generally, the paper attempts to provide microeconomic fundamentals to the production of financial services carried out by a banking system that borrows from the rest of the world and lends domestically to both households and firms. The intermediation process is subject to a technological and a balance sheet constraint, and banks are modelled following the industrial organization approach, i.e. banks provide an special type of services in the economy.

Under the existence of a banking system that operates a decreasing returns technology, the model predicts milder recessions following a decrease in the liquidity of international financial markets than otherwise. The banking technology is the mechanism that renders stationarity in the small-open-economy RBC model. However, it produces a counter-factual behavior of spreads: as the bank intermediates more when the economy faces higher inflows of capital, banking spreads are higher during the booms and lower during the recessions.

The numerical exercises have shown that: first, a demand for working capital needs is not an effective mechanism to align the RBC model's prediction with the actual effect of interest disturbances on domestic output. Second, the importance of including explicitly the role of the financial system depends on how far the technology is from a constant returns technology. In any case, interest-rate disturbances with a standard deviation of 3% raise output volatility in less than 10%, with respect to the scenario where only productivity shocks drive business cycles. Third, if the supply of domestic financing has a gentle (or zero) slope, the standard model is unable to reproduce the volatility of loans in actual developing countries.

It must be recognized that the characterization made for banks disregards several aspects of the banking system. In particular it does not address risk management in none of its variants (credit risk, liquidity risk), insolvency costs, and equity capital considerations, among other things. It seems that these elements must be part of models intended to account for other links connecting the financial and non-financial sectors in emerging countries, links that cannot be captured by a neoclassical characterization of banks. This hints at models of asymmetric information in banking as a mechanism to explain the macroeconomic volatility induced by capital flows in emerging countries.

References

Agénor, P.-R. (1997). Borrowing risk and the tequila effect. *IMF Working Paper*, WP/97/86.

Beck, T., Demirgüç-Kunt, A., and Levine, R. (1999). A new financial database on financial development and structure. *mimeo*.

Blankenau, W., Kose, A., and Yi, K.-M. (2001). Can world real interest rates explain business cycles in a small open economy? *Journal of Economic Dynamic & Control*, 25:867–889.

Burnside, C., Eichenbaum, M., and Rebelo, S. (2001). Hedging and financial fragility in fixed exchange rate regimes. *European Economy Review*, (45):1151:1193.

Calvo, G., Leiderman, L., and Reinhart, C. (1993). Capital inflows and real exchange rate appreciation in latin america: The role of external factors. *IMF Staff Papers*, 40(1):108–151.

Calvo, G., Leiderman, L., and Reinhart, C. (1996). Inflows of capital to developing countries in the 1990's. *Journal of Economic Perspectives*, 10(2):123–139.

Calvo, G. and Mendoza, E. (2000). Rational contagion and the globalization of security markets. *Journal of International Economics*, 51.

Christiano, L. (1991). Modeling the liquidity effect of a money shock. *Federal Reserve Banks of Minneapolis Quarterly Review*, (15):1–34.

Christiano, L. and Eichenbaum, M. (1992). Recent developments in macroeconomics. *American Economic Review (AEA Papers and Proceedings)*, 82(2):346–353.

Corbo, V. and Hernández, L. (2001). *Capital Flows, Capital Controls, and Currency Crisis: Latin America in the 90's*, chapter Private Capital Inflows and the Role of Fundamentals. Michigan University Press.

Correia, I., Neves, J., and Rebelo, S. (1995). Business cycles in a small open economy. *European Economic Review*, 39:1089–1113.

Díaz-Giménez, J. E. P., Fitzgerald, T., and Alvarez, F. (1992). Banking in computable general equilibrium economies. *Journal of Economic Dynamics and Control*, 16:533–559. 69.

Freixas, X. and Rochet, J.-C. (1997). *Microeconomic of Banking*. MIT Press.

Greenwood, J., Hercowitz, Z., and Huffman, G. (1988). Investment, capacity utilization, and the real business cycle. *American Economic Review*, 78(3):402–417.

Greenwood, J., Rogerson, R., and Wright, R. (1995). *Household Production in Real Business Cycle Theory*, chapter 6, in Frontiers of Business Cycle Research, Edited by T. Cooley, pages 157–174. Princeton University Press.

Gurley, J. and Shaw, E. (1960). *Money in the Theory of Finance*. Washington: Brooking Institution.

King, R. and Plosser, C. (1984). Money, credit and prices in real business cycle. *American Economic Review*, 74:363–380.

Mendoza, E. (1991). Real Business Cycles in a Small Open Economy. 81(4):797–818.

Neumeyer, P. and Perri, F. (2001). Business cycles in emerging economies: The role of interest rates. *mimeo*.

Oviedo, P. (2002). Macroeconomic risk and banking crises in emerging countries. In Progress.

Schmitt-Grohé, S. and Uribe, M. (2002). Closing small open economy models. *Journal of International Economics*, forthcoming.

Sealey, C. and Lindley, J. (1977). Inputs, outputs, and a theory of production and cost at depository financial institutions. *Journal of Finance*, 32:1251–1266.

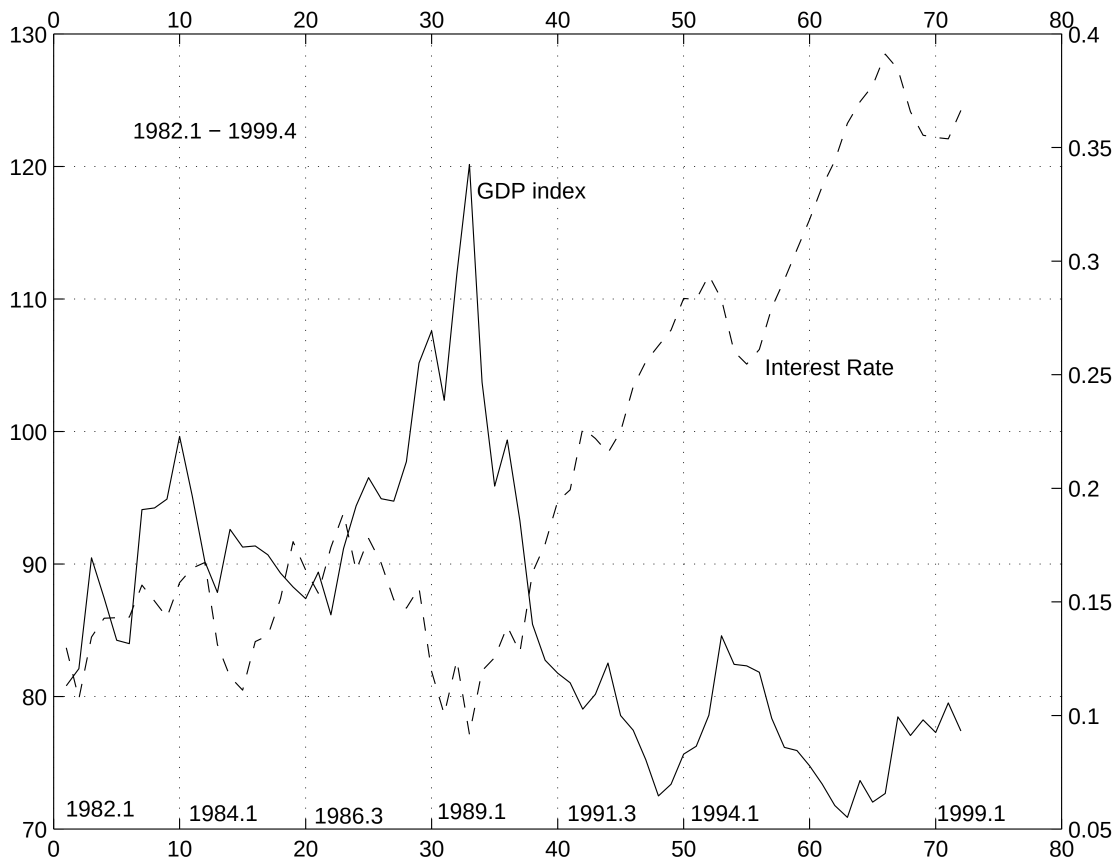

Figure 1: Argentina GDP index and Country-Specific Interest Rate. 1982-1999
Source: Argentinean National Accounts (at 1986 and 1993 prices), Federal Reserve Bank of St. Louis and J.P. Morgan EMBI index.

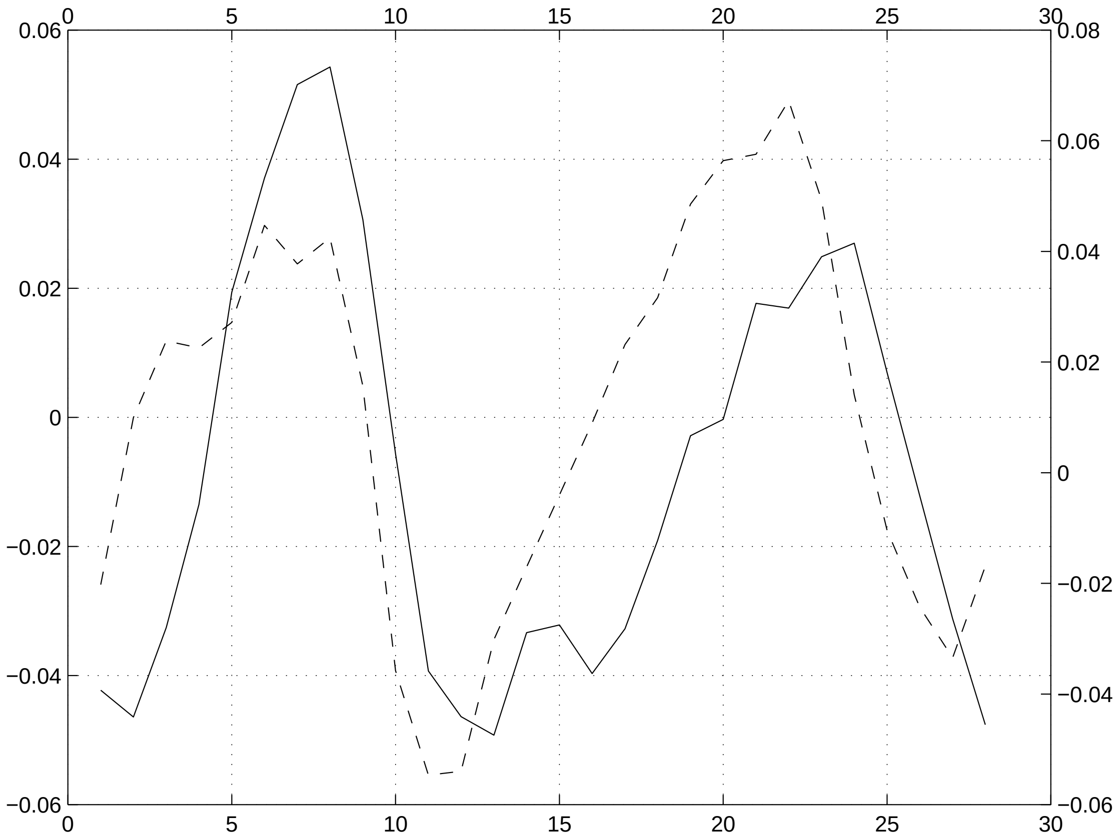

Figure 2: Argentina GDP and Bank Loans, 1993-1999

Loans are represented by the dashed line. Source: Argentinean National Accounts (at 1993 prices) and Banco Central de la República Argentina.

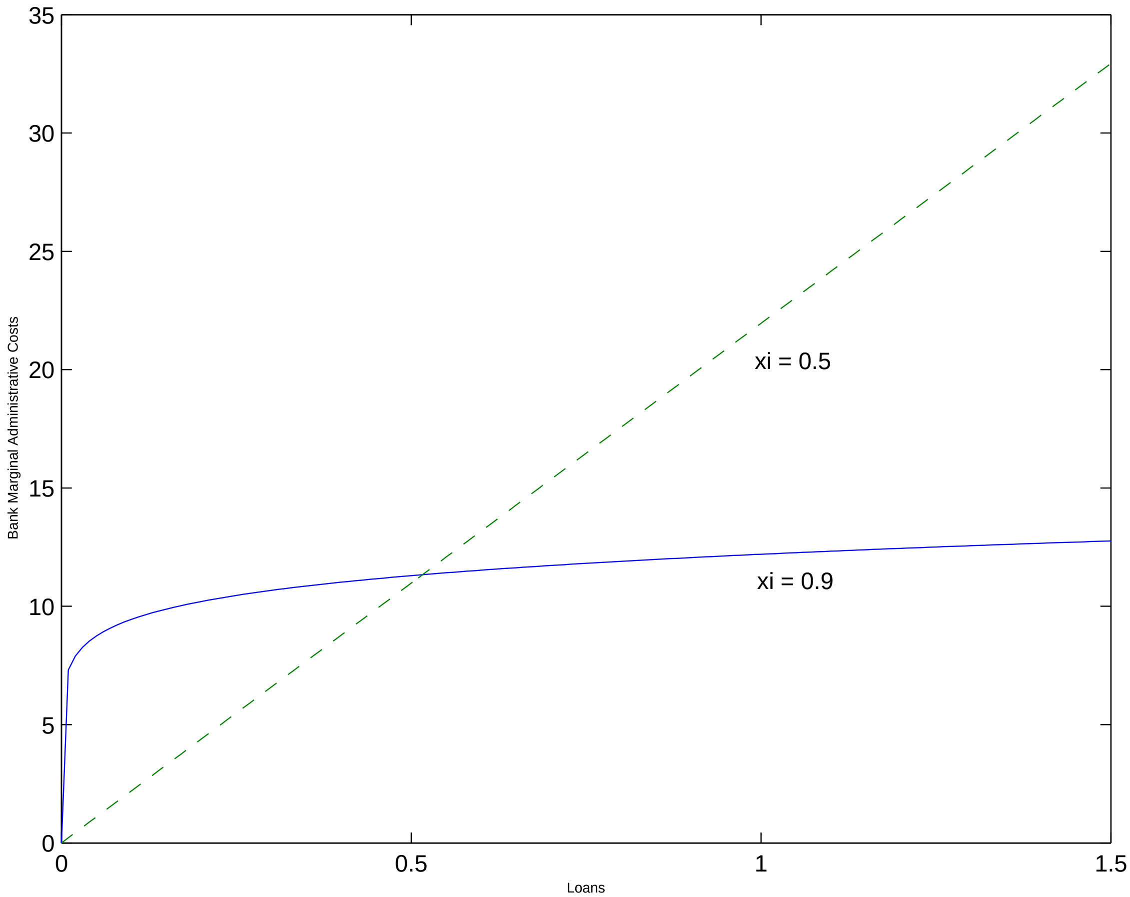

Figure 3: Bank Marginal Operative Costs

. The parameter ξ determines the share of the fixed factor x in the production of loans.

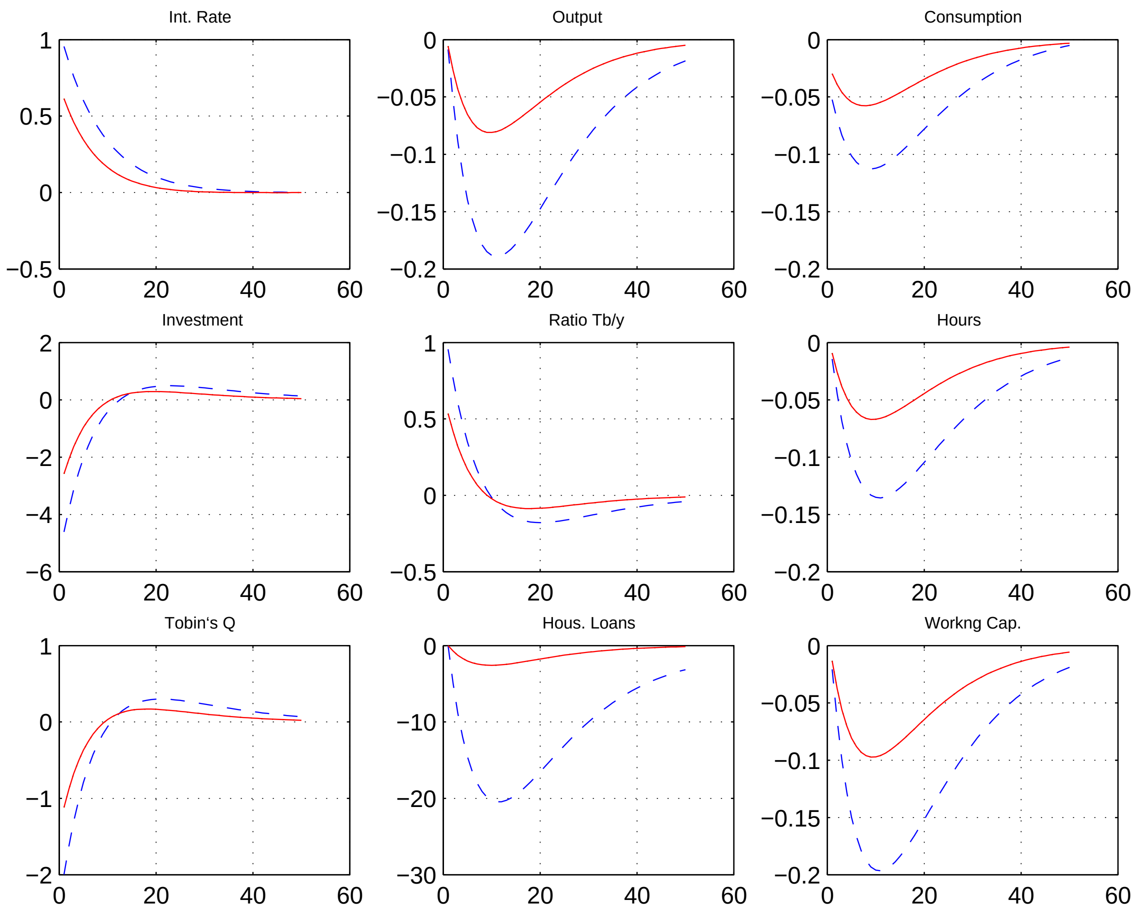

Figure 4: Impulse Responses to a 1% Innovation to the International Interest Rate: Banks versus Direct Financing

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Dashed lines are used for the non-intermediated economy.

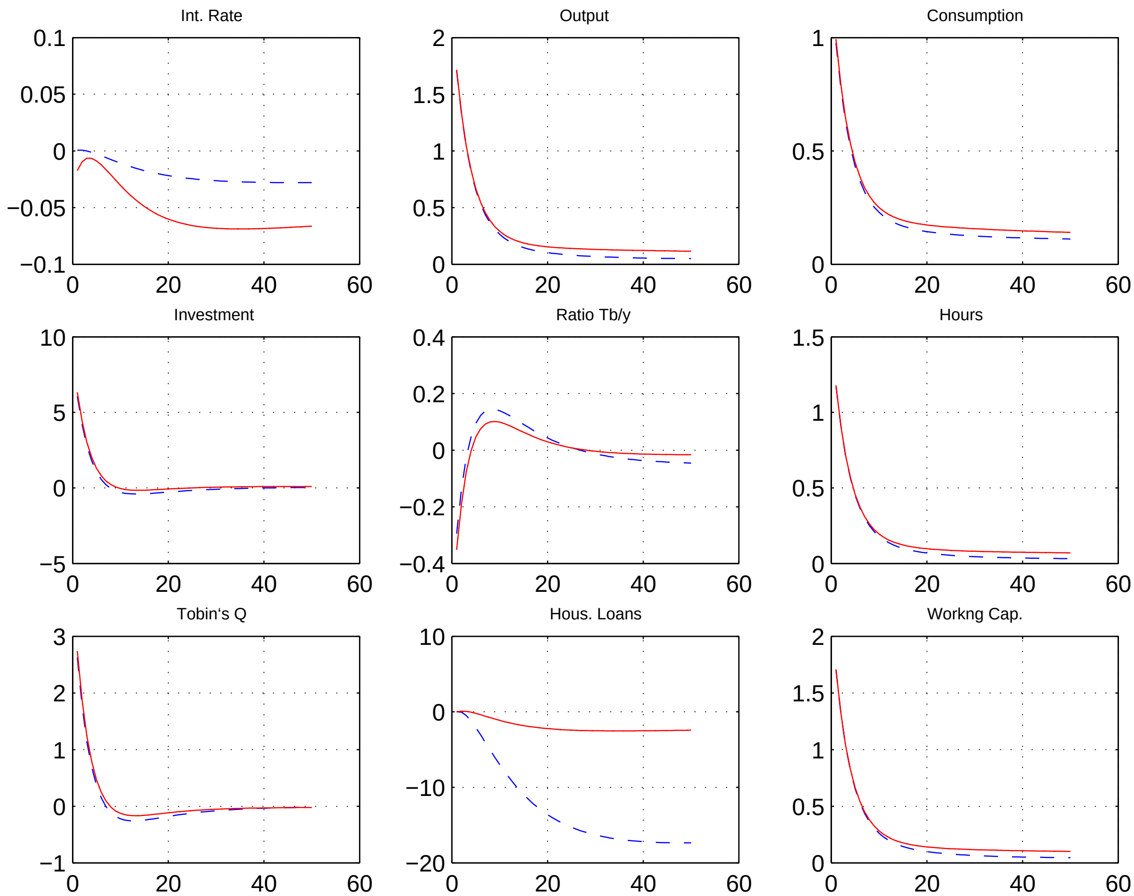

Figure 5: Impulse Responses to a 1% Innovation to Productivity: Banks versus Direct Financing

. Dashed lines are used for the non-intermediated economy.

Table 1: Argentina: Business Cycles Statistics

National Accounts at 1993, 1986 and 1970 prices

	NA's at 1993 Prices 1993:1-1999:4			NA's at 1986 Prices 1980:1-1996:4			NA's at 1970 Prices 1970:1-1990:4		
Variable (x)	σ_x/σ_y	$\rho_{x_t,x_{t-1}}$	ρ_{x_t,y_t}	σ_x/σ_y	$\rho_{x_t,x_{t-1}}$	ρ_{x_t,y_t}	σ_x/σ_y	$\rho_{x_t,x_{t-1}}$	ρ_{x_t,y_t}
Output (y)	3.002	0.828	1.000	4.343	0.780	1.000	3.121	0.675	1.000
Consumption	1.157	0.826	0.911	1.197	0.794	0.959	3.374	0.716	0.693
Investment	2.673	0.800	0.959	3.031	0.809	0.929	4.954	0.762	0.594
Net Exports.	1.056	0.762	-0.884	2.286	0.836	-0.830	2.922	0.779	-0.649
Fin. System	1.549	0.702	0.809	0.487	0.739	-.—	-.—	-.—	-.—
Int. rate Pesos.	0.681	0.185	-0.235	-.—	-.—	-.—	-.—	-.—	-.—
Int. rate $	0.473	0.446	-0.235	-.—	-.—	-.—	-.—	-.—	-.—
Tot. Loans	1.638	0.813	0.555	14.636	0.923	-.—	-.—	-.—	-.—
Hours	1.220	0.486	0.521	-.—	-.—	-.—	-.—	-.—	-.—

Notes: The absolute standard deviation of output is reported in the output row. Dashes are used for non available data in the respective edition of the National Accounts (NA's).

Table 2: The Effect of Interest-Rate Shocks on Business Cycles under Direct Financing (no Banks)

	Productivity Shocks			Productivity and Interest-Rate Shocks					
	σ_r=0 σ_y=3.680			σ_r=1.00 ρ_r=0.9 σ_y=3.710			σ_r=3.00 ρ_r=0.9 σ_y=3.850		
Variable (x)	σ_x/σ_y	$\rho_{x_t,x_{t-1}}$	ρ_{x_t,y_t}	σ_x/σ_y	$\rho_{x_t,x_{t-1}}$	ρ_{x_t,y_t}	σ_x/σ_y	$\rho_{x_t,x_{t-1}}$	ρ_{x_t,y_t}
Output (y)	1.000	0.808	1.000	1.000	0.810	1.000	1.000	0.823	1.000
Consumption	0.881	0.921	0.852	0.879	0.921	0.852	0.862	0.923	0.855
Investment	2.850	0.678	0.869	2.996	0.693	0.823	3.895	0.751	0.610
TB/output	0.345	0.933	-0.282	0.398	0.905	-0.238	0.666	0.849	-0.101
Hous. Loans	101.9	1.000	-0.300	102.0	1.000	-0.287	102.8	1.000	-0.191
Work. Cap.	0.995	0.806	1.000	0.996	0.808	1.000	0.999	0.822	1.000
Hours	0.686	0.806	1.000	0.687	0.808	1.000	0.689	0.822	1.000
Capital	0.466	0.536	0.996	0.485	0.538	0.996	0.608	0.568	0.996
$\rho_{S,I}$	0.7947			0.7485			0.531		

Notes: σ_y is the standard deviation of output. σ_r is the percentage standard deviation (volatility) of the international interest rate. ρ_r is the autocorrelation of the interest-rate process. Innovations to productivity are characterized by σ_{ε_z}=1.26 and ρ_z=0.74. The adjustment cost parameters h_1 and h_2 are both set equal to 3.4.

Table 3: The Effect of Interest-Rate and Productivity Shocks on Business Cycles with and without Banks

	Direct Financing			Intermediated Economy					
	σ_r=1.00 ρ_r=0.9 σ_y=3.710			σ_r=1.00 ρ_r=0.9 σ_y=4.020			σ_r=3.00 ρ_r=0.9 σ_y=4.030		
Variable (x)	σ_x/σ_y	$\rho_{x_t,x_{t-1}}$	ρ_{x_t,y_t}	σ_x/σ_y	$\rho_{x_t,x_{t-1}}$	ρ_{x_t,y_t}	σ_x/σ_y	$\rho_{x_t,x_{t-1}}$	ρ_{x_t,y_t}
Output (y)	1.000	0.810	1.000	1.000	0.837	1.000	1.000	0.839	1.000
Consumption	0.879	0.921	0.852	0.786	0.913	0.950	0.785	0.914	0.950
Investment	2.996	0.693	0.823	2.797	0.692	0.864	3.075	0.710	0.782
TB/output	0.398	0.905	-0.238	0.196	0.725	-0.424	0.334	0.769	-0.241
Hous. Loans	102.0	1.000	-0.287	9.358	1.000	-0.466	9.847	0.999	-0.407
Work. Cap.	0.996	0.808	1.000	0.973	0.830	0.999	0.976	0.832	0.999
Int. Rate	0.297	0.924	-0.213	0.286	0.970	-0.450	0.468	0.904	-0.318
Hours	0.687	0.808	1.000	0.671	0.830	0.999	0.673	0.832	0.999
Capital	0.485	0.538	0.996	0.632	0.620	0.998	0.652	0.998	0.622
$\rho_{S,I}$	0.7485			0.9359			0.8358		

Notes: σ_y is the standard deviation of output. σ_r is the percentage standard deviation (volatility) of the international interest rate. ρ_r is the autocorrelation of the interest-rate process. Innovations to productivity are characterized by σ_{ε_z}=1.26 and ρ_z=0.74. The adjustment cost parameters h_1 and h_2 are both set equal to 3.4.

Table 4: The Effect of Working Capital and the Slope of the Supply of Financial Services on Volatility

	σ_r =0	σ_r =3.00							
		ξ =0.9				ξ =0.5			
	τ=0.01	τ=0.50	τ=0.25	τ=0.50	τ=0.75	τ=0.01	τ=0.25	τ=0.50	τ=0.75
σ_y	3.670	3.710	3.700	3.700	3.700	3.850	3.840	3.820	3.810
Variable (x)	σ_x/σ_y	σ_x/σ_y	σ_x/σ_y	σ_x/σ_y	σ_x/σ_y	σ_x/σ_y	σ_x/σ_y	σ_x/σ_y	σ_x/σ_y
Consumption	0.765	0.772	0.768	0.764	0.760	0.760	0.758	0.755	0.752
Investment	2.854	3.339	3.320	3.296	3.266	3.173	3.109	3.036	2.956
TB/output	0.174	0.407	0.398	0.388	0.377	0.255	0.238	0.219	0.198
Hous. Loans	8.943	5.919	7.215	9.702	15.98	1.060	1.328	1.847	3.176
Work. Cap.	0.975	0.970	0.974	0.979	0.983	0.989	0.993	0.996	0.998
Int. Rate	2.444	0.495	0.493	0.490	0.487	0.473	0.457	0.443	0.435
Hours	0.672	0.669	0.672	0.675	0.678	0.682	0.685	0.687	0.688
Capital	0.597	0.614	0.621	0.628	0.636	0.742	0.740	0.739	0.738
$\rho_{S,I}$	0.9543	0.7817	0.7931	0.8055	0.8187	0.9517	0.9564	0.9616	0.9670

Notes: σ_y is the standard deviation of output. σ_r is the percentage standard deviation (volatility) of the international interest rate. ρ_r is the autocorrelation of the interest-rate process. ξ is the share of the specific factor x used in the production of loans. Innovations to productivity are characterized σ_{ε_z}=1.26 and ρ_z=0.7. The adjustment cost parameters h_1 and h_2 are both set equal to 3.2.