Liquidity Cycles*

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Abstract

We study an economy where firms face credit constraints tied to the value of their assets and financiers differ in their information on the market for firms' assets. Financiers with poor information on the asset market make mistakes in asset liquidation, hoarding assets during booms and trading them during recessions. We find that asset liquidity and the composition -informed versus uninformed- of firms' financiers breed each other in a cumulative fashion and that their interaction generates cycles in asset values and output.

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1 Introduction

In the last two decades or so, many countries worldwide, such as the Nordic countries in the early nineties, Mexico in 1995, Japan and the South East Asian countries in the late nineties, have experienced unprecedented boom-and-bust cycles. There appear to be two empirical regularities across most of these episodes. First, the boom-and-bust economies have generally featured large price movements in their asset markets. Second, in the wake of financial liberalization, several boom-and-bust economies have featured a "reshuffling" in their financial markets, with new financiers eroding the market shares of established ones. For example, in the Nordic countries banks significantly expanded their presence in the real estate sector, while in the South East Asian countries (e.g. Indonesia) foreign banks became major players in the local credit markets. In this paper, we show that, when we account for the possibility that financiers have different information on the market liquidity of firms' assets,[1] possibly due to different familiarity with the local market, the interaction between the price of firms' assets and the composition -informed versus uninformed- of firms' financiers may generate boom-and-bust cycles.

In our economy, firms face financing constraints and their access to credit is tied to the market value of their assets (as in Kiyotaki and Moore, 1997, and a vast literature on financial imperfections).

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The higher the liquidity and, hence, the market price of firms' assets, the higher the expected return that firms can pledge to financiers and the easier their access to credit. The gist of our analysis consists of the role of asset prices in generating a boom-and-bust output cycle through their interaction with the composition of financiers. Precisely, suppose that a positive shock to the productivity of assets raises their price. The increase of the asset price relaxes credit constraints and thereby amplifies the positive output effects of the shock. However, by tilting the composition of firms' financiers towards uninformed ones, the increase of the asset price also sows the seeds for the following recession.

The intuition for this result is as follows. In our economy, firms can invest in generic projects or in specialized and more productive ones. Firms can also borrow from financiers with deep information or from financiers with poor information on the asset market. Informed financiers are efficient asset sellers: using their information, they resell assets when their price peaks and defer resale when their price is on the rise. In contrast, uninformed financiers make "mistakes" and may resell assets too early or too late. We show that informed financiers may be less willing to fund specialized projects than uninformed ones. In fact, the assets of these projects are specific to the original firms and, hence, intrinsically hard to resell. Thus, the liquidation ability of informed financiers goes wasted under these projects. Furthermore, the reluctance of informed financiers to fund specialized projects is stronger when the asset price is higher. In fact, the higher the price, the higher the liquidation value that an informed financier will give up if she funds a specialized project rather than a generic.

Now, suppose that a positive shock to the productivity of assets raises their price. The increase of the asset price renders informed financiers less willing to fund specialized projects, inducing more firms to borrow from uninformed financiers. In turn, uninformed financiers make mistakes in timing their asset sales: they hoard assets during the boom, further fostering their price at that time, and resell them during the recession, further depressing their price. Hence, the change in the composition of financiers exacerbates the volatility of the asset price which, in turn, further tilts the composition of financiers towards uninformed ones. In sum, asset liquidity and price on one side and the composition of financiers on the other breed each other in a cumulative fashion. Furthermore, since output is positively related to the asset price through credit constraints, the increase in the volatility of the asset price exacerbates output volatility.

This paper relates to the literature on financial imperfections and the business cycle. In this literature, one of the closest analyses is Kiyotaki and Moore (1997), who show that, through their effect on credit constraints, changes in asset prices can amplify productivity shocks.[2] As stressed by Matsuyama (2004a), in Kiyotaki and Moore (1997) changes in asset prices do not generate business cycles but the propagation and amplification of shocks. Put differently, a "credit multiplier" but not a "credit reversal" mechanism is at work. This issue is fundamental. It is commonly argued that in the boom-and-bust economies the booms endogenously created the conditions for the following

recessions. Focusing on the amplification of shocks, most of the literature on financial imperfections cannot explain a full boom-and-bust cycle.[3]

There is only a handful of papers in which financial imperfections generate instability and fluctuations besides amplification and propagation. Matsuyama (2004a and 2004b) are the closest to our analysis.[4] In Matsuyama (2004a), for example, during booms credit flows to "bad" projects, meant as projects more exposed to credit constraints and that generate less pecuniary externalities. This change in the composition of projects progressively erodes borrowers' net worth until the economy peaks and thereafter enters a recession. In Matsuyama (2004a and 2004b), financiers are homogenous and business fluctuations stem from changes in the composition of investment projects. In our economy, business fluctuations stem from changes in the composition of financiers. Clearly, our explanation and Matsuyama's may be seen as complementary. Some scholars argue that the "boom-and-bust economies" suffered from a deterioration of the quality of projects during the booms (see, e.g. Corsetti and Pesenti, 1999). However, other scholars (see, e.g. Radelet and Sachs, 1998) downplay this argument and claim that, in the wake of financial liberalization, during the booms the most evident pattern consisted of firms' tendency to borrow from new financiers, such as foreign investors or investors previously active in other sectors.

This paper also relates to the literature on asset pricing in environments with informed and uninformed traders. Grossman and Stiglitz (1980) develop a model in which noise traders extrapolate information on the future return of a risky asset from its current price. However, the price contains imperfect information on future returns. In fact, traders cannot discern whether the price of the asset is high because the future return will be high or because current asset supply is low. The behavior of informed (uninformed) financiers in our paper mirrors that of informed and uninformed traders in Grossman and Stiglitz (1980). In particular, if the asset price was fully informative, there would be no difference between informed and uninformed financiers and cycles would not arise. Thus, this paper may also be thought as an application of the idea of Grossman and Stiglitz (1980) to the theory of business cycles.[5]

The remainder of this analysis is organized as follows. In section 2, we lay out the setup. In section 3, we solve the model. In section 4, we characterize the equilibrium and show the existence of cycles. In section 5, we conclude.

2 Model Setup

The economy lasts two periods ($t = 1, 2$) and each period has a "morning" and an "afternoon". There is a unit continuum of entrepreneurs and two unit continua of financiers, informed and uninformed. There are two storable goods, a final good and productive assets. Each financier is endowed with one unit of final good in each period, while entrepreneurs have no endowment. Entrepreneurs' utility

is $U_t = c_t - cn^2/2$ while financiers' utility is $U_t = c_t + c_{t+1}$, where c is the consumption of the final good, $n \in [0,1]$ is the degree of specialization of the entrepreneur's project, and $cn^2/2$ is the effort cost that the entrepreneur sustains to specialize.

The Entrepreneurial Sector.

Morning (Production). In the morning, each entrepreneur can transform one unit of final good into one unit of assets. At the end of the morning, the assets produce with probability π; otherwise production fails but the assets can be resold. The expected return of a project is

$$\pi y(1+n) + (1-\pi)(1-n)\ell_t. \tag{1}$$

In (1), $y(1+n)$ is the amount of final good produced in case of success: y reflects the ability of the entrepreneur as a primary user of assets and is uniformly distributed over the support $[\frac{1}{\pi}, \frac{1}{\pi}+1]$. ℓ_t is instead the amount of final good expected from the asset resale, gross of transaction costs. As it is made clear by (1), specialization yields an output edge yn in case of success. However, it renders the assets specific to the original entrepreneur and, hence, less saleable: $n\ell_t$ is the amount of final good lost in the resale in the form of a transaction cost.

Afternoon (Liquidation). In the afternoon, each entrepreneur can employ one unit of resold assets, obtaining instantaneously an amount $x\phi_t$ of final good. x reflects the idiosyncratic ability of a second hand user and is uniformly distributed over the support $[0,1]$. ϕ_t reflects the aggregate productivity of second hand users and satisfies

$$\phi_1 = \theta_1 + \varepsilon, \tag{2}$$

$$\phi_2 = \theta_2. \tag{3}$$

In (2)-(3), $\varepsilon \sim N(0,1)$ while θ is an autoregressive component. We let θ take value θ^H ("boom") or $\theta^L < \theta^H$ ("recession"). Without loss of generality, we assume that $Pr(\theta_1^L) = Pr(\theta_1^H) = 1/2$ and the stochastic process of θ is

$$\begin{bmatrix} \theta_2^H \\ \theta_2^L \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} \theta_1^H \\ \theta_1^L \end{bmatrix}. \tag{4}$$

Hence, the economy can experience a recession followed by a boom or a boom followed by a recession.

The Financial Sector. In the morning, each entrepreneur can patronize one financier and, after that, enter a debt contract. We assume that in the negotiation the financier has full bargaining power.

Our economy features limited contract enforceability. First, an entrepreneur can implement a generic project ($n = 0$) or a specialized one ($n > 0$) but she cannot commit to a degree of

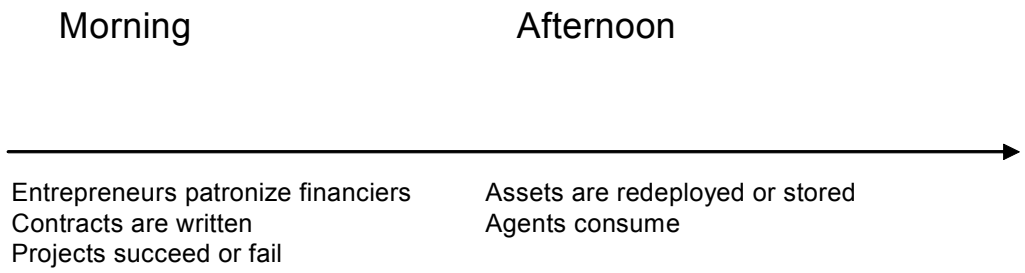

Figure 1: Within Period Time Line.

specialization n. Second, an entrepreneur can divert output from a successful project. The maximum value of debt an entrepreneur can commit to repay equals

$$\overline{D} = (1-\alpha)y + \min\left\{\omega, (1-\alpha)yn\right\}. \tag{5}$$

Thus, the output verification technology features a decreasing marginal return to specialization: when $n > \omega/y(1-\alpha)$, the entrepreneur can commit at most an amount ω of the output edge.

Information Structure. The values of θ_1, ε_1 and θ_2 are realized at the beginning of the relevant period. Entrepreneurs and informed financiers observe them, while uninformed financiers do not. A forward asset market is open at the financing stage of each period. In this market, entrepreneurs buy forward the assets of failed projects and financiers sell forward assets contingent on the failure of funded projects.

2.1 Discussion of the Setup

The assumption that entrepreneurs have a lower discount factor than financiers is standard in the literature on credit imperfections (see e.g., Kiyotaki and Moore, 1997). This guarantees that entrepreneurs do not accumulate enough savings to eventually self-finance their projects. The assumption that entrepreneurs (financiers) are fully impatient (patient) is for simplicity.

In the entrepreneurial sector, the critical feature is that a specialized project yields more output than a generic in case of success but its assets are less liquid. In our opinion, this effectively characterizes specialized projects. As for the second use of assets, a simplifying feature is that resold assets produce instantaneously. Hence, second hand users do not need external finance to purchase assets. Gorton and Huang (2004) assume that agents need to finance purchases of used assets and endogenize the asset demand, relating it to the aggregate supply of liquidity. Here, we endogenize the asset supply, relating it to financiers' liquidation decisions.

In the financial sector, the assumption that contracts are imperfectly enforceable renders the choice between informed and uninformed financiers meaningful. If output or the degree of special-

ization were perfectly contractible, uninformed financiers would be redundant. In spite of modelling differences, our specification of the technology and of the financial structure shares important features with Matsuyama (2004a and 2004b). As in these papers, entrepreneurs choose between a more productive and a less productive project and the more productive one may be more difficult to finance because its expected return is less easy to commit. In Matsuyama (2004a and 2004b) entrepreneurs may end up investing in the less productive projects. Here, entrepreneurs can fund more productive projects by addressing uninformed financiers (see below). Thus, the heterogeneity of financiers is our novelty.

We finally turn to the information structure. The notions of "informed" and "uninformed" financiers have several real world counterparts, such as foreign versus domestic financiers, financiers with a consolidated experience of the sector versus inexperienced financiers, and so forth. The existence of a forward market for firm assets implies that their price is publicly observable in the morning of each period. In practice, in the real world, at each point in time some projects are financed while other projects fail and their assets are resold. Our timing, in conjunction with the existence of a forward asset market, aims at representing this scenario.

3 Model Solution

In solving the model, we focus first on agents' decisions taking as given the asset prices p_1 and p_2 in the two periods. The debt contract specifies the loan, the type of project -generic or specialized- and the value of debt D due to the financier at the end of the morning. It also implies that in case of project failure the financier can repossess assets for a market value up to D. In the first period, she can resell assets in the afternoon or store and resell them in the afternoon of the second period. Thus, we start by solving for the first period decision of a financier when to resell assets if the funded project fails. Then, we solve for the degree of specialization chosen by an entrepreneur if she implements a specialized project. After that, we solve for the decision of a financier whether to fund a generic project, a specialized one, or not to fund the entrepreneur. Then, we solve for the decision of an entrepreneur whether to patronize an informed or an uninformed financier. After solving for agents' decisions and deriving the asset demand and supply in each period, we solve for the asset prices p_1 and p_2.

Agents' Decisions. Consider the decision of a financier when to resell assets. The financier compares her proceeds in the first period with her expected proceeds in the second.[6] Formally, let λ^F be an indicator variable taking on the value of one if a financier of type $F = I$ (informed), U (uninformed)

resells in the first period, and zero otherwise. Breaking ties in favor of early resale,

$$\lambda^F = \begin{cases} 1 & if \quad p_1 \geq E^F(p_2) \\ 0 & if \quad p_1 < E^F(p_2) \end{cases}, \tag{6}$$

where $E^F(p_2)$ is the first period expectation of p_2 conditional on the information of a financier of type F. The reader should keep in mind that, when the resale decision is made, the information set of an informed financier includes the realization of θ_1, while that of an uninformed financier includes only the price p_1. This will be crucial in the analysis.

Next, we solve for the degree of specialization chosen by an entrepreneur who implements a specialized project. n solves

$$\max_n \left\{ \pi[y(1+n) - D] - \frac{cn^2}{2} \right\}. \tag{7}$$

Henceforth, we focus on the case in which, for the minimum optimal n, $n > \omega/y(1-\alpha)$. This also implies $n = \pi y/c$: thus, the higher the ability of the entrepreneur, the higher n.

We now turn to the decision of a financier whether to fund a generic project, a specialized one, or not to fund the entrepreneur. Denote $V^F_{g,t}$ ($V^F_{s,t}$) the period t financier's expected return if a generic (specialized) project is implemented. Taking into account that $n = \pi y/c$, in the first period,

$$V^F_{g,1} = \pi(1-\alpha)y + (1-\pi)\left[\lambda^F p_1 + (1-\lambda^F)E^F(p_2)\right], \tag{8}$$

$$V^F_{s,1} = \pi[(1-\alpha)y + \omega] + (1-\pi)(1-\frac{\pi y}{c})\left[\lambda^F p_1 + (1-\lambda^F)E^F(p_2)\right]. \tag{9}$$

In the second period, analogous expressions apply, with the difference that assets are necessarily resold and the terms in the square parenthesis in (8) and (9) are replaced by p_2.

Breaking ties in favor of a generic project, a financier of type F will fund a specialized project if and only if $V^F_{s,t} > V^F_{g,t}$ and $V^F_{s,t} \geq 1$. Operating algebraic manipulations, $V^F_{s,1} > V^F_{g,1}$ can be rewritten as

$$\omega > \frac{(1-\pi)y\left[\lambda^F p_1 + (1-\lambda^F)E^F(p_2)\right]}{c}. \tag{10}$$

In words, a specialized project will be funded if and only if: i) the higher output that the financier obtains from this project (left hand side of (10)) exceeds her loss in terms of the lower asset liquidity (right hand side of (10)); ii) its expected return does not fall short of the financier's opportunity cost of funds ($V^F_{s,1} \geq 1$). Analogous conditions hold for a generic project and for the second period. These conditions are straightforward to derive and we omit them.

We are now in a position to characterize entrepreneurs' distribution. In what follows, we assume that, when indifferent, an entrepreneur patronizes an informed financier.

Lemma 1 *i) In each period t, there exists a level of entrepreneurial ability y_t such that only the measure $\left(\max\left(1+\frac{1}{\pi}-y_t\right),0\right)$ of entrepreneurs with $y \geq y_t$ obtain credit; ii) In the first period,*

there exists a level of entrepreneurial ability y^* *such only the measure* $\left(\max\left(1+\frac{1}{\pi}-y^*\right),0\right)$ *of entrepreneurs with* $y \geq y^*$ *borrow from uninformed financiers. In the second period, all entrepreneurs borrow from informed financiers.*

PROOF: Consider first point i). The expected return $V_{a,t}^F$ of a financier under a specialized project is monotonically increasing in y. This implies that there exists a value y_t such that $V_{s,t}^F \gtreqless 1$ for $y \gtreqless y_t$. Furthermore, an entrepreneur always chooses a specialized project, if this is feasible. Consider then point ii). The right hand side of (10) is increasing in y. This implies that there exists a value y^* such that for $y > (\leq) y^*$ (10) holds (does not hold). Furthermore, both informed and uninformed financiers have to resell any residual asset in the second period so that no meaningful choice arises between the two types of financiers in the second period.

The impossibility for low-ability entrepreneurs ($y < y_t$) to obtain credit is a standard result in the literature on financial imperfections (for example, see Holmstrom and Tirole, 1997). In fact, low-ability entrepreneurs cannot pledge enough expected returns to financiers and cover their opportunity cost of funds. The result ii) in the lemma is less standard. In our economy, high-ability entrepreneurs ($y \geq y^*$) patronize uninformed financiers in the first period. The intuition is as follows. For a given degree of specialization, an informed financier expects to obtain a higher value than an uninformed one from asset resale. Because under a specialized project assets have lower liquidity than under a generic one, informed financiers may be unwilling to fund specialized projects and thereby waste their liquidation ability. The unwillingness of informed financiers to fund specialized projects is more likely for high-ability entrepreneurs because these have the incentive to specialize more. Therefore, high-ability entrepreneurs ($y \geq y^*$) have to borrow from uninformed financiers in order to implement specialized projects.

Asset Prices. We now turn to the asset market. In each period, in equilibrium, the asset demand M_t^d equals the supply M_t^s, i.e.

$$M_t^d = M_t^s. \tag{11}$$

Consider first the asset demand. Each entrepreneur with $x\phi_t \geq p_t$ demands one unit of assets. Taking into account that the distribution of x is uniform,

$$M_t^d = 1 - \frac{p_t}{\phi_t}. \tag{12}$$

Consider then the asset supply. In the afternoon of the first period, only the assets of the projects failed in the first period and not stored are resold. In the afternoon of the second period, the assets of the projects failed in the first period and stored between the first and the second period are resold

together with the assets of the projects failed in the second period. Therefore,

$$M_1^s = (1-\pi)\left[\lambda^I(y^*-y_1)+\lambda^U\left(1+\frac{1}{\pi}-y^*\right)\right], \quad (13)$$

$$M_2^s = (1-\pi)\left[1+\frac{1}{\pi}-y_2+(1-\lambda^I)(y^*-y_1)+(1-\lambda^U)\left(1+\frac{1}{\pi}-y^*\right)\right]. \quad (14)$$

In (13), $(1-\pi)\,\lambda^I\,(y^*-y_1)$ $((1-\pi)\lambda^U\left(1+\frac{1}{\pi}-y^*\right))$ is the supply of assets by informed (uninformed) financiers that come from projects failed in the first period. In (14), $(1-\pi)\left(1+\frac{1}{\pi}-y_2\right)$ is the supply of assets that come from projects failed in the second period, while $(1-\pi)(1-\lambda^I)(y^*-y_1)$ $((1-\pi)(1-\lambda^U)\left(1+\frac{1}{\pi}-y^*\right))$ is the supply of assets that come from projects failed in the first period and have been stored by informed (uninformed) financiers. Crucially, in both periods the asset supply is endogenous and it depends on financiers' resale decisions λ^I and λ^U. In turn, these decisions hinge on the information possessed by financiers in the first period.

4 Equilibrium

We now characterize the equilibrium. For a given choice of the structural parameters π, ω, α, and given realizations $\theta_1, \theta_2, \varepsilon$, the equilibrium is defined by a vector $[y_1, y_2, y^*, p_1, p_2, E^I(p_2), E^U(p_2), \lambda^I, \lambda^U]$ such that agents maximize utility and in both periods the credit and the asset markets clear. Note that, given the specified process for θ, once θ_1 is known θ_2 is also known. Furthermore, there is no aggregate uncertainty in the second period. Hence, for an informed financier $E^I(p_2) = p_2$.

We focus on the boom-recession scenario; the results for the recession-boom scenario are symmetric. In proposition 1, we compare the patterns of output and the asset price with those that would obtain in an economy where informed financiers always funded specialized projects. This may be thought as an economy where entrepreneurs (or a social planner in their place) can discourage financiers from funding generic projects rather than specialized ones. Hence, in this benchmark economy no entrepreneur would need to borrow from uninformed financiers ($y^* = 1 + \frac{1}{\pi}$).

Proposition 1 *Assume that a boom is realized in the first period followed by a recession in the second period, that is $\theta_1 = \theta^H$ and $\theta_2 = \theta^L$. There exists a region of the parameter space such that: i) In the first period, the asset price and output are higher than in the benchmark economy; ii) In the second period, the asset price and output are lower than in the benchmark economy.*

PROOF: In the Appendix.

For example, it can be shown that the proposition holds for the following choice of parameters: $\pi = 0.75$, $\alpha = 0.36$, $\omega = 0.095$, $c = 2$, $\theta = 0.8$, $\theta = 0.3$, $\varepsilon = -0.3$. Proposition 1 illustrates the key result of this paper. In commenting the proposition, we proceed in steps. We start by analyzing the interaction between asset liquidity and price and the composition of financiers (subsection 4.1).

We then investigate how this interaction may generate output fluctuations (subsection 4.2). After that, we turn to the informational role of the asset price (subsection 4.3). As discussed previously, in our economy the equilibrium asset price p_1 has a dual effect. Not only it clears the asset market in the first period, as in any standard Walrasian setting, but it also affects the information set of uninformed financiers by revealing information about the underlying θ_1 and, hence, about θ_2. In sum, uninformed financiers infer θ_2 from the equilibrium p_1. Finally, we perform a sensitivity analysis of the equilibrium, relating the magnitude of the asset price cycle and the output cycle to the parameters of the model (subsection 4.4).

4.1 Asset Price and the Composition of Financiers

The interaction between the market liquidity of firms' assets and the composition -informed versus uninformed- of financiers unfolds as follows. When a boom raises the asset price in the first period, informed financiers become less willing to fund specialized projects. This happens because the higher the price, the higher the liquidation value that an informed financier will give up if she funds a specialized project rather than a generic one. As a result, some high-ability entrepreneurs relocate their borrowing from informed to uninformed financiers in order to invest in specialized projects (y^* falls). In turn, this change in the composition of financiers affects the intertemporal distribution of the asset supply and the dynamic pattern of the asset price in the way we turn to describe.

Uninformed financiers make mistakes in timing their resale of assets. When a boom is realized in the first period, followed by a recession in the second, financiers should concentrate their asset resale in the first period, when the price is high, without waiting for the second period. Informed financiers correctly anticipate the decline of the price that will occur in the second period. In fact, they observe $\theta_1 = \theta^H$, which is a sufficient statistic for $\theta_2 = \theta^L$. Instead, uninformed financiers do not observe the realization of θ_1, but only the price p_1. Furthermore, as we better argue shortly, p_1 is not a sufficient statistic for θ_1 and, hence, for θ_2. Therefore, uninformed financiers may misunderstand a boom ($\theta_1 = \theta^H$) for a recession ($\theta_1 = \theta^L$). If this happens, they will expect that the asset demand will rise further ($\theta_2 = \theta^H$) and they will defer their asset resale to the second period. The "mistake" of uninformed financiers depresses the asset supply in the first period and fosters it in the second. In turn, the increase in the volatility of the asset price feeds back on the composition of financiers, further raising the share of uninformed financiers in the first period. All in all, asset liquidity and price on one side and the composition of financiers on the other breed each other in a cumulative fashion.

4.2 Output

We now analyze how the described interaction between asset liquidity and price and the composition of financiers affects output. In our economy, the output in period 1 equals

$$\mathcal{Y}_1=\pi A + (1-\pi)(B-C), \tag{15}$$

In (15), A is the output of successful projects, i.e.

$$A = \int_{y_1}^{1+\frac{1}{\pi}} (y + \frac{\pi y^2}{c})dy, \tag{16}$$

while B is the output obtained from liquidated assets, i.e.

$$B = \frac{\varphi_1 + p_1}{2}\left[\lambda^I(y^* - y_1) + \lambda^U(1 + \frac{1}{\pi} - y^*)\right]. \tag{17}$$

In (17) $(\varphi_1 + p_1)/2$ is the average productivity of a liquidated asset in period 1, while the term in the square parenthesis is the measure of assets that are liquidated. Finally, C measures the transaction costs sustained in asset liquidation, i.e.

$$C = \lambda^I p_1 \int_{y_1}^{y^*} \frac{\pi y}{c} dy + \lambda^U p_1 \int_{y^*}^{1+\frac{1}{\pi}} \frac{\pi y}{c} dy. \tag{18}$$

As for the output in period 2, it is also straightforward to write it as the sum of the output of successful projects and the output of liquidated assets net of transaction costs, with weights respectively given by the probability of success and failure of the projects. For the sake of brevity, we omit the relevant expressions, which are available from the authors.

In our economy, all else being equal, the higher the asset price the higher the expected return that an entrepreneur can pledge to a financier. Thus, as in Kiyotaki and Moore (1997) for example, the share of entrepreneurs $1-y_t$ who have access to the credit market and can invest in projects is an increasing function of the asset price p_t. This implies that when the asset price cycle exacerbates, the output cycle tends to exacerbate too. Note that an opposite force tends to dampen the comovement between output and the asset price. When uninformed financiers defer the resale of their assets, they shift the output of these assets from the first to the second period. This tends to moderate output during the boom and to foster it during the recession. This effect is however of second-order magnitude and is dominated by the direct effect that the asset price has on output through credit constraints.

4.3 The Informativeness of the Asset Price

The arisal of endogenous cycles hinges on the limited informativeness of the equilibrium price p_1. If the price was fully informative, informed financiers would not differ from uninformed ones. The

limited informativeness of p_1 stems from the randomness of the asset demand. In turn, this is due to the randomness of the aggregate productivity ϕ_1, as induced by the noise ε_1. This feature of our environment mirrors Grossman and Stiglitz (1980), in which the randomness of the supply of a risky asset dilutes the informativeness of its equilibrium price.

There is however a second factor that dilutes the informativeness of p_1. When a boom is realized in the first period, informed financiers resell assets immediately. This fosters the asset supply in the first period, moderating p_1. In contrast, when a recession is realized in the first period, informed financiers defer resale to the second period. This depresses the asset supply in the first period, raising p_1. Therefore, the behavior of informed financiers reduces the positive correlation between p_1 and θ_1, increasing the probability that uninformed financiers misunderstand a boom for a recession and make mistakes in asset resale.

4.4 Sensitivity Analysis

In this sub-section, we perform a sensitivity analysis of the equilibrium. We are interested in the impact of selected parameters of the model, namely α and π, on the magnitude of the asset price cycle and the output cycle. α, i.e. the share of output that an entrepreneur cannot pledge to a financier, can reflect the efficiency of the legal system of the economy: a worse legal system implies that a higher share α of output can be diverted. The probability of success π of the projects can instead be thought as a measure of the riskiness of the firms: the higher π, the lower the riskiness. We fix the other parameters as follows: $\omega = 0.095$, $c = 2$, $\theta = 0.8$, $\theta = 0.3$, $\varepsilon = -0.3$.

In figure 2, we display the percentage drop of output and the asset price between period 1 and period 2 as a function of α. All else being equal, a higher α fosters the magnitude of both the asset price and the output drop. Furthermore, α shifts the action from the output cycle to the asset price cycle. In figure 3, we display the percentage drop of output and the asset price between period 1 and period 2 as a function of π. All else being equal, a higher π lowers the magnitude of both the asset price and the output drop. Furthermore, π shifts the action from the asset price cycle to the output cycle.

We put forward the following interpretation for these findings. The mechanism that generates endogenous cycles hinges on fluctuations of the asset price. Both a lower α and a higher π tend to reduce the relevance of collateral values for financiers' decisions, and hence to erode the importance of fluctuations in the asset price. When α is lower, pledgeable output constitutes a higher share of the expected return of a financier and correspondingly the collateral value constitutes a smaller share. Analogously, when the probability π of success of the project is higher, the collateral value constitutes a smaller share of the expected return of a financier. Hence, in both cases the mechanism that generates instability loses relevance.

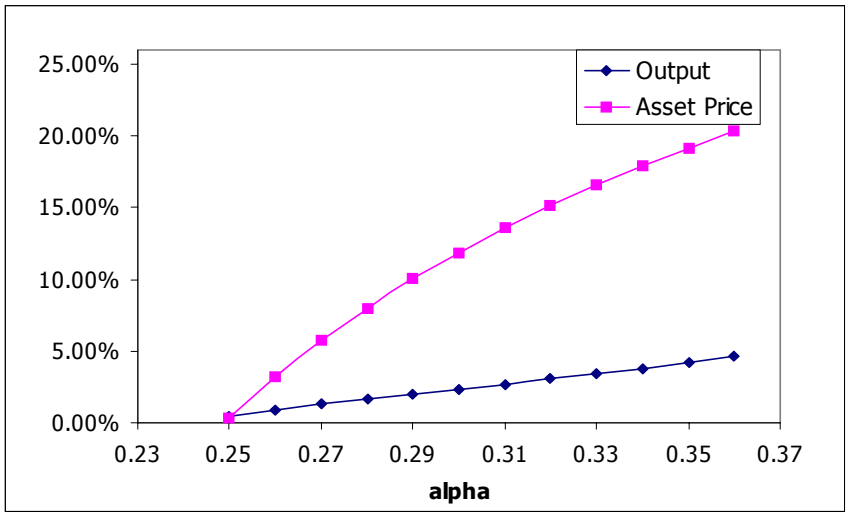

Figure 2: Output and Asset Price Drop: the Effect of α.

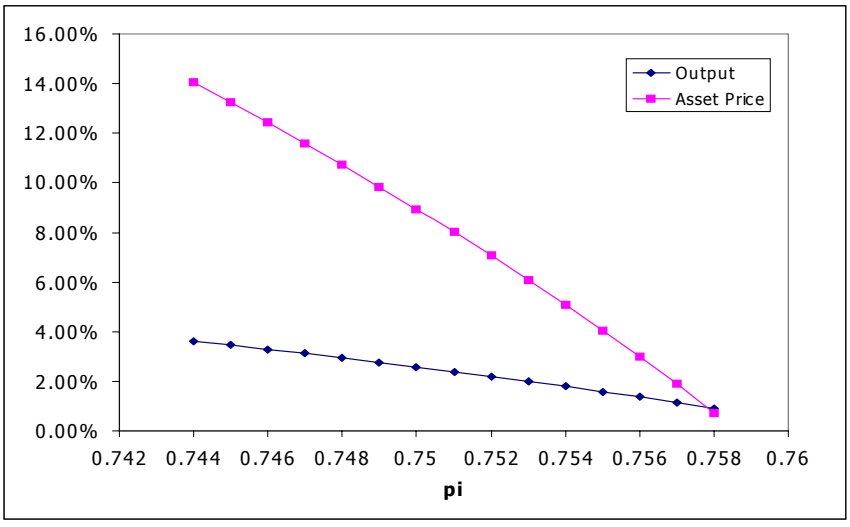

Figure 3: Output and Asset Price Drop: the Effect of π.

5 Conclusion

In this paper, we have put forward an explanation of boom-and-bust cycles based on the interaction between the market liquidity of firms' assets and the composition of firms' financiers. The key engine of this interaction is financiers' heterogenous information on the market liquidity of firms' assets.

Recently, some studies have stressed the role that governments have in injecting liquidity in the asset market during recessions. For example, in Gorton and Huang (2004) the government steps in to foster the demand for firms' assets whenever the private sector is short of funds. This prevents inefficient fire sales of the assets of distressed firms. There is however an equally important role played by governments during recent busts that is largely neglected in the literature. Besides injecting liquidity, governments have often created institutions, the "Asset Management Companies", whose main purpose has been to collect information on the asset market and thereby coordinate the trade of assets. The Asset Management Companies (e.g. the Swedish Securum) have played a critical role in identifying the best moments for the liquidation of the assets of distressed firms, as well as best users of these assets (Klingebiel, 2000). This paper provides a macroeconomic rationale for the informational role of Asset Management Companies. Especially in an economy that has experienced an episode of financial liberalization, many financiers are unlikely to have accurate knowledge of the market liquidity of firms' assets. This paper suggests that in such an economy institutions specialized in disseminating information on asset liquidity can be valuable in stabilizing the economy. A fascinating, though thorny, issue is to gauge quantitatively the stabilizing effect of this "dissemination of information". We leave this and other issues for future research.

References

[1] Allen, F. and D. Gale (2004) "Financial fragility, liquidity, and asset prices", Journal of the European Economic Association, 2, 6, 1015-1048.

[2] Bernardo, A. and I. Welch (2004) "Financial market runs", Quarterly Journal of Economics, 119, 135-158.

[3] Corsetti, G., P. Pesenti, and N. Roubini (1999) "What caused the Asian currency and financial crisis?", Japan and the World Economy 11, 3, 305-373.

[4] Diamond, D. and R. Rajan (2001). "Banks, short-term debt, and financial crises: theory, policy implications, and applications", Journal of Monetary Economics, Proceedings of Carnegie Rochester Conference on Public Policy.

[5] Gorton, G. and L. Huang (2004) "Liquidity, efficiency, and bank bailouts", American Economic Review, 94, 3, 455-483.

[6] Grossman, S. J. and J. Stiglitz (1980) "On the impossibility of informationally efficient markets", American Economic Review 70, 393-408.

[7] Holmstrom, B. and J. Tirole (1997) "Financial intermediation, loanable funds and the real sector", Quarterly Journal of Economics 112, 4, 663-691.

[8] Iacoviello, M. (2005) "House prices, borrowing constraints anf monetary policy in the business cycle", American Economic Review, forthcoming.

[9] Kiyotaki, N. and J. Moore (1997) "Credit cycles", Journal of Political Economy 105, 2, 211-48.

[10] Klingebiel, D. (2000) "The use of asset management companies in the resolution of banking crises", World Bank, Financial Sector Strategy and Policy Group, Policy Research WP 2284.

[11] Matsuyama, K. (2004a) "The good, the bad and the ugly: An inquiry into the causes and nature of credit cycles", Unpublished working paper, Northwestern University.

[12] Matsuyama, K. (2004b) "Credit cycles and credit traps", Unpublished working paper, Northwestern University.

[13] Radelet, S. and J. Sachs (1998) "The onset of the East Asian financial crisis", Unpublished working paper, Harvard University.

[14] Shleifer, A. and R. Vishny (1992) "Liquidation values and debt capacity: a market equilibrium approach", Journal of Finance 47, 4, 1343-1366.

[15] Schneider, M. and A. Tornell (2004) "Balance sheet effects, bailout guarantees and financial crises", Review of Economic Studies, forthcoming.

[16] Yuan, K. (2005) "Asymmetric price movements and borrowing constraints: a rational expectations equilibrium model of crises, contagion, and confusion", Journal of Finance 60, 1, 379-412.

6 Appendix

SUMMARY OF THE SYSTEM:

The structural parameters must satisfy the following restrictions:

$$0 < \pi < 1, \tag{19}$$

$$0 < \alpha < 1, \tag{20}$$

$$0 < \omega < \frac{1-\alpha}{\pi c}, \tag{21}$$

$$c > 1+\pi, \tag{22}$$

while the stochastic process of θ and ε is specified in the main text. Let

$$\lambda^I = \frac{1}{2}\left(\operatorname{sgn}\left(p_1 - p_2\right) + 1\right), \tag{23}$$

$$\lambda^U = \frac{1}{2}\left(\operatorname{sgn}\left(p_1 - E^U(p_2)\right) + 1\right). \tag{24}$$

For a given value of $E^U(p_2)$, the equilibrium vector of the residual endogenous variables $[y_1,\ y_2,\ y^*,\ p_1,\ p_2]$ is the unique solution of the system

$$y_1 = \frac{1}{\pi}\frac{1-\left(\pi\omega+(1-\pi)\max\left(p_1,p_2\right)\right)}{(1-\alpha)-\frac{1-\pi}{c}\max\left(p_1,p_2\right)} \tag{25}$$

$$y_2 = \frac{1}{\pi}\frac{1-\left(\pi\omega+(1-\pi)\,p_2\right)}{(1-\alpha)-\frac{1-\pi}{c}p_2} \tag{26}$$

$$y^* = \frac{c\omega}{(1-\pi)\max\left(p_1,p_2\right)} \tag{27}$$

$$p_1 = (\theta_1+\varepsilon_1)\left(1-(1-\pi)\left(\lambda^I(y^*-y_1)+\lambda^U(1+\frac{1}{\pi}-y^*)\right)\right) \tag{28}$$

$$p_2 = \theta_2\left(1-(1-\pi)\left(1+\frac{1}{\pi}-y_2+(1-\lambda^I)(y^*-y_1)+(1-\lambda^U)(1+\frac{1}{\pi}-y^*)\right)\right). \tag{29}$$

Now, let $s^L = \Pr\left(\theta_2 = \theta^L | p_1\right)$. Using the Bayes rule

$$s_L = \frac{\Pr(p_1 \left|\theta_1 = \theta^H\right.)}{\Pr(p_1 \left|\theta_1 = \theta^L\right.) + \Pr(p_1 \left|\theta_1 = \theta^H\right.)}. \tag{30}$$

Define $p_{2H} = p_{2|\theta_2=\theta_H}$ and $p_{2L} = p_{2|\theta_2=\theta_L}$. The equilibrium value of $E^U(p_2)$ equals

$$E^U(p_2) = (1-s_L)p_{2H} + s_L p_{2L}. \tag{31}$$

SOLUTION ALGORITHM:

The algorithm to solve the system (25)-(31) follows these steps:

1. Set $\theta_1 = \theta^H$ and choose a value for ε. Guess a value for λ^U (say $\lambda^U = 0$).

2. Solve the system made by equations (25) to (29). Obtain values for y_1, y_2, y^*, p_1 and p_2 conditional on the guess $\lambda^U = 0$. Set $p_{2H} = p_2$.

3. Calculate the numerator of s_L from the probability density of ε, which gives us $\Pr(p_1 \left| \theta_1 = \theta^H \right.)$.

4. Plug the value of p_1 into the system made by (25) to (29) where you now switch the values of θ_1 and θ_2.

5. Solve the resulting system for new values of $y_1, y_2,\ y^*, p_2$ and for ε_U (which is now treated as an endogenous). Set $p_{2L} = p_2$.

6. The probability density of ε_U gives $\Pr(p_1 \left| \theta_1 = \theta^L \right.)$.

7. Using (30), calculate s_L.

8. Using (31), calculate $E^U(p_2)$.

9. Verify that the guess was correct, i.e. indeed $E^U(p_2) > p_1$.

Notes

[1]The term "liquidity" is used with different meanings in the literature. The meaning in this paper, i.e. the market liquidity of corporate assets, mirrors that in Shleifer and Vishny (1992) and Gorton and Huang (2004).

[2]Iacoviello (2005) develops a model of propagation based on the interaction between house prices and credit constraints.

[3]The self-reinforcing nature of booms or busts is also at the center of a few models on liquidity in the financial sector. Focussing on the banking sector, Allen and Gale (2004) study an economy where declines in asset prices force some banks in liquidation, which in turn further depresses asset prices, in a self-reinforcing fashion. Focussing on financial markets, Bernardo and Welch (2004) construct a model of a "financial market run" in which risk neutral investors liquidate a risky stock for fear of a future liquidity shock.

[4]Less related to our study, a small literature investigates "boom-and-bust" episodes in open economies by looking at the build-up of a currency mismatch between firms' assets and liabilities. Shneider and Tornell (2003) is the only study that investigates a full boom-and-bust cycle. In their analysis, during a boom the interaction between credit constraints and currency mismatch generates financial fragility, meant as a scenario in which a small negative shock can trigger a severe crisis. Diamond and Rajan (2001) build a model in which domestic banks with high liquidation skills intermediate the short-term funds of foreign investors. The short-term maturity of banks' liabilities commits domestic banks to fund illiquid investments, but also generate a mismatch between the maturity of banks' assets and liabilities. In turn, this mismatch exposes the economy to a financial crisis.

[5]There is a literature that uses the intuition of Grossman and Stiglitz (1980) to explain asset market crises and contagion. For example, Yuan (2005) presents a model in which informed traders are credit rationed. She shows that the informativeness of the asset price decreases when the price falls, generating crises and contagion.

[6]Since a financier is endowed with one unit of final good in each period, she has no incentive to liquidate immediately solely in order to accumulate funds and be able to fund a new project in the second period. The same result would obtain if we allowed financiers to borrow from each other.