MODEL OF FINANCIAL RISK CONTAGION IN THE GLOBAL FINANCIAL MARKETS

Evaldas Račickas[1], Asta Vasiliauskaitė[2]

[1]*Kaunas University of Technology, Lithuania, evaldas.racickas@gmail.com*
[2]*Kaunas University of Technology, Lithuania, asta.vasiliauskaite@ktu.lt*

Abstract

The study of financial risk contagion is growing in importance with the expanding global scope of financial markets. From the end of the twentieth century, more and more linkage in financial crisis is accompanied with the globalization of economy and finance. Financial contagion refers to a scenario in which small shocks, which initially affect only a few financial institutions or a particular region of an economy, due to the rapid development of the globalization in economy and finance, spread to the rest of financial sectors and other countries whose economies were previously healthy. The mechanism through which financial risk from one country or economic sector is transmitted to other country or economic sector is very different.

In this article the mechanism of financial risk contagion process is analyzed, the ways of financial risk contagion are emphasized and the model of financial risk contagion in the global financial markets is presented. The main finding about financial contagion is that countries do not need to be linked directly by macroeconomic fundamentals in order to transmit shocks. There are a lot of other different channels of financial risk contagion by which a shock can be transmitted and a crisis can spread to other countries.

Keywords: financial crisis, financial risk, financial contagion, contagion channel, market shock, financial integration, debt, banks, mortgages.

JEL Classification: F34, F36, G01, G10, G15, G21.

Introduction

The latest global financial crisis triggered by the credit crisis in the USA as its epicenter, quickly spread across the globe. The crisis starts spreading around the world in the middle of 2007 and along the 2008, where stock markets in major economies fell, followed by collapses of large companies and leading financial institutions. In a world where economies are integrated, the spread of such crisis due to the phenomenon of financial risk contagion is unavoidable.

A poor understanding of the transmission of economic and financial crises has in the past few years prompted a surge of interest in international economic integration and its relationship to international financial contagion. There are several branches of literature explaining the mechanism of financial contagion. One branch of them (Claessens, 2001; Abeysinghe & Forbes, 2002; Rigobon, 2002; Kali & Reyes, 2009; Abd Majid & Hj Kassim, 2009) emphasizes contagious currency crises, relating such crises to various monetary and financial sector vulnerabilities and trade factors. These studies often look for the underlying causes behind a simultaneous set of speculative attacks. The second branch of literature (Bae *et al*, 2003; Kaminsky & Reinhart, 2003; Pritsker, 2004; Clark *et al*, 2009; Cheung *et al*, 2010) explains contagion transmission as a result of linkages among financial institutions. This type of contagion is often described by general equilibrium model which explains how a small liquidity preference shock in one of the financial intermediary due to the linkages among financial institutions can spread throughout all the other financial institutions in that region and thus destabilize the whole economy. The debate on the relative importance of trade linkages versus financial flows continues to be unresolved. However, both groups of researchers agree that it is difficult to separate these two ways of financial contagion, because most countries that are linked in trade are also linked in finance. Finally, the third branch of literature explaining the mechanism of financial contagion emphasizes financial contagion among financial markets. This stream of researches tries to explain contagion through correlated information or correlated liquidity shock channel.

The aim of this paper is to reveal the theoretical aspects of financial contagion, to examine the main ways of financial shock transmission from one country's financial market that causes changes in asset prices in another country's financial market and to construct the general model of financial risk contagion in the global financial markets.

Research methodology: In this article systematic and comparative analysis of scientific literature is done, statistical data analysis is presented and various visualization techniques are used.

The concept of financial risk contagion

In scientific literature there is still no firm consensus among the economists and scientists on the appropriate definition of financial contagion. Borrowing from epidemiological terminology, contagion is intrinsically associated with a spread of diseases, with a probability of an even more dismally consequences of death. Contagion was often used as a synonym for the Bubonic Plague in Europe as late as the 19th century. The term also implies, at least to some, that those who are affected by the financial crises do so through no fault of their own. However, this idea is strongly resisted by some analysts: speculators appear to discriminate in choosing the countries they attack (Dungey & Tambakis, 2003).

As a usefull benchmark, the World Bank has restrictively defines financial contagion as a cross-country transmission of shocks or the general cross-country spillover effects. This follows Eichengreen & Rose (1995) and Eichengreen, Rose & Wyplosz (1996), who propose that contagion refers to the association of excess returns in one country with excess returns in another country after controlling for the effects of fundamentals.

Meanwhile, Dornsbusch (2000) defines contagion as a significant increase in cross-market linkages after a shock to an individual country (or group of countries). This definition highlights that there are many links through which shocks are transmitted in normal times from one country to another, including trade and financial links. The ways in which shocks are transmitted do seem to differ, however, during times of crises. Empirical work has helped identify the type of links and other macroeconomic conditions, which can make a country vulnerable to contagion during such crisis periods, although less is known on the importance of microeconomic conditions and institutional factors in propagating shocks. Thus it has helped to identify those countries which are at risk of contagion and some, albeit quite general, policy interventions which can reduce the risks.

As the difficulties in deriving a unique definition of contagion, and financial contagion in particular, already make apparent, contagion is a very broad field of study, which depends on (partly) very different strands of literature. To systemise it, one may distinguish between different categories, into which the contagion literature can be classified.

- The market or channels of financial contagion concerned,
- The way contagion emerges,
- Theoretical versus empirical approach.

One distinction focuses on the channels of financial contagion. Huang (2000) calls them the ABC channels of financial contagion, meaning the asset market channel, the banking channel, and the currency channel. A similar categorisation is made by Pritsker (2001), that studies contagion via real sector linkages, financial market linkages, and through the interaction of financial institutions and financial markets.

As a matter of these various channels through which certain risks can spread, also the mechanism that provokes the emergence of contagion will differ. Thus, another possibility to classify the contagion literature is the way the risk is transferred. A common way is to distinguish between fundamental causes, e.g. common shocks, trade linkages or financial linkages, and investors' behaviour, which is based on liquidity problems, informational asymmetries; investor reassessments, etc. (Claessens & Forbes, 2004). One may also make a distinction between the literature that analyses the risk of a financial shock to cause a simultaneous failure of a set of markets or institutions and the literature that focuses on the risk that the failure of one (or more) institutions will be transmitted to others due to explicit financial linkages (Furfine, 2003).

Aharony & Swary (1983) classify contagion effects into pure and signalling or information-based effects. Pure contagion contains all events that spread across institutions, irrespective of the cause of the event. Signalling contagion effects, on the other hand, contain events whose revelation is correlated across the industry or market. Such a signal may be the failure of a financial institution. For instance, a failure of a credit institution may indicate a bad condition of the overall economy. Bank debt holders will, therefore, take account of this circumstance in their interaction with banks, i.e. they will require higher interest rates on their deposits and, thus, raise the borrowing costs of these institutions. On the other hand, good performance of the market players may be interpreted as a sign for a healthy economy.

A different way, to distinguish contagion effects, is to classify them into direct and indirect effects. While direct contagion concerns events that give rise to immediate loss or exposure, indirect contagion results in changes in others' behaviour, which in turn may cause consequential loss or exposure. Hence, direct contagion is always concerned with an obligation that cannot be met by the primary entity and, this has immediate consequences for the affected entity in the form of a pecuniary loss. In particularly adverse instances those events may even trigger chain reactions (i.e. domino effects), provoking the failure of other

entities. This chain reaction is then associated with contagion. The infection of these companies, however, does not have any direct relation to the initial shock, e.g. a liability that cannot be met. The exposure simply comes from the linkage between the entities.

In contrast, when contagion is indirect the affected entity suffers no immediate loss, as a result of liabilities or difficulties of the emanating entity, but due to the prospected change in behaviour of other agents. The consequences cannot be directly referred to the original event, even if it was the main trigger of these adverse reactions, that is, without the event one would not have seen any reactions. For instance, bad news from one institution leads to the conclusion that other institutions are also in trouble. Such reputation risk is manifest in risks becoming correlated and, therefore, can be seen as a matter of self fulfilling prophecy.

Lastly, the literature can also be grouped into those papers with a theoretical focus – both positive and normative – and those that intend to show contagion empirically, by using a large set of different statistical methodologies for the analysis of prominent financial crises, e.g. the Russian or Brasilian crisis, the Southeast Asian crisis, etc. or events, such as the terrorists attacks on the 11th September or the failure of Long Term Capital Management (e.g. Bae *et al.*, 2003).

Despite the variety of approaches to the definition of financial risk contagion, the consequences of financial contagion are always the same. The shock originated in one country due to the rapid process of financial markets' globalization very quickly spreads to other country and becomes a cause of financial crisis occurrence.

The channels of financial risk contagion in the global financial markets

The mechanism through which a shock can be transmitted from one country to the other is very complicated and can differ during the term of particular crisis. Therefore, in order to examine the process of financial risk contagion it is important to determine the individual channels through which contagion might occur. The knowledge of financial contagion mechanism provides more insight on exactly why a crisis in one country affects other countries, and has recently been the most popular approach used in academic studies. Some of the most recent work in this area has also used firm-level data to examine the exact channels through which crises spread. Since many cross-country linkages through trade and financial channels are highly correlated, focusing on microeconomic data permits a more concise identification of the various channels through which contagion can occur.

In the financial risk contagion mechanism the main economic units are the real sectors, the financial markets, the banks and the non-bank financial market participants. The linkages among these economic units are used in order to derive the contagion channels.

1. ***Real sector.*** Ideally, the real sector linkages should be derived from an open economy model of the world macroeconomy. All potential financial market participants can trade in all markets. Therefore the attributes of the financial markets such as the actual prices of the assets in one market, the liquidity of the market, and the extent to which the prices reflect the true values of the assets are very related. Conditions in financial markets affect real sector GDP for three potential reasons. First, the price of assets affects national wealth, and hence aggregate demand. Second, the liquidity of financial markets and the price of the assets affect businesses desire and ability to raise money for investment. This has implications for aggregate demand today and for aggregate supply in the future. Banks are very important economic units for their ability and willingness to finance investments in the economy whereas the GDP of the real sectors of the other countries stays significant because of the effect that other countries GDP has on net exports for primary country. Finally, the monetary, fiscal, and exchange rate policies of a country also influence GDP through their effect on aggregate demand in that country.

2. ***Financial Markets.*** The assets that trade on the market of a country are claims on the cash flows of the real sector. In a world with complete and perfect markets, the price of the assets should depend only on how the cash flows covary with consumption, and there should be no need for financial intermediaries. However, because there are market imperfections, intermediaries play an important role in lending funds (banks), underwriting security issues (investment banks), providing liquidity in markets (securities broker/dealers and market markets), and in spreading risks towards those investors most willing to bear them (hedge funds and mutual funds). Therefore, the prices and liquidity of financial markets are potentially affected by the capital position of these intermediaries relative to their risks. For example, banks with low capital

relative to risk may be less willing to purchase risky securities or extend credit to others for doing so, potentially impairing market liquidity. The financial position of non-bank financial market participants (NBFMP) relative to their risks may also affect securities prices. Specifically, if NBFMP are unable to assume risks that securities broker/dealers can only hold temporarily, then broker/dealers may be less willing to take on risk, reducing liquidity. NBFMPs may affect markets for a different reason: If they hit hard constraints on borrowing, they may be unable to provide further liquidity, and may become liquidity demanders if they are forced to sell a large amount of securities over a short amount of time.

3. *Banks.* Banks take deposits and extend loans to financial and non-financial firms. The value of the bank's assets potentially depends directly on the real sector of each country because whether the country is in recession or not affects the likelihood of defaults by its debtors. The bank's liability base depends on the financial health of other banks that have deposits with it because these deposits might be withdrawn when those banks face financial distress. The value of the bank's assets and liabilities also depend on the prices and liquidity in financial markets because the value of banks' assets and liabilities fluctuate with market prices, and because banks are brokers and dealers in many markets. To the extent that banks also make deals with NBFMPs, the value of the bank's financial position and its risk is also tied to the financial performance of NBFMPs.

4. ***Non-bank financial market participants.*** Non-bank financial market participants (NBFMP) take funds from the general public, and borrow from banks, in order to invest in financial markets. Their ability to attract funds for investment depends on their own financial position as determined by the assets they hold, and financial market prices. Besides, their ability to borrow also depends on the willingness of banks and the general public to extend credit, or to place funds under management with an NBFMP. Finally, the NBFMPs financial position also depends on NBFMP-specific influences such as the skill of the management team, and the NBFMP's reputation and track record.

The framework of potential interlinkages provide for a large number of channels through which a shock in one place, or to one type of economic unit can be transmitted to others. The model of shocks transmission can be applied as proceeding along chains, i.e. the shock begins with one economic unit. It then spreads to a first set of economic units that are linked with it, and then to a second set of economic units that are linked to the first set, and so on. In scientific literature all of the analysis attention is restricted to transmission chains that involve only a small number of links. This is with little loss of generality because longer chains will mostly contain repetition of the connections that can be explored in the shorter chains.

When constructing model of financial risk contagion it is very important to define the main indicators that could evaluate the occurrence of financial crisis due to its contagion from the original ground-zero country to the other appropriate financial crisis possessed country.

Financial crisis indicators

With increasing globalization and financial integration, occurrence of financial crises and their transmission from one country to another become more and more arguable issue. The main field in the scientific literature among researches is how to determine whether a country is actually facing a crisis, isolated incidents, or just economic noise. Many scientists (Kaminsky *et al.*, 1998; Berg & Pattillo, 1999; Kamin *et al.*, 2001; Edison, 2003; Dermirgüç-Kunt & Detragiache, 2000; Eichengreen & Arteta, 2000; Lanoie & Lemarbre, 1996; Marchesi, 2003; Lestano *et al.*, 2003; Kaminsky & Reinhart, 2009; Reinhart & Rogoff, 2009; Rose & Spiegel, 2009), exploring the phenomenon of financial risk contagion and herewith financial crisis contagion in the global financial markets, search the main indicators that could indicate the presence of financial crisis in the country. These researchers have quantifiably demonstrated that there are several indicators, each with relative correlation to the incidence of a financial crisis.

The empirical studies summarized in Table 1 share the idea that it is possible to identify a number of domestic and external macroeconomic fundamental indicators as the main determinants of a financial crisis. Some explanatory variables are exclusive for currency crises, banking crises or debt crises; others are informative for more than one type of crisis. The first two columns in the table list the indicator and a brief summary of its economic interpretation. The last column lists the reference.

Seven variables are grouped as external sector indicators, five of which are related to the current account and two to the capital account. These variables are certainly affected not only by domestic economic conditions and policies, but also by global conditions such as fluctuations in the US dollar, international

capital flows and commodity prices. The second group contains 16 indicators, nine financial indicators and seven domestic real and public sector variables that are partly or fully driven by economic policy. Finally, three global indicators reflect major economic shifts in industrial countries and movements of oil prices which may trigger a crisis. Some indicators are multiple crises indicators in the sense that the same indicator hints at more than one type of financial crises. However, it is not sure whether such a multiple crises indicator affects the probability of two or more types of financial crises simultaneously, or whether it triggers one type of crisis which in turn rolls over to a second type of crisis, and a third. Usually it is difficult to separate currency, banking and sovereign debt crisis. Often, these types of financial crisis are closely intertwined and escalate from one to another. For instance, a drop in international competitiveness may result in a currency crises as a result of which a banking crises evolves. Our model allows for one indicator to affect two or more types of crises.

Table 1. Indicators of financial crises

Financial contagion indicator	Interpretation	Reference
External sector (current account)		
Real exchange rate	A measure for the change in international competitiveness and a proxy for over(under)valuation. Overvalued real exchange rate is expected to produce higher probability of financial crisis.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Kamin *et al.* (2001); Edison (2003); Dermirgüç-Kunt & Detragiache (2000); Eichengreen & Arteta (2000); Baig & Goldfajn (1999); Berg (1999); Perry & Serven (2004); Reinhart & Rogoff (2009); Tobin (1998)
Export growth	An indicator for a loss of competitiveness in international good market. Declining export growth may be caused by an overvalued domestic currency and hence a proxy for currency overvaluation. On the other hand, if export growth slows due to reasons unrelated to the exchange rate, this may cause devaluation pressure. In both cases, declining export growth can be a leading indicator for a sizeable devaluation.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003); Marchesi (2003); Berg (1999); Goldstein (1998); Reinhart & Rogoff (2009); Reinhart et al. (2000); Lestano et al. (2003)
Import growth	Weak external sector is part of currency crises. Enormous import growth could lead to worsening in the current account and have been often related with currency crises.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003); Berg (1999); Reinhart *et al.* (2000)
Terms of trade	Increases in terms of trade should strengthen a country's balance of payments position and hence lower the probability of crisis. Terms of trade deteriorations may precede currency crisis.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Kamin *et al.* (2001); Berg (1999); Dermirgüç-Kunt & Detragiache (2000); Lanoie & Lemarbre (1996); Reinhart *et al.* (2000)
Ratio of the current account to GDP	A rise in this ratio is generally associated with large external capital inflows that are intermediated by the domestic financial system and could facilitate asset price and credit booms. Increases in the current account surplus are expected to indicate a diminished probability to devalue and thus to lower the probability of a crisis.	Berg & Pattillo (1999); Kamin *et al.*(2001); Eichengreen & Arteta (2000);Lanoie & Lemarbre (1996); Marchesi (2003); Berg (1999); Corsetti *et al.* (1998); Goldstein (1998); Reinhart & Rogoff (2009)
External sector (capital account)		
Growth of foreign exchange reserves	Declining foreign reserves is a reliable indicator that a currency is under devaluation pressure. A drop in reserves is not necessarily followed by devaluation, central bank may be successful in defending a peg, spending large amounts of reserves in the process. On the other hand, most currency collapses are preceded by a period of increased efforts to defend the exchange rate, which are marked by declining foreign reserves. Total value of foreign reserves are also used as indicators of a country's financial difficulty dealing with debt repayment.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003); Marchesi (2003); Corsetti *et al.* (1998); Reinhart *et al.* (2000), Lestano et al. (2003)

Continuation of Table 1

Financial contagion indicator	Interpretation	Reference
External sector (capital account)		
Ratio of M2 to foreign exchange reserves	Captures to what extent the liabilities of the banking system are backed by foreign reserves. In the event of a currency crisis, individuals may rush to convert their domestic currency deposits into foreign currency, so that this ratio captures the ability of the central bank to meet their demands.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Kamin *et al.* (2001); Edison (2003); Dermirgüç-Kunt & Detragiache (2000); Eichengreen & Arteta (2000), Lestano et al. (2003)
Financial sector		
M1 and M2 growth	These indicators are measures of liquidity. High growth of these indicators might indicate excess liquidity which may fuel speculative attacks on the currency thus leading to a currency crisis.	Kamin *et al.* (2001); Berg (1999); Reinhart *et al.* (2000), Lestano et al. (2003)
M2 money multiplier	An indicator associated with financial liberalization. Large increases in the money multiplier can be explained by draconian reductions in reserve requirements.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003); Reinhart *et al.* (2000)
Ratio of domestic credit to GDP	Very high growth of domestic credit may serve as a crude indicator of the fragility of the banking system. This ratio usually rises in the early phase of the banking crisis. It may be that as the crisis unfolds, the central bank may be injecting money to the bank to improve their financial situation.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003); Dermirgüç-Kunt & Detragiache (2000); Eichengreen & Arteta (2000); Berg (1999); Collyns & Abdelhak (2002); Reinhart *et al.* (2000); Sutela (1999)
Excess real M1 balance	Loose monetary policy can lead to currency crisis.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003); Reinhart *et al.* (2000)
Domestic real interest rate	Real interest rate can be considered as proxy of financial liberalization, in which the liberalization process itself tends to lead to high real rates. High real interest rates signal a liquidity crunch or have been increased to fend off a speculative attack.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003); Dermirgüç-Kunt & Detragiache (2000); Barro (2001); Berg (1999); Crotty (2009); Reinhart *et al.* (2000); Reinhart *et al.* (2000); Wade & Veneroso (1998)
Lending and deposit rate spread	An increase of this indicator above some threshold level possibly reflects a deterioration in credit risk as banks are unwilling to lend or decline in loan quality.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003); Reinhart *et al.* (2000)
Commercial bank deposits	Domestic bank run and capital flight occur as crisis unfolds	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003); Reinhart *et al.* (2000)
Ratio of bank reserves to bank assets	Adverse macroeconomic shocks are less likely to lead to crises in countries where the banking system is liquid.	Dermirgüç-Kunt & Detragiache (1997); Lestano et al. (2003); Wade & Veneroso (1998)
Domestic real and public sector		
Ratio of fiscal balance to GDP	Higher deficits are expected to raise the probability of crisis, since the deficits increase the vulnerability to shocks and investor's confidence.	Dermirgüç-Kunt & Detragiache (2000); Eichengreen & Arteta (2000); Reinhart *et al.* (2000); Wade & Veneroso (1998)
Ratio of public debt to GDP	Higher indebtedness is expected to raise vulnerability to a reversal in capital inflows and hence to raise the probability of a crisis.	Kamin *et al.*, (2001); Lanoie & Lemarbre (1996); Eichengreen & Arteta (2000); Berg (1999); Reinhart *et al.* (2000)
Growth of industrial production	Recessions often precede financial crises.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003)
Changes in stock prices	Burst of asset price bubbles often precede financial crises.	Kaminsky *et al.* (1998); Berg & Pattillo (1999); Edison (2003); Baig & Goldfajn (1999); Barro (2001); Berg (1999); Crotty (2009); Goodhart (2008); Kindleberger (1978); Reinhart *et al.* (2000); Rose & Spiegel (2009); Sutela (1999)

Continuation of Table 1 is at the next page

Continuation of Table 1

Financial contagion indicator	Interpretation	Reference
Domestic real and public sector continued		
Inflation rate	The inflation rate is likely to be associated with high nominal interest rates and may proxy macroeconomic mismanagement which adversely affects the economy and the banking system.	Dermirgüç-Kunt & Detragiache (1997); Lanoie & Lemarbre (1996); Marchesi (2003); Berg (1999); Collyns & Abdelhak (2002); Reinhart & Rogoff (2009); Wade & Veneroso (1998)
GDP per capita	High income countries may be less likely to reschedule their debt than poorer countries since the costs of rescheduling would tend to be more onerous for more advanced economies. Deterioration of the domestic economic activity are expected to increase the likelihood of a banking crisis.	Dermirgüç-Kunt & Detragiache (1997); Eichengreen & Arteta (2000); Lanoie & Lemarbre (1996); Marchesi (2003); Barro (2001); Collyns & Abdelhak (2002); Reinhart & Rogoff (2009); Rose & Spiegel (2009)
National saving growth	High national savings may be expected to lower the probability of debt rescheduling.	Lanoie & Lemarbre (1996); Lestano et al. (2003)
Global economy		
Growth of world oil prices	High oil prices are associated with recessions.	Edison (2003); Lestano et al. (2003); Reinhart & Rogoff (2009)
US interest rate	International interest rate increases are often associated with capital outflows.	Edison (2003); Kamin *et al.* (2001); Eichengreen & Arteta (2000); Baig & Goldfajn (1999); Reinhart & Rogoff (2009)
OECD GDP growth	Higher foreign output growth should strengthen exports and thus reduce the probability of a crisis.	Edison (2003); Kamin *et al.* (2001); Eichengreen & Arteta (2000); Lestano et al. (2003); Reinhart & Rogoff (2009)

According to the empirical studies (Caramazza *et al.*, 2000; Kaminsky *et al.*, 1998; Berg & Pattillo, 1999; Kamin *et al.*, 2001; Edison, 2003; Dermirgüç-Kunt & Detragiache, 2000; Eichengreen & Arteta, 2000; Lanoie & Lemarbre, 1996; Marchesi, 2003; Lestano *et al.*, 2003; Kaminsky & Reinhart, 2009; Reinhart & Rogoff, 2009; Rose & Spiegel, 2009) countries that suffered the major financial crises appear to differ in a number of ways from the countries that did not face financial crisis:

- On the external side, the *appreciation of the real exchange rate* during the three years prior to the onset of each financial crisis, a possibly proxy for loss of international price competitiveness and exchange rate misalignment, is almost 15 percentage points larger on average for crisis than for non-crisis emerging economies. For the industrial countries, the appreciation is not significantly different between crisis and non-crisis countries. The *external current account deficit* in the year before the crisis is also larger on average by over 2 percentage points of GDP in crisis than in non-crisis countries for both industrial and emerging market economies, which may further indicate poor trade competitiveness in the crisis countries. As a further indication of weak external performance, the *growth of exports in relation to GDP* in the three years before the crisis is also 11 percentage points lower on average for crisis than for non-crisis emerging market countries, while not significantly different for industrial countries. Other external sector variables, apart from short-term external debt in relation to total external debt, are insignificantly different between crisis and non-crisis countries.

- Evidence of pre-crisis domestic macroeconomic imbalances that have made a country vulnerable to financial market contagion include *slow GDP growth* in the three years prior to the crisis, a high *unemployment rate* and a *banking crisis*. Prior to the past financial crisis, GDP growth was on average 2 percentage points lower and unemployment rate 4 percentage points higher in crisis than in non-crisis industrial countries. The differences in output growth between crisis and non-crisis countries are smaller for the emerging market economies. Low output growth and high unemployment may be an indicator that external or domestic imbalances may become increasingly untenable or that governments will be unwilling to defend exchange rate arrangements by implementing policies, such as raising short-term interest rates that could slow down real activity even further. All of the industrial countries and a few emerging market economies that had a banking crisis in the year prior to a global currency crisis also suffered currency market pressure.
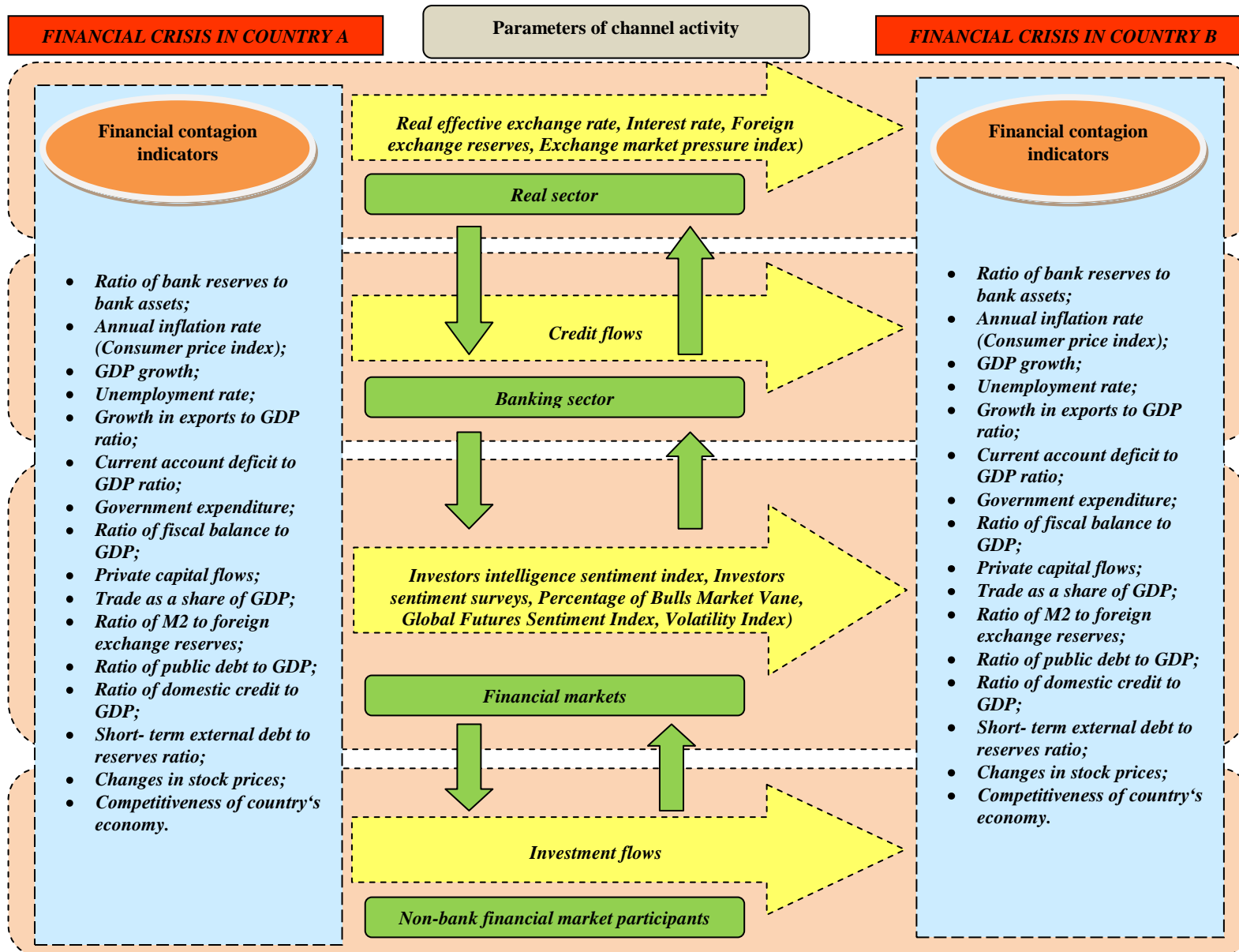
Domestic imbalances in terms of large *general government fiscal deficits* or substantial monetary expansions, proxied by the *growth of broad money (M2) to GDP*, can fuel expectations of inflation and therefore lead to pressures on the currency. However, these variables are indistinguishable on average between crisis and non-crisis countries during the period before financial crisis.

- Trade linkages as measured by the *implied appreciation of the real exchange rate* and the *implied decline of export market growth* induced by crises in other countries are generally significantly different on average between crisis and non-crisis economies. The difference between crisis and non-crisis countries with respect to the implied slowdown in export market growth is greatest for the emerging market economies and weakest for the industrial countries in the term of financial crisis.

- Financial weaknesses or fragilities, proxied by the inadequacy of international reserves to cover speculative attacks, in crisis countries are significantly larger than in non-crisis ones. In particular, the ratio of *short-term debt to international reserves* in the year before crisis is almost 200 percentage points higher in emerging crisis economies compared with non-crisis economies. This indicates that these crisis economies were vulnerable to a change in investor sentiment in an unfriendly or illiquid external environment – potential source of financial contagion. The ratio of *broad money (M2) to international reserves* is the inverse of the extent to which liquid domestic liabilities of the banking system are backed by foreign exchange reserves and thus is a measure of the banking system's ability to withstand currency pressures. For emerging market crisis economies, this ratio in the year before the crisis is 30 percentage point higher, on average, than in non-crisis economies. There are, however, no significant differences between crisis and non-crisis industrial countries.

- *Common credit* financial market linkages seem to be very important in explaining differences between crisis and non-crisis emerging market economies. The common creditor is identified by the country that lent the most to the first country in crisis during the term of financial crisis. The common creditor variables – that is, the importance of the common creditor for the borrowing country and the importance of the borrowing country for the common creditor in the year prior to the crisis – are significantly higher in the crisis emerging market economies than in the non-crisis ones. On average, the common creditor holds a 10 percentage point higher share of the external bank liabilities of the crisis countries than of the non-crisis countries, whereas the average crisis country holds a 5 percentage point higher share of the external loan portfolio of the common creditor than the average non-crisis country. A variable indicating mutual importance, constructed by multiplying the two common creditor variables, is also almost always higher for crisis compared with non-crisis emerging market economies. The *short term share of debt to BIS banks*, a proxy for the maturity composition of bank liabilities, is also significantly higher in crisis than in non-crisis countries before the occurrence of financial crisis. However, the short term share of debt to BIS banks does not bear significant differences for other crises. Risk management factors are proxied by *stock market variability* and the *stock market correlation with the stock market of the first crisis country*. Although the stock market variability is not significant, the stock market correlation with the stock market of the first crisis country is significantly different for crisis and non-crisis countries. These results suggest potential market-linked transmission mechanisms for contagion, where creditors may rebalance their portfolios at the onset of a crisis for common creditor, liquidity, and risk management factors. If there are regional differences in primary creditor relationships or stock market correlations, these also help to explain the regional bunching of financial crises.

The majority of financial contagion indicators mentioned above and explaining the contagion of financial crises in the global financial markets can be used in order to build the model of financial risk contagion.

Model of financial risk contagion

Once the financial crisis is indicated by using the group of financial contagion indicators, it is necessary to determine and evaluate which channel of financial risk contagion – real sector, banking sector, financial markets or non-bank financial markets participants - is the most active in the term of appropriate financial crisis. Consequently, all the channels of financial risk contagion should be analyzed separately. Figure 1 illustrates the model of financial risk contagion in the global financial markets.

Figure 1. Model of financial risk contagion

FINANCIAL CRISIS IN COUNTRY A | **Parameters of channel activity** | **FINANCIAL CRISIS IN COUNTRY B**

Financial contagion indicators (left and right)

Real effective exchange rate, Interest rate, Foreign exchange reserves, Exchange market pressure index)

Real sector

Credit flows

Banking sector

Investors intelligence sentiment index, Investors sentiment surveys, Percentage of Bulls Market Vane, Global Futures Sentiment Index, Volatility Index)

Financial markets

Investment flows

Non-bank financial market participants

Left column indicators:
- *Ratio of bank reserves to bank assets;*
- *Annual inflation rate (Consumer price index);*
- *GDP growth;*
- *Unemployment rate;*
- *Growth in exports to GDP ratio;*
- *Current account deficit to GDP ratio;*
- *Government expenditure;*
- *Ratio of fiscal balance to GDP;*
- *Private capital flows;*
- *Trade as a share of GDP;*
- *Ratio of M2 to foreign exchange reserves;*
- *Ratio of public debt to GDP;*
- *Ratio of domestic credit to GDP;*
- *Short- term external debt to reserves ratio;*
- *Changes in stock prices;*
- *Competitiveness of country's economy.*

Right column indicators:
- *Ratio of bank reserves to bank assets;*
- *Annual inflation rate (Consumer price index);*
- *GDP growth;*
- *Unemployment rate;*
- *Growth in exports to GDP ratio;*
- *Current account deficit to GDP ratio;*
- *Government expenditure;*
- *Ratio of fiscal balance to GDP;*
- *Private capital flows;*
- *Trade as a share of GDP;*
- *Ratio of M2 to foreign exchange reserves;*
- *Ratio of public debt to GDP;*
- *Ratio of domestic credit to GDP;*
- *Short- term external debt to reserves ratio;*
- *Changes in stock prices;*
- *Competitiveness of country's economy.*

In order to investigate the mechanism of financial crisis transmission from one country to another, in our model of financial risk contagion these financial contagion indicators should be surveyed: ratio of bank reserves to bank assets, annual inflation rate (consumer price index), GDP growth, unemployment rate, growth in exports to GDP ratio, current account deficit to GDP ratio, government expenditure, ratio of fiscal balance to GDP, private capital flows, trade as a share of GDP, ratio of M2 to foreign exchange reserves, ratio of public debt to GDP, ratio of domestic credit to GDP, short- term external debt to reserves ratio, changes in stock prices, competitiveness of country's economy. Analysis of financial contagion indicators helps to identify the present situation of country's economy and to evaluate whether the financial crisis hit country or not. If many of financial contagion indicators show the presence of financial crisis in country A, the same indicators are explored in country B in order to determine has the country been affected by financial crisis through the contagion. When the relation between the origin financial crisis country and the other financial crisis country is observed, the financial crisis contagion channels' activity should be measured.

All the financial risk contagion channels have their parameters of activity. Real sector channel is assessed by real effective interest rate, interest rate, foreign exchange rate and exchange market pressure index that is a function of the observed variations of the three previous parameters. Banking sector channel is often analyzed by evaluating changes in credit flows. Financial markets channel is examined through measuring the changes of investors' sentiments. Methods of measuring sentiment include investor surveys, investor mood, retail investor trades, mutual fund flows, trading volume, dividend premium, closed-end fund discount (closed-end funds are investment companies who issue a fixed number of shares, which then trade on stock exchange. The closed-end "discount" (or occasionally "premium") is the difference between the net asset value of a fund's actual security holdings and the fund's market price), option implied volatility, IPO (initial public offerings) first-day returns, IPO volume, equity issues over total new issues and insider trading. As it can be seen there are a lot of measures that let to evaluate activity of financial crisis contagion through the financial markets channels. Nevertheless, several indices measuring channel activity are derived. In our model of financial risk contagion the financial markets channel activity is measured by using such parameters as investors' intelligence sentiment index, investors' sentiment surveys, percentage of bulls' market vane, global futures sentiment index and volatility index. Finally, the non-bank financial market participants channel activity is investigated by analyzing investment flows.

According to the model of financial risk contagion, the most important conclusion that can be drawn is that countries do not need to be linked directly by macroeconomic fundamentals in order to transmit shocks. All that is required for transmission of shocks is for macroeconomic variables to be shared indirectly through other countries. This explains how contagion has occurred between weakly linked markets. Moreover, the mechanism of shocks transmission is very sophisticated and it is very difficult to decide through which financial risk contagion channel the financial crisis has spread. Thus only the regression and sensitive analysis could show which of the channels of financial risk contagion is the most sensitive in the terms when the country's economy is struck by different type of financial crisis.

Conclusions

1. The problems induced by financial crises become more serious and significant in the context of the globalization and internationalization of financial markets. The financial crises in one region may adversely influence other regions in geographically different parts of the world, which could escalate and trigger problems in the whole global financial system.
2. Over the past two decades, financial market crises with similar features have occurred in different regions of the world. The idea that since countries are interconnected through trade linkages, a shock originating in one country can be transmitted and amplified because of the pattern of interconnections in the network has been provided in the scientific financial literature. Unstable cross-market linkages during a crisis are referred to as financial contagion.
3. There are many possible channels by which a crisis in one country or region may spread to other countries or regions. The severity and scope of the contagion depend on the particular type of contagion involved. In this paper different channels through which real shocks are transmitted from one country to another are discussed. They involve contagion via real sector, contagion via banking sector, contagion via financial markets and contagion via non-bank financial market participants.

4. Many scientists and researchers, when analyzing the phenomenon of financial risk contagion, agree that most crises include multiple financial contagion indicators and distinguish four different groups of indicators: external sector indicators, financial sector indicators, domestic real and public sector indicators and global economy indicators. All indicators and their observance let both academics and politicians to evaluate the current economic situation and to determine if a country is struck by financial crisis or not.

5. The constructed model of financial risk contagion describes the process of financial crisis transmission between two different countries. The financial contagion indicators help to identify the crisis situation in country's economy and the parameters of financial channel's activity let to evaluate the importance of appropriate financial channel when transmitting shock in the term of corresponding financial crisis. The activity of financial crisis contagion channels differ when the country's economy is struck by currency crisis, banking crisis or sovereign debt crisis.

6. The other most important conclusion about financial contagion to be drawn from our model is that information asymmetries exacerbate contagion. The effects of contagion on asset prices are much greater in markets with greater information asymmetries. Countries with high levels of asymmetric information experience great fluctuations in asset prices, whereas countries with low levels of asymmetric information do not. When high levels of asymmetric information are present, uninformed investors perceive changes in asset prices in other countries as possibly reelecting information held by informed investors, thus inducing them to alter their expectations about the fundamental value of assets, causing asset prices to change. Emerging markets have higher levels of asymmetric information than do developed markets. This explains why emerging markets are affected much more severely by contagion than developed markets.

References

1. Ali, L., & Kestens, Y. (2006). Contagion and Crises Clusters: Toward a Regional Warning System? / Review of World Economics, 2006. Vol 142 (4), 814-839 p.

2. Allen, F., & Gale, D. (1999). The Asian crisis and the process of financial contagion / Journal of Financial Regulation and Compliance, 1999. Vol. 7, No. 3. 243-249 p.

3. Baker, M., & Wurgler, J. (2007). Investor Sentiment in the Stock Market / Journal of Economic Perspectives, 2007. Vol. 21, No. 2. 129-151 p.

4. Berg, A., & Pattillo, C. (1999). Predicting currency crises: the indicators approach and an alternative / Journal of International Money and Finance, 1999, Vol. 18, No. 4, 561–586 p.

5. Caramazza, F., *et al.* (2000). Trade and Financial Contagion in Currency Crises / International Monetary Fund (IMF) Working Paper. January, 2000. 1-46 p.

6. Cheung, W., *et al*. (2010). Global capital market interdependence and spillover effect of credit risk: evidence from the 2007–2009 global financial crisis / Applied Financial Economics, 2010, Vol. 20, 85–103 p.

7. Claessens, S., & Forbes K. (2004). International Financial Contagion: The Theory, Evidence and Policy Implications / Conference 'The IMF´s Role in Emerging Market Economies: Reassessing the Adequacy of its Resources' organized by RBWC, DNB and WEF in Amsterdam on November 18-19. 1-34 p.

8. Deltuvaitė, V., (2011). Measuring the costs of banking crises: theoretical and practical aspects / International conference of Economics and Management, 2011, Vol. 16. 1089-1100 p.

9. Dermirgüç-Kunt, A., & Detragiache, E. (1997). The determinants of banking crises in developing and developed countries / International Monetary Fund (IMF) Working Paper, 1997, Washington, D.C. No. 106.

10. Dermirgüç-Kunt, A., & Detragiache, E. (2000). Monitoring banking sector fragility: a multivariate logit approach / World Bank Economic Review, 2000, Vol. 14, No. 2, 287–307 p.

11. Dornbusch, R. *et al.* (2000). Contagion: Understanding How It Spreads / The International Bank for Reconstruction and Development, The World Bank Research Observer, August 2000. Vol. 15, No. 2. 177-197 p.

12. Edison, H. J. (2003). Do indicators of financial crises work? An evaluation of an early warning system / International Journal of Finance and Economics, 2003, Vol. 8, No. 1, 11–53 p.

13. Edwards, S., (2000). Contagion / University of California, Los Angeles and Mational Bureau of Economic Research, February 2000. 1-39 p.

14. Eichengreen, B., & Arteta, C. (2000). Banking crises in emerging markets: presumptions and evidence / Center for International and Development Economics Research, Working Paper, 2000, California, Berkeley. No. 115.

15. Forbes, K.. J., & Rigobon, R. (2002). No contagion, only interdependence: measuring stock market comovements / Journal of Finance, 2002, No. 57, 2223–2261 p.

International conference of Economics and Management, 2011, Vol. 16. 1174-1184 p.

16. Kali, R., & Reyes, J. (2009). Financial contagion on the international trade network / Economic Inquiry, 2009, Vol. 48, No. 4, 1072-1101 p.

17. Kamin, S. B., *et al.* (2001). The contribution of domestic and external sector factors to emerging market devaluations crises: an early warning systems approach / International Finance Discussions Papers, 2001, Board of Governors of the Federal Reserve System, Washington, D.C. No. 711.

18. Kaminsky, G. L., & Reinhart, C. M. (1999). The twin crises: the causes of banking and balance-of-payments problems / American Economic Review, 1999, Vol. 89, No. 3, 473–500 p.

19. Kaminsky, G. L., *et al.* (1998). Leading indicators of currency crisis / International Monetary Fund (IMF) Staff Papers, 1998, Washington, D.C., Vol. 45, No. 1.

20. Karolyi, G. A. (2004). Does international financial contagion really exist? / Journal of Applied Corporate Finance, 2004. Vol. 16.2-3. 136-146 p.

21. Kroszner R. S., *et al.* (2006). Banking Crises, Financial Dependence, and Growth / World Bank Working Paper No. 2855. 1-61 p.

22. Lestano, J. J., & Kuper, G. H. (2003). Indicators of financial crises do work! An early-warning system for six Asian countries / Paper work, Departament of Economics, University of Groningen, December 2003, 1-39 p.

23. Mayr, B., (2007). Financial contagion and intra-group spillover effects / Dissertation of the University of St. Gallen, Graduate School of Business Administration, Economics, Law and Social Sciences, 2007, Bamberg, 1-177 p.

24. Moser, T. (2003). What Is International Financial Contagion? / International Finance, 2003. 6 (2), 157-178 p.

25. Pasquariello, P. (2006). Imperfect competition, information heterogeneity, and financial contagion / The Review of Financial Studies, 2007. Vol. 20, No. 2. 392-426 p.

26. Pritsker, M. (2000). The Channels for Financial Contagion / Washington DC: Board of Governors of the Federal Reserve System. Working paper, August 11, 2000. 1-26 p.

27. Račickas, E., & Vasiliauskaitė, A. (2011). Channels of financial risk contagion in the global financial markets /

28. Rogoff, K. (1999). International institutions for reducing global financial instability / Journal of Economic Perspectives, 1999, Vol. 13, No. 4, 21–42 p.

29. Rungcharoenkitkul, P. (2011). Risk Sharing and Financial Contagion in Asia: An Asset Price Perspective / International Monetary Fund (IMF) Working Paper, October 2011, Asia and Pacific Department, Vol. 11, No. 242, 1-41 p.

30. Sachs, J. D., *et al.* (1996). Financial crises in emerging markets: the lessons from 1995 (with comments and discussion / Brookings Papers on Economic Activity, 1996, No. 1, 147–198 p.

31. Serguieva, A., *et al.* (2010). Financial Contagion Simulation through Modelling Behavioural Characteristics of Market Participants Capturing Cross-Market Linkages / Department of Computer Science, University College London, 2010, London, 1-17 p.

32. Tjahjawandita, A., *et al.* (2009). Spatial Contagion of Global Financial Crisis / Working Paper in Economics and Development Studies, August 2009, Department of Economics, Padjadjaran University, 123-138 p.

33. Van Rijckeghem, C. & Weder, B. (2001). Sources of Contagion: Is it Finance or Trade? / Journal of International Economics 54: 293-308 p.

34. Van Rijckeghem, C. & Weder, B. (2001). Spillovers Through Banking Centers: A Panel Data Analysis of Bank Flows / International Monetary Fund (IMF) Paper work, July 2001, 1-32 p.

35. Zhang, Z., (2001). Speculative attacks in the Asian crisis / International Monetary Fund (IMF) Working Paper, 2001, Washington, D.C. No. 189.