Stockholm School of Economics
Department of Economics
Master's Thesis
January 2007

Financial Contagion in Emerging Markets

Abstract

The fact that there were several similarities between the financial crises in Mexico 1995 and Asia 1997 makes it interesting to examine whether a model that explained the Mexican crisis also can be applied on the Asian crisis. Thus, this thesis aim is to do a quantitative study of nineteen emerging market economies with a model consisting of three explanatory variables: appreciated real exchange rate, weak banking system and scarce foreign exchange reserves. To the best of my knowledge, a follow-up study of this model has never been made before. Contribution: if the model does a good work explaining also the Asian crisis, it may be used by the market (e.g. international investors and currency traders) as an early warning indicator of future contagious crises in emerging markets. However, by running regressions I found that the R^2 values are low (adjusted R^2 are negative) and neither of the null hypotheses are significant at ten percents level. The conclusion is hence that the model does a poor job explaining what happened in Asia and that further research is needed in order to find a model which can explain patterns when financial crises in emerging markets becomes contagious due to creditors withdrawal of capital.

Key words: Contagion, Asian crisis, Mexican crisis, Macroeconomic fundamentals

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Presentation: 10:15 – 12:00, 13 February 2007
Location: Room 542

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Acknowledgements:
I would like to thank my tutor Martin Flodén for highly beneficial advice and support. I would also like to express my gratitude towards Associate Professor Per-Olov Edlund who kindly helped me solve statistical queries. Finally, the support and encourage received by family and friends during my educational years have also been highly appreciated, especially when writing this thesis.

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1. INTRODUCTION

1.1 BACKGROUND

> *"It's like there are two businesses here. The old business, which works fine under normal conditions, and this stand-by business, when the world goes mad."*
>
> Eric Rosenfeld of Long-Term Capital, New York Times Magazine (January 24 [1999])

Prior to the Mexican crisis in 1995 the word contagion had not reached out to the majority of politicians and economists and did therefore only constitute a small part of the economic literature. That changed however, when the Asian crisis 1997 and Russian crisis 1998 showed the very same patterns. Hence, over a couple of years three major financial crises put large parts of the developing world under severe financial distress. The common characteristic between these three crises was the fact that investors decided to withdraw capital causing the countries to experience balance-of-payment crises and in addition, attacked currencies. This phenomenon was named *contagion*[1].

One of the first explanations given subsequent to the Mexican crisis discussed whether current account deficits could be the main driver. That could not be applied for Mexico however, since they had not suffered from neglected financials in the past. Other solutions to the phenomena thus started to arise, implying that the initial literature became quite sprawling. Nowadays economists are more accustomed to these kinds of crises and the literature has thus also become fine tuned as a distinction between pure contagion and fundamental based contagion is agreed on.

In order to understand the source of contagion in South America the American professors Jeffery Sachs, Aaron Tornell and Andrés Velasco conducted a study in 1996. Their model assumed that a country's fundamentals were of significant matter when explaining the fact that contagion hit some countries more than others. The model contained three explanatory variables; high real exchange rate appreciation, weak banking system and scarce reserves. With an R^2-value of almost 70 percent and null hypotheses significant at ten percents level,

[1] The term contagion derives from the medical sector implying that crises spread like diseases to countries located closely to the first affected country.

they concluded that the model explained the Mexican crisis quite well. As there were similarities between the Mexican and the Asian crises and in order to maybe reach some consensus within the area, I will investigate whether the model can explain the Asian crisis as well.

1.2 PURPOSE

The aim of this thesis is thus to conduct a quantitative study based on the model created by Sachs et al [1996] and test if can explain also the Asian crisis. To the best of my knowledge, a study like this has never been made before. If the model does a good work explaining the Asian crisis[2] it might be used by the market (e.g. international investors and currency traders) as an early warning indicator of future contagious crises in emerging markets. This might be the thesis's contribution. On the other hand if the model can not be applied, there is a need of further research in order to find this type of indicator.

1.3 METHOD

I have collected data for 19 of the 20 emerging market economies Sachs et al used in their study from 1996[3]. The country missing is Taiwan for which data was not included in the main data source used i.e. the International Monetary Funds data base called International Financial Statistics. Sachs et al collected the Taiwanese data from Key Indicators and the Monthly Bulletin of Statistics of the Republic of China. However, the time period available on the Internet for the latter was not adequate for this study and unfortunately I did not receive the figures from them in due time. On the other hand, as Taiwan was one of the few countries in Asia surviving the crisis quite well, their absence should not be of major significance.

I have chosen this specific model for three reasons; first of all, many economists regard macroeconomic similarities between countries as being a key cause of contagious crises in emerging markets. Second, the fairly simple structure implied that implementation and collection of data was not a major obstacle[4] [5]. Third, quantifying other plausible causes of

[2] i.e. showing a sufficiently high R^2-value and null hypotheses significant at least at 10 percents level.
[3] Argentina, Brazil, Chile, Colombia, India, Indonesia, Jordan, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, South Africa, Sri Lanka, Thailand, Turkey, Venezuela and Zimbabwe.
[4] With the exception of Taiwan
[5] Other similar models do exist however, their structure tend to be much more complicated.

contagion in Asia e.g. herding behaviour among international creditors, require collection of data that would take more time than a ten point thesis can spare.

The rationale behind the selection of the Asian crisis as follow up study depends mainly on the similarities that prevailed between the South American (Mexican) crisis and the Asian crisis but also on my own interest in learning more about Asian history.

The theoretical frame of reference contains mostly of articles written by internationally well-known economists which are commonly referred to when discussing contagion. I have selected the different theory angels based upon this aspect. I have not been critical towards the actual conclusions made in the different models and studies which I am aware of. I have also accepted every theory as having an equal probability of being true. Whenever I have found a contradiction to any of the theories, I have presented the opponents view as well.

The rest of this thesis is outlined as follows; next section contains the theory part which begins with a discussion regarding the definition of contagion followed by a number of contagion theories with a distinction between fundamental based contagion and pure contagion. The Asian crisis is discussed in section three with special emphasis on the common characteristics among the five worst affected countries and similarities between the Mexican crisis and the Asian crisis. A caption on the relationship between a governments foreign exchange reserves, capital withdrawals and a currency's devaluation is addressed as well. In section four I conduct my own study based on the model used by Sachs et al [1996] with a discussion regarding the obtained results as closure in part five.

2. THEORY

2.1 DEFINITION OF CONTAGION

Even though the literature on contagion nowadays is extensive and comprehensible, little consensus of the results is made. The main impediment of obtaining consensus is the fact that economists have not yet agreed upon the general definition of contagion. Some economists are broad and general and argue that contagion occurs when a shock in one country is past on to other countries (Pritsker [2000]). Definitions of this kind only explain *what* happens not *why* it happens. One benefit of using a broad framework however, is that everybody can agree on them. Unfortunately they do not add to any further understanding.

In order to be more precise and also analyze why contagion occurs, definitions of all sorts is presented in the literature. Some definitions are based on investor behaviour arguing that investors not paying for information are more likely to listen to rumours, implying that the definition is connected to herding behaviour (Calvo and Mendoza [1999] and World banks restrictive definition [www.worldbank.org]). Definitions focusing on linkages are also common and one idea being that contagion is defined as a situation when asset prices or financial flows have a significantly higher degree of comovements subsequent to a shock in one country (compared to the comovements prior to the crisis) (Dornbusch, Park and Claessens [2000]).

Definitions based on countries similar fundamentals exist as well. The study conducted later assumes that plummeted foreign exchange reserves, a weak banking sector and an appreciated currency are factors having a great influence when defining contagion. However, other fundamental based definitions exist as well since some economists focus entirely on fiscal and trade deficits. Hence, definitions based on fundamentals can consist of several different components, every one with their unique composition of variables.

Getting a straight answer regarding a definition on contagion is hence impossible since it does not exist any common interpretation that everyone can agree on. Thus, the definition is closely related to what the specific author view as the cause of contagion.

2.2 CONTAGION THEORIES

As written in the introduction the concept contagion has been given much more attention in the aftermath of three major contagion crises of the 1990s[6]. The articles written subsequent to the Mexican crisis tend to use the term contagion and hence refer to all kind of reasons e.g. banking system, foreign exchange reserves, herding behaviour or portfolio theory.

Over the last couple of years a generalization has been made between these two concepts; pure contagion and fundamental based contagion. This distinction was presented in Dornbusch et al [2000], Kaminsky and Reinhart [2000] and most recently by Dungey, Fry and Martin [2005]. Fundamental based contagion implies a spreading of shocks due to e.g. trade links, macroeconomic similarities or financial links. Pure contagion on the other hand, refers to a spread of shocks with another cause than the three just mentioned. It could be due to herding behaviour, portfolio theory or political decisions.

2.2.1 Pure Contagion

Investor and other financial actor's behaviour

In an article from 2000 Pritsker classifies investor behaviour as being rational or irrational. A rational withdrawal of money occurs e.g. if a country's short-term liabilities are smaller than the foreign assets. If this happens, investors start calculating on a country's repayment capability and realize that if every investor demanded their money back, the country has not got enough foreign exchange to repay everyone. These types of withdrawals are individually rational. Another rational withdrawal is the result of e.g. a natural disaster, a military coup or plummeted export prices. If any of these incidents are realized there is a risk of creditors demanding their money back due to the increased probability of changing growth and decreased investors' returns.

Irrational withdrawals on the other hand, are often the result of herding behaviour among investors. Investors withdraw capital because other investors withdraw. The true reason for the initial withdrawal can be rational. They often become irrational however, when they are interpreted by others as a signal of a forthcoming crisis in an area. Examples are given below.

[6] Mexico 1995, Asia 1997 and Russia 1998

Calvo and Mendoza [1998] argued that during the crises in Mexico 1995, Thailand 1997 and Russia 1998, creditors did not take the time, effort nor expense to compute personal evaluations of a specific country's fundamentals. There are certain risks of investing abroad and the lack of information plays a large part of this risk. For a creditor it is expensive to monitor emerging markets because they often change, partly due to unstable political systems. Cost consciousness is the reason creditors seldom allow themselves this expense and thus follow the few informed.

In another study from 1998, Mullainathan presents a more psychological explanation why creditors simultaneously withdraw capital. He states on page two; "memory influences beliefs by shaping knowledge of these [i.e. past (my addition)] events, which by nature are qualitative and ephemeral". His model is based on two facts; rehearsal and associativeness. Rehearsal implies that if a person remembers an occurrence once it is easier to remember it again at a later stage. Associativeness implies that the memory recalls previous events if similarity prevails between two events. The latter explains investors' behaviour when a crisis has occurred. They simply recall previous crises and get "cold feet" which often lead to an overestimation of the likelihood of the occurrence of a crisis. This overestimation implies that capital is withdrawn from other countries as well.

Portfolio Theory

Folkerts-Landau and Garber [1998] find especially Value-at-Risk models (VaR) being a major cause of contagion. One argument being that contagion arises when the volatility of return on assets increase, implying that investors withdraw capital as the statistical probability of loosing money increases. However, in an article from 1999 Schinasi and Smith show that this is not at all unique for VaR models but is a general feature of all portfolio theory. They argue that the reason investors rearrange their portfolios and withdraw investments from critical areas depends on the share of leverage in the portfolio;

> *"The claim that VaR rules are the source of contagion or market volatility in recent crises and turbulence seems unwarranted. […] The general conclusion is simple, but fundamental: an investor with a leveraged portfolio will reduce risky asset positions if the return on the leveraged portfolio is less than the cost of funding."* (p. 21)

This implies that withdrawal due to a higher probability of default is common in all portfolio theory i.e. not only VaR models. Contagion is rather the consequence of portfolio rearrangement due to high leverage, where the investor simply can not afford loosing too much money on an investment, without being in severe financial distress.

Political decisions

In an article from 1999 Drazen claims that contagion is essentially due to political circumstances because if the political objective is lacking, speculators could not put pressure on countries currencies. He studied the European crisis in 1992-1993 and constructed a model which assumed that the Central Banks are forced to keep their exchange rates fixed due to political demands. If a country choose to abandon their fixed exchange rate, it becomes cheaper in a political sense for others to abandon their exchange rates as well. The probability that other countries also change their exchange rate regimes hence increases, leading to a situation where speculators can put pressure on countries exchange rates with subsequent attacks as a result.

2.2.2 Fundamental Based Contagion

Global changes

Changes in developed countries can affect emerging markets as well if there e.g. is a change in interest rates. This is described by Chuhan, Claessens and Mamingi [1998] when they investigated what happened if the U.S. interest rates changed. They found that changing U.S. interest rates and/or U.S. industrial production are important factors to consider as it affects capital in- and outflows to emerging markets. This implies that creditors might withdraw capital from an emerging market due to the possibility of obtaining a better interest elsewhere. Changing commodity prices have the same effect; if a country is an exporter of e.g. copper and the world market price increases, customers will search for substitutes which imply decreased exports and an absence of capital inflow.

Trade

As argued by Glick and Rose [1999] and Eichengreen, Rose and Wyplosz [1996] countries with trade links easily transfer crises to each other. If country A experiences a financial crisis

with a devaluated currency as a result, investors might withdraw their investments from country A's trade partner country B as well[7]. The reason being investors' prediction that since A is in a financial distress, B's exports will diminish which will have a direct effect on B's growth and thus the capital they have invested in B as well.

A subject related to this is competitive devaluation; Gerlach and Smets [1994] claim that if A devaluate their currency, they can experience a temporary increase in competitiveness due to the fact that prices are sticky. This means that for some time, B will have a harder time competing with A and as a result miss out on export possibilities since it now is more lucrative to trade with A. If this situation occurs, B may also be the target of the next currency crisis as their growth decreases. This is especially the case if B's exchange rate is not floating freely since they thus are forced to keep the predetermined exchange rate level[8].

Eichengreen, Rose and Wyplosz [1996] also put forward that even though trade links play a large part in the event of contagious crises, they are not the only driver. Similar macroeconomic fundamentals between countries are also important factors to consider.

Macroeconomic similarities[9]

Economists like Eichengreen et al [1996], Radelet and Sachs [1998a], Sachs, Tornell and Velasco [1996], Dornbusch et al [2000], Park and Song [2000] and Kaminsky and Reinhart [2000], all found similarities in macroeconomic fundamentals being of particular importance when explaining contagion patterns. If two countries experience weak fundamentals and one of them experiences a financial crisis, there are strong indications that the second country will be the next victim. According to Dornbusch et al [2000], the reason is twofold; first, having weak fundamentals is similar to having a low immune defence, the probability of getting sick increases. Second, similar macroeconomic structures may also imply that investors rethink before investing in a country that has resemblances with a country in crisis since it is interpreted as an increased risk for their invested capital.

[7] Assuming that the two countries have relatively large trade ties.
[8] A discussion regarding the impact fixed/pegged exchange rates have in the event of a crisis is available in section 3.1.2.
[9] i.e. foreign exchange reserves, GDP, banking sector, foreign debt, current account etc.

Park and Song [2000] illustrate:

> *"It seems only reasonable to expect that a currency crisis in one country will lead to an attack on the currencies of other countries which have macroeconomic conditions similar to those of the country where the crisis begins."* (p 2)

Kaminsky and Reinhart [2000] exemplifies by stating that if a country with a bad banking system is revealed as being vulnerable to a currency crisis, investors could look at other countries' banking systems and search for similarities. If they find countries having comparable banking systems, they see an increased probability of a crisis occurring and as a result get more suspicious.

Financial linkages

In an article from 2004 Caramazza, Ricci and Salgado argued that contagion arises when two countries have the same lender (creditor). If country A suffers from a financial crisis country B is affected if the creditor due to A's crisis, needs to rearrange the loan portfolio. This implies that B may have their loans limited or in worst case declined. The authors also claim that the contagion effect will be much larger if the creditor's portfolio to a large part contains of loans to B since this also imply that investors do not see the same growing potential in B and therefore withdraw their investments. Kaminsky and Reinhart [1998] also advocate financial linkages as a cause of contagion but they also state that due to high correlation between trade and financial links, it is a hard task isolating one cause from the other.

2.3 HOW TO STOP CONTAGION

The key of preventing contagion is by stopping creditor panics and a common suggestion can be read in e.g. Dornbusch, Park and Claessens [2000]. Just as Caramazza, Ricci and Salgado [2004] they also argue that financially integrated countries are more vulnerable because of the ties between them. One way of preventing financial integration is inserting capital controls; e.g. taxes and barriers of different kind. By doing this the financial ties vanishes and hence also the risk of contagious crises. However, opponents of this solution exist as well. Calvo and Mendoza [1999] for instance, do not advocate this as the effects these types of restrictions have on e.g. globalisation and growth are yet too unexplored. They are afraid emerging market economies will experience a slower development process if capital controls are introduced.

Another way of stopping contagion is to be more restrictive regarding bank lending. According to Mishkin [2000] the financial liberation process in Asia implied bank lending to increase dramatically. When restrictions like interest rate ceilings disappeared and the quality of borrowers declined, credit extension actually grew at a higher speed than GDP implying high risk-taking. A moral hazard problem occurred since the once that provided money to the Asian banks i.e. depositors and foreign lenders, relied on the government to bail them out. The solution according to Mishkin is to apply a better financial supervision so that lending booms with subsequent degeneration of banks balance sheets is avoided. By doing this, one key cause of financial crises is limited and contagion does not occur as easily. If a financial crisis already has occurred, Mishkin suggests that an international lender of last resort could give international reserves to Central Banks in order to help them defend the currency from speculative attacks.

Speculative attacks occur when a Central Bank has the exchange rate fixed or pegged and creditors' start demanding their money back. Even though capital has disappeared from the country, the Central Bank still has to repay money (using the foreign exchange reserves) at a predetermined exchange rate level. When other investors begin to understand that capital withdrawals are made from a country, speculations regarding how long the Central bank can keep the local currency's peg occur. At some point too many capital withdrawals have been made implying that the fixed or pegged exchange rate can not be defended anymore. Thus, when the currency eventually abandons its fixed or pegged exchange rate, a huge devaluation is made causing investors that still have not left the country to loose even more money. The fear the initial investors and creditors felt regarding currency devaluation, ironically becomes self-fulfilling at the end. Morris and Song Shin [1998] wrote an article claiming that both the European exchange rate in 1992 and the Mexican peso in 1995 were victims of speculation which certainly contributed to the subsequent crises. Speculators' beliefs about other speculators' actions are essential since if speculators expect that other speculators will not attack a currency, they follow the first actors and the currency will be "spared". On the other hand, if they think others in fact attacks they will do it as well which sooner or later implies a currency collapse.

Perkins, Radelet, Snodgrass, Gillis and Roemer [2001] presented five options to stop capital withdrawals and the government has a key role in every one of them. First, just as Mishkin

[2000] suggested, a lender of last resort is needed. The government can prevent depleted foreign exchange reserves by lending money from the IMF or the World Bank. The rationale is to assure investors that liabilities and assets are equal and stop withdrawals based on the fact the government do not have capital enough to repay the amount international actors have invested. Second, by applying a policy reform with the intention to e.g. strengthen the banking sector, the perceived weakness in the economy system is corrected. This can imply that instead of withdrawing capital, investors may add capital. Third, by tightening the monetary and fiscal policy, the government can decrease the demand for foreign exchange and maybe also restrict imports. Fourth, the government can prevent capital withdrawal by reorganizing the foreign debt maturity and postpone the date for repayment. Fifth, a lassiez-faire attitude by the government, resulting in depleted foreign exchange reserves, bank runs and deep recessions, still leads to a point in time where creditors can take advantage of the low asset prices, implying that investments are profitable again and an economic recovery is at hand.

Perkins et al argued that the most suitable option depends on the basis of the crisis and international lenders opinion. During the Mexican, Asian and Russian crises, the IMF played a key role helping the affected countries with financial advice. However, it was heavily debated whether the aid from the IMF truly was helping these countries. Some economists argued that it became contra productive and helped the crises go even further instead of doing the opposite. The programs given by the IMF implied two things; first, tightening of financial and monetary policies in order to lessen total demand and need for foreign exchange. Second, shut down fragile financial institutions. The debate entailed questions whether these actions worked as a negative signal to investors i.e. that the countries were in trouble, or if it signalled that the countries had everything under control.

Another remedy for contagion was given in an article from 2005 where Leitner used a model conducted by Allen and Gale [2000] showing that financial linkages between banks can help stop contagion. The model confirms that a strong bank can help a bank close to bankruptcy by cross holdings of deposits. The rationale is to insure themselves against individual liquidity shocks. By constructing a common buffer, banks get incentives to help a bank in need of capital and thus stop the fuel needed to create contagion. The underlying principle is if other banks do not help the bank close to bankruptcy, they may very well be the next victim themselves.

3. THE ASIAN CRISIS 1997

Already in 1994 private capital inflows to an amount of $40 billions streamed in to the five most affected countries i.e. Malaysia, South Korea, Indonesia, the Philippines and Thailand. Eastern Asia was a dynamic market having experienced a rapid growth rate over several years. In 1996, private capital inflows increased even more with a top notation of roughly $100 billion annually. Six months later, capital inflow had turned into a capital outflow of $1 billion. This huge withdrawal of private capital flows represented about 10 percent of the five countries mutual GDP before the crisis. (Perkins et al [2001]). At the same time, remarkable pressure was put on the Thai baht for the first time. The subsequent collapse of the Bangkok Bank of Commerce and the fact that the Central Bank had to add money in order to keep the financial system running was the first indication of a crisis. It was not until one year later, on May 14th 1997 the attack reached its highest level. During this day the stock market plummeted by almost 7 percent. On June 19th Thailand's Finance Minister decided to resign, causing the largest drop on the stock market; a fall by 11 percent. The Finance Minister was advocating a currency peg against the dollar and when he was gone the incentive to change to a floating exchange rate regime increased. This situation led to a liquidity withdrawal by international investors which at the end caused the prophecy to be realized, i.e. the pegged Thai baht could not stand the pressure and was put floating on July 2nd 1997. This was the start of the crisis which on July 11th spread to the Philippines causing them to abandon their peso's peg and a few days later, on July 14th the Malaysian ringitt was also put floating (Kamisky and Schmukler [1999]). In a couple of days, the Asian Tigers was put under a lot of pressure, striving to avoid the crisis. Table 1 illustrates the financing situation between 1994 and 1999.

Even though economists like e.g. Krugman realized that there were large current account deficits in Eastern Asia even a couple of years before the Thai baht collapsed, the true scenario with bank runs and domestic asset collapses were never anticipated and occurred quite suddenly (Krugman [1998]).

However, as can be seen in Table 1 the current account switched from being a deficit of approximately 5 percent of GDP in 1996 to surpluses of approximately 5 percent of GDP in

1998. This means that the countries recovered quite fast which to some extent can be explained by the fact that creditor panics had a key role in the development of the crisis (Perkins et al [2001]).

3.1 CONTAGION IN ASIA

Why did the crisis in Thailand spread to other Asian countries? In the case of the Asian crisis, the most affected countries all experienced rapid economic growth over a couple of years. They had also received huge amounts of international private capital with mostly short-termed maturities. A financial liberation process was also prevailing which implied a quick expansion of the banking system with increased lending as consequence. Most of these countries had their currencies fixed or pegged against the U.S. dollar which also contributed in the escalation of the crisis. Government policies and particularly banking, financial and exchange rate policies were similar between these countries (Miskin [2000] and Perkins et al [2001]).

3.1.1 Financial Liberation

At the end of the 1980s and beginning of the 1990s a financial liberation process took place in many Asian countries. Unfortunately this process was done too quickly and thus lacked the legal and supervisory security net that is needed. It implied that the financial systems became vulnerable since the expansion of private banks and financial institutions was moving fast and the banks owned by the government became less and less important. The fact that the governments changed the banks' lending policies meant that they was not forced to support investments chosen by the government anymore but could chose more freely among the investment proposals. The governments also removed the interest rate controls, implying that banks now could determine the appropriate interest rates themselves. The foreign liabilities also started to increase as the governments exhorted the banks to borrow from international banks and relend the funds domestically. The numbers of private banks were increasing at the same time since they were allowed to borrow internationally, implying that the domestic lending to the private sector also increased dramatically. This development meant that a large part of the domestic banks' lending portfolios were financed by international lenders.

Since a Financial Supervisory Authority was lacking in many of these countries, monitoring of the banks' financial conditions did not come off. As time went by, banks started to fund projects with bad prospects, which placed them in an even weaker position (Mishkin [2000]).

3.1.2 Fixed Exchange Rates

The exchange rates in the most severe hit countries were all either fixed or pegged against the U.S. dollar, i.e. none of the countries had currencies that could change according to the market's supply and demand. Fixed exchange rates can cause three different problems; first of all, since investors predict that the risk of loosing money due to changing exchange rates is limited, large capital inflow were common. The fact that it was specifically short-termed inflow implied there were large risks of capital withdrawal if something went wrong. Second, having a fixed exchange rate implies that imports slowly increase and exports decrease as a difference between domestic production costs and the dollar prices of export sales occurs. If this difference is not equalized, the profitability of exporting goods vanishes. Third, if some investors start withdrawing their capital, a fixed exchange rate works as a multiplier of withdrawals and causes the foreign exchange reserves to diminish. If investors start withdrawing money and thus want instant repayment, the government is still forced to meet the demand for foreign exchange at the fixed predetermined rate. Sometimes, the short-termed debts are larger than the reserves and if the exchange rate is fixed, the Central Bank has a hard task defending the currency.

It is in situations like these speculations regarding how long a Central Bank can defend the fixed exchange rate occur. Both the Thai baht and the Korean won were exposed to these types of speculative attacks. In the case of the baht, the value against the U.S. dollar weakened from 25 bath per dollar in July 1997 to 54 baht per dollar in January 1998 before appreciating back to normal levels later that year. The won experienced a similar pattern; before the crisis, the exchange rate against the dollar was 900 won and at the end of 1997, the currency had depreciated to 1 900 won per dollar (Perkins et al [2001]). Depreciation against U.S. dollar can be viewed in Graph 1.

3.1.3 Private Capital Inflow

During the 1990s, foreign investments to the Asian countries increased sharply due to the domestic environment in these countries (as described above) and changes in the world markets. Since both the U.S. and Japan at the time had low interest rates, investors became inspired to invest money abroad where they could receive higher returns. The countries in Eastern Asia had a couple of years with rapid economic growth and were of course also a contributing factor to the increased capital inflows. If these inflows to Asia would have had a long-term fashion, it would have caused problems in the investors' home countries as the size of invested capital was so large. Since the maturity was mainly short-termed, this problem never occurred; the main part of the loans to the crisis countries had a maturity of less than one year.

There are some benefits of having short-termed maturities, both as a lender and as a borrower. From the lenders' perspective, the risk was lower since the time exposed was quite short. From the borrowers' perspective, short-termed loans implied lower interest rates compared to long-term loans, and as long as the growth rate in these countries continued to increase, short-term loans could fund long-term projects if the lender extended the loan at the maturity date. If anything went wrong or if the lenders had reason believing that anything might have get wrong, the benefits suddenly turns into drawbacks as a short-termed loan also can get withdrawn quickly and this is what happened in Asia. It is important to note that it was not only foreign lenders requiring their money back, also domestic lenders required to have their money back as they noticed what was about to happen (Perkins et al [2001]).

3.2 SIMILARITIES BETWEEN MEXICO AND ASIA

The Mexican crisis started in December 1994 when the foreign exchange reserves became depleted due to major capital withdrawals and a speculative attack towards the peso occurred. This was unexpected since Mexico historically did not suffer from bad financials rather, the opposite prevailed as Mexico was held up as a model for others to imitate (Martinez [1998]). Contagion of the Mexican crisis came true when capital withdrawals started to take place in other South American countries as well. Argentina was one of the worst affected countries with losses in bank deposits of 18 percent and foreign exchange reserves plummeted 50 percent between December 1994 and March 1995 (Calvo and Reinhart [1996]) implying that

huge pressure was put on the Argentinean currency as well. Brazil was another country experiencing the same thing happening in Mexico and Argentina. Thus; the capital withdrawals started in Mexico and the subsequent devaluation of the peso spread to other South American countries and their currencies. The spread of this investor panic was named the *tequila effect*.

The aim of this thesis is to investigate whether a model explaining the Mexican crisis also can be applied on the Asian crisis, similarities between the two crises do exist. As written in an IMF paper by Martinez 1998, the most striking similarity between these two crises is a feature common for practically all emerging markets i.e. the lack of economic policies that can handle large international capital flows.

To start of at the initial stage, the financial problems Mexico and Thailand experienced, came as a shock to the world since both of them hade reasonably sound fundamentals. High inflation for instance, had been a major cause of financial crises in other parts of the world but in these two cases it was not even an issue. Rather, a pre-crises feature in both Mexico and Asia was large capital inflows thanks to macroeconomic stabilization, structural reforms, strong economic growth and lucrative interest rates levels (Martinez [1998]). Capital inflows to Asia can be seen in Table 1. In Mexico alone, capital inflows in 1992 and 1993 averaged $30 billion annually (Perkins et al [2001]). These capital inflows implied increased domestic demand, meaning boosted stock and real estate prices, increases in banks' assets and liabilities and large deficits in the external current accounts (Martinez [1998]).

In both cases these huge inflows quickly turned into outflows partly due to changing attitudes among investors and creditors. In Mexico a political murder at the beginning of 1994 made investors rethink their investment decisions and capital begun to flow out of the country at a fast pace (Perkins et al [2001]). Another feature of significant matter prior to both crises was the fixed or pegged exchange rates in both Mexico and Asia. As can be read in section 3.1.2 above, fixed exchange rates have serious drawbacks when investors start withdrawing capital and speculative attacks is at hand. As in Thailand, the Mexican peso was also put floating after huge speculative pressure (Martinez [1998]).

A weak banking system was also a characteristic shared by Mexico and Asia that played a key role in the build-up of the crises. Both Mexico and Asia had a financial liberation process

implying a privatization of the banking sector a couple of years before the collapses. As in section 3.1.1, this privatization attracted international investors which increased the supply and hence demand for money. The growth of credit to the private sector was huge in both Mexico and Asia and since a Financial Supervisory Authority was lacking in Mexico as well, banks did not have any pressure regarding internal controls (Martinez [1998]).

3.3 A DESCRIPTIVE MODEL

In order to simplify the understanding of the test conducted in the next section, the connection between credit withdrawal, exchange rates and a Central Bank's foreign exchange reserves is a crucial relationship. In the paper written by Sachs et al [1996], a simple model is presented in order to clarify the situation. As already argued, the crucial factor when it comes to contagious financial crises is the withdrawals of resources made by investors and creditors. If this happens, the government has a number of choices. If they decide to let the exchange rate depreciate they thus cause international creditors to experience losses of capital which implies a reduced will of withdrawing additional resources. If the inflow of money used to finance a current account deficit, adjustments have to be made in order to handle the lack of capital. This can be made through two alternatives; the government can create a recession and hence lessen the international investors demand for withdrawing. Another alternative is to let the real exchange rate depreciate in value which implies a shift of capital from the nontradable to the tradable sector. These two alternatives i.e. recession or devaluation, both lead to an enhanced current account. The course of action being implemented depends on the government's preferences and restrictions. If the real exchange rate has appreciated compared to the value needed in order to handle the lack of capital in the current account and if tradables are rigid and do not react to changes in the real exchange rate, the exchange rate is required to depreciate more in order to decrease the current account deficit and reach a more appropriate level corresponding to the diminished capital inflows. Putting the country into a recession is a better strategy in scenarios like these. On the other hand, if the country is sensitive to reversed demand, a recession is not likely to be imposed and a more suitable alternative would be to let the currency depreciate.

Often, the difference between these two strategies depends on the country's banking system. Strong banking systems stand firm even in events of recessions as opposed to a weak banking

system which implies bankruptcies and hence even deeper economic distress in the country. The most severe affected countries during both the Mexican and the Asian crises suffered from weak banking systems. As can be read later, the main reason in these two cases was the fact that a financial liberation process was done too quickly and thus lacked a legal and supervisory security net. In the case of Mexico, it implied that the Central Bank hesitated to raise the interest rate to the appropriate level in order to bring an end to the depleted foreign exchange reserves.

According to Sachs et al [1996], the probability for international investors to experience capital losses increases if the country they chose to invest in suffers from an appreciated real exchange rate and a weak banking system.[10] If investors are aware of this and therefore chose not to invest in these countries "the government will implement a sharp nominal devaluation in order to bring about the necessary adjustment in the external accounts, thus justifying investors' expectations" (p. 155). This is not expected to arise if the country has strong fundamentals.

The ratio of gross reserves to short-term debt is also of significant matter if a country has a high net reserve ratio. Then a country with weak fundamentals does not necessarily mean capital losses for investors as the government then can chose to deplete the reserves in stead of depreciating the exchange rate. According to Sachs et al, if the country has high reserves a financial crisis does not occur.

A model can help explain the relationships. It assumes that capital withdrawals are consequences of a country's weak fundamentals; in this case, the banking sector is weak. Suppose a government has a fixed or pegged exchange rate with nominal exchange rate E_0 (i.e. domestic currency per unit of foreign currency) and real exchange rate $P/(E_0P^*)$. The government will have the exchange rate pegged as long as the foreign exchange reserves, R, is large enough to finance a capital outflow of K. The currency will not be devalued provided that $K \leq R$. However, if $K > R$, the currency will be devalued. If the latter occurs, the government will set up a target nominal exchange rate, E^t. Hence; if $K \leq R$, the exchange rate in period one will be equal to the exchange rate in period zero, i.e. $E_1 = E_0$. However, if $K > R$, the exchange rate in period one will be E^t. The size of currency devaluation is: $D = (E_1/E_0)$-

[10] In the study conducted later, this is referred to having weak fundamentals.

1. When K ≤ R there will not be a currency devaluation, implying that D in this scenario is equal to 0. On the other hand, if K > R and a devaluation occurs, D will be equal to: $(E^t - E_0)/E_0$.

The target nominal exchange rate E^t is selected based on a variety of parameters e.g. financial liberation and terms of trade. The most important factor to consider is the strength of the banking sector. When the banking sector is strong, E^t will be equal to the long-run real exchange rate called *e*. If the banking sector is weak or in a crisis, E^t will have a lower value than *e*, implying that the targeted real exchange rate is more depreciated than the long run real exchange rate. The reason being, that if the banking sector is weak the government is not keen on preserving the high interest rates in order to defend the exchange rate.

One way of measuring weakness of a banking sector is by looking at the recent lending propensity. If a lending boom (LB) of loans is prevailing, there is a risk that banks are having poor monitoring capabilities, implying there is a large share of weak borrowers in the lending portfolio. In situations like these, the targeted real exchange rate can be written:

$$E^t = e\, f(LB), \qquad f^{'} = (LB) > 0, \qquad f(0) = 1$$

To summarize, the real exchange rate can take two paths depending on the size of the Central Bank's reserves:

$$D = \begin{cases} \left(\frac{e}{E_0}\right) f(LB) & if\ \mathrm{K} > \mathrm{R} \\ 0 & if\ \mathrm{K} \leq \mathrm{R} \end{cases}$$

The interpretation if this being that devaluation of the currency occurs if investors and creditors withdraw more capital than the Central Bank has in its reserves. The size of the devaluation is largest in two alternative cases; either if the exchange rate is appreciated compared to the long-run average, i.e. e/E_0 is a high number, or if there has been a recent lending boom (LB high) in the country implying a weak banking sector. A weak banking sector due to e.g. lending booms or an appreciated exchange rate is not the only factor to consider for international creditors and investors. If the country has sufficient reserves, they can "balance" a situation with weak fundamentals and thus avoid capital withdrawals and subsequent devaluations since the government can use the reserves in order to compensate for the loss of capital. Knowing this clarifies the model used later in this thesis.

However, there is a risk of a multiple equilibria occurring due to the fact that capital volatility depends on the most likely performance of the exchange rate. A strange circularity arises because the probability of devaluation depends on whether creditors and investors withdraw capital or not. Capital withdrawal depends on the investors' and creditors' beliefs regarding devaluation. The risk of multiple equilibria itself is something to keep in mind when discussing a topic like this.

4. EMPIRICS

4.1 EXPLAINING THE MODEL

In a study from 1996, Sachs, Tornell and Velasco argued that many of the explanations offered subsequent to the Mexican crisis lacked a deeper understanding and the results were thus often trivial and entailed explanations that did not grasp the overall picture. In the paper from 1996, the authors tried to give the so called tequila effect a more robust explanation. The paper's focus was whether there were differences in fundamentals or signs of contagion explaining why the tequila effect affected some countries more than others.

In order to explain this, a model containing three aspects was developed; high real exchange rate appreciation, weak banking systems and scarce reserves.[11] The hypothesis claims it was only countries with weak fundamentals and low reserves that got hit by the contagion effect, i.e. small foreign exchange reserves, an overvalued real exchange rate and a weak banking sector. Countries with strong fundamentals were not as affected by the crisis since investors' withdrawal of money only lasted for a short period of time. According to the findings; "[…] a high ratio M2/Reserves, a high initial real exchange rate, and a significant increase in bank lending to the private sector before 1994 all tended to increase the crisis index in 1995." [Sachs et al p 3].

The authors wanted to test countries that were exposed to international capital flows and hence chose 20 emerging markets[12] that fulfilled this condition. Some countries were excluded though, e.g. China, Hungary and Poland as they at the time were transition economies, and Nigeria which lacked data. With an R^2-figure of roughly 70 percent, they

[11] Note that this model does not answer the question of the exact point in time when a financial crisis occurs.
[12] Argentina, Brazil, Chile, Colombia, India, Indonesia, Jordan, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, South Africa, Sri Lanka, Taiwan, Thailand, Turkey, Venezuela and Zimbabwe.

stated that the model accounts for the contagion phenomenon quite well. This section starts by explaining the variables used in the model and ends by describing the implementation phase.

4.1.1 Crisis Index

This is the dependent variable of the formula and entails the percentage change of both the depreciation rate of the domestic currency against the U.S. dollar and the percentage change of domestic foreign exchange reserves between the end of May 1997 and the end of each month up until the end of November 1997.

The idea behind this crisis index *(IND)* is if investors withdraw their capital, the Central Bank can respond by either letting the exchange rate depreciate or by defending the currency. The rationale for the former, passive response is that investors find the currency overvalued and depreciation is therefore an action to bring back the currency to its market value. The latter alternative implies either usage of the foreign exchange reserves and makes supporting purchases of the domestic currency, or to raise the country's interest rates in order to create an attractive investment climate. An interest rate change can not be a part of the index since it, according to the authors, does not exist any "reliable and comparable cross country interest rate data" (Sachs et al [1996] p 10). The index contains of reserves and exchange rates only.

This all sum up to the result that if IND is high, the country has either experienced sharp devaluation or plummeted reserves, which both is an indication of a contagion effect. The computed values of IND can be seen in Table 2.

4.1.2 Real Appreciation

In this variable called *RER,* the real exchange rate is calculated using a formula containing trade weights for the U.S., Japan and Germany together with the CPIs of these countries in relation to the specific country's CPI[13]:

$$Q = \frac{CPI_{domestic}}{w_{US} \cdot (CPI_{US} \cdot E_{US}) + w_{JP} \cdot (CPI_{JP} \cdot E_{JP}) + w_{DE} \cdot (CPI_{DE} \cdot E_{DE})}$$

[13] This formula is not explicitly stated in the article. The basic form: Q = P / (E P*) which e.g. Hall and Taylor [1997] uses.

Definition of nominal exchange rate (E) is domestic currency unit per foreign currency unit. This show a somewhat simplified picture over the world as the specific country only trades with the U.S., Japan and Germany. In the study by Sachs et al, the real exchange rate average between 1986 - 1989 and the average between 1990 - 1994 is calculated. Then the percentage change between these two figures is conducted and the RER-index is computed. For my study, I have used the average of 1991 - 1993 and 1994 - 1996 as time period.[14]

Sachs et al argued they preferred the real exchange rate *average* of 1990-1994 instead of using only 1994 because if contagion occurs, investors are likely to have left the country only if the currency has been overappreciated for an extended period of time.

RER's interpretation: high values (positive) imply that the real exchange rate has appreciated and small values (negative) imply that the real exchange rate has depreciated compared to the base period[15]. A contagion scenario strikes countries with high values of RER. The computed values of RER can be seen in Table 2.

4.1.3 Lending Boom

It is not easy to quantify how weak a banking sector is, since comparing cross-country bank balance sheets require data sources that do not exist (according to Sachs et al). However, by computing banks' vulnerability indirectly, the result can be analyzed. The underlying principle is that if banks' lending increase dramatically over a short period of time, they will not be able to do a detailed screening of the borrowers, which imply that the portfolio contains a large part of weak borrowers. Sachs et al explains it like this;

> *"High risk areas, such as credit cards and consumer and real estate loans, tend to grow more than proportionally in these cases of lending booms. In addition, regulators (particularly in developing countries) soon find their limited oversight capacity overwhelmed."* (p 11).

[14] Due to some countries lack of data, these intervals are shorter compared to the ones used by Sachs et al. However, I do not estimate the difference to be of significant matter for the study.
[15] The exchange rate appreciates some years before the crisis as capital flows in to the country. An initial currency appreciation hence indicates that large withdrawals can be made in the event of a future financial crisis.

In order to calculate whether a country has a strong or weak banking sector, I first calculate the ratio between the banking institutions' claims on the private sector[16] to GDP, i.e. B/GDP. The second step implies calculating the percentage change between the ratios which in the Sachs et al article was 1990 – 1994. For this study however, the corresponding years are 1992 – 1996 and the variable is named LB. The computed values of LB can be seen in Table 2.

4.1.4 M2/Reserves

As mentioned in section 4.1.1 if investors withdraw their capital and the Central Bank would like to intervene and defend the currency, one solution is to use the reserves in order to cover the liquid liabilities. These liabilities consist of two parts; direct liabilities i.e. the monetary base, and banks' liabilities. This implies that if banks' liabilities are a large part of the total liquid liabilities, the possible claims on the Central Bank increases. In a scenario where a large number of customers fear that the banks are insolvent and withdraw their deposits and the Central Bank does not defend the currency, there is a large risk of bankruptcies. In order to grasp how large capacity the Central Bank has to cover banks' losses, a measurement of reserve surpluses is necessary. According to Sachs et al, the proper way to do this is by calculating money supply (broad money, i.e. M2), to foreign exchange reserves. In the original study, this ratio was calculated for November 1994. The corresponding period for this study is June 1997 and the variable is named M2/R. The computed values of M2/R can be seen in Table 2.

4.2 IMPLEMENTATION

In order to implement the model, I have to classify countries as having strong or weak fundamentals and high or low reserves by organizing RER, LB and M2/R according to predetermined critical levels. If a country has strong fundamentals i.e. a low value of RER (i.e. real exchange rate has not appreciated) and a low value of LB (i.e. no lending boom) and at the same time also show high reserves (i.e. low value of M2/R), the country is not a target for capital withdrawal and speculative attacks[17]. In addition, if fundamentals are strong but

[16] This notation comes from the IMF database. Please see the data appendix for further descriptions.
[17] Note that both RER and LB is considered when it comes to fundamentals. Strong fundamentals only apply if both RER and LB is low. Any other combination of the two implies having weak fundamentals.

reserves are low, the country is still not considered vulnerable. *It is only when both fundamentals and reserves are vulnerable a country is likely to suffer from withdrawals and currency collapse.*

Since the critical levels used by Sachs et al are not explicitly stated, I have to do some experimentation in order to find the appropriate levels. I started from the fact that Sachs et al classified thirteen of the twenty countries as vulnerable. I strove for similar results as it seemed reasonable[18]. I initially classified countries as having strong fundamentals if their values of both RER and LB were in the lowest quartile of the sample. Otherwise, weak fundamentals are prevailing. This implied that nearly all countries ended up having weak fundamentals. I narrowed the classification in order to get a more realistic result and ended up with following:

- Weak fundamentals → highest quartile of both RER and LB
- Low reserves → highest quartile of M2/R

These levels deemed fourteen of the nineteen countries as being vulnerable to capital withdrawals and currency attacks. The exposed countries are: Sri Lanka, Philippines, Peru, Thailand, Colombia, Turkey, Malaysia, Indonesia, Chile, South Africa, Pakistan, India, Brazil and Venezuela. Five countries were considered not vulnerable: Zimbabwe, Jordan, Korea, Mexico and Argentina.

A dummy variable is created for weak fundamentals where $D^{WF} = 1$ implies weak fundamentals while $D^{WF} = 0$ implies strong fundamentals. A dummy is also created for the reserves ratio with $D^{LR} = 1$ being equal to having low reserves and $D^{LR} = 0$ is equal of having high levels of the reserves.

In order to test whether the crisis index IND can be explained by levels of RER, LB and M2/R the following equation is used:

$$IND = \beta_1 + \beta_2 \cdot RER + \beta_3 \cdot LB + \beta_4 \cdot \left(D^{LR} \cdot RER\right) + \beta_5 \cdot \left(D^{LR} \cdot LB\right) + \beta_6 \cdot \left(D^{LR} D^{WF} \cdot RER\right) + \beta_7 \cdot \left(D^{LR} D^{WF} \cdot LB\right) + \varepsilon$$

[18] I am aware of the fact that the result might end up being different depending on which classification I chose to make. However, I do not estimate my classification being unrealistic. In addition, I am not aware of any alternative solution to the problem.

β_2 and β_3 show the effect countries with high reserves and strong fundamentals have on IND. In line with the model, these coefficients are equal to zero. $\beta_2 + \beta_4$ and $\beta_3 + \beta_5$ show what will happen if a country has low reserves but strong fundamentals and vice versa. It is assumed in the model that $\beta_2 + \beta_4 = \beta_3 + \beta_5 = 0$ since this combination of variables does not imply capital withdrawals and subsequent attacks. Finally, $\beta_2 + \beta_4 + \beta_6$ and $\beta_3 + \beta_5 + \beta_7$ show what will happen when both fundamentals are weak and reserves are low. In this situation, $\beta_2 + \beta_4 + \beta_6$ should be negative meaning that if the real exchange rate has depreciated in May 1997, it implies a smaller value of IND. In addition, $\beta_3 + \beta_5 + \beta_7$ should be positive as a large lending boom should increase the value of IND.

Results from the regression can be seen in Table 3 where the dependent variable IND differs over a six month period. To begin with, only one coefficient turned out to be significant at ten percents level and that was the intercept for the December values. The highest R^2 value is roughly 27 percent and obtained for the July figures which represent the shortest time period of only two months.

To confirm the result a t-test is used, in order to test the different hypotheses the model predicts. The test statistic used is the following with (n - k) degrees of freedom (Edlund [1997] p. 164);

$H_0 = \beta_2 + \beta_3 = c$

$$t = \frac{\left(\hat{\beta}_2 + \hat{\beta}_3\right) - c}{\sqrt{\hat{\text{var}}\left(\hat{\beta}_2\right) + \hat{\text{var}}\left(\hat{\beta}_3\right) + 2 \cdot \hat{\text{cov}}\left(\hat{\beta}_2, \hat{\beta}_3\right)}}$$

By conducting a t-test, it is clear that all hypotheses are rejected at a 10 percents level. To be able to compare results, the figures received by Sachs et al are shown in Table 4.

To sum up, the model does a poor job explaining the Asian crisis. The reason is threefold; first of all, only one coefficient was significant at ten percent and this was the intercept. Second, R^2-values are not high enough to be of significant matter. Third, by computing a t-

test, it is clear that no hypothesis even comes close of being significant. Hence, in the case of the Asian crisis, the model does not show a result satisfying enough to conclude that it can be used as a warning indicator for future contagion in emerging markets.

5. CONCLUSION

Even though important similarities between the Mexican and the Asian crises prevailed, the model used by Sachs et al can not be applied when explaining the Asian crisis. This does not imply that all models based on macroeconomic fundamentals should be rejected. It is likely that another model with a different composition of explanatory variables indeed can be useful. As discussed in part 2.1 this is one of the main obstacles when it comes to receiving consensus in contagion theory.

As already discussed, Thailand was one of the worst affected countries in the Asian crisis. It was there it all started. Meanwhile, when looking at Table 1 Thailand does not seem to be as affected as it truly was. Even though Thailand's IND value is the second highest (roughly 77 percent implying either high devaluation or plummeted reserves), neither the real exchange rate RER nor the lending boom LB show signs of a crisis since these values are surprisingly low. The same goes for Indonesia, Korea and Malaysia whose values of RER and LB also are low. On the other hand, their values of IND are according to the expectations i.e. rather high. The only country showing expected values are the Philippines which has high values of both RER and LB. The third explanatory variable, M2/R is hard to interpret since it is not convincing in either way. The five Asian countries all have values of roughly five in there reserves ratio.

Knowing that countries in the Asian area all experienced financial liberation processes with subsequent increased lending, I expected their values of a lending boom to be higher. The same argument can also be applied on the real exchange rate since previous studies have shown that international capital poured into these countries thanks to e.g. strong economic growth. This should have caused the real exchange rate to appreciate substantially prior to the crisis however, that development is not captured by Table 1.

Thus, my final evaluation of the model can be divided in two parts. First, when considering the figures of above all RER and LB, I am not surprised the R^2 levels turned out to be low. On the other hand, the explanatory variables per se are neither unrealistic nor improper considering research of the Asian crisis. With the latter in mind I am actually a bit surprised that the model had such low explanatory power.

The true reason so many investors and creditors simultaneously decided to withdraw their capital from Asia is hard to deliver a uniform answer to. It can very well be a combination of all suggestions given in the theory section 2.2 above. A portfolio trustee, an industry investor or a creditor does not want to loose money. This is of course the essential cause behind the withdrawals. The factor regarded as most significant when it came to the possibility of the crisis spreading outside of Thailand is unclear. One investor may have decided it was time to leave due to the weak banking sector all countries experienced. Another trustee may have regarded higher interest rates in other parts of the world as the incentive for leaving while a third actor may have left simply because the other two did. The individual decision taken by investors and creditors regarding why money was withdrawn require a qualitative study of the investors' specific reasons, a scope beyond the aim of this thesis. What can be agreed upon however, is that many Asian countries shared specific similarities and ties which implied a more vulnerable and exposed position.

One also have to bare in mind that prior to the Mexican crisis, international creditors had not experienced contagious crises of this dimension. Hence, at that stage maybe herding behaviour as we know it today did not play a major role since investors did not know how extensive the Mexican crisis finally became. The Asian crisis happened just one year later which implied creditors having the Mexican crisis in fresh memory. Hence, maybe pessimistic market expectations implied that e.g. Mullainathan's explanation regarding associativeness[19] is not far away from the truth. Maybe creditors did overestimate the probability of a contagion effect since a similar scenario happened in Mexico just two years earlier.

[19] i.e. that the memory recalls previous events if similarity prevails between two events

APPENDIX

DATA APPENDIX[20]

Index

The crisis index consists of two parts; depreciation and the changes in reserves. The depreciation is calculated as the change in the average exchange rate (called rf in the IFS database) between June 1997 and the end of each following month up until January 1998. The other part of the index contains the change in foreign exchange reserves (line 1.d.d in IFS) between May 1997 and January 1998.

M2 over Reserves

I calculated M2/R for June 1997 because the Asian crisis started in the beginning of July. Total Reserves refers to Total Reserves minus Gold (line 1 ld). To calculate M2 I used the sum of Money (line 34) and Quasi Money (line 35). Some countries had M2 figures available but in order to get a homogeneous result, I decided to calculate M2 in the same way for all countries i.e. by using the former description. The average exchange rate (rf) was used in order to convert Money and Quasi Money to US dollars.

Lending Boom

I calculated the change in B/GDP between 1992 and 1996. As argued by Sachs et al, if bank lending increase roughly over a short period of time, the banks' capacity to screen borrowers and projects decline and therefore there is a large part of weak borrowers in the portfolios. 1992 to 1996 were chosen since countries with weak banking sectors should have increased their lending over these years. The lending boom ratio is calculated in two steps; first, Claims on Private Sector (line 32d) over GDP (line 99b) is received. I used the average nominal exchange rate (rf) in order to convert them to US dollar. The last step entails calculating the change in the B/GDP-ratio between 1992 and 1996.

Real Exchange Rate Appreciation

This figure is calculated in several steps; first, I calculated trading weights of the U.S., Japan and Germany using their respective GDP-figures (line 99b). This weight sum to one and represent a country's bilateral trade shares between the U.S., Japan and Germany. The second step is to calculate the change in real exchange rate depreciation between the average of 1991-1993 and 1994-1996 respectively. In order to calculate the real exchange rate, I used the aforementioned formula:

$$Q = \frac{CPI_{domestic}}{w_{US} \cdot (CPI_{US} \cdot E_{US}) + w_{JP} \cdot (CPI_{JP} \cdot E_{JP}) + w_{DE} \cdot (CPI_{DE} \cdot E_{DE})}$$

I used the average nominal exchange rate (rf) and CPI (line 64) when calculating the real exchange rate. The last step is to calculate the percentage change between the two time

[20] To be able to compare how well the model fits for the Asian crisis, I follow the same criteria as Sachs et al

periods. Sachs et al had longer time periods (five and four years) however, due to the lack of data; I had to shrink the time period interval to three years on both periods.

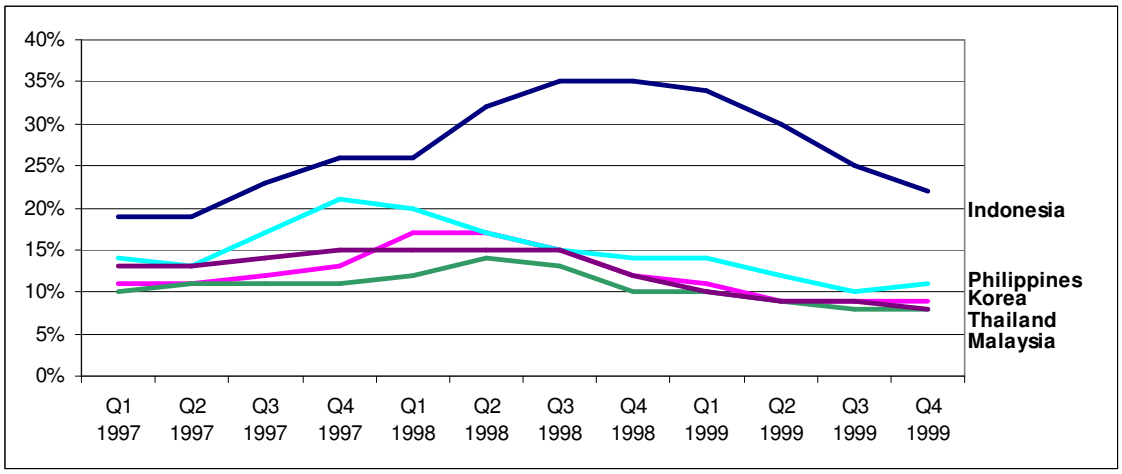
TABLES AND GRAPHS

Table 1: External financing in five Asian emerging markets [21](Billion USD)

	1994	1995	1996	1997	1998	1999
Current Account Balance	-24.6	-41.3	-54.6	-26.3	58.5	43.2
Net External Financing	47.4	80.9	100.6	28.8	-0.5	-1.2
Net Private Flows	40.5	77.4	103.2	-1.1	-28.3	-4.8

Source: Perkins, Radelet, Snodgrass, Gillis and Roemer [2001] page 557.

Graph 1: Depreciation rate against USD



Definition:
Respective country's percentage change in domestic currency against USD between the middle of quarter 1 and the middle of each quarter up until the middle of quarter 4 1999.

[21] South Korea, Indonesia, Malaysia, Thailand and the Philippines

Table 2: Crisis indicators

	Crisis index IND[I]	Real appreciation RER[II]	Lending Boom LB[III]	Reserves ratio M2/R[IV]
Argentina	-4.780	9.164	30.448	3.578
Brazil	-15.666	32.500	-47.843	3.177
Chile	-9.481	12.765	20.512	1.847
Colombia	23.146	35.655	49.241	1.903
India	6.886	-5.869	-5.032	7.508
Indonesia	60.581	5.312	21.791	6.223
Jordan	-45.293	-1.500	24.058	4.306
Korea	56.432	3.597	2.911	6.197
Malaysia	57.102	4.394	27.820	4.907
Mexico	-5.596	-16.831	-32.953	5.366
Pakistan	-14.942	-1.779	4.557	20.875
Peru	-3.017	5.807	129.672	1.431
Philippines	47.088	15.719	139.593	4.934
South Africa	-10.350	-7.622	8.169	17.900
Sri Lanka	-15.529	3.990	229.562	2.941
Thailand	77.687	5.958	49.474	5.220
Turkey	29.697	-17.196	30.074	3.104
Venezuela	-12.420	9.494	-56.281	0.924
Zimbabwe	103.820	-0.417	22.223	4.677

Figures from the International Financial Statistics.

Explanation:

I. **IND:** Percentage change in devaluation rate against USD and percentage change in foreign exchange reserves. Time period: between end of May 1997 and the end of each month up until the end of November 1997. A high value indicates high devaluation or plummeted reserves. Figures are given in percent.

II. **RER**: The real exchange rate is calculated using a formula containing trade weights for the U.S., Japan and Germany together with the CPIs of these countries in relation to the specific country's CPI. The trade weights are equal to one and represent the specific country's trade share with US, Japan and Germany. The formula contains of a percentage point change between the average of 1991 to 1993 and the average of 1994 to 1996. A high value implies appreciation against base period which increases the risk of contagion. Figures are given in percent.

III. **LB**: Percentage change between 1992 and 1996 regarding the size of the claims of the banking sector on the private sector to GDP. A high value indicates soared bank lending which imply a vulnerable banking sector. Figures are given in percent.

IV. **M2/R**: Ratio of broad money (M2) to foreign exchange reserves in June 1997. A high value indicates low foreign exchange reserves and thus a more exposed position to self-fulfilling panics among investors i.e. if the *stock* of M2 >> stock of foreign exchange reserves → attack on the currency.

Please, see the Data Appendix for further definitions and calculations.

Table 3: Explaining the Crisis Index (IND) for the Asian crisis 1997

Dependent variable: Crisis Index

Independent variable:	May -97 to ***July***	May -97 to ***Aug***	May -97 to ***Sept***	May -97 to ***Oct***	May -97 to ***Nov***	May -97 to ***Dec***
Constant ($\hat{\beta}_1$)	0.040	0.047	0.071	0.078	0.222	0.434
	(0.054)	(0.103)	(0.117)	(0.138)	(0.162)	(0.215)*
RER ($\hat{\beta}_2$)	0.790	0.717	0.509	1.228	1.891	4.877
	(1.253)	(2.391)	(2.707)	(3.184)	(3.735)	(4.973)
LB ($\hat{\beta}_3$)	-0.361	-0.187	0.064	-0.216	-0.389	-1.317
	(0.455)	(0.868)	(0.982)	(1.155)	(1.355)	(1.805)
RER D^{LR} ($\hat{\beta}_4$)	2.413	3.363	3.289	4.317	4.857	9.283
	(1.633)	(3.116)	(3.528)	(4.150)	(4.868)	(6.482)
LB D^{LR} ($\hat{\beta}_5$)	-0.608	-0.019	0.164	0.695	0.226	0.442
	(0.722)	(1.378)	(1.561)	(1.836)	(2.153)	(2.867)
RER D^{LR} D^{WF} ($\hat{\beta}_6$)	-0.824	-0.737	-0.389	-0.871	-1.961	-5.373
	(1.355)	(2.586)	(2.928)	(3.445)	(4.040)	(5.380)
LB D^{LR} D^{WF} ($\hat{\beta}_7$)	0.405	0.194	-0.057	0.227	0.365	1.254
	(0.445)	(0.850)	(0.962)	(1.132)	(1.328)	(1.768)
Summary:						
R^2	0.269	0.123	0.124	0.200	0.122	0.226
Adjusted R^2	-0.096	-0.315	-0.314	-0.200	-0.317	-0.161
Null Hypotheses	**p values**					
$\hat{\beta}_2 + \hat{\beta}_4 = 0$	0.19	0.36	0.45	0.35	0.34	0.14
$\hat{\beta}_2 + \hat{\beta}_4 + \hat{\beta}_6 = 0$	0.15	0.28	0.32	0.25	0.32	0.17
$\hat{\beta}_3 + \hat{\beta}_5 = 0$	0.33	0.91	0.91	0.84	0.95	0.81
$\hat{\beta}_3 + \hat{\beta}_5 + \hat{\beta}_7 = 0$	0.46	0.93	0.91	0.83	0.93	0.90

* Significant at 10% level

Explanation:

Crisis Index (IND) is the dependent variable. D^{LR} represents a dummy variable for low reserves. It is equal to one for countries having their M2/R in the highest quartile of the sample. D^{WF} represents a dummy variable for weak fundamentals. It is equal to one for countries with values of both RER and LB in the highest quartile of the sample. The parenthesis contains standard errors.

Table 4: Explaining the Crisis Index (IND) for the Mexican crisis 1995

Dependent variable: Crisis Index (IND)

Independent variable	Nov 94 to Jan 95	Nov 94 to Feb 95	Nov 94 to Mar 95	Nov 94 to Apr 95	Nov 94 to May 95	Nov 94 to June 95
Constant ($\hat{\beta}_1$)	-21.927	-21.198	-27.783	-37.039	-32.179	-35.735
	(33.116)	(30.341)	(41.622)	(36.678)	(33.577)	(37.724)
RER ($\hat{\beta}_2$)	-3.540	-3.818	-5.171	-6.393	-6.992	-8.779
	(2.420)	(2.343)	(3.046)	(2.727)	(2.723)	(3.665)
LB ($\hat{\beta}_3$)	1.026	1.098	1.450	1.770	1.739	1.973
	(0.865)	(0.805)	(1.071)	(0.950)	(0.931)	(1.143)
RER D^{LR} ($\hat{\beta}_4$)	3.328	3.692	5.026	6.165	6.774	8.339
	(1.948)	(1.969)	(2.486)	(2.276)	(2.321)	(3.435)
LB D^{LR} ($\hat{\beta}_5$)	-4.041	-4.427	-5.565	-6.835	-6.342	-6.730
	(3.601)	(3.287)	(4.507)	(3.954)	(3.655)	(4.028)
RER D^{LR} D^{WF} ($\hat{\beta}_6$)	1.442	1.577	3.401	2.886	2.821	2.014
	(1.407)	(1.354)	(1.695)	(1.542)	(1.283)	(1.623)
LB D^{LR} D^{WF} ($\hat{\beta}_7$)	5.573	6.053	8.232	8.895	7.998	8.700
	(4.121)	(3.827)	(5.100)	(4.407)	(3.909)	(4.507)
Summary						
R^2	0.516	0.564	0.665	0.690	0.714	0.675
Adjusted R^2	0.292	0.363	0.510	0.546	0.583	0.512
Null Hypotheses			**p values**			
$\hat{\beta}_2 + \hat{\beta}_4 = 0$	0.71	0.81	0.84	0.72	0.71	0.51
$\hat{\beta}_2 + \hat{\beta}_4 + \hat{\beta}_6 = 0$	0.38	0.26	0.05	0.07	0.03	0.34
$\hat{\beta}_3 + \hat{\beta}_5 = 0$	0.30	0.21	0.26	0.12	0.13	0.16
$\hat{\beta}_3 + \hat{\beta}_5 + \hat{\beta}_7 = 0$	0.14	0.11	0.07	0.04	0.03	0.95

Source: Sachs et al [1996] page 165.

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