A MARKET-RISK APPROACH TO LIQUIDITY RISK ANALYSIS

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INTRODUCTION

A financial crisis usually is due to the emergence of one or more risks to the financial system at a particular point in time. The costs to the economy affected by a crisis are high, which is why financial system stability is of constant concern to economic authorities, including the central banks.[1]

According to Sir Andrew Large (2005), Deputy Governor of the Bank of England, this concern should translate into a profound analysis of those risks, the idea being to monitor their course in the interest of preserving financial stability. Nonetheless, any such analysis depends essentially on what is known about the origins of the risks at hand and, more importantly, the underlying forces that might result in a situation were a risk to a particular institution becomes a problem for the financial system as a whole.

The intention of this article is to help readers understand the mechanics of liquidity risk, particularly the forces that allow it to be "transmitted" to every institution in the financial system, in the event of a crisis.[2] Specifically, we try to show how the liquidity risk to these institutions can become a financial crisis by being "converted" into a market risk. Briefly speaking, the process works as follows. When a financial institution runs into liquidity problems, it tries to liquidate some of its negotiable assets to cover its obligations. If the demand for those

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[1] In the case of Colombia's central bank, a financial crisis could even restrict the application of monetary policy. See Vargas et al. (2006).

[2] Liquidity risk is associated with the possibility that a financial institution might be unable to meet its obligations, as required, given a lack of liquid resources to do so.

assets is not perfectly elastic, their price will drop. And, if the banks list those assets on their balance sheets at market prices (mark to market), the drop in price results in a loss in portfolio value for every institution in system. This is how liquidity risk ends up becoming a market risk.

This idea is explained herein by simulating a microeconomic model that captures a bank's treasury objectives and behavior in the face of uncertainty surrounding its liquidity needs and opportunities for investment. To accomplish this, the article is divided into four sections. The first classifies the major contributions to literature on how liquidity risk operates. As we attempt to demonstrate, literature on this subject tends to ignore the "mechanics" of liquidity risk. The second section provides an outline of the model and the third contains the results of its simulations. The fourth section offers several thoughts in the form of a conclusion.

I. STATE OF THE ART

Recent studies on individual liquidity risk as the source of systemic risk can be classified into three groups.[3] This classification is, however, arbitrary and not necessarily exclusive; its only objective is a straightforward identification of how the ideas contained in this article contribute to the state of the art.

The first group of studies emphasizes the idea that liquidity risk can pose a problem for the financial system as a whole, given the possibility of a run on banks. Diamond and Dybvig (1993) outline this situation using a model that exhibits a possible equilibrium where all depositors "run" to the bank to withdraw their deposits.[4] A particularly valuable feature of their study – which is reflected in this article – is its baseline: namely, the structure of bank liquidity. In other words, the reason for a bank's

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[3] Systemic risk is associated with the possibility that the financial problems of a particular institution subsequently (and by various means) could have an adverse effect on other institutions (see De Bandt and Hartmann, 2000). While our review focuses on the most recent articles (i.e. since circa 1980), it does not imply the phenomena mentioned are new or have not been analyzed before. For example, see Kindleberger (1978) for what is now a classic analysis.

[4] This equilibrium is, however, just one of many that are possible in the model, and the selection of any one in particular is not justified. Gorton (1988) suggests the appearance of a bank-run equilibrium is determined by how agents perceive the aggregate state of the economy. Groton (1988) and Dwyer and Hasan (1994) have analyzed various historic experiences with bank runs.

existence implies the transformation of liquid liabilities (deposits) into non-liquid assets (portfolio). This transformation implies the emergence of liquidity risks in the event that banks face deposit shocks.

Most of the researchers fall within the second group of studies where, in the words of Craig Furfine (1999), liquidity risk can be a source of systemic risk as long as “the failure of one or a small number of institutions is transmitted to others through *explicit ties between them”* (our translation and italics). These ties are associated, primarily, with the existence of credit exposure on the interbank market. When a bank fails because of a liquidity problem, it inevitably declares its inability to pay its liabilities on the interbank market. This leaves other banks in a difficult financial situation and eventually in bankruptcy (with the subsequent inability to pay their liabilities).

Various studies associated with this group analyze the problem from different angles. They include Allen and Gale (2000), Rochet and Tirole (1996), Freixas, Parigi and Rochet (2000), Castiglionesi (2004), Iori and Jafarey (2000), Iori, Jafarey and Padilla (2003) and Estrada (2001). The last two works share a feature taken up in this article: computer simulation of a macroeconomic model that captures a bank’s treasury behavior. According to the authors, because of the controlled environment and the limitations in existing information,[5] this is a good way to address the problem.

The third group of studies is the least developed. Its most representative authors are Schnabel and Shin (2004); Cifuentes, Ferrucci and Shin (2005) and Plantin, Sapra and Shin (2005). According to their conclusions, when an institution encounters liquidity problems, it generally will try solve them by selling off a portion of its liquid assets, thereby disrupting the market for negotiable assets in which other institutions participate. This is how liquidity risk becomes a market risk. Nonetheless, the works of these authors impose a series of restrictions if the mechanism to become a reality. For example, the presence of an interbank market or procyclical capital controls is required. Moreover, they do not explicitly model the existence of liquidity risk.[6]

The fundamental idea behind the present articles originates with this last group, as our objective is to show that a bank with liquidity problems can be a source of market risk for the rest of the financial system. Therefore, we will attempt

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5 There are several empirical studies on the appearance of contagion in interbank markets. See Furfine (1999). An interesting application of the network theory to this problem is developed by Boss et al. (2005).

6 In these articles, the source of initial disruption is always exogenous.

to explicitly include liquidity risk, using the ideas of the first group – through a simulation model similar to those of the second group – and to overcome the restrictions imposed by the third group. We also attempt to show that the mechanism for conversion (from liquidity risk to market risk) is present, even without the existence of a bank run, interbank market or procyclical control, as argued by each of the three groups, in that order.

II. THE MODEL

A. The Assertion

The theoretical exercise presented in this section is based on prior works by Iori, Jafarey and Padilla (2003) and Estrada (2001), which consist of a model that captures the daily problem faced by the treasurer (or liquidity manager) of a financial institution in an environment of uncertainty surrounding the depositors' liquidity needs and the institution's investment possibilities.

The treasurer described by the model can be regarded as a representative agent of the financial system. The fundamental assumption, therefore, is that his behavior is representative of that of all treasurers of all banks in the system, and his sole objective is to meet the bank's obligation to depositors who need liquidity. Moreover, the treasurer has no financial tools at hand to cover all liquidity contingencies.[7] The following structure represents the financial institution's equilibrium, on the basis of which the representative treasurer makes his decisions.

Loan Portfolio *Investments in negotiable assets* *Cash*	*Deposits*

The bank's assets are comprised of the loan portfolio, investments in a sole negotiable asset, to be bought or sold on the market and listed on the balance sheet at market prices,[8] and cash. The bank's liabilities are the deposits of its customers.

Given the random behavior of deposits, the bank might not have enough cash to satisfy the demands of its depositors. As mentioned earlier, in this model, the

[7] In this sense, the model is characterized by the presence of incomplete markets.

[8] In other words, mark-to-market practices are used in the valuation of this asset. The other items on the balance sheet are not traded on the market.

treasurer has no interbank market to turn to. So, he tries to sell the bank's investments in the negotiable asset, and the buyers of such investments will be other treasurers whose liquidity position may not be problematic. The supply and demand for investments on the market are what determine the new market price at which the investments of all banks are valued. If the price falls, so does the value of the investment portfolio of all banks, leaving them in a less comfortable position to deal with future liquidity shocks.

B. How the Model Operates: What happens during period t?

Figure 1 represents the temporary structure of the model, focused particularly on what happens within a representative period of time; that is, period *t*. At the start of period *t*, the financial system is comprised of N_t banks, labeled with the exponent *k*, where $k \in \{1, 2, \ldots, N_t\}$. When the period begins, bank treasurer *k* inherits an amount of cash from the previous period, M^k_{t-1}. Said amount comes from subtracting the transactions in which the bank has been involved from net reserve deposits (expression (1) in Figure 1). Once in possession of this amount, the treasurer must deal with four types of flows simultaneously:

1. *Portfolio earnings*: income from capital and interest on the portfolio placed two periods earlier; the interest rate (r_l) is exogenous and constant (expression (2)).

2. *Income from interest on investments*: received in proportion to the stock of investments. The interest rate (r_a) is constant and exogenous (expression (3)).

3. *Outlays for interest on deposits*: paid every period. Here, the depositors never "run" on the bank to withdraw the capital from their deposits (this model does not include bank runs), except in the case mentioned in the following point. The rate of interest paid to depositors (r_{dt}) is given in expression (4) as a function of the number of banks in the system (Salop, 1979). A liquidity gap inevitably occurs as a result of the difference between the frequency of portfolio earnings and outlays on deposits.[9]

4. *Movements of depositors between banks:* although depositors never conduct a "run" on the banking system, they might move their deposits from one bank to another due, for example, to geographic migration. The equation (5) takes into account the behavior of the deposits with each bank. According to that expression, the accrued deposits of the financial system (given exogenously) are distributed at random among all the banks in the financial system.

[9] In the International Monetary Fund's Financial System Assessment Program (FSAP), this liquidity gap is a crucial tool when analyzing risk to the financial system.

Figure 1

The Representative Treasurer Model

Inherited from the previous period:

$$M_{t-1}^{k} = D_{t-1}^{k}(1-\beta) - L_{t-1}^{k} - p_{t-1}A_{t-1}^{k} \quad (1)$$

At the start of the period, the treasurer confronts four types of flows:
i)Portfolio earnings
ii) Movement of depositors
iii) Outlays for interest
iv) Income from interest on investments

$$(1+\rho_l)^2 L_{t-2}^{k} \quad (2)$$

$$(\rho_a)A_{t-1}^{k} \quad (3)$$

$$r_{dt}D_{t-1}^{k} \rightarrow \quad r_{dt} = \rho_l - \frac{\alpha}{N_t} \quad (4)$$

$$D_t^{k} = \pi D_{t-1}^{k} + (1-\pi)\left[(1-\sigma_d)\frac{D_t}{N_t} + \sigma_d \varepsilon_t^{k} D_t\right] \quad (5)$$

$$\hat{M}_t^{k}$$

After calculating the liquidity needs created by these flows, the treasurer estimates his "intraperiod liquidity position" (6).

$$\hat{M}_t^{k} + \beta D_t^{k} = D_t^{k} - (p_{t-1}A_{t-1}^{k}) - L_{t-1}^{k} - r_{dt}D_{t-1}^{k} + (1+\rho_l)^2 L_{t-2}^{k} + \rho_a A_{t-1}^{k} \quad (6)$$

$$\hat{M}_t^{k} + \beta D_t^{k} > 0 \quad (7)$$

$$\hat{M}_t^{k} + \beta D_t^{k} < 0 \quad (8)$$

According to the "intraperiod liquidity position", the treasurer determines his supply (if liquidity is needed) or demand (after having made a portfolio placement in the event of excess liquidity) with respect to the negotiable asset.

$$o_t^{k} = (1-\sigma_o)\frac{\Omega}{N_t} + \upsilon_t^{k}\sigma_o\Omega \quad (9)$$

$$w_t^{k} = \min\left\{\max\left[0, \hat{M}_t^{k}\right], o_t^{k}\right\} \quad (10)$$

$$b_t^{k} = \frac{\hat{M}_t^{k} - w_t^{k}}{p_{t-1}} \quad (11)$$

$$s_t^{k} = -\min\left\{0, \frac{\hat{M}_t^{k} + \beta D_t^{k}}{p_{t-1}}\right\} \quad (12)$$

The demand and supply converge in the market for the negotiable asset.

$$x_{ij} = \min\left[s_t^{i}, b_t^{j}\right] \forall i,j \in \left[1,2,\ldots,N_t\right] \quad (13)$$

$$\sum_{j=1}^{N_t} x_{ij} \le s_t^{i} \forall i,j \in \left[1,2,\ldots,N_t\right] \quad (14)$$

$$x_{ij} \le \sum_{j=1}^{N_t} b_t^{j} \forall i,j \in \left[1,2,\ldots,N_t\right] \quad (15)$$

$$p_t = p_{t-1}\exp\left[-\lambda\left(\sum_{j=1}^{N_t} s_t^{j} - \sum_{j=1}^{N_t} b_t^{j}\right)\right] \le 1 \quad (16)$$

Banks that have failed are liquidated

$$D_t = D_{t-1} + \sum_{j=1}^{B_t}\left\{\hat{M}_t^{j} + \gamma\left[L_{t-1}^{j} + p_{t-1}A_{t-1}^{j}\right] - D_{t-1}^{j}\right\} \quad (17)$$

The accounts on the balance sheet are restated or updated.

$$M_t^{k} = D_t^{k}(1-\beta) - L_t^{k} - p_t A_t^{k} \quad (18)$$

Donde:
t: index for the period
k, i, j: bank ratios
M: cash
D^k: : deposits of bank *k*
b: reserve
L: loan portfolio
p: market price of the negotiable asset
A: stock of investments in the negotiable asset
r_l: lending rate
r_a: yield on the negotiable assete
r_{dt}: deposit rate
a : cost associated with movement by depositors
D: aggregate deposits
p : self-regressive component of deposits
s_d: random component of aggregate deposits (to be distributed among the *N* banks)
e_t^k: the portion of random deposits remaining to bank *k*
$\hat{M}$: the cash position during the period
o_t^k: portfolio of loans bank *k* is able to extend
W: aggregate demand for credit
s_o: random component of aggregate portfolio demand (to be distributed among the *N* banks)
u_t^k: the portion of random portfolio demand that remains in bank *k*
w_t^k: amount of the portfolio effectively extended by bank *k*
s_t^k: supply of negotiable assets
b_t^k: demand for negotiable assets
x_{ij}: transaction carried out between bank *i* (supplier) and bank *j* (demander)
l : parameter that incorporates the elasticity of the demand
B: banks that fail
g: percentage of assets recovered for depositors in the liquidation process.

Based on the foregoing (with a bit of algebra[10]), the treasurer calculates his cash position ($\hat{M}_t^k$) and, more often, his "intraperiod liquidity position (IPLP)". This indicates the amount of liquidity he has on hand to pay depositors (expression (6). It is comprised of the sum of cash ($\hat{M}_t^k$) and available reserves(bD_t^k). The combination of the four flows can leave the treasurer in one of two situations:

[10] The algebra in this section is not presented, but will be provided by the authors upon request.

- Positive IPLP: the treasurer has enough liquidity to pay depositors, and the surplus is equivalent to the IPLP (7).

- Negative IPLP: the treasurer does not have enough liquidity to pay depositors, in an amount equivalent to the IPLP (8).

Once all the bank treasurers have undergone the same experience, the banking system is left divided between banks with a liquidity surplus and those with a shortage. The banks with a liquidity shortage turn to the market for the negotiable asset to liquidate a portion of their investment stock and to secure the liquidity they lack. The amount of the negotiable asset that needs to be sold on the market is given by expression (12). It equals the IPLP divided by the price of the negotiable asset before the market opens (p_{t-1}).[11]

The banks with a positive IPLP do not use all their surplus liquidity to purchase investments in the negotiable asset. First, they invest a portion in loan portfolio placement.[12] However, the portfolio that can be placed also has a stochastic pattern given by expression (9), where the aggregate demand for credit in the economy (*W*) is exogenous and constant. The amount of the portfolio the treasurer is effectively able to place (w_t^k in expression 10) is restricted by the size of the liquidity surplus (net resources in reserve).

If, after portfolio placement, the treasurer still has surplus liquidity, he will use it to purchase negotiable assets on the market. His bank's demand for negotiable assets is determined by expression (11). If *W* is especially large, the demand for the negotiable asset is reduced, thereby reducing the size of the market. This point will be considered in the following section.

The supply of negotiable assets (from banks with liquidity needs) and the demand for them (on the part of banks with surplus liquidity) come together in the market, where purchase and sale transactions x_{ij} are conducted. Their viability is determined by conditions (13-15). Condition (14), in particular, indicates the market does not necessarily empty out, inasmuch as some supplier banks may not be able to liquidate as many negotiable assets as required to meet their liquidity needs. Finally, a new price (expression (16)) is determined on the market. It is the price at which all transactions are conducted and all investments are "revalued".

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11 Necessary sales of the negotiable asset are assessed at the actual market price, because investments are valued on a mark-to-market basis.

12 This is guaranteed by making the exogenous portfolio rate (ρ_l) greater than the exogenous rate on the negotiable assets (r_a).

C. The End of Period t and the Channel of Contagion: Market Risk

When the market closes, the banks that were unable to liquidate the amount of negotiable assets required to satisfy their liquidity needs enter into bankruptcy and are liquidated by the regulator, whose only job is to take over banks in that situation. The regulator liquidates the failed bank's assets at a discount and turns them over to the depositors, who redeposit those resources with other banks in the system. The aggregate deposits in the system evolve according to equation (17), where 1-γ is the liquidation cost.

During the subsequent period (t+1), the treasurer inherits a quantity of cash determined by (18). It is important to note that the stock of investments is valued at the new market price (p_t), even with respect to banks that did not participate in the market for the negotiable asset. This is precisely the channel of contagion emphasized herein (and, hence, the channel through which systemic risk materializes). In other words, the reduction in the price of the negotiable asset that can occur with the appearance of liquidity risk in certain institutions affects other institutions by leaving them less prepared for future liquidity shocks, since the cushion for dealing with those shocks looses value. Therefore, the probability of bankruptcy in future periods becomes greater.

In short, the conversion of liquidity risk to market risk can disseminate among banks, obviously causing bankruptcies and financial crisis. Within the scope of the model, these events are understood as the simultaneous bankruptcy of a large number of institutions. The following section explores this interaction between liquidity risk and market risk through simulations of the model.

III. SIMULATIONS

The principal results of the simulations done with the model described in the previous section are summarized in this section. Three types of simulations were carried out, the difference being the initial structure of the simulated financial system.

All the exercises, however, have the following characteristics in common. To begin with, 150 time periods (iterations) were simulated in each case. Secondly, to exacerbate the liquidity risk, the initial banks (N_0) were divided into two groups: the first group receives interest from income in $t = 0$ (as if it had made portfolio placements in $t = -2$), while the second only receives income from interest up to $t = 1$ (as if it had made a portfolio placement only in $t = -1$). Consequently, in all the simulations, the financial crisis of the first period is deeper than in subsequent periods, due to the artificial creation of this liquidity gap. Finally, each outcome is the product of an average of 1,000 simulations. Hereinafter, the definition of financial stability is understood as the number of "surviving" banks during a particular time period.

A. Homogeneous System

A system comprised of ten banks (N_0 = 10) identical in the structure of their initial balance[13] is used in this section. The effect - all else being constant - of W (aggregate demand for credit) and s_d (volatility of deposits) on financial stability is shown in Graph 1. According to Panel A, Graph 1, the aggregate demand for credit has a negative impact on financial stability. At that particular point in time, a larger number of banks clearly survive with less a demand for credit.

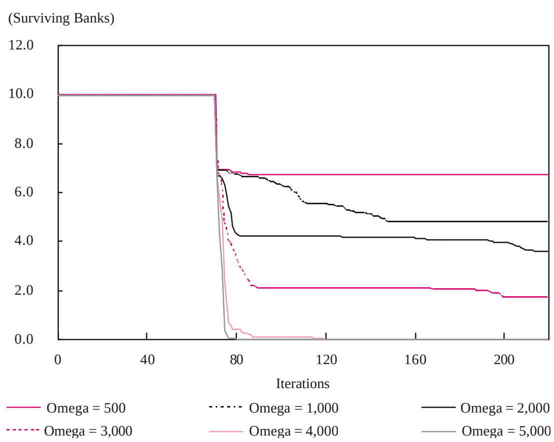
This can be interpreted as the effect the size of the investment market has on financial stability. If the aggregate demand for credit is greater, expression (9) indicates this reduces the demand for investments and, therefore, the size of the investment market. If the size of the investment market is less, the same level of supply has a more pronounced impact on the drop in price. In other words, it exacerbates market risk and, consequently, poses more of a threat to financial stability.

The effect - all else being constant - of more volatility with respect to deposits is not as clear (Panel B, Graph 1). Considering the range of the results of each simulation, it is possible to conclude, statistically, that volatility has no impact on stability.

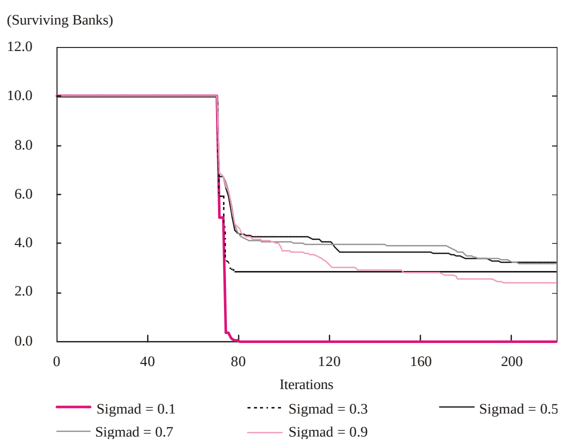
Graph 1

Financial Stability: The Homogeneous Case

Panel A



Panel B



Source: The authors' calculations.

B. Heterogeneous System: Random Case

To incorporate the heterogeneous nature of the financial system, we simulated a financial system comprised of ten banks. In each case, the structure

[13] The following is the set of parameters used in this simulation: $A_0 = D_0 = L_{-1}^a = L_{-2}^b$ = 1,000. a = 0.1. b = 0.2. s_d (when it does not change) = $s_0 = g = p$ = 0.5, r_1 = 0.1. r_a = 0.05. W = 2,000 (when it does not change). l = 0.01,

of their initial balance was selected at random.[14] Both Panel A and Panel B in Graph 2 confirm the results obtained in the homogeneous case, particularly the negative impact more demand for credit has on the system. In this instance, although the magnitude of the first financial crisis is vastly similar in all cases and there is no surviving bank by the end of the iterations. Banks belonging to systems that face less demand for credit clearly survive longer.

C. Heterogeneous System: A Simulation of the Colombian Banking System

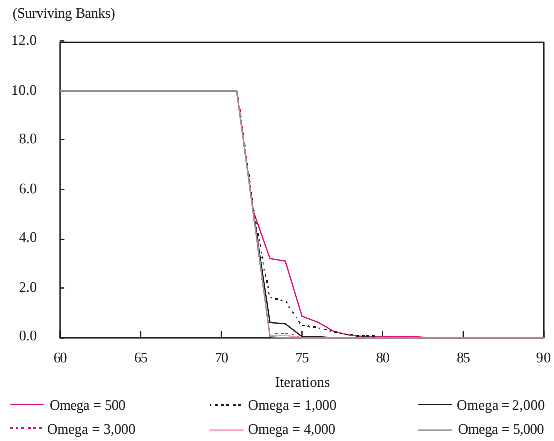
One alternative to the random heterogeneity of banks is to use, as the initial balance structure, the structure of balance of banks that were part of the Colombian financial system in November 2005. That month, the system was comprised of 16 banks. To reflect the structure of the balance in the Colombian financial system, the system's total assets were standardized at 1,000. The initial deposits, portfolio and investments for each of the 16 banks were calculated on the basis of this standardization.

A significant feature of the simulation should be mentioned at this point. As noted earlier, the initial banks were divided into two groups. In this case, it is impossible to determine which banks pertain to each group. The results, therefore, have to be presented according to two extreme distributions, with the largest banks in the system situated in the first group; the second in size in the second group.[15]

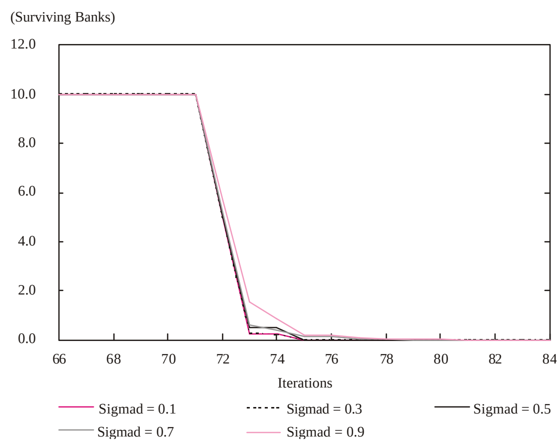
Graph 2

Financial Stability: The Random Heterogeneous Case

Panel A



Panel B



Source: The authors' calculations.

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[14] In other words, A_0. D_0 and L_{-1} or L_{-2} are the same for a *particular* bank but are different among banks, in which case the selection within the interval [0.1000] is random. This makes it possible to incorporate the existence of "big" and "small" banks within the simulated system. The set of parameters used was:

a = 0.1, b = 0.2. s_d (when it does not change) = s_o = g = p = 0.5. r_l = 0.1. r_a = 0.05. W = 2,000 (when it does not change). l = 0.01,

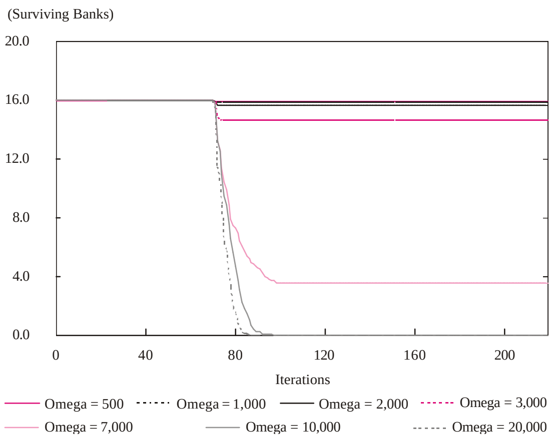
[15] The following set of parameters was used in this simulation:

a = 0.1, b = 0.06 (real data), s_d (estimated in this case, so it does not change) = 0.9, $s_{d'}$ = g = 0.5, p = 1 (estimated), r_l = 0.152 (calculated), r_a = 0.00132 (estimated), l = 0.01.

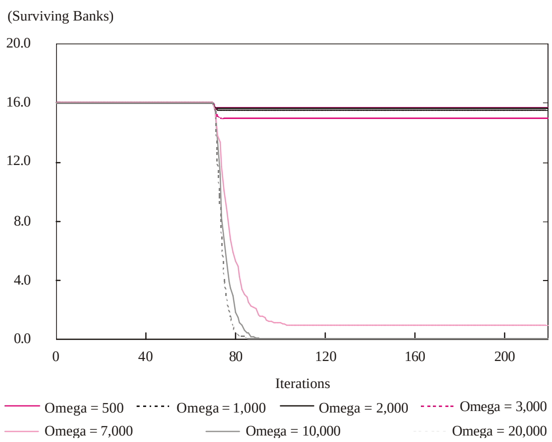
Graph 3

Financial Stability: The Colombian Case

Panel A



Panel B



Source: The authors' calculations.

All else being constant, the impact of W on financial stability with each of the two distributions is shown in Graph 3. As to demand for credit, the principal outcome is the same. Only with an extreme demand for credit do none of the 16 banks survive the 150 iterations. If W is small enough, less than one bank, on average, fails by the end of the 150 iterations.

IV. CONCLUSIONS

The purpose of this article is to demonstrate that liquidity risk to financial intermediaries can become a systemic risk and eventually a financial crisis, when banks with liquidity problems disrupt the normal operation of the markets where they do business. In this sense, liquidity risk becomes a market risk for all institutions in the banking system.

Through simulation of a microeconomic model, we not only show this mechanism works, but that it is crucially dependent on the "depth" of such markets. The mechanism also is shown to be present, even in the absence of credit exposures in the interbank market, procyclical controls or bank runs.

The practical usefulness of this exercise can be questioned, inasmuch as the results originate with a very limited theoretical specification.[16] However, it has several realistic lessons to offer, despite the controlled environment. To begin with, in addition to the mere fact of risk "conversion", there is the recent concern expressed by economic authorities in Colombia over the threat market risk poses to stability of the country's financial system.[17]

[16] For example, the mechanism makes no sense if the Central Bank is willing to inject into the system the amount of liquidity required at a given moment, in the event of problems. Nevertheless, it is possible to argue that, because central banks are concerned about controlling inflation, intervention of this sort has its limits. The mechanism outlined in this article can occur once that limit is reached.

Also emphasized in this article is the importance of monitoring certain variables. In a particular environment, these can contribute to financial instability. The depth of the market in which banks interact is a case in point.

As to the source of liquidity risk, the results described herein support the idea that market liquidity is not an exogenous element. In developing countries, such as Colombia, market liquidity is crucially dependent, for example, on the behavior of foreign markets. Turbulence on those markets can be mirrored quickly in liquidity shortages in the domestic financial system, which can have a negative impact on the value of assets and financial stability through interaction endogenous to the way banks behave.

On the other hand, it is possible to regard the mechanisms mentioned in this article as a logical outcome of the growing complexity of financial markets. Banks now have various investment alternatives at their disposal, which can be transacted easily on the financial markets. Nevertheless, the study by Schnabel and Shin (2004) reminds us that a complex financial system is not essential for "conversion" to occur. That argument favors the simplicity of the model used for this article.

The model also teaches us a very subtle lesson that is important to bear in mind. According to Plantin, Sapra and Shin (2005), investment assessment practices such as the mark-to-market method (despite its transparency) can pose a threat to financial stability due to their tendency to accentuate the financial cycles. In the context of this exercise, that tendency is evident.

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[17] In this respect, see recent editions of the *Financial Stability Report* published by Banco de la República. Investments in negotiable assets account for nearly one third of the holdings in Colombia's banking system, and a good portion are valued at market prices.

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