Equity Market and Foreign Capital

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June 26, 2004

Abstract.

I present a model highlighting that a market mechanism is not always effective in stabilizing an open equity market. The existence of foreign capital causes heterogeneous arbitrage conditions in the equity market, which may simultaneously trigger a currency crisis and financial turmoil even if the equity market is well developed. This paper also suggests that exit levies on early capital outflows eliminate such problems. JEL Classification: E58, F31, F32, G15

Key Words: equity market, foreign capital, financial turmoil, heterogeneous arbitrage conditions, capital controls.

1. Introduction

It is often claimed that there is a strong linkage between financial turmoil and currency crises.[1] One observation is that currency crises occur partly due to unexpected capital movements, and that they interact with financial turmoil around

1 See Kaminsky and Reinhart (1999).

the same time. Despite a large body of empirical evidence suggesting this linkage, only a small amount of theoretical work is available.

In this paper, I present a formal analysis of the issue. The highly motivated objective of this paper is to show that a market mechanism is not always effective in stabilizing an open equity market. A widely accepted hypothesis states that a market mechanism eliminates the possibility of speculative attacks, despite speculative behaviors often being observed in equity markets. I prove that the equity market mechanism does not always eliminate the possibility of financial turmoil in an emerging market, and seek effective policies to eliminate the possibility of sudden capital outflows.

I study these issues in a discrete and finite time model. The benchmark model is provided by Diamond and Dybvig (1983). They have argued that social welfare can be enhanced through the creation of a banking system by providing a proper deposit contract. However, this banking system simultaneously produces the possibility of self-fulfilling bank runs. The Diamond-Dybvig model is a seminal contribution to the understanding of why financial panics occur even when economic fundamentals are sound.

This framework can be applied to analyze the relationship between exchange rate regime and financial fragility, as Chang and Velasco (2000) has shown. Their model is successful in clarifying the relationship between exchange rate regimes and currency and/or banking crises. Further, Chang and Velasco (2001) has provided a framework in which a banking crisis may interact with foreign creditor panics.

However, these results heavily depend on the assumption of an incomplete domestic financial market. In order to focus on the investigation of the hypothesis whether the market mechanism stabilizes a financial market in an emerging country, it is necessary to embed a well-developed financial market into Chang-Velasco's framework.

Jacklin (1987) has made an interesting attempt to introduce an equity market mechanism into the Diamond-Dybvig model. This attempt allows us to examine the hypothesis and shows that an equity market arrangement can achieve the same allocations as in Diamond-Dybvig's banking system without producing the possibility of a run. This suggests that an equity market has a self-stabilizing mechanism, as indicated by the hypothesis. I examine the performance of an equity market in the manner proposed by Jacklin (1987) and show how the self-stabilizing mechanism of an equity market performs during speculative attacks.

Two distinct analytical differences arise from my extension of Jacklin's model. First, I introduce the equity market mechanism into the issue of twin crises, instead of the banking deposit contract already provided by Chang and Velasco (2000, 2001). This allows me to relax the implicit assumption of the Diamond-Dybvig theory, the limited access of agents to financial markets, and to provide a further analysis of financial turmoil in the complete domestic market. Second, in contrast to Jacklin's model, I prove that the equity market mechanism is not always effective in stabilizing the economy. The self-stabilizing mechanism in the equity market is insufficient in eliminating speculative attacks under the fixed exchange rate regime,

and consequently, a currency crisis itself will trigger a financial panic in the economy. I show that a mere suspicion of a currency crisis is sufficient to produce a currency crisis and a speculative attack in the equity market.

Financial panics may also occur when information is asymmetric or noisy, as Gorton (1985) and Chen (1999) have stated. However, the purpose of my paper is to focus on the impact of foreign capital. In order to concentrate on the theoretical investigation of the capital movement mechanism, I leave the issues regarding the information asymmetry to future researches.

This paper is organized as follows. The basic model is presented in Section 2. Section 3 studies the problem of the premature withdrawal of invested money, which leads to a currency crisis. Section 4 examines one of the policies that can eliminate such a problem. Section 5 discusses several implications of my analysis and concludes with suggestions for future researches.

2. The Economic Environment

I consider a three-period economy, indexed by T = 0,1,2. There are two countries, home and foreign, and two kinds of consumption goods, a home consumption good, and a foreign consumption good. The home consumption good is used only in the home country and its price is fixed at one unit of the home currency, “peso.” In contrast, the foreign consumption good can be consumed and traded both in the home country and the foreign country, and its price is normalized at one unit of the foreign

currency "dollar."[2] Hence, pesos and dollars can be interchangeably referred to as units of currencies or consumption.

The home country has the following production technology. An investment of pesos produces an output of pesos, and dollar production requires an investment of dollars initially. It is assumed that the production technology of pesos is identical to that of dollars. All investments in the production occur at T = 0. The production process is infinitely divisible. Any portion of the production can be interrupted at T = 1, immediately yielding a total return equal to the initial investment, but then no additional return occurs in period 2. On the other hand, when the production process is not interrupted at T = 1, it yields a total return per unit of investment of R at T = 2. R is a constant and $R > 1$, which is known to all at T = 0.

The economy under analysis is populated by $n + N$ agents, where n is the number of home agents and N is that of foreign agents. Each home agent is endowed with one unit of peso and each foreign agent with one unit of dollar. As described above, home agents derive utility from pesos and dollars, and foreign agents derive utility from dollar consumption.

In the initial period, neither home nor foreign agents know the optimal time to consume, and at the beginning of T = 1, both agents discover their type. With probability λ ($0 < \lambda < 1$), the agents are impatient (type 1) and needs to consume at T = 1. With probability $(1 - \lambda)$, the agents discover their type as patient and are

2 In this model, a home consumption good can be interpreted as a non-tradable good and the foreign consumption good as a tradable good.

indifferent to consume either at T = 1 or at T = 2 (type 2). Let x_i^J (J = H, F; H represents home and F represents foreign) indicate the consumption of an agent i in J country at period 1. Let y_i^J denote the quantity of period 2 consumption of an agent i in J country. Subsequently, the expected utility of the representative agent in J country can be written as

$$\lambda u(x_1^J) + (1-\lambda)u(x_2^J + y_2^J). \tag{1}$$

Here, the function $u(\cdot)$ is smooth, strictly increasing, strictly concave, and satisfies Inada conditions.

Since there is individual and not aggregate uncertainty, it is clear that both home and foreign agents will find it advantageous to form a coalition rather than to act in isolation. I will call this coalition the "company." The objective of the company is to pool the investment at T = 0 and liquidate it according to the necessity of agents in order to maximize the social welfare, subject to the constraint that makes the aggregate consumption feasible. From the assumption of the production technology, the resource constraint in this model yields the same constraint as for Diamond-Dybvig's deposit contract. The following is the resource constraint for J = H, F:

$$\lambda\left(x_1^J + y_2^J/R\right) + (1-\lambda)\left(x_2^J + y_2^J/R\right) = 1. \tag{2}$$

When foreign agents act collectively with home agents, it is required to set the relative price of peso for dollar in order to avoid trouble over allocation. Denote the relative price of peso in terms of dollar at period T by e_T, which can be interpreted as the exchange rate in this model. I assume the existence of the central bank in the

home country, which has the responsibility to convert pesos and dollars upon request. Note that the central bank must respect a sequential service constraint. This constraint requires that the central bank meet the requests of agents on a first-come first-served basis. At the beginning of this economy, the exchange rate is given equal to 1.

Hence, the social optimal solution is to maximize (1) subject to the resource constraint (2) under $e_T = 1$. Then, the optimal allocation satisfies the following:

$$x_2^J * = y_2^J * = 0\,,\ u'(x_1^J *) = Ru'(y_2^J *)\,, \text{ and } \lambda x_1^J * + (1-\lambda)\, y_2^J * / R = 1\,, \tag{3}$$

for J = H, F, where the asterisk indicates optimality. Since $u'(x_1^J *) = Ru'(y_2^J *)$ and R > 1, it is easy to see that $x_1^J * < y_2^J *$.

I now define the relationship between the company and each home/foreign agent. The company issues one unit of share per unit of investment of either peso or dollar at T = 0. The company-shareholders relationship returns a two-period dividend stream d at T = 1 and $(1-d)R$ at T = 2 to the shareholders of the record at the initial date and the final period, respectively[3]. Implicit in the definition is the existence of a market in the ex-dividend shares at T = 1, and p represents the price of the ex-dividend shares at T = 1.

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3 The assumption on dividend payments might be special in the sense that the company distributes dividends at T = 1 although there is no additional profit from the initial investment. This assumption can be relaxed at little cost, that the liquidation value of the company is more than the initial investment. However, this aspect of the question is not essential in this paper and the result is not dependent on this assumption.

There is an additional assumption in this model. All payments from the company to its shareholders are offered in the form of bank notes that can be liquidated at the central bank into one peso or one dollar, depending on agents' requests, per unit of bank note. This indicates that the central bank can create bank notes based on the amounts of pesos plus dollars in the home country. Therefore, the central bank stands ready to refund bank notes in either pesos or dollars at the fixed rate at any time. The motivation for this lies in the situation that the central bank has a responsibility to guarantee the convertibility of the bank notes into commodity money, such as pesos, and to exchange pesos into dollars. It is natural to impose this assumption in the analysis of an emerging country, taking into consideration its country risk. Thus, the home/foreign agents must visit the central bank to exchange the bank notes into pesos/dollars.

Accordingly, the sequence of events is as follows. At the initial date, each home/foreign agent purchases the company's share at the price of one peso. At the beginning of period 1, shareholders receive the first dividend d from the company. After receiving the dividend, home/foreign agents participate in the share market to trade their shares. If they acquire the bank notes, they must exchange them for pesos or dollars at the central bank in period 1, according to their consumption preference. If this is not followed, they must delay their consumption activity until T = 2 if they decide to possess shares.

The central bank refunds the bank notes to the home/foreign agents sequentially, at the exchange rate of one unit of peso per bank note or one unit of dollar per bank

note, respectively, upon the agents' requests. From the assumption, it is natural to consider that the central bank will stop the repayment of dollars (or pesos) if their stock is exhausted.

Finally, the company liquidates all its remaining investments and distributes bank notes to the shareholders at T = 2. No additional repayment from the company is expected; hence, shares are not traded in this period. The shareholders at T = 2 then exchange the bank notes for pesos or dollars, which they subsequently consume.

Given this regime, the question is that if and how the optimal allocation described in (3) will be implemented in this economy. In an equity economy with dividend d and the price p for ex-dividend share, now the following can be proven.

Proposition 1. This economy can achieve optimal allocation if d is set equal to λx_1^J *.

Proof. Suppose that each home/foreign agent anticipates that the pesos/dollars solvency of the central bank is robust. Conjecture that $p = (1-\lambda)d/\lambda$ is an equilibrium relationship between p and d. Since impatient agents have an infinite marginal rate of substitution between consumption in the first and second period, it is clear that the marginal rates of substitution will not be equalized in equilibrium. Rather, equilibrium is driven by market clearing. Impatient agents offer all their ex-dividend shares at any $p > 0$, which promises a return $(1\text{-}d)R$. Since patient agents are indifferent between consumption at T = 1 and T = 2, patient home agents will buy ex-dividend shares for any $p < (1-d)R$ and patient foreign agents will buy shares

for any $p < (e_1/e_2)(1-d)R$. The arbitrage condition of patient foreign agents should be identical to that of patient home agents for the central bank to be responsible for currency convertibility at the fixed rate e_T=1.

Suppose that the fraction λ^+ $(\lambda \le \lambda^+ \le 1)$ of agents want to sell their shares in order to consume at T = 1. Market clearing requires that

$$\lambda^+(n+N)(d+p) = d(n+N),$$

where the left hand side reflects the aggregate amount of consumption at T = 1, and the right hand side indicates the aggregate liquidation of the production technology at period 1, which gives $p = \dfrac{(1-\lambda^+)d}{\lambda^+}$. Since the fraction λ^+ satisfies $\lambda \le \lambda^+ \le 1$, and the optimality requires $x_1^J * < y_2^J *$, the following inequality maintains for any realization of λ^+:

$$p = \frac{(1-\lambda^+)d}{\lambda^+} \le \frac{(1-\lambda)d}{\lambda} = (1-\lambda)x_1^J * < (1-\lambda)y_2^J *.$$

From the resource constraint,

$$y_2^J * = \frac{(1-\lambda x_1^J *)R}{1-\lambda} = \frac{(1-d)R}{1-\lambda}.$$

Together these imply that $p < (1-d)R$, which indicates that each foreign and home agent who is patient has no incentive to sell shares at T = 1. This induces the patient agents to prolong their consumption, that is, $\lambda^+ = \lambda$. In this case, the consumption schedule for each agent can be written as

$$x_1^H = x_1^F = d + p* = \lambda x_1^J * + (1-\lambda)x_1^J * = x_1^J *,$$

$$y_2^H = y_2^F = \left(1 + \frac{d}{p*}\right)(1-d)R = \frac{(1-d)R}{1-\lambda} = y_2^J *,$$

$$x_2^H = y_1^F = x_2^H = y_1^F = 0,$$

and the equilibrium price p^* is $p^* = (1-\lambda)d/\lambda$. In this case, the central bank runs out of neither pesos nor dollars before completing the refund. Therefore, this economy achieves the optimal allocations. Q.E.D.

The proposition states that the equity-dividend economy can achieve optimal allocations. As Jacklin (1987) had suggested, an equity market system eliminates the possibility of a financial panic in a model of a closed economy, but still achieves the same allocation as Diamond-Dybvig's banking system. This implies that an equity market has a self-stabilizing mechanism. This is consistent with the widely accepted hypothesis that the market mechanism eliminates the possibility of speculative attacks. However, an emerging economy with foreign capital inflows has to be concerned about international liquidity and domestic liquidity. Next, I discuss how this allocation can be implemented, taking into account international liquidity.

3. Foreign capital movement and the exchange rate regime

In the last section, I showed that the economy can achieve allocation that is immune to a run when the solvency of the central bank is expected to be robust. The next question is how this allocation can be implemented in an international liquidity provision. From the facts that the fixed exchange rate regime is vulnerable to speculative attacks, it is natural to analyze the possibility of the central bank exhausting pesos/dollars and stopping convertibility before all the requests for refunds are over.

In the initial period, there are N units of dollars at T = 0. For the amount of dollars to evolve as in the company's production process, a total return should be equal to the initial investment of dollars at T = 1 and R times at T = 2 in the absence of liquidation.

In addition, as described in Section 2, the central bank must respect the sequential service constraint. The exchange rate of a bank note into dollars (hereafter the exchange rate) is assumed to sustain the fixed rate $e_T = 1$ until the central bank exhausts its stock of dollars. After the central bank's failure, the exchange rate is expected to decline infinitely.

I define a "financial turmoil" as a situation where some (or all) patient agents deviate from the optimality and quit delaying their consumption at T = 1. Consider the case where all patient foreign agents demand early withdrawal and the central bank fatally runs out of its dollars. The central bank will stop convertibility if the demand of dollars exceeds its reserves. This occurs when the present value of shares possessed by foreign agents overtakes the liquidation value of dollars N. The following inequality represents the above situation:

$$N(d + \tilde{p}) > N , \tag{4}$$

where the market clearing price of the share is determined as

$$(\lambda n + N)(d + \tilde{p}) = d(n + N) . \tag{5}$$

At T = 1, only the central bank serves dollars sequentially. If all the foreign agents demand early withdrawal, the exchange rate at T = 1 is given by

$$e_1 = \begin{cases} 1 & if \quad N_j < N\left(d + \tilde{p}\right)^{-1} \\ \infty & if \quad N_j \geq N\left(d + \tilde{p}\right)^{-1} \end{cases} \tag{6}$$

and

$$e_2 = \begin{cases} 1 & if \;\; N\left(d + \tilde{p}\right) \leq N \\ \infty & if \;\; N\left(d + \tilde{p}\right) > N, \end{cases} \tag{7}$$

where N_j is the number of foreign agents serviced before agent j.

Since the exchange rate after the central bank's failure becomes $e_1 = \infty$, e_2 is also infinitely large. In such a case, a sudden capital outflow emerges in equilibrium.

Proposition 2. If (4) holds, there exists an equilibrium in which all foreign agents sell their shares and repatriate their capital to the foreign country. In addition, the sudden capital outflow produces the crash in the share price.

Proof. Suppose that all foreign agents sell their shares and demand dollars at T = 1. Clearly, price $\tilde{p}$ is smaller than p^*. Therefore, no home agents have an incentive to change their share-holding strategy, which was described in Section 2.

From the fact that $d + \tilde{p} = \dfrac{(n+N)d}{\lambda n + N} = \dfrac{x_1^J * \lambda(n+N)}{\lambda n + N}$, inequality (4) holds in some cases. In such cases, the central bank fails to supply dollars during period 1. This can be interpreted as an exchange rate alteration. When the central bank stops bank note-dollar convertibility, holding shares from period 1 to period 2 is worthless for foreign agents, while selling shares at T = 1 and attempting to obtain dollars early are optimal for any foreign agents, regardless of their type. Hence, a sudden capital outflow and a consequent recession of the share market occur at the same

time.

In this case, the consumption schedules are marked with tildes and determined as,

$$\tilde{x}_1^H = d + \tilde{p}\,,\ \ \tilde{y}_2^H = \left(1+\frac{d}{\tilde{p}}\right)(1-d)R\,,\ \ \tilde{y}_1^F = \tilde{y}_2^F = \tilde{x}_2^H = \tilde{y}_1^H = 0\,,$$

$$\tilde{x}_1^F = \tilde{x}_2^F = \begin{cases} d+\tilde{p} & if \quad N_j < F(d+p)^{-1} \\ 0 & if \quad N_j \geq F(d+p)^{-1}. \end{cases} \tag{8}$$

The proof is complete. ■

This proposition implies that although the share price declines during the phase of a sudden capital outflow, all foreign agents prefer to retrieve their capital during the early stage. This is because the impact of an exchange rate alteration overtakes that of the share price depreciation. The expectation of a sudden capital outflow causes a crash in the share market as well as an actual currency crisis, and the optimal allocation described in Section 2 cannot be implemented. Clearly, the amount of capital outflow at T = 1 increases compared with the optimal case, that is,

$$\lambda N(d+p^*) = Nd < \frac{Nd(n+N)}{\lambda n + N} = N(d+\tilde{p})\,. \tag{9}$$

The problem is that once foreign agents suspect currency convertibility, anything that causes them to anticipate a sudden capital outflow will trigger a sudden capital outflow. Even worse, a currency crisis and even a depression in the share market hit the economy of the home country simultaneously in the aspect of excess dollar demand at T = 1.

Notably, even if the total return of the company is not reflected by the behavior

of the foreign agents, a sudden capital outflow occurs. A foreign capital movement itself has a great influence on international liquidity. In this case, the self-stabilizing mechanism in the equity market is insufficient in eliminating financial turmoil. In other words, even if there is a well-developed financial market and *domestic liquidity* is not binding, a suspicion of exchange rate alteration makes *international liquidity* binding. Consequently, it causes a crash in the share market, a sudden capital outflow, and a currency crisis at the same time.

Therefore, it is legitimate for the government of the home country to seek a policy that can help to eliminate the problem of a sudden capital outflow. Next, I analyze the policy that can prevent this problem.

4. Capital controls on early withdrawal

In the preceding section, I showed that currency crises and depressions in the share market might occur in the home country. This section analyzes a policy that can eliminate the risk of sudden capital outflows. This policy is known as capital control.

Suppose that the government of the home country imposes an outright capital control on early capital outflows. Although there are several types of capital outflow controls, I concentrate on analyzing exit levies on the repatriation of capital.[4]

The government of the home country introduces a capital outflow control in the form of a non-interest-bearing compulsory reserve requirement for early capital

4 The forms and types of capital controls that have generally been taken are shown in Ariyoshi et al. (2000).

outflows. This indicates that all foreign agents who require dollars at T = 1 must deposit at least the requirement rate t $(0 \leq t \leq 1)$ of their capital in the unremunerated reserve until T = 2. The requirement rate is known to all at T = 0. Under the capital control, impatient foreign agents sell their shares and consume 1-t of their liquidating capital at T = 1, and the rest is assumed to be seized until at T = 2.

Under the capital control, a sudden capital outflow never occurs even if this economy satisfies (4) when the requirement rate on the non-interest-bearing compulsory reserve is large enough. Consider the case where the requirement rate t satisfies the following:

$$t \geq 1 - \frac{\lambda n + N}{d(n+N)}. \tag{10}$$

This requirement rate maintains the inequality $(1-t)(d+\tilde{p})N \leq N$. Even if a sudden capital outflow occurs, the central bank never fails, and the exchange rate remains stable. In this case, the arbitrage condition for each patient home agent is p < (1-d)R, and the arbitrage condition for each patient foreign agent becomes (1-t)p < (1-d)R. If some foreign/home patient agents sell their shares, the share price is expected to decline. However, no impatient agents will purchase the shares at any p > 0. Therefore, under the capital control economy, all patient agents consume at T = 2, and a sudden capital outflow never occurs in the presence of the capital control. The share price is determined as $p = p^*$. Consequently, only the consumption schedule of impatient foreign agents changes because of the exit levy at T=1, and at T =2, the dollar is useless for them.

One problem persists; the capital control on early capital outflows might deteriorate the welfare of each foreign agent. However, foreign agents might prefer the capital control in the case where they consider that the cost of financial fragility exceeds the cost of the capital control. Let W_F denote the expected welfare of each foreign agent at T = 0. It is given by

$$W_F(t,\theta) = E\left[\lambda u(x_1^F) + (1-\lambda)u(x_2^F + y_2^F)\right]. \tag{11}$$

Define t^* as the smallest requirement rate t, which satisfies (10) and θ as the subjective probability of a sudden capital outflow. The expected welfare can be written as

$$W_F(t,\theta) = \begin{cases} (1-\theta)\left[\lambda u\left((1-t)x_1^F *\right) + (1-\lambda)u(y_2^F *)\right] + \theta E\left[u\left((1-t)\tilde{x}_i^F\right)\right] & \text{if } t < t^*, \\ \lambda u\left((1-t)x_1^F *\right) + (1-\lambda)u(y_2^F *) & \text{if } t \geq t^* \end{cases}$$

for i = 1,2. It is easy to find that

$$E\left[\tilde{x}_i^F\right] \leq u\left(E\left[\tilde{x}_i^F\right]\right) = u(1)$$

and

$$u\left[(1-t^*)(d+p^*)\right] = u\left[\left\{\frac{\lambda n + N}{d(n+N)}\right\}\left(\frac{d}{\lambda}\right)\right] = u\left[1 + \frac{(1-\lambda)N}{\lambda(n+N)}\right]. \tag{12}$$

These relationships yield

$$\begin{aligned} W_F(t=0,\theta=1) &= E\left[\tilde{x}_i^F\right] \\ &< (1-t^*)(d+p^*) \\ &< W_F(t^*,\theta). \end{aligned} \tag{13}$$

Hence, if foreign agents expect that the probability of a sudden capital outflow is large, the compulsory reserve requirement improves the welfare of each foreign agent when the government imposes reasonable capital control. The appropriate requirement rate will eliminate both the possibility of a sudden capital outflow and

recessions in the share market, and in some cases, it will achieve a better pay-off for foreign agents.

5. Conclusion

I have provided a formal analysis on the performance of foreign capitals in the share market in a country with foreign capital inflows under the fixed exchange rate regime. In addition, I have shown the linkage between financial turmoil and a sudden capital outflow. It is interesting that a currency crisis produces a crash in the share market even in an economy where financial markets are open and well developed. Further, the compulsory reserve requirement on early withdrawal could prevent the problem of sudden capital outflows.

The intuition behind the results can be summarized as follows. Foreign agents must face two markets, a share market and a currency market, if they want to invest in the home country. In this case, two arbitrage conditions arise in the share market: that of home agents and foreign agents. Heterogeneity of the arbitrage conditions produces the possibility of speculative attacks in the share market. Therefore, the hypothesis that the self-stability mechanism in the share market eliminates the possibility of financial turmoil is not always supported in this paper.

The most important element in this paper is that the hypothesis that a market mechanism eliminates speculative attacks is not always supported theoretically. Under the heterogeneous arbitrage conditions, anything that causes investors to anticipate a sudden capital outflow will lead to a currency crisis, and a suspicion of

exchange rate alteration is the cause of heterogeneous arbitrage conditions, which may offset the self-stabilizing mechanism in the share market.

Capital controls may induce capital inflows if the financial market is fragile. This is because the cost of financial fragility might exceed the cost of capital controls for agents in the economy with financial fragility. In this case, the capital controls would not squeeze foreign agents, and the compulsory reserve requirement on early capital outflows would not deteriorate the welfare of foreign agents under the appropriate requirement rate level. However, capital controls should not be overused because the policy makers may fail to induce foreign capital inflows if they intend to impose heavy exit levies on capital outflows. Only the smallest requirement rate will be effective in eliminating all the problems that I have described in this paper.

References

Ariyoshi, A. et al. (2000) 'Capital Controls: Country Experiences with Their Use and Liberalization,' International Monetary Fund, Washington, D.C.

Burnside, C., M. Eichenbaum, and S. Rebelo (2000) 'Government Guarantees and Self-Fulfilling Speculative Attacks,' forthcoming Journal of Economic Theory

Caballero, R., and A. Krishnamurthy (2001) 'A "Vertical" Analysis of Crises and Intervention: Fear of Floating and Ex-ante Problem,' NBER Working Paper 8428

Chang, R., and A.Velasco (2000) 'Financial Fragility and the Exchange Rate Regime,'

Journal of Economic Theory 92, 1–34

– (2001) 'A model of financial crises in emerging markets,' *The Quarterly Journal of Economics* 116, 489–517

Chen, Y. (1999) 'Banking Panics: The Role of the First-Come, First-Served Rule and Information Externalities,' *Journal of Political Economy* 107, 946–968

Corsetti, G., P. Pesenti, and N. Roubini (1999a) 'Paper Tigers? A model of the Asian Crisis,' *European Economic Review* 43, 7

– (1999b) 'What caused the Asian currency and financial crisis? Part Ⅰ: A macroeconomic overview,' *Japan and the World Economy* 11, 305–373

Diamond, D., and P. Dybvig (1983) 'Bank Runs, Deposit Insurance, and Liquidity,' *Journal of Political Economy* 91, 401–419

Freixas, X., and J. Rochet (1998) Microeconomics of Banking (Cambridge, MA: MIT Press)

Gorton, G. (1985) 'Bank Suspicion of Convertibility,' *Journal of Monetary Economics* 15, 177–194

Jacklin, C. (1987a) 'Demand deposits, trading restrictions and risk sharing,' in *Contractual arrangements for intertemporal trade*, ed. E. Prescott, and N. Wallace (Minneapolis, MN: University of Minnesota Press pp. 26–47)

– (1993b) 'Market rate versus fixed rate demand deposits,' *Journal of Monetary Economics* 32, 237–258

Jacklin, C., and S. Bhattacharya (1988) 'Distinguishing Panics and Information-based Bank Runs: Welfare and Policy Implications,' *The Journal of*

Political Economy 96, 568–592

Kaminsky, G., and C. Reinhart (1999) 'The Twin Crises: The Causes of Banking and Balance of Payments Problems,' *American Economic Review* 89, 473–500

Krugman, P., (1979) 'A Model of Balance of Payment Crises,' *Journal of Money, Credit, and Banking* 11,311-325

Tobin, J. (1974) The new economics: one decade older (Princeton, NJ: Princeton University Press)

von Thadden, E.-L. (1998) 'Intermediated versus Direct Investment: Optimal Liquidity Provision and Dynamic Incentive Compatibility,' *Journal of Financial Intermediation* 7, 177–197