Intermediation of Capital Inflows: The Macroeconomic Implications of Neoclassical Banks and Working Capital

P. Marcelo Oviedo*

Iowa State University

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Abstract

This paper studies the business cycle implications of fluctuations in foreign capital inflows driven by exogenous world interest-rate changes in a small open economy endowed with a ‘neoclassical’ banking technology. Banks are the only domestic agents with access to international capital markets. They intermediate capital inflows by borrowing abroad and lending to domestic firms and households in a competitive credit market. Whereas firms demand credit to finance their working capital, households use credit for consumption smoothing. Calibrating different versions of the model to the Argentine economy for the period 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 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: business cycles, capital flows, financial intermediation, small open economies.

JEL Classification Code: E32, E44, F32, F1.
1 Introduction

This paper investigates the mechanism through which interest-rate driven capital inflows affect the business cycles of a small open economy (SOE) that is endowed with neoclassical banks. Both, the cost of international financing and international capital flows are crucial for the macroeconomic performance of emerging economies. In the 1990’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 1990’s, flew out giving rise to deep recessions, unemployment, and financial turmoil. Figure 1 illustrates the relationship between the international interest rate and the output performance of Argentina in the period 1982-1999. The contemporaneous correlation between the three-month Argentine interest rate and a GDP index is equal to -0.781. A similar pattern seems to relate the interest rate and output in other developing counties like Mexico and Brazil.

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. 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. Banks in emerging market countries obtain much of their funding placing bonds in international capital markets; inasmuch as it becomes easier to borrow from these markets during periods of high international liquidity, there is also a high contemporaneous correlation between bank loans and GDP; Figure 2 shows the Argentine example where such correlation is equal to 0.64.

Contrary to the evidence on the importance that capital flows and the liquidity of interna-

\footnote{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.}
tional capital markets have in explaining business cycles in emerging market countries, interest-rate swings induce changes of second order of magnitude in the RBC model of a SOE. Mendoza (1991) shows this result calibrating the model to the Canadian economy. In the RBC model, 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 vary their consumption path and reallocate their savings affecting the supply of physical capital.

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 closed economy. The demand for working capital would become an extra mechanism to raise the response of business cycles to interest-rate shocks because 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) not only affects the supply side of input markets but also the demand side through the change in firms’ production costs.

Neumeyer and Perri (2001) assume that firms fund their production process by 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.

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2Following 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. Correia et al. (1995) finds the same results for the Portuguese economy using a modified version of this RBC model.

3The utility index in Mendoza (1991) rules out the intertemporal substitution in labor.
and so it is more plausible they would be granted by domestic banks. This paper studies the
business fluctuations of a SOE in which a neoclassical banking system intermediates the inflows
of foreign capital and firms demand working capital to finance the input costs that have to paid
in advance. The model provides an analytical framework to study the interactions between the
financial and non-financial sectors in emerging economies, as well as to study the effect of working
capital and the interest-rate elasticity of capital inflows on business cycles using the SOE version
of the RBC model.

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, is used in the paper. The
transformation of financial securities and the exclusive access to international financial markets
are 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.4
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 granting loans requires the use of capital, labor, and specific ‘banking skills’. Banks, whose
revenues come from the intermediation margin, choose their financial-assets position so as to

4Oviedo (2003) appeals to the asymmetric information approach to discuss the role of aggregate-credit risk
and banking crises in the business cycles of emerging countries.
maximize their profits. 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 taken jointly.

Banks issue an internationally traded bond and the proceeds are lent to other agents in the economy: firms and households. Firms and banks 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.

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 before the debt default, 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) and Calvo et al. (1996). After studying the capital inflows to Latin America at the beginning of the 90’s, they conclude that much of these inflows were driven by factors external to the region such as the macroeconomic strength in the developed economies and changes in the regulation of their capital markets. Similarly, Corbo and Hernández (2001) indicate 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 a 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 of the undergoing conditions in a particular country.
The main findings of the paper can be summarized as follows. First, adding working capital needs to the RBC model of a SOE is not enough to break the neutrality of business cycles to interest-rate shocks. Second, only when the supply of credit is not 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, which take the form of borrowing-in-advance constraint. 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 which is independent on the initial conditions. 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. Whereas his banks operate a costless technology and the interest-rate margin arises only due to the imposition of reserve requirements, the interest-rate margin in this paper’s model arises because the production of intermediation services uses real resources.

The rest of the paper proceeds with other three sections. Section two presents the model and section three discusses 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, namely, banks, firms and households, that interact in four competitive markets: labor, capital, loans, and goods. The economy grows at a constant and exogenous rate, $\gamma$, determined by a standard labor augmenting technological change. The model describes the transformed economy where the steady state growth has been eliminated.\(^5\)

2.1 The Household’s Problem

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

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

(1)

where $c_t$ represents consumption and $n_t$ the labor supply; the time endowment is normalized to one and household’s leisure is the time not spent working, i.e. $1 - n_t$. The instantaneous utility function is continuously differentiable and concave, $\beta \in (0, 1)$, is the intertemporal discount factor and $E_t$ is the time-$t$ expectation operator.\(^6\) The household faces the following flow budget constraint in every period $t$ from $t = 0$ to $\infty$:

$$w_t n_t + r^k_t k_t + \pi^b_t + \pi^y_t + \left[ (1 + \gamma)L^h_{t+1} - L^h_t \right] \geq c_t + i_t \left[ 1 + \Psi \left( \frac{i_t}{r_t} \right) \right] + L^h_t r^L_t$$  

(2)

\(^5\)Be $X_t$ the level of the technology at time $t$; be $X_0$ its initial value at time $t = 0$, which is set equal to one for convenience; and be $\gamma$ the growth rate of $X_t$; then, because of the mentioned technological change and the functional forms to be adopted later, all non price variables except labor grow at the rate $\gamma$. Growing variables are then detrended by dividing through $(1 + \gamma)^t$.

\(^6\)Because of the trend growth, the pure rate of time preference $\beta$ is different from $\beta$ because, as is shown in section section 3.2, the latter also depends on $\gamma$ and a preference parameter.
The RH’s counts on three sources of resources which are described in the left hand side of eq. (2): labor income, property income and banks loans. Labor income depends on the wage rate, \( w_t \), and the labor services supplied. Property income has two components. First, income coming from renting capital \( k_t \) at the rental rate \( r_k \). Second, since the RH is the owner of both banks and firms, it receives profits from these two sectors, \( \pi_i \) \( (i=b, y) \). \( \pi_i \) is going to be interpreted as the return \( (z_t) \) to banking skills \( (x) \) which are inelastically supplied by the household, i.e. \( \pi_b = z_t x \). While perfect competition will make firm profits equal to zero, banks’ profits will fluctuate over the business cycle. Finally, excesses of expenditures over income are covered by increasing the demand for bank loans.\(^7\)

The RH uses of income, which are shown on the right-hand-side of eq. (2), are purchases of consumption and investment goods, \( i_t \), including (convex) installation costs, \( (\Psi(\cdot)i_t) \). Investment (net of adjustment costs) and the law of motion of the household’s capital stock are defined by:

\[
i_t = (1 + \gamma)k_{t+1} - k_t(1 - \delta) \tag{3}\]

where \( \delta \) is the depreciation rate. To avoid having an infinite level of household debt, the no-Ponzi game condition (NPGC) \( \lim_{t \to \infty} E_0 \left[ \prod_{s=0}^{k_t-L_{h_{t+1}}} \right] \geq 0 \) is imposed. Initial conditions for the capital stock, \( k_0 \), and household loans, \( L_{h_0} \), complete the description of the RH’s problem.

The RH’s Optimality Conditions

The RH chooses the contingent sequences \( \{c_t, n_t, L_{h_{t+1}}, k_{t+1}\}_t \geq 0 \), so as to maximize eq. (1) subject to eqs. (2) and (3), the NPGC, and the initial conditions \( L_{h_0}, k_0 \). The RH’s information set at time \( t \) includes the historic values of all variables until time \( t-1 \) and the value of \( (L_{h_t}, k_t, z_t, r_t) \), where \( z_t \) sets the value of the economywide productivity shock \( e^{z_t} \), and \( r_t \) is the international interest rate.

The following optimality conditions along with eq. (2) and (3)) characterize the optimal RH’s

\(^7\)The stock of \( t+1 \)-dated loans are multiplied by \( (1 + \gamma) \) to account for the trend growth of the economy.
decision process for $t = 0, \ldots \infty$

$$\frac{-u_n(c_t, 1 - n_t)}{u_c(c_t, 1 - n_t)} = w_t \quad (4)$$

$$(1 + \gamma)u_c(c_t, 1 - n_t) = \beta E_t[u_c(c_{t+1}, 1 - n_{t+1})(1 + r_{t+1}^L)] \quad (5)$$

$$(1 + \gamma)u_c(c_t, 1 - n_t)P^q_t = \beta E_t[u_c(c_{t+1}, 1 - n_{t+1})(P^k_{t+1} + r_{t+1}^k)] \quad (6)$$

where $u_j(\cdot), j = c, n$ stands for the derivative of the utility index with respect to $j$, and where $P^q_t$ and $P^k_t$ are given by:

$$P^q_t = 1 + \Psi \left( \frac{it}{kt} \right) + \Psi' \left( \frac{it}{kt} \right) \frac{1}{kt}it \quad (7)$$

$$P^k_t = (1 - \delta) \left[ 1 + \Psi \left( \frac{it}{kt} \right) \right] + (1 + \gamma)\Psi' \left( \frac{it}{kt} \right) \frac{kt+1}{kt^2}it \quad (8)$$

$P^q_t$ is the Tobin's Q, and represents the consumption value-cost of a marginal unit of new capital. $P^k_t$ is the ex-rental value of a marginal unit of installed capital. The transversality condition indicates that:

$$\lim_{t \to \infty} \beta^t E_0 \left[ u_c(c_t, n_t)(k_t - L^b_t) \right] = 0$$

Eq. (4) equates the marginal rate of substitution of consumption for leisure to the wage rate. Eqs. (5) and (6) 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 given up to repay what is borrowed today.

The left hand side of eq. (6) 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 so. These benefits have two components: the future rental income from an extra unit of capital, $r_{t+1}^k$, and the future (after depreciation) value of that unit of capital, $P^k_{t+1}$. The latter includes the benefits from future reductions in adjustment costs as it can be seen in eq. (8).
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 its input costs 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:

$$\pi^y_t = e^{zt} f(k^y_t, n^y_t) - (r_t^k k^y_t + w_t n^y_t)(1 + \varphi r^L_t)$$

(9)

where $f$ is an increasing and concave production function; $k^y_t$, and $n^y_t$ are the capital and labor services employed by the firm and $\varphi$ is the fraction of input costs paid in advance. This specification of the working capital permits having a demand for financing different from the value of input costs. The exogenous dynamics of $z_t$ is given by:

$$z_t = \rho^z z_{t-1} + \varepsilon^z_t$$

(10)

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 includes financing costs:

$$e^{zt} f_{n^y}(k^y_t, n^y_t) = w_t (1 + \varphi r^L_t)$$

(11)

$$e^{zt} f_{k^y}(k^y_t, n^y_t) = r_t^k (1 + \varphi r^L_t)$$

(12)

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

$$L^y_t \equiv (n^y_t w_t + k^y_t r_t^k) \varphi$$

(13)
At each date $t$, the RF observes prices $r_t^L$, $w_t$, and $r_t^k$, and chooses the amount of labor and capital services according to eqs. (11) and (12). These equations also show how the domestic interest rate $r_t^L$ affects production.\footnote{It is shown later that $r_t^L$ is positively correlated with the international rate $r_t$.} A rise in $r_t^L$ depresses the gross cost of employing labor and induces firms to raise labor demand and production. Since $\varphi=0$ 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. The extent to which international interest-rate disturbances give rise to capital flows capable of breaking the neutrality of the RBC model to interest-rate shocks discussed by Mendoza (1991) will depend on how important this new factor-demand effect becomes for the economy’s business cycles.

### 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 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 (like ATM’s, buildings and computer networks), labor (financial advisors, managers, tellers, etc.), and banking skills which can be identified with “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 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:

$$L_t = e^{z_t}g(k_t^b, n_t^b, x)$$

(14)
where $e^zt$ is the economy-wide productivity shock discussed before and the financial intermediation technology, which is described by $g(\cdot)$, is represented by a continuous and concave function. $k^b_t$ and $n^b_t$ are the capital and labor demanded by banks and $x$ represents the banking skills supplied to the bank. Observe that, 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 pairs $(n^b_t, k^b_t)$ for any combination of loans $L_t$ and input prices. The bank cost function, $BCF_t$, can be written as:

$$BCF_t = BCF(L_t, w_t, r^k_t, r^L_t) = (\tilde{k}_t^b r^k_t + w_t \tilde{n}_t^b) (1 + \varphi r^L_t)$$

where a “∼” over a variable denotes the conditional factor demand, i.e. $\tilde{n}_t^b = \tilde{n}_t^b(w_t, r^k_t, L_t, r^L_t)$ and $\tilde{k}_t^b = \tilde{k}_t^b(w_t, r^k_t, L_t, r^L_t)$. The cost function incorporates the fact that the bank must also pay its factor inputs in advance. Particularly, the working capital demanded by banks is:

$$L_t^b \equiv (\tilde{n}_t^b w_t + \tilde{k}_t^b r^k_t) \varphi$$

(15)

The RB maximizes the profit function that depends on the interest-rate margin, the inflows of capital intermediated, and the administrative costs,

$$\pi^b_t = (r^L_t - r_t) L_t - BCF_t$$

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

$$r_t = \rho_0 + \rho^r r_{t-1} + \varepsilon^r_t$$

(16)

$\varepsilon^r_t$ is a zero mean, i.i.d. process with $Var(\varepsilon^r_t) = \sigma^2_\varepsilon$.

The optimal level of bank loans is determined by maximizing $\pi^b_t$ with respect to $L_t$. At the
optimal $L_t$, the intermediation spread is equal to the marginal administrative cost,

\[ r_t^L - r_t = \frac{\partial BCF_t}{\partial L_t} \]

An alternative interpretation of eq. (17) indicates that, at the optimum, the marginal revenue of lending a unit of resources, $r_t^L$, is equal to the marginal cost of lending, which is equal to 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 inputs demanded.

A critical element of this model is that the RB’s marginal cost function has a finite elasticity.\(^9\) Eq. (17) shows that the marginal administrative costs imposes a wedge between the domestic and international interest rate. When the marginal administrative cost curve is flat, i.e. $\frac{\partial BCF_t}{\partial L_t}$ is constant, the interest rate spread $r_t - r_t^L$ is independent of $L_t$ and the domestic rate $r_t^L$ rises in exactly the same magnitude as a given rise in $r_t$. This is no longer the case when banks operate with a fixed supply of banking skills. When the marginal administrative cost curve has a finite elasticity, i.e. $\frac{\partial BCF_t}{\partial L_t}$ 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 role of these administrative costs is studied in detail in section 3 to see the effect of the level and slope of the marginal cost of financing on the model dynamics.

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.\(^10\) Because of the

\(^9\) 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.

\(^10\) See the review in Schmitt-Grohé and Uribe (2003).
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.\footnote{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 $\beta$ are given from the standpoint of the small open economy.} For example, if the economy starts with an $L_0$ lower than the steady state 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 \textit{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 $\{c_t, n_t, k_{t+1}, L^h_t\}_{t=0}^{\infty}$; a sequence of contingent allocations for each firm, $\{n^y_t, k^y_t, L^y_t\}_{t=0}^{\infty}$; a sequence of contingent allocations for each bank $\{n^b_t, k^b_t, L^b_t, L_t\}_{t=0}^{\infty}$; and a sequence of nonnegative contingent prices $\{r_t, r^L_t, r^k_t, w_t, P^q_t, P^k_t\}_{t=0}^{\infty}$ such that,

1. The allocations $\{c_t, n_t, k_{t+1}, L^h_t\}_{t=0}^{\infty}$ 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 $\{n^y_t, k^y_t, L^y_t\}$ maximizes firm’s profits at time $t$ given the prices $\{r_t, r^L_t, r^k_t, w_t, P^q_t, P^k_t\}$.

3. The allocation $\{n^b_t, k^b_t, L^b_t, L_t\}$ maximizes bank’s profits at time $t$ given the prices $\{r_t, r^L_t, r^k_t, w_t, P^q_t, P^k_t\}$ and observing the balance sheet constraint, $b_t = L_t$.  

11 For example, if the economy starts with an $L_0$ lower than the steady state 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 \textit{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.
4. The markets for capital services, labor services, loans and goods clear in every period:

\[ k_t = k^y_t + k^b_t, \quad n_t = n^y_t + n^b_t, \quad L_t = L^y_t + L^b_t + L^h_t; \]

\[ e^{zt} f(k^y_t, n^y_t) + b_{t+1} - b_t(1 + r_t) = c_t + i_t[1 + \Psi_t(i_t/k_t)] \]

3 Numerical Analysis

After specifying its functional forms, the model is calibrated according to the Argentine national accounts and also using standard parameter values in the literature. The model is then log-linearized around its non-stochastic steady state to compute impulse-response functions and second moment statistics under different assumptions about intermediation technology, and the demand for working capital.

3.1 Functional Forms

The functional forms of the utility index in eq. (1) and the production functions for firms and banks in eqs. (9) and (14) are as follows.

\[ u(c_t, 1 - n_t) = \frac{(c_t - \frac{\nu}{\mu} n^y_t)^{1-\sigma}}{1-\sigma} \quad (18) \]

\[ e^{zt} f(k^y_t, n^y_t) = e^{zt} A^y (k^y_t)^\alpha (n^y_t)^{1-\alpha} \quad (19) \]

\[ L_t = e^{zt} g(k^b_t, n^b_t) = e^{zt} A^b \left( (k^b_t)^\alpha (n^b_t)^{(1-\alpha)} \right)^\xi x^{1-\xi} \quad (20) \]

The RH has an isoelastic instantaneous utility index and \( \sigma \) 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 \( A^b \) scale total factor productivity; \( \alpha \) 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 in the financial industry is equal to \( 1 - \alpha \xi \).

The model is consistent with trend growth under the following circumstances. First, the productivity of the fixed factor \( x \) grows at the rate \( \gamma \). Second, preferences specified in eq. (18) implicitly mean that because of the existence of some kind of home production, the utility of leisure also grows over time at the rate \( \gamma \).\(^{12}\)

Completing the specification of the functional forms, the parameter \( \psi \) governs the value of adjustment costs in the capital-adjustment cost function:

\[
\Psi \left( \frac{i_t}{k_t} \right) = \frac{\psi}{2} \left( \frac{i_t}{k_t} - (\gamma + \delta) \right)^2
\]

a specification that turns the adjustment costs equal to zero at the steady state.

### 3.2 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, bank output is equal to 2.5% of national output. Argentinean National Accounts (ANAs) indicate that the financial industry output is equal to 4% of GDP (in the period 1993-1999). However, the financial-industry output in the ANAs includes other financial services, like those offered by insurance companies and which were not considered in the model.

Argentina has grown at 2.6% per year during the last 25 years, so \( \gamma = 0.026 \) on an annual basis. As for the interest rates, \( r \) is initially set equal to 6.5% on annual basis, as is standard in the business-cycle literature. 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

\(^{12}\)This requirement can be rationalized appealing to the work by Greenwood et al. (1995) who show that an economy with home production is observationally equivalent to another without home production but with different preferences.
non-stochastic steady state. The value of the international interest rate and interest-rate margin imply that $r^L$ is equal to 10.75% on annual basis.

$\sigma$ is set equal to 2 and $\mu$ is set equal to 1.45 as in Mendoza (1991), which implies that $\nu=6.61$. Eq. (5) implies that $\beta$ 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 $B=0.987$. As for the factors’ share, $\alpha = 0.35$ and $\xi$ is set equal to 0.75; considering the factor $x$ as specific labor, total labor share in the financial industry then rises to 0.74, 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 banking skills in the national income is equal to 0.62%; for simplicity, $x = 1$.

ANAs indicate that the consumption-GDP ratio is equal to 0.78, and the investment ratio equal to 0.19. 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 $L/GDP$ takes different values depending on the value of $\varphi$. In the benchmark model $\varphi$ is set equal to 1, so that firms have to paid in advance the cost of all inputs used during a quarter. Under this assumption, on annual basis, $L/GDP=0.64$, $L^b/GDP=0.38$; and $(L^y + L^b)/GDP=0.25$. The implied annual capital output ratio is $k/GDP=2.02$ and $\delta=0.068$ on annual basis; 1.9% of the labor and capital are employed in the financial industry; and $r_k=18.37\%$ is the annual rate of return on capital gross depreciation.

The autocorrelation coefficient of productivity is chosen so that the model reproduces the output persistence of the Argentinean economy. The persistence parameter $\rho^r$ in the international interest-rate process is fixed to 0.87. Two standard deviations for the quarterly interest rate are considered, $\sigma_r=1.00\%$ and 3.00%.
3.3 Numerical Results

The quantitative exercises address the following questions. To what extent do working capital needs magnify the real effects of model interest-rate fluctuations? How is this magnification altered by the introduction of a banking system? 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 domestic agents obtain financing by placing bonds in the world capital market. On the other hand, when the parameter $\varphi$ 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.

3.3.1 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 effects cause a fall in consumption and investment expenditures and a decrease in the current account deficit. The income effect arises because the shock augments the debt burden in a debtor country; the substitution effect follows from a (relatively) more expensive actual consumption which makes the representative household 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.

As shown in Figure 3, adding a costly-operated banking system can append an attenuating effect to this interest-rate-driven recession. 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 as 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 \( L_t = e^{zt} A^b \left( (t^b) \alpha (n^b) (1 - \alpha) \right)^{\xi} x^{1-\xi} \) and consider two special cases, \( \xi = 1 \) and \( \xi = 0 \). When \( \xi = 1 \), 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 spread 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 \( r_t^L \). On the other hand, for \( 0 < \xi < 1 \), the elasticity of the
loans supply is inversely related to the value of $\xi$ as it is shown in Figure 4.

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, $r_t^L$, and not $r_t$, is the relative price of future consumption. Since $r_t$ rises more than $r_t^L$, 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 fall more in the non-intermediated economy as well. Thus, the recession following a capital outflow is milder in the banking economy due to the dampening effect performed by bank administrative costs. Notice that 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. 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 and this induces households to accumulate capital. In the standard model, the trade balance becomes countercyclical when the pro-borrowing effect dominates the pro-saving effect.\(^{13}\) 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 no longer the case in the model of section 2 where the interest-rate spread is countercyclical. 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

\(^{13}\)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
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 rises on impact because the pro-borrowing effect induced by the productivity shock as well the increased demand for working capital exert an upward pressure on the domestic interest rate. As the productivity shock is falling back to its mean value, the demand for working capital falls and the household savings built during the expansion pushes the interest rate down. This similarity is going to be explored further in quantitative terms next.

3.3.2 Business-Cycles Statistics

For the quantitative study of the volatilities induced by the above shocks under alternative setups, models’ statistics are compared to those of the Argentine economy which are reported in Table 1.\footnote{It should be noted that the Argentinean national accounts (ANAs) 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 ANAs measure macroeconomic variables at 1993 prices and its sample goes from 1993.1 to the present. However, this edition has several differences with the ANAs at 1986 prices. Moreover, these two editions show differences with the ANAs at 1970 prices. Given these deficiencies, it has been opted to report the business cycle statistics that arise from each of these series instead of reporting single figures.} The analysis is carried out in three steps. First, banks are ruled out and the non-intermediated economy is tested under two scenarios, one where the economy is only hit by productivity shocks and the other where both productivity and interest-rate disturbances drive business cycles. This step will show that the existence of a demand for working capital is not enough to break the neutrality of business fluctuations to interest-rate shocks. In the second step, the banking economy is compared with the economy under direct financing to show that the introduction of banks hardly alters the previous results. The third step shows that what matters to have interest-rate induced business cycles is the interest-rate elasticity of the economy’s credit supply. Two additional quantitative exercises are performed next. One compares the banking
economy with an economy without banks but subject to an (exogenous) interest-rate premium and the other shows that the precedent results are unaffected by an alternative specification of the working capital demand where only labor costs have to paid at front.

**Interest-Rate Shocks and Working Capital under Direct Financing.** The first set of simulations are performed setting the innovations to productivity so that the model reproduces the (average) Argentine output volatility: \( \sigma_{GDP} = 3.5\% \). Similarly, \( \rho^z \) is set to mimic the average GDP autocorrelation observed in Argentina and the adjustment cost parameters \( \psi \) is set equal to 0.525 to reproduce the relative volatility of investment. To minimize the role of banks, the intermediation margin is reduced (from 4.25\% to 0.42\%) but not completely eliminated so that the model still preserves the stationarity of its equilibrium dynamics.

As Table 2 shows, moderate interest-rate perturbations have minor effects on output fluctuations and the investment-saving correlations. 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 raised from 1\% to 3\%, except for investment expenditures and the trade balance, 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 impacts of interest-rate shocks on production because of the working capital needs.

To explain how the neutrality of interest-rate disturbances is invariant to the introduction of working capital consider the firms’ labor optimality condition in eq. (11). The log-linear version of the right-hand side of that equation can be written as \( \hat{w}_t + \frac{\varphi r^L}{1 + \varphi r^L} \hat{r}_t^L \). When \( \varphi = 1 \) and \( r^L = 10.75\% \), as in the calibrated economy, the coefficient of \( \hat{r}_t^L \) is equal to 0.097. Thus, from the standpoint of the RF, a 10\% rise in \( r_t^L \) is approximately equivalent to a 1\% rise in the wage rate. Therefore, the negligible relevance of the changes in the cost of financing on the demand side

\[ \hat{z} \equiv \frac{\ln(z)}{dt}, \text{ and undated variables refer to their steady state value.} \]
of the labor market is explained by the relatively small coefficient of $\hat{r}_L$ and by the buffer-effect induced by banks.

The large volatility of household loans is at odds with the volatility of loans in Argentina during the 1990’s (see the ANAs at 1993 prices). As is shown next, the introduction of the banking system reduces considerably the volatility of household loans although the model retains the neutrality of the GDP to interest-rate disturbances. The focus will turn to the intermediation technology and the demand for working capital.

**Banks versus Direct Financing.** Table 3 compares the non-intermediated with the intermediated economy, the latter being affected by interest disturbances equal to 1% and 3%. The results under direct financing are reproduced from Table 2 to facilitate the comparisons. The characteristic of the exogenous stochastic processes and the adjustment cost parameters are the same as above, while administrative costs induce interest-rate spreads equal to 0.425% and 4.25%, respectively.\(^\text{16}\)

The neutrality of the GDP to interest-rate disturbances is hardly raised when the banking sector is considered explicitly. However, the introduction of the banking system lowers considerably the relative volatility of household loans; furthermore, whereas the banking system reduces the volatility of consumption it also raises the investment-saving correlation. The higher investment-saving correlation in the intermediated economy is due to the fact that the financial system breaks the standard separation between consumption and investment decisions.

**The Intermediation Technology and the Size of the Working Capital Demand.** To investigate the robustness of the precedent results, this paragraph discuss how they hinge upon the elasticity of the loans supply (which depends on the value of $\xi$) and upon the size of the working capital needs (which depend on the value of $\varphi$). Table 4 summarizes the effect of alternative values of $\xi$ and $\varphi$. Whereas setting $\varphi = 0.01$ almost vanishes the demand for working capital,

\(^\text{16}\)Recall that administrative costs are not completely eliminated in the non-intermediated economy to preserve the stationarity of the equilibrium dynamics.
capital, setting $\varphi = 1.5$, raises the importance of the financial costs in production decisions.

When $\xi = 0.95$ the banking system operates a technology that is close “close” to a constant-returns technology and the credit supply becomes flatter. In these circumstances, the changes in the business-cycle statistics produced by alternative values of $\varphi$ are less noticeable, except for household loans. On the contrary, setting $\xi = 0.55$ not only raises the volatility of output but also aligns the volatility of loans with the volatility observed in practice and reported in Table 1.

These results indicate that what really matters to raise the response of business cycles to the changing conditions in international financial markets is the elasticity of the economy’s total credit with respect to the domestic interest rate and not a demand for working capital.

Neoclassical Banks versus Debt Elastic Interest-Rate Premium and Convex Portfolio Adjustment Costs. The combination of neoclassical banks and the fixed supply of banking skills is what induces stationarity to the model dynamics in this paper. This paragraph compares the equilibrium dynamics arising from that combination with other two stationarity-inducing techniques adopted in the literature and discussed by Schmitt-Groh´e and Uribe (2003): the debt-elastic interest-rate premium and portfolio-adjustment costs. The model of section 2 can accommodate these two stationarity-inducing techniques by eliminating the banking system and by adding either the interest-rate premium or the portfolio adjustment costs. Letting $\overline{L}$ be the steady-state level of the sum of households’ and firms’ debt, a debt-elastic (international) interest-rate premium implies that in a model without banks, the domestic interest-rate is given by:

$$r_t^L = r_t + \zeta_1(e^{L_t - \overline{L}} - 1)$$

(21)

Under the assumption of portfolio-adjustment costs, a term like $\zeta_2/2(L_t - \overline{L})^2$ has to be added to the household budget constraint in eq. (2). In these two specifications of the model, $\zeta_1$ and $\zeta_2$, as well as $\overline{L}$ are constant parameters. As it is shown in Schmitt-Groh´e and Uribe (2003), for small values of $\zeta_1$ and $\zeta_2$ satisfying $\zeta_1 = (1 + r)\zeta_2$, the two specifications of the model imply
similar dynamics.

There exist no major differences between the dynamics of the risk-premium model (and consequently the portfolio-adjustment cost model) and the dynamics of the model with banks.\textsuperscript{17} This is because both models can be set to produce the same elasticity of credit supply which is what becomes key for the business cycle statistics. To see this, Figure 6 compares the slopes of the supply of credit induced by the banking system and the exogenous risk-premium in eq. (21) respectively. Consistent with the results shown above, what matters for the equilibrium dynamics of the risk-premium model is the slope of domestic financing, which rises with $\zeta_1$.

\textbf{Working Capital and Factor Inputs} The literature exploring the relation between business cycles and working capital is split between models where working capital needs arise, as in the model of this paper, because all factors of production have to be paid in advance and models where only labor costs have to be paid at front. Being the elasticity of credit supply and not the demand for working capital the important element to explain business cycle statistics, one would not expect significant changes in these statistics following the alternative specification of the demand for working capital.

Two minor modifications to the model of section 2 are required to accommodate the case where only labor costs have to be paid in advance. One modification takes up the new rental cost of capital $r^k_t$ (instead of $r^k_t(1 + r^L_t \varphi)$) and requires to change eq. (12) and the bank cost function; the other modification is related to the working capital demands: eqs. (13) and (15) become $L^y_t = n^y_t w_t \varphi$ and $L^b_t = n^b_t w_t \varphi$, respectively.

Comparing the benchmark model’s results (shown in the last three columns of Table 3) with the results of the version of the model where only labor costs are paid at front confirms the presumption that business cycle statistics are not modified substantially under the alternative setup. The absolute volatility of GDP falls from 3.700 to 3.697%; and except for household loans whose relative volatility falls from 3.729% to 3.339%, none of the other relative volatility

\textsuperscript{17}Results are not shown to conserve space.
statistics change considerably: the change in the relative volatility of the remaining variables is not larger than 1.5%.

4 Concluding Remarks

The standard RBC model of a SOE predicts that interest-rate shocks are unable to produce significant output variance. Thus, neither country-specific (international risk-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 could 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 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 a special type of service in the economy.

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 by less than 2.5%, 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.

Under the existence of a banking system that uses banking skills that are in fixed supply, the model predicts milder recessions following a decrease in the liquidity of international financial markets than otherwise. This is because the banking systems acts as a buffer-mechanism that compensates the higher international interest rate with lower administrative costs and viceversa. However, the buffer mechanism implies a counter-factual behavior of spreads: as banks intermediate more when the economy faces higher inflows of capital, banking spreads are higher during booms and lower during recessions.

It must be recognized that the characterization made for banks disregards several aspects of the banking system. In particular it does not address the role of credit risk, liquidity risk, insolvency costs, nor 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


Figure 1: Argentina GDP index and Country-Specific Interest Rate. 1982-1999

Notes: (1) The GDP index is used to fit together three editions of the Argentina National Accounts. (2) The interest-rate was calculated using the US-Treasure T-bills rate and the risk premium measured by JP Morgan (Emerging Markets Bonds Index) for Argentina.

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

Notes: (1) Loans, which are represented by the dashed line, are total loans of the financial system. (2) Loans' statistics are taken from the Central Bank of Argentina.
Figure 3: Impulse response functions of models with and without banks. Interest-rate shock

Notes: (1) The impulse-response functions show deviations with respect to the steady-state value of the variables. (2) The initial shock is equal to a 1% standard deviation of the international interest rate. (3) Dashed lines are used for the economy without banks. (4) The trade-balance ratio is the the trade-balance-to-GDP ratio.

Figure 4: Banking skills share in Bank Output (1-\(\xi\)) and the Marginal Cost of Financial Intermediation

Notes: (1) Marginal costs of intermediation are measured at quarterly basis; (2) except for the value of \(\xi\) and \(A^b\), parameters and variables take their calibrated values; (3) the graph illustrate the effect of three values of the pair \((\xi, A^b)\): (0.55,32); (0.75,64); and (0.95,120).
Figure 5: Impulse response functions of models with and without banks. Productivity shock

Notes: (1) The impulse-response functions show deviations with respect to the steady-state value of the variables. (2) The initial shock is equal to a 1% standard deviation of $z_t$. (3) Dashed lines are used for the economy without banks. (4) The trade-balance ratio is the trade-balance-to-GDP ratio.

Figure 6: Stationary inducing techniques: banks versus interest-rate premia

Notes: (1) $(1 - \xi)$ is the share of banking skills in the production of financial services. (2) $\zeta$ is the parameter controlling the international risk-premium in the risk-premium model; $\zeta=0.00074$ is the value calibrated in Schmitt-Grohé and Uribe (2003); the graph for $\zeta=0.00025$ is shown to illustrate how the parameter value affect the elasticity of supply of credit. (3) The full line represents the marginal cost of financial intermediation and the dashed and dashed-dotted line represent the interest rate premia arising from the exogenous risk premium under two different values of $\zeta$. (4) The risk-premium functions, which are equal to zero at the steady-state value of total loans, are scaled up to facilitate the comparison between the banking model and the risk-premium model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>NA’s at 1993 Prices</th>
<th>NA’s at 1986 Prices</th>
<th>NA’s at 1970 Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \sigma_x / \sigma_Y )</td>
<td>( \rho_{x,t-1} )</td>
<td>( \rho_{x,t} )</td>
</tr>
<tr>
<td>GDP (( \Upsilon ))</td>
<td>3.002</td>
<td>0.828</td>
<td>1.000</td>
</tr>
<tr>
<td>Cons.</td>
<td>1.157</td>
<td>0.826</td>
<td>0.911</td>
</tr>
<tr>
<td>Inv.</td>
<td>2.673</td>
<td>0.800</td>
<td>0.959</td>
</tr>
<tr>
<td>N.Exp.</td>
<td>1.056</td>
<td>0.762</td>
<td>-0.884</td>
</tr>
<tr>
<td>Fin.Syst.</td>
<td>1.549</td>
<td>0.702</td>
<td>0.809</td>
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<tr>
<td>( r ) in Pes.</td>
<td>0.681</td>
<td>0.185</td>
<td>-0.235</td>
</tr>
<tr>
<td>Loans</td>
<td>1.638</td>
<td>0.813</td>
<td>0.555</td>
</tr>
<tr>
<td>Hours</td>
<td>1.220</td>
<td>0.486</td>
<td>0.521</td>
</tr>
</tbody>
</table>

Notes: (1) \( \Upsilon \) represents the GDP and \( x \) is the general notation for variables in the first column except for GDP. (2) The variables are: GDP; consumption; investment; net exports; financial-system output; interest rate for loans in pesos; interest rate for loans in dollars; total loans; and hours. (3) The absolute volatility of output is underlined; (4) \( \sigma_j \) represents the standard deviation of the variable \( j \) and \( \rho_{i,j} \) stands for the correlation between variables \( i \) and \( j \).

Table 2: Interest-Rate Shocks and Business Cycles under Direct Financing

<table>
<thead>
<tr>
<th>Variable</th>
<th>Productivity Shocks</th>
<th>Productivity and Interest-Rate Shocks</th>
<th>Productivity and Interest-Rate Shocks</th>
</tr>
</thead>
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<tr>
<td></td>
<td>( \sigma_r = 0.00 )</td>
<td>( \sigma_r = 1.00 )</td>
<td>( \sigma_r = 3.00 )</td>
</tr>
<tr>
<td></td>
<td>( \sigma_Y = 3.50; \rho_{Y,t-1} = 0.754 )</td>
<td>( \sigma_Y = 3.53; \rho_{Y,t-1} = 0.758 )</td>
<td>( \sigma_Y = 3.74; \rho_{Y,t-1} = 0.783 )</td>
</tr>
<tr>
<td>c</td>
<td>0.945</td>
<td>0.619</td>
<td>0.769</td>
</tr>
<tr>
<td>( i(1+H) )</td>
<td>3.550</td>
<td>0.347</td>
<td>0.793</td>
</tr>
<tr>
<td>( tb )/GDP</td>
<td>0.544</td>
<td>0.081</td>
<td>-0.229</td>
</tr>
<tr>
<td>( r^L )</td>
<td>0.108</td>
<td>-0.121</td>
<td>-0.130</td>
</tr>
<tr>
<td>( H^h )</td>
<td>14.061</td>
<td>-0.117</td>
<td>-0.119</td>
</tr>
<tr>
<td>( L^y )</td>
<td>1.005</td>
<td>0.755</td>
<td>1.000</td>
</tr>
<tr>
<td>( n^y )</td>
<td>0.697</td>
<td>0.755</td>
<td>0.999</td>
</tr>
<tr>
<td>( k^y )</td>
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</tbody>
</table>

Notes: (1) \( \Upsilon \) is used to represent the GDP and \( x \) is the general notation for the variables in the first column. (2) The model variables in the table are GDP; consumption; investment; net exports; trade-balance-to-GDP ratio; household loans; domestic interest rate; and firms’ working capital, labor and capital. (3) \( \sigma_j \) represents the standard deviation of the variable \( j \) and \( \rho_{i,j} \) stands for the correlation between variables \( i \) and \( j \). (4) The last row of the table shows the investment-saving correlation.
Table 3: Direct Financing versus Financial Intermediation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Direct Financing</th>
<th></th>
<th>Financial Intermediation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\sigma_r = 1.00)</td>
<td></td>
<td>(\sigma_r = 1.00)</td>
<td></td>
</tr>
<tr>
<td>(\sigma_Y)</td>
<td>(0.781)</td>
<td></td>
<td>(0.847)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{\xi x,\xi t})</td>
<td>(0.784)</td>
<td></td>
<td>(0.828)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{\xi x,\xi t})</td>
<td>(0.781)</td>
<td></td>
<td>(0.851)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{\xi x,\xi t})</td>
<td>(0.778)</td>
<td></td>
<td>(0.874)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{\xi x,\xi t})</td>
<td>(0.775)</td>
<td></td>
<td>(0.896)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{S,I} = 0.593)</td>
<td>(0.53)</td>
<td></td>
<td>(0.65)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{S,I} = 0.847)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\rho_{S,I} = 0.756)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: (1) \(\Upsilon\) represents the GDP and \(x\) is the general notation for the variables in the first column. (2) The model variables in the table are GDP; consumption; investment; trade-balance-to-GDP ratio, household loans; domestic interest rate; and firms' working capital, labor and capital. (3) \(\sigma_j\) represents the standard deviation of the variable \(j\) and \(\rho_{i,j}\) stands for the correlation between variables \(i\) and \(j\). (4) The last row of the table shows the investment-saving correlation.

Table 4: Intermediation Technology and Working Capital Needs

<table>
<thead>
<tr>
<th>Variable ((x))</th>
<th>(\sigma_r = 0)</th>
<th></th>
<th>(\sigma_r = 3.00)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(\varphi)</td>
<td>(\xi = 0.75)</td>
<td></td>
<td>(\xi = 0.55)</td>
<td></td>
</tr>
<tr>
<td>(0.01)</td>
<td>(0.01)</td>
<td></td>
<td>(0.01)</td>
<td></td>
</tr>
<tr>
<td>(0.50)</td>
<td>(0.50)</td>
<td></td>
<td>(0.50)</td>
<td></td>
</tr>
<tr>
<td>(0.75)</td>
<td>(0.75)</td>
<td></td>
<td>(0.75)</td>
<td></td>
</tr>
<tr>
<td>(1.5)</td>
<td>(1.5)</td>
<td></td>
<td>(1.5)</td>
<td></td>
</tr>
<tr>
<td>(\sigma_Y)</td>
<td>(3.69)</td>
<td></td>
<td>(3.60)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{\xi x,\xi t})</td>
<td>(0.784)</td>
<td></td>
<td>(0.828)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{\xi x,\xi t})</td>
<td>(0.781)</td>
<td></td>
<td>(0.851)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{\xi x,\xi t})</td>
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<td></td>
<td>(0.874)</td>
<td></td>
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<tr>
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<td>(0.775)</td>
<td></td>
<td>(0.896)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{S,I} = 0.847)</td>
<td>(0.53)</td>
<td></td>
<td>(0.65)</td>
<td></td>
</tr>
<tr>
<td>(\rho_{S,I} = 0.756)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: (1) \(\Upsilon\) represents the GDP and \(x\) is the general notation for the variables in the first column. (2) The model variables in the table are GDP; consumption; investment; trade-balance-to-GDP ratio, household loans; domestic interest rate; and firms' working capital, labor and capital. (3) \(\sigma_j\) represents the standard deviation of the variable \(j\) and \(\rho_{i,j}\) stands for the correlation between variables \(i\) and \(j\). (4) The last row of the table shows the investment-saving correlation.