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24. November 2006

Online at <http://mpa.ub.uni-muenchen.de/2073/>  
MPRA Paper No. 2073, posted 28. March 2007

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Second Development Conference of the GRES  
Université Montesquieu-Bordeaux IV  
23-24 November 2006

# Is it Time to Get Radical?

## A game theoretic analysis of Asian Crisis and capital control

Berly Martawardaya\* and Simone Salotti\*

### I. Introduction

Policy makers sought to achieve exchange rate stability, monetary policy freedom to achieve domestic goals and maintain a regime of free international capital mobility. (Obstfeld, Shambaugh, and Taylor, 2004). But reaching all three at the same time is regarded academically as impossible and self-contradictory. At most policymakers can be mutually consistent and choose to pursue two out of the three objectives. After the collapse of Bretton Woods agreement, most countries converged in pursuance of the first and third objective.

Some European countries went even further and established Euro as common currency with a supranational monetary authority that leaves no room for independent adjustment of monetary policy with regard to domestic economics goals. If European countries, with all their economic might and long history of monetary policies, are still prone to crisis<sup>1</sup>, then it should not be surprising that other regions score lower on the stability front. Asian crisis in 1997 has been a major surprise since East Asia was the fastest growing region in the world at the time; even IMF praised the economic performance of the region shortly before the crisis. The economic contraction caused by the crises in the region proved to be very significant. Indonesia experienced the largest peacetime contraction in the world since 1960 (Fuman and Stiglitz, 1998).

Asian economic crisis questioned the virtue of free international capital mobility (Krugman 1999, Stiglitz 2002), and cast doubts on the link between financial openness and the probability of a crisis (Edwards, 2005). The impact of a sudden stop of capital inflows and massive capital outflows on a country's output and on the exchange rate could be devastating, especially after a period of regular capital inflows. As we write now, some affected countries have only recently regained their pre-crisis levels of output.

In this paper we address three main issues. How herd behaviour among investor exacerbated the crisis. How can capital control help? How to implement capital control without reducing international confidence? Banarjee (1992) developed a model of herd behaviour which results in inefficient outcome. We put this model in a setting of financial crisis and we introduce the possibility for a country to set up capital controls. We find that capital controls can reduce the effects of financial crisis and help stabilize the macroeconomic situation of the region, switching the outcome toward an efficient one. We propose a specific kind of ad hoc capital control similar to a the trading suspension in the stock market with a role for the IMF.

This paper is organized with the following structure in mind. Section II provides a brief summary and chronology of the Asian crisis. Section III contains a literature review on currency crisis and Section IV develops a game theoretic analysis to study capital controls. We put forward our proposal in Section V and Section VI concludes the analysis.

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<sup>1</sup> For instance, think of speculative attacks against Pound Sterling and Italian Lira in 1992.

## II. Miracle to Crisis

The World Bank published “The East Asian Miracle: Economic Growth and Public Policy” in 1993, joining the choir of praise to East Asian economies. The book, mainly funded by Japanese government, lavishly praised the East Asian governments’ role in economics. The most cited causes of the so called economic miracle were high percentage of exports, high savings rates, high quality of the human capital and efficient governments, as well as close business-government collaboration (World Bank 1993, Ito 2001). The same factors after the crisis were cited as the reasons of a high external dependence, of the inefficiency in capital allocation and hindering free market as well as crony capitalism.

It’s impossible to deny the vast economic improvement, along with the decrease in inequality that accompanied growth in the region. During a thirty years period until 1996, Indonesia, Malaysia and Thailand sustained 4-5 percent growth per annum while South Korea experienced a 7.4 percent per annum with only one year of negative growth. The poverty rates in East Asia decreased from 60 % in 1975 to about 20 % in 1995 (Fuman & Stiglitz 1998). In relative terms, average incomes in the above countries were 10 percent of US average in 1965 but rose to 27 percent in 1995. The last miracle of post war Japan is less impressive in comparison.

The stories of economic crises usually follow a similar path. An economy that had been receiving large amount of investments and capital inflows for considerable period and expect to do so in the future, abruptly had to face loan repayment under adverse conditions that lead to a default (or to a nearly default) on its loans. Add large drop exchange rate (think of many of Latin American crises) and a rapid contagion to get a time worn recipe for crises (Eichengreen and Wyplosz (1996) demonstrated that a currency crisis in an industrialized country can spread to the others). The root of the crisis in Asia could be traced back to financial liberalization in the early 90’s that left the banking sector of those countries with numerous loan and deposit institutions, a lot of them small and unprofessionally managed, exposed to foreign loans without hedging. The cosy relationships with governments together with expectation of bail out in times of trouble didn’t help them prepare when the crisis arrived.

All the countries affected by the Asian Crisis (Indonesia, Malaysia, Singapore, South Korea and Thailand) received clean bill of health with praise from IMF just a couple of months before the crisis started to develop, and even after its start<sup>2</sup>. Therefore we will proceed by assuming those countries at least lying in the middle, if not on the strong side, in terms of the quality of their fundamentals. A lack of transparency, crony capitalism and weak financial institutions have characterized to some extent those countries, but pointing to those aspects as the main causes of the crisis would prevent to explain thoroughly why economic expansion that preceded the crisis could occur in the first place.

After the Asian crisis there has been numerous studies on East Asia. A number of economists quickly pointed out the fault of the East Asian model and cited the crisis as the proof (see for example Yusuf, 2001), failing to explain the reasons of the previous growth miracle. We’ve chosen to follow Radelet and Sachs (1998) to describe what happened: they divide the time period into three sub-periods. The build-up to the crisis took place from 1990-1997, when the short term external debt was rapidly increasing due to the East Asian shining economic performance with stellar exports growth. This event caused appreciation of the exchange rates and expansion of bank lending that hid a growing weakness in the banking system. Some of the lending was used to

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<sup>2</sup> In Hong Kong in September 1996 at an IMF and WB meeting (Stiglitz, 2002)

prop and speculate on the real estate sector which led to property boom and pulled even more bank lending to properties with inflated price. Second, in early 1997 three *chaebol* in South Korea announced bankruptcies with billion of dollars in debt; at the same time, in Thailand, the property bubble started to burst and resulted in drop of property prices. Both cases led to difficulties in the banking sector (Kaminsky and Reinhart, 1999, consider as “twins” banking crisis and financial ones) and Thai currency started experiencing speculative attacks since late 1996. Thai government reneged on promise to bail out close to 4 billion dollars of bad property debt that led to more speculations on possible floatation of baht, which Thai government denied, due to draining of currency reserves. Baht was float on July 2 and capital outflow, from all the Asian countries, followed immediately. Exchange rate fell, loans were not extended and credit ratings were downgraded.

The initial response to the crises is the third stage of time line. By trying too hard to maintain exchange rate, Thai government lost massive amounts of reserves. Thus, they remained with fewer foreign exchange reserves with respect to outstanding debts to international banks, together with financial sectors still in disarray. Other governments in the regions also did their part in undermining their own credibility; Malaysia reneged on its plan to establish funds to support stock prices while Indonesia retracted plan to postponed hundreds of major investment programs. Worse, state enterprise was ordered to pull out deposit from banking system. Korea used up her reserves to maintain won value after letting the *chaebol* going through bankrupts. IMF offered standard structural adjustment program with high interest rates, low growth of money supply and closing insolvent banks. The entire original program were discarded within months and left investors even more eager to pull out their money.

### **III. Theories of Crisis**

Krugman (1979) provided the main foundation crisis when the central bank faced rapid depletion of foreign currency reserves due speculative attack noticing weak economic fundamentals. Obstfeld (1986) altered the model and showed that the attack could still occur despite sufficiently strong economic fundamentals, thus turn the speculative attack into a self-fulfilling acts. Credibility of monetary authority become important since independent speculator would not start speculating, thus start the self-fulfilling crisis, if they perceive strong intent, consistency and capability (Obstfeld 1991, 1994; Isard 1995).

Models (Cole and Kehoe 1996; Obstfeld 1996; Sachs, Tornell and Velasco 1996) have been developed where a country with good fundamentals won't definitely suffer a crisis where a country with bad fundamentals will definitely suffer a crisis, but for countries in the middle the expectations of speculators will be self fulfilling.

Fuman & Stiglitz (1998) investigate three possible causes of a financial crisis. First, it is possible that the East Asian economic policies, that served them so well in early stages of development, were no longer suitable in a more prosperous situation. Second, the countries involved have abandoned the behaviours that have brought them prosperity. Third, the policy was no longer suited to a changing world. We investigate deeper the last possibility focusing on the recent large increase (3.3 % of GDP on 1990 to 8.3 % of GP in 1996) in capital inflows, comprehending also short term capital/debt that could create enormous strains on economies.

Masson (1999) analyzed models that produced multiple equilibriums in financial markets instead of the standard single equilibrium models. When investors recognize possibility of switching to another equilibria, it introduces volatility that with higher impact than economic fundamentals. Multiple equilibria models acknowledge the low predictability of asset prices and authority's decision to devalue currency. Masson also proposed taxonomy for crises in developing countries with regard to its cause. The monsoonal effect, as its name suggests of a monsoon that affect all ships in the region, is an external shock (i.e. change in US monetary policy) that affects numerous developing countries. The spillovers effects come from macroeconomic linkages among developing countries such as trade flows. The pure contagion effects are those that are not related to macroeconomic fundamentals. With regard to contagion, Maig & Goldfajn (1999) found evidence for contagion between financial markets of Thailand, Malaysia, Indonesia, Korea and the Philippines where correlation between currency and sovereign spread increase significantly during the Asian crisis.

Rogoff (1999), chief economist of the IMF, proposes some modifications in the international institutions in order to reduce instability. He started by examining the problems with the status quo, proposing to take the developing country perspective into account, instead of just the American one. He defended the Washington Consensus of financial liberalization with argument from the theoretical side where it supposed to be beneficial, while conveniently failed to cite literature on the risk of financial liberalization to small economy and massive empirical findings that point out capital flow from capital-poor country to capital-rich country after liberalization.

In a famous column, Paul Krugman (1998) proposed to temporarily sacrifice international capital mobility in order to benefit from a stable exchange rate and an independent monetary policy in the time of crisis. To Krugman's surprise, the government of Malaysia imposed capital controls a couple of weeks after the publication of his column. This measure received scores of criticism from the academia and international organizations, who forecast an economic slowdown and smaller future investments. But after a few years, Malaysian economy performed better than the other affected countries. Investments continue to arrive there, even though a recent study by Goh (2005) puts some shadows on that, showing that long term flows have yet reached again the pre-crisis levels.

Banerjee (1992) developed a model of herd behaviour in sequential decision where each decision maker looks at the decisions made by previous decision makers that may have informational value in taking their own decision. The result is herd behaviour and inefficient equilibrium. Krugman (1999) elaborated the line of argument and applied it into a currency crisis setting with numerous independent investors. In a public good setting, it is well known that the large number of players will reduce the contributions of each while repeated interactions will increase it. Thus, it is not surprising to find numerous smart and rational investors from all around the world; with practically no physical interaction between them, took actions that benefit them if taken individually but caused harm when taken collectively.

Stiglitz (2004) strongly criticize the move by US Treasury and IMF to push for capital account liberalization in the 1980s with disregard to alternate view that questions the tenacious link between liberalization and growth. He quoted Rogoff, former IMF chief economist, admission of how liberalization could cause stability with higher cost compare with benefit of liberalization. Tying the force measure across the board with the trade and aid issue could be seen as an ideological act instead of sound economic policy.

## IV. Let's Get Radical

We restate Banarjee's results in a setting of financial crisis and we introduce the possibility for a country to set up capital controls. Let us observe the simple game tree above with two investors/creditors. We assume that crisis is entirely exogenous, can not be precisely predicted and only known when it starts to unravel, and investors are risk averse toward volatility. Then the circumstances will resemble a symmetric prisoner dilemma below:

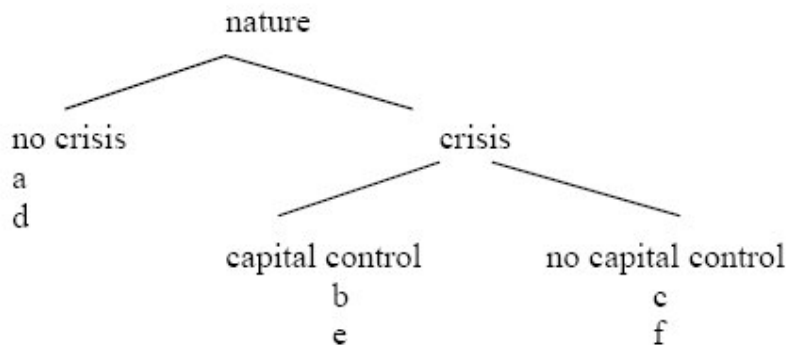
*Table 1.*  
*The capital flight game*

	Stay	Flight
Stay	b	d
Flight	a	c

Payoff to stay in the time of crisis when other also flight is the lowest, followed by flight when other also flight. The highest payoff is to flight when other stay follow by stay when other also stay ( $a > b > c > d$ ). This is a common situation when action of one person affects the payoff of other as numerous occasions of bank run and stock exchange panics remind us. The logic of prisoner dilemma dictates in absence of communication<sup>3</sup> and binding commitment both players will choose to take their money away from crisis affected countries.

Let us extend the model where the government can choose to impose capital controls when crisis occurred. Payoff for investors/creditors is stated in the first line and the government's one in the second. No crisis naturally have the highest payoffs followed by capital control, assuming good timing and effective implementation<sup>4</sup>, compare to no capital control ( $a > b > c$  and  $d > e > f$ ). Building from previous game, in the time of a crisis, all investors want to flight but capital control will serve as a coordination mechanism to stay, thus make them better off.

*Graph 1.*  
*The capital control game*

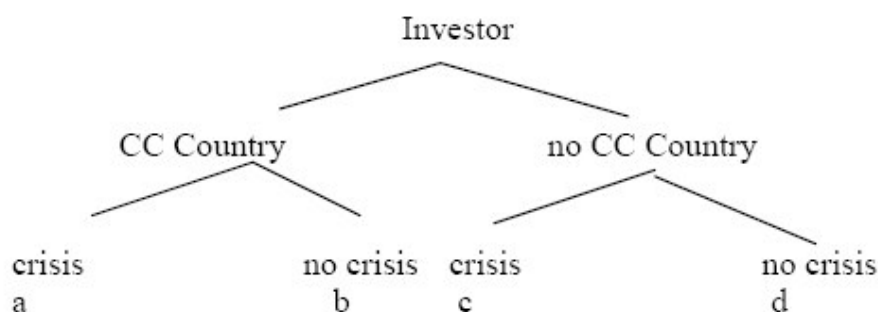


<sup>3</sup> We think this is a credible assumption since during a crisis there is hardly time for thousands of investors to sit down and discuss common exit strategies.

<sup>4</sup> Here we abstract from implementations problems that arise when governments try to impose controls on capital flows (in this case on outflows). There are also other issues that we don't develop here, such as the wide possible kinds of controls that a country can choose (see Magud and Reinhart, 2005, for a list of controls implemented in a bunch of countries in the last years), the many effects that controls can have apart from keeping capitals in the country, included the long term ones (see Goh, 2005).

If we group the countries in a region as those that will impose capital control in the time of crisis and those that will never impose it, investors can performed backward induction to choose which country to invest in the first place. To simplify matter we assume the two countries are identical and provide similar payoff. We also assume that payoff when there is no crisis is identical in both countries ( $b = d$ ) and according to previous game the payoff in country that will impose capital control in time of crisis is higher compare to those who won't ( $a > c$ ). Capital inflow will go to the former knowing they will gain more in the time of crisis.

*Graph 2.  
The regional capital control game*



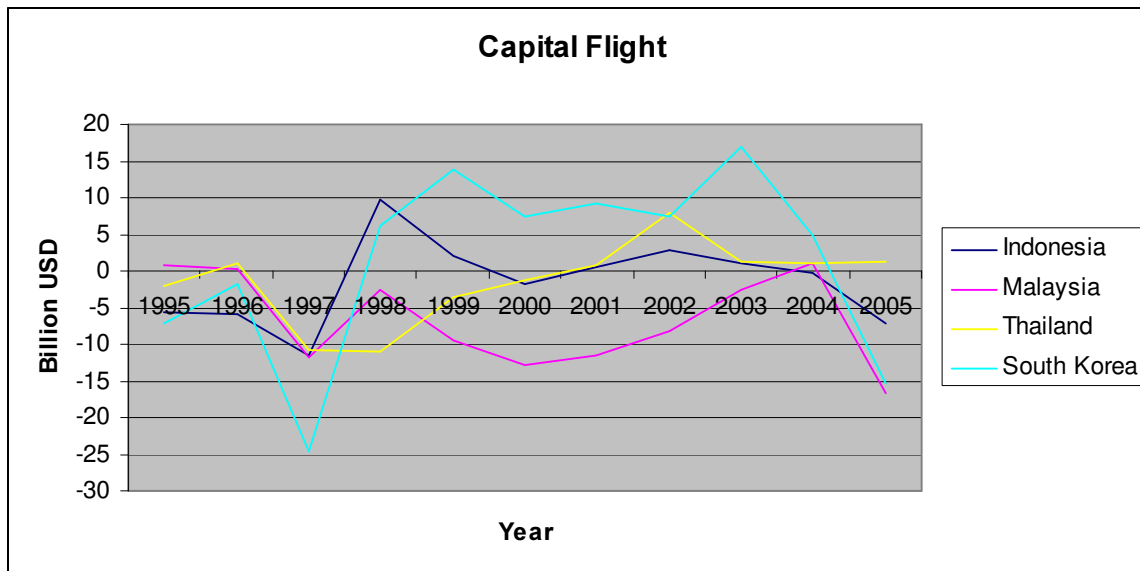
Now we extend further the analysis to take into account the contagion effect where investors take away their money not only from affected country but also from its neighbours. As seen in the next table with similar structure to table 1 ( $a > b > c > d$ ), it will be a race to impose capital control in reverse to race to capital flight in table 1 since the payoff to impose capital control is higher when other also impose.

*Table 2.  
The regional capital flight game*

	No CC	CC
No CC	b	d
CC	a	c

We calculated Capital Flight as current-account balance with the sign reversed plus the change in international reserves, minus the change in total external debt stock (not adjusted for the effects of cross-currency valuation changes), minus net direct investment. The data show that Malaysia is the only country in the period that did not experience positive capital flight (apart from small positive values in 1995 and 2004). We believe that this provides support for our hypothesis about the payoffs of the game in Graph 1 (in particular  $a > c$ ).





Source: IFS and EIU

## V. Controlling Capital Controls

The idea of applying controls on capital flows is not free of problems and some assumptions need to be made for effective implementation. However, there are few doubts about the effectiveness of Malaysian controls<sup>5</sup>, even if Malaysian government received strong critics from all over the world. The country is going on applying some kind of controls, especially the ones on the currency. Today no speculations are possible on Ringgit and this is the strongest among the possible restrictions on the currency markets.

We observe major adjustments between the US dollar and the Euro; on the other hand there are *de facto* fixed exchange rates in some Asian countries such as China and Malaysia. Their currencies hardly float, while their official reserves are growing at incredible swift rates. Numerous economists claim that the Euro is suffering from a burden that comes from the actions taken by those Asian nations<sup>6</sup>. The need for a reform of the international financial architecture is discussed more and more. A prominent proposal of a super chapter XI made by Stiglitz (2002), opens the possibility of declaring international default in case of difficulties in payments. We would like to advance the idea of a reform of our own that, if successfully implemented, could have two kinds of advantages.

We propose the application of trading suspension to currency market in case of speculations that bring excessively downward (or upward) the value of the currencies. Trading suspension is a widely accepted instrument in developed stock markets. In USA, for example, it has appeared since more than 70 years ago as Section 12(k) of the Securities Exchange Act of 1934. In the event of emergency, defined as sudden and excessive fluctuations of securities prices generally, or a substantial threat against fair and orderly markets, the Security & Exchange commission is authorized to suspend trading in any security for a period not exceeding 10 business days. The

<sup>5</sup> Literature on capital controls suffers from various shortcomings; one is the high number of studies about Chile and Malaysia compared to few empirical evidences from all the other cases. Thanks to that we can state that there are few doubts on Malaysian case, while we must be careful when speaking of other countries.

<sup>6</sup> See Maccario, Savona, Stroppa ad Zazzara (2006).

argument for trading suspension is to protect public interest and private investors when public information about a company (we're talking about stock and bond markets) is not current, accurate, or adequate.

This could bring to an end the speculations in case of unjustified attacks (unjustified in the sense of no lack of fundamentals). As explained by Kryzanowski (1979) for the stock market, the suspension period could allow for more transparency, by making available new information. This new information (about the strength of fundamentals) can be favourable or unfavourable; with these new elements the operators of the market could decide to go further selling (or buying) the currency or to reverse their behaviour. The suspension period could also cool down the market frenzy and reduce incentive for herd behaviour. Our proposal would be less 'free market averse', unlike actual Malaysian controls, and easier to realize than Stiglitz's<sup>7</sup>, since the latter would require legal adjustments in numerous countries and could encounter rejection due to infringement to national sovereignty.

We admit that it's hard to precisely foresee the results of such suspensions, since it's impossible to assume that they would be equal to the ones obtained from the study of stock markets (for example Kryzanowski's: no rapid answer of the market to unfavourable information, rapid positive answer in case of favourable information). Thus, more study is needed in order to fix the percentage of change in the value of the currencies that could determine the trading suspension, and the extension of the period. To investigate the possible effects would require more research, such as simulations and modelling, in order not to wrongly impose stock markets conditions on currency markets.

Our proposal also provides a new role for the IMF: it could act as the regulator of currency exchange, determining the standardized conditions where capital controls could be justified. The IMF has the authority and the expertise to define the criteria of application of this new (new for currency markets, although it's pretty old for stock markets) measure, leaving to the member countries the freedom of choice on implementation. Giving to the IMF the role of global SEC for currency market would reduce heterogeneity of regulations among countries and could provide stability for actors of that market.

## **VI. Conclusions**

The search for the root of crises led us to rediscover the importance of proper sequencing and timing of financial liberalization. East Asian has prospered with strength in real sector export, fuelled by human capital and government policy that was not accompanied by pre-cautious financial sector.

With the assistance of game theoretical framework, we analyzed herd behaviour of international investors in the time of financial crisis. Under free international capital mobility, uncertainty and lack of coordination among investors with short-horizon, we found prisoner dilemma type of arrangement that exacerbated financial crisis. We extended the model to analyze multiple countries under financial crisis and fear of contagion. We found that the ability to impose capital control, under certain conditions, will isolate the crisis and reduce contagion effect.

Applying the analysis to a multi-stage game including the government, we found that a credible threat of capital control could reduce herd behaviour and help the country to escape the worst of

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<sup>7</sup> As stated by Eichengreen (1999), it's important to care about implementation problems when speaking about possible reforms of the international financial architecture.

financial crisis. We proposed the employment of a trading suspension policy in place of free capital mobility, which is regularly requested by the IMF and the international community. Therefore, freedom to employ capital controls is a policy tool that enables the flight from the macroeconomic trilemma and enables policy makers to pursue all of the three goals at the same time.

## References

- \_\_\_\_\_, *The East Asian Miracle: Economic Growth and Public Policy*, World Bank, 1993.
- Baig, Timur and Ilan Goldfajn, "Financial Market Contagion in the Asian Crisis," *IMF Staff Papers* Vol 46 no 2 (June 1999).
- Banerjee, Abhijit V., "A Simple model of Herd Behaviour," *The Quarterly Journal of Economics*, Vol. 107, No 3. (August 1992), 797-817.
- Cole, Harold L. and Timothy J Kehoe, "A Self-fulfilling Model of Mexico's 1994-95 Debt Crisis," *Journal of International Economics*, Vol 41. No 3-4 (November 1996), 309-330
- Edwards, Sebastian, "Capital Controls, Sudden Stops and Current Account Reversals", *NBER Working Paper No. 11170*, March 2005.
- Eichengreen, Barry, "Toward a New International Financial Architecture", *Institute for International Economics*, 1999.
- Fuman, Jason and Joseph E. Stiglitz, "Economic Crises: Evidence and Insights from East Asia," *Brookings Panel of Economic Activity*. 1998.
- Goh, Soo Kohn, "New Empirical Evidence on the Effects of Capital Controls on Composition of Capital Flows in Malaysia", *Applied Economics*, 2005, 37, pp. 1491-1503.
- Isard, P., *Exchange Rate Economics*, Cambridge University Press, Cambridge. 1995.
- Ito, Takatoshi, "Growth, Crisis and the Future of Economic Recovery in East Asia", in *Rethinking the East Asian Miracle*, edited by Stiglitz, Joseph and Yusuf, Shahid, Oxford University Press, 2001.
- Jeann, Olivier, "Are Currency Crisis Self Fulfilling? A test," *Journal of International Economics* 43, 263-286, 1997.
- Krugman, Paul, "A model of balance-of-payment crises," *Journal of Money, Credit and Banking* 11, 311-326. 1979
- \_\_\_\_\_, "Saving Asia: Its time to get radical", *Fortune Magazine*. 1998.
- \_\_\_\_\_, *The Return of Depression Economics*, New York: W.W. Norton & Company, 1999..
- Kryzanowski, Lawrence, "The Efficacy of Trading Suspensions: A Regulatory Action Designed to Prevent the Exploitation of Monopoly Information", *The Journal of Finance*, vol. XXXIV, no. 5, December 1979.
- Maccario, Aurelio, Savona, Paolo, Stroppa, Davide and Zazzara, Cristiano, "Global Imbalances: Issue and Key Questions. The European Perspective", *Working paper for the conference "In search of a new Bretton Woods..."*, Florence, October 2006.

- Magud, Nicolas and Reinhart, Carmen M., "Capital Controls: an Evaluation", *NBER Working Paper 11973*, June 2005.
- Masson, "Multiple Equilibria, Contagion and the Emerging Market Crises," *IMF Working Paper WP/99/164*. 1999.
- Obstfeld, Maurice, Rational and self-fulfilling balance of payment crisis, *American Economic Review* 76, 72-81. 1986.
- \_\_\_\_\_, "Destabilizing effects of exchange rate escape clause, *NBER Working Paper 3603*. 1991.
- \_\_\_\_\_, "The logic of currency crisis, *Cashiers Economiques et Monetaires* 43, 189-213. 1994.
- \_\_\_\_\_, Jay C. Shambaugh and Alan M. Taylor," The Trilemma in History: Tradeoffs among Exchange Rates, Monetary Policies and Capital Mobility," *NBER Working Paper 10396*. 2004.
- Radelet, Steven and Jeffrey Sachs, "The Onset of the East Asian Financial Crisis," *NBER Working Paper* no W6680, August 1998.
- Rogoff, Kenneth, "International Institutions for Reducing Global Financial Instability," *The Journal of Economic Perspectives*, Vol 13, No 4 (Autumn 1999), 21-42.
- Sachs, Jeffrey D., Aaron Tornell and Andres Velasco, "Financial Crisis in Emerging Markets: The Lessons from 1995," *BPEA* Vol 1. 1996, 147-198.
- Sen, Amartya, *Development as Freedom*, New York: Alfred Knopf Inc. 1999.
- Summers, Larry, "International Financial Crises: Causes, Prevention and Cures" *American Economic Review*, May 2000, 1-17,
- Stiglitz, Joseph, *Globalization and Its Discontents*, New York: W.W. Norton & Company, 2002.
- \_\_\_\_\_, Capital Liberalization, Globalization and IMF, *Oxford Review of Economic Policy*, Vol 20, No.1, 50-71 , 2004.
- Yusuf, Shahid, "The East Asian Miracle at the Millennium", in *Rethinking the East Asian Miracle*, edited by Stiglitz, Joseph and Yusuf, Shahid, Oxford University Press, 2001.