

Contagion of Financial Crisis: Evidence of ARDL Model

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Abstract: Our aim in this paper is to demonstrate that trade provides an important channel for contagion beyond the macroeconomic and financial similarities. We used both the long memory process to measure the crisis persistence, and the ARDL model in order to study the long-term relationship between the contagion and the international trade indicators. Our results show that trade links are the main contagion channels of the Asian and Russian economies.

Keywords: Contagion; ARDL, financial crises; Long memory

1. INTRODUCTION

We can say that in a world characterized by globalization and where the financial markets play an important role in the contribution of the global savings, the trade ties are an important channel of contagion. Pritsker (2001) could discriminate between the different forms of financial markets, where we recall the role of the banking crises in the transmission or the "contagion channel". If the real sector of economy i is hit by a crisis, it will strike negatively one of the international banks which lend economic companies i . If the bank lends companies in a country j , it will be led to adjust its credit segments in this economy, hence the crisis is transmitted.

If the common lender is strictly exposed in an economy in crisis, so the necessary adjustments to reduce the risk are accompanied by a decrease in the loans to other economies. The spread of the crisis therefore a double: from one economy to another and from an exchange market to a credit one. Since the financing of the emerging economies is based primarily on banks, a common lending bank can finance various economies simultaneously (Pritsker, 2001).

The transmission channel can be considered as an indicator of crisis in the emerging economies by attempting to calculate an indicator of vulnerability to common bank creditor. However, this channel is not important when the bank exposure in the first economy hit by the crisis is important, requiring a readjustment of the portfolio of the common credit bank. It the latter should also be an important source of payment of other countries hit by the crisis. Moreover, the affected economies should be highly dependent on the bank so that cannot find other sources of direct funding.

This paper is divided into two sections: the first one describes the econometric methodology and the second section presents the empirical results.

2. ECONOMETRIC METHODOLOGY

The vulnerability index to the proxy contagion must contain two elements: the dependence of borrowers and the lenders' exposure (total loans given by lenders) based on the studies of Caramazza et al. (2000) and Sbracia and Zaghini (2001), the indicator of contagion is presented as follows:

$$I_{Contagion} = dr_{cc}^i * er_{cc}^i \quad (1)$$

With

$$dr_{cc}^i = \frac{E_{cc}^i}{\sum_j E_j^i} \quad (2)$$

With E_{cc}^i and $\sum_j E_j^i$ respectively indicate the borrowing country i from the common creditor and total liabilities of country i with respect to the developed countries.

The relative exposure (er) is the ratio of the common assets creditor to the country i and its total loans to the emerging countries. According to Caramazza et al (2000), the relative dependence (dr) is the ratio between the amount that economy i is ones to the in common creditor i (cc) and the sum of the liabilities of country i in front of the developed economies reviewed by the BIS.

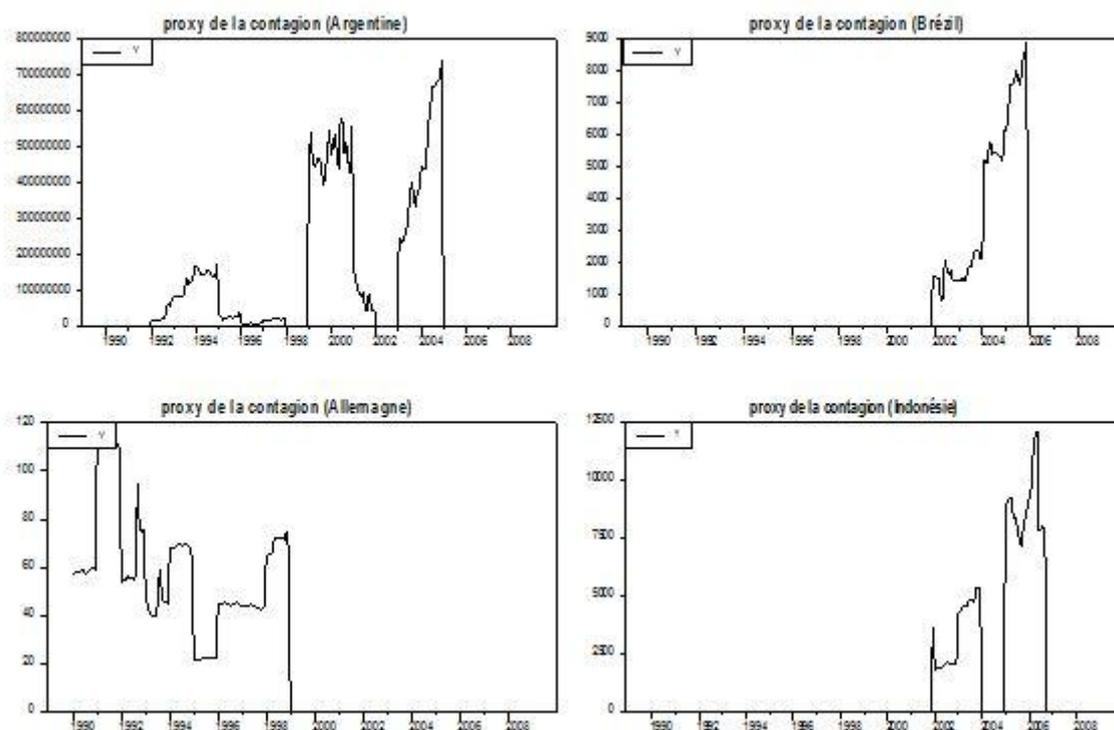
The indicator of vulnerability to the common bank creditor joint bank (contagion proxy) is nothing but the multiplication of the relative exposure by the relative dependence (Caramazza et al, 2000).

$$er_{cc}^i = \frac{A_{cc}^i}{\sum_{i \in PE} A_{cc}^i} \tag{3}$$

Where A_{cc}^i indicate the assets of the common creditor and $\sum_{i \in PE} A_{cc}^i$ denote the total equity of the common creditor in emerging countries.

Caramazza et al. (2004) constructed a variable that enabled us to control the extent of the commercial contagion (rather than its risk), to better isolate the impact of the common creditor. The commercial contagion variable¹ is the average prices, the implied appreciation of the real exchange rate and the implicit decline of the market of exports respectively caused by the crises.

A proxy of high contagion is both a strong dependence of the borrowing country and high exposure of the common creditor. Conversely, the decline of the proxy (as in the Asian region from 1997 to 2000) reflects the same time decrease the dependence of emerging countries to bank financing (using other funding sources) and lower exposure lenders (portfolio rebalancing and flight to quality). The proxy of contagion gives expected results since the economies affected by the Asian and Russian crises have high proxy during times of crises (see figures 1 Appendix).



¹This measure of trade contagion avoids some deficiencies in the devices previously used as the study of Caramazza et al. (2000), for a more detailed discussion of previous measurements of contagion through trade.

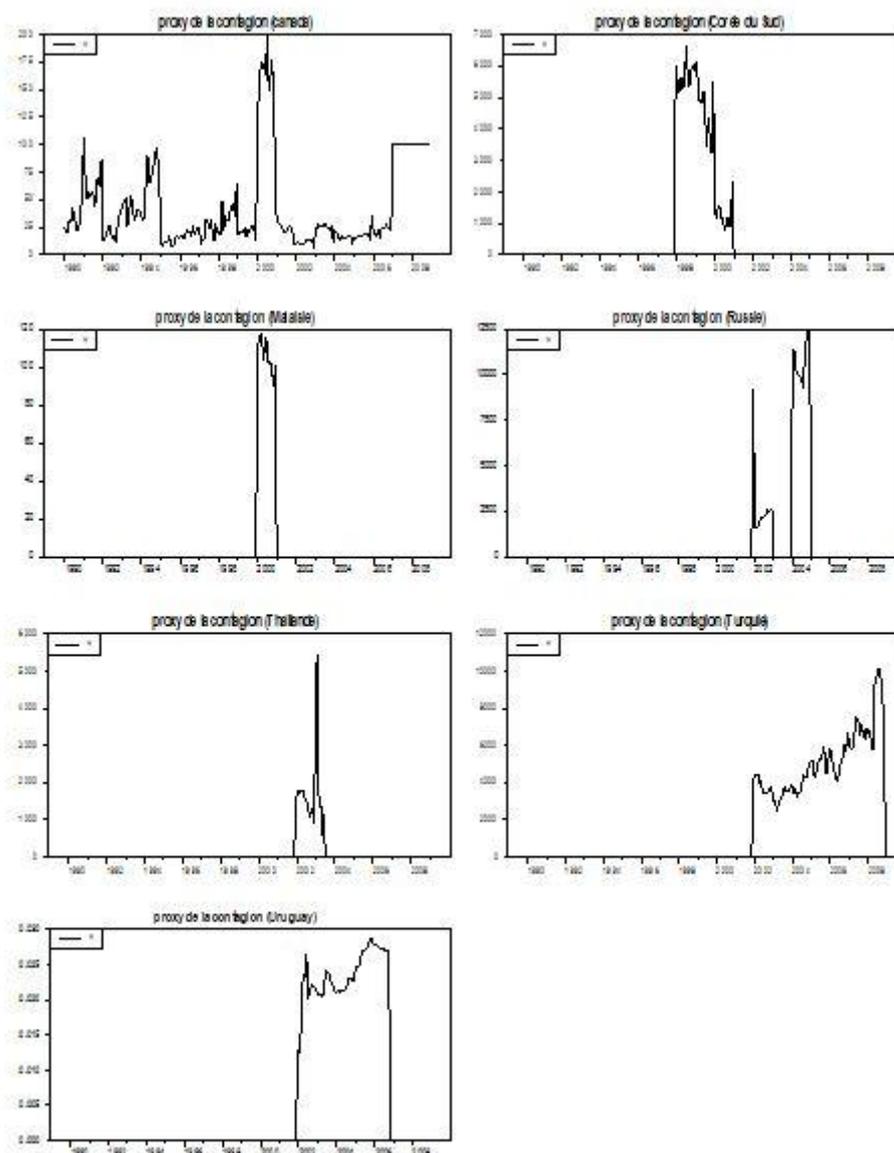


Figure1. Proxy of contagion

Caramazza et al (2004) identified the contagion model of accordant:

$$contagion_t = \alpha_0 + \sum_{i=1}^{p1} \alpha_i RER_{t-i} + \sum_{j=1}^{p2} \alpha_j DBC_{t-j} + \sum_{h=1}^{p3} \alpha_h CC_{t-h} + \varepsilon_t \quad (4)$$

With *RER* , *DBC* and *CC* denote the real exchange rate, the deficit of the current account and the common creditor, α_0 , α_1 , α_2 and α_3 are the parameters to be estimated. *p1*, *p2* and *p3* respectively indicate the numbers of delays for *RER*, *DBC* and *CC*.

Since the order of integration is not always equal to 1 or 0, so we cannot use the Johansen cointegration technique of Jeselius (1990) because it requires that all variables are integrated of 1. In order to explain the proxy of contagion by the real exchange rate, the deficit of the current account and the common creditor, we used the ARDL models (Auto Regressive Distributed Lag) of Pesaran and Shin (1999), which allow order to introduce variables of different integrations. The ARDL model requires that there is a long-term relationship between the variables considered. We used the method of Pesaran and Shin (1999) to determine the long term relationship. Since the order of integration is not always equal to 1 or 0, so we cannot use the Johansen cointegration technique-Jeselius (1990) because it requires that all variables are integrated of 1. In order to explain the proxy of contagion by the real exchange rate, the deficit of the current account and the common creditor, we used the ARDL

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$$\Delta contagion_t = \alpha_0 + \alpha_1 contagion_{t-1} + \alpha_2 RER_{t-1} + \alpha_3 DBC_{t-1} + \alpha_4 CC_{t-1} + \sum_{j=0}^p \beta_j \Delta RER_{t-j} + \sum_{j=0}^p \lambda_j \Delta DBC_{t-j} + \sum_{h=1}^{p3} \Phi_j \Delta CC_{t-j} + \varepsilon_t \quad (5)$$

To test the existence of long-term relationship, Fisher's test is applied to the first delay of the four variables studied. The null hypothesis of the test Fisher as following:

$$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0 \quad (6)$$

3. EMPIRICAL RESULTS

The sample of the countries chosen in our empirical study includes 20 countries²(5 in East Asia, seven in Latin American countries and the G8 countries) as well as the mortgage price index for the United States. The composition of this sample is explained by the fact that it includes most countries which the most severe experienced financial crises in the last decade.

Table1. Fisher test

	Ger	Arg	Br	Ca	S-K	In	Ma	Ph	Ru	Th	Tu	Ur	Ve
contagion	0.74	0.32	0.11	1.15	1.22	0.75	0.79	1.05	1.41	0.14	0.35	1.25	0.77
RER	0.17	0.24	1.05	0.28	0.54	0.57	1.12	0.45	0.24	0.28	0.48	0.18	1.28
DBC	0.46	0.41	0.26	0.09	1.26	0.68	1.36	0.09	0.19	1.20	0.67	1.28	1.08
CC	0.08	0.68	1.29	1.24	0.38	0.48	1.15	1.06	0.98	0.20	0.14	0.17	1.09

Note: Ger, Arg, Br, Ca, SC, In, Ma, Ph, Ru, Th, Tu, Ur and Ve indicate respectively Germany, Argentina, Brazil, Canada, South Korea, Indonesia, Malaysia, Philippines, Russia, Thailand, Turkey, Uruguay and Venezuela.

If there is a long-term relationship then:

$$\Delta contagion_t = \alpha_0 + \sum_{j=0}^{p1} \gamma_j contagion_{t-j} + \sum_{j=0}^{p2} \beta_j RER_{t-j} + \sum_{j=0}^{p3} \lambda_j DBC_{t-j} + \sum_{h=1}^{p4} \Phi_j CC_{t-j} + \varepsilon_t \quad (7)$$

With p1, p2, p3 and p4 indicates are variable delays numbers studied using the Akaike Information Criteria and Schwartz estimating sequentially model (6) for orders from p = 0 to 12. The second step is to estimate a differentiated ARDL model is written as follows:

$$\Delta contagion_t = \alpha_0 + \gamma_1 \Delta contagion_{t-1} + \beta_1 \Delta RER_{t-1} + \beta_2 \Delta RER_{t-2} + \lambda_1 \Delta DBC_{t-1} + \lambda_2 \Delta DBC_{t-2} + \phi_1 CC_{t-1} + \varepsilon_t \quad (8)$$

with are the coefficients corresponding to the short-term dynamics. The error correction model is defined as follows:

$$ECT_t = contagion_t - \hat{\mu}_0 - \hat{\mu}_1 RER_t - \hat{\mu}_2 DBC_t - \hat{\mu}_3 CC_t \quad (9)$$

The estimated coefficients of long term μ_1 , μ_2 and μ_3 are obtained through estimation ARDL model of equation (8) by OLS.

Proxy contagion is calculated for Germany, Argentina, Brazil, South Korea, the Philippines, Russia, Thailand, Uruguay and Indonesia. That is to say there is a high probability that the crisis has spread from Thailand to South Korea, Indonesia, Malaysia, the Philippines, Canada, Russia, Brazil, Argentina, Venezuela and Uruguay. The period studied is located between January 1990 and December 2008.

² Germany, Argentina, Brazil, Canada, South Korea, the United States, France, Hong Kong, Italy, Indonesia, Japan, Malaysia, Mexico, Russia, Singapore, Taiwan, Thailand, Turkey, the United Kingdom and Uruguay.

Table2. Estimating the model of contagion of financial crises

	α_0	γ_1	β_1	β_2	λ_1	λ_2	φ_1
Germany	2.80 (0.85)	-	1.23 (0.00)	-	0.00 (0.00)	-	-0.029 (0.00)
Argentina	6738 (0.00)	0.50 (0.00)	4.77 (0.40)	-1.72 (0.22)	-1.93 (0.00)	4.99 (0.51)	-3.58 (0.20)
Brazil	-2249 (0.10)	-	1.55 (0.00)	-7.96 (0.05)	1.71 (0.00)	-	2.85 (0.02)
South Korea	-6222 (0.00)	0.15 (0.45)	7.68 (0.00)	-1.73 (0.30)	-5.74 (0.24)	-	-5.25 (0.01)
Indonesia	2270 (0.02)	-	-0.29 (0.02)	-	0.72 (0.07)	-	3.21 (0.07)
Malaysia	18.50 (0.37)	-	-9.83 (0.15)	-8.10 ⁻⁴ (0.54)	-2.10 ⁻² (0.79)	-	1.36 (0.06)
Philippines	-713 (0.00)	0.51 (0.04)	2.79 (0.00)	-0.002 (0.02)	0.005 (0.00)	-	-2.91 (0.11)
Russia	1146 (0.00)	-	-2.13 (0.00)	2 (0.00)	-0.36 (0.00)	0.20 (0.00)	-3.55 (0.00)
Thailand	-1732 (0.00)	-	5.81 (0.00)	-0.40 (0.94)	0.53 (0.91)	-	1.38 (0.01)
Turkey	5781 (0.00)	0.50 (0.00)	-8.72 (0.00)	-2.84 (0.00)	5.15 (0.00)	-	-1.25 (0.13)
Uruguay	-0.02 (0.00)	0.60 (0.00)	0.002 (0.00)	-9.10 ⁻⁶ (0.00)	10 ⁻⁵ (0.00)	-	3.10 ⁻⁶ (0.00)
Venezuela	17797 (0.00)	-	-1.33 (0.00)	-5.17 (0.12)	1.19 (0.00)	-	-1.16 (0.00)

Note :(.) The values correspond to the significance of the estimated parameters.

The expected signs of the estimated variables are positive.

- According To the table (2), we note that the RER includes the depth of depreciation and speed for Germany, the Philippines, Brazil, Thailand, South Korea and Uruguay.

- Anover-valuation which makes exports less competitive and favors imports over local products is the main reason for the distrust of investors.

- The Widening current account deficit is considered as a sign of weakness and may participate in the increase in the probability of a crisis for Brazil, Indonesia, the Philippines, Turkey and Venezuela.

- CC: Rising credit of the Central Bank may inform the financial weakness of the banking system for Malaysia and Thailand.

- Vulnerability to crises in Latin America is due to the external debt and the loss of confidence in the banking system. This has contributed to financial fragility (for Brazil the external public debt was 250 billion in 2002) (IMF, 2009).

- For Thailand, Malaysia and South Korea invested private capital were of the order of \$ 74 billion for 1995. The debt consists mainly of short-term loans (60% in dollars and 40% in yen) (Cartapanis et al, 2003). This is a significant risk to the growth of Asian economies. Local banks used these loans to provide credit to local borrowers. These exchanging currency against the currency in which the course was under pressure, it is a real perverse effect of international capital movements. Countries primary objective financing clean current account deficit to economic development, they become the cause of the real appreciation of the exchange rate and the deterioration of current account balances because of their speculative.

The RER variable was statistically significant with a negative sign for Indonesia, Russia, Turkey and Venezuela. This result confirms that the overvaluation of the real exchange rate (listed on the uncertain) was one of the causes of the crises of the last decade.

According to Table 2, we note that the contagion of the crisis has a negative effect on the real exchange rate for Indonesia, Malaysia, Russia, Turkey and Venezuela. This table shows the estimated series of proxy of contagion for countries affected by the financial crises of recent decades. The model of contagion was estimated indicated by the explanatory variables such as the real exchange rate, the current account deficit and the common creditor.

It was expected that the real overvaluation (RER) is significant for the Latin America region. This indicator has played a major role in triggering the crisis especially in Argentina and Brazil. The introduction of the currency board system (currency board) of Argentina had resulted in the appreciation of the peso following the appreciation of the dollar vis-à-vis many currencies. This has worsened the price competitiveness of Argentine producers especially following the Brazilian crisis (Brazil is the largest trading partner of Argentina). Note that the introduction of this system was to the introduction of monetary stability. Argentina was marked by a long period of high volatility particularly during the eighties.

Since the introduction of a new currency (the Real) in 1994, Brazil had a crawling peg³. This parity has created a structural problem of public finances and ongoing imbalance in its foreign trade. So the country has huge financing needs to cover this imbalance and adjust its debt. Given the enormous capital flows leaving Brazil, the central bank devalued the Real 8%. This impairment was insufficient and the currency lost more than 37% of its value in October 1999. It should be said that the current account deficit exceeds 4.5% of GDP in Brazil and 58.5% in Mexico in 2002 (Maechler and Ong, 2009).

Financial links whose common credit is very important. Depending on the model of Caramazza et al (2004), indeed, the most significant variable suggests a financial market-related contagion transmission mechanism as a creditor to rebalance its portfolio in a crisis emerges. Weakness or financial fragility indicators are significant and correctly signed. These indicators including short-term debt ratio of reserves, an indicator of insufficient international reserves to cover speculative attacks and the share of short-term debt to BIS banks.

Indeed, the increase in loans from the central bank can learn about the financial weakness of the banking system. These variables include indicators of external and domestic fundamentals and a proxy of contagion from commercial links. This set of variables allows studying the importance of measuring the weak financial linkages⁴. The goal here is simply to test whether the RER variable DBC and CC are of crisis contagion channels.

4. CONCLUSION

The variety of financial crises experienced by the world during the last decade traces the birth of a new crisis (Asian crisis). The crisis that began with the financial collapse of domestic countries to achieve the other emerging countries is the result of globalization in interdependence. This ensures, through multiple channels, the transmission of a shock to all commercial and financial shareholders of the countries affected by the various crises.

The real estate crisis is thus a systemic and global financial crisis characterized by a deterioration of credit criteria, a depreciation of the price of real estate and securities as well as a lack of bank capital. In addition, from this crisis, we get to witness a financial asymmetry few savings that can escape the crisis that hit the United States, but so far, the United States has escaped all the crises in other economies. This leads us to believe that during the Asian crisis of 1997, the flow of capital to the safest financial areas benefited the US economy indeed that the extension of the expansion phases characterized by the wave of new technologies.

The asymmetry of information, the presence of moral hazards, and the role played by credit rating classes, whose main task is to control the risk, lead us to associate, but with a lot of failure, the models third generation.

³ The crawling peg it is an exchange system in which the exchange rate is set regularly in small increments, either fixed rate or in response to changes in certain indicator variables, such as past inflation differential relative to major trading partners.

⁴ Caramazza et al (2000) tested the behavior of these variables for countries that have undergone the exchange market pressure during the major financial crises of the 1990s, also including the EMS mechanism.

Note that the Asia Pacific region is the most affected by this common bank creditor effect during crises in emerging countries nineties. At the end of this region, which are Thailand's highest indices showing the extreme vulnerability of the Thai banking system to a sudden reversal Japanese bank capital. In 1997, when the effect of the resulting contagion of the devaluation of the Thai baht is the strongest, the exchange rates are important values for the main countries affected by the crisis.

Finally, vulnerability to contagion channel fell sharply in 2000 for the majority of countries in the sample. Finally, the fragility that contagion channel fell sharply in 2000 for several Asian countries. This is the result of a huge diversification of investment banking major borrowing countries and a better distribution of emerging market funds.

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Citation: Fadhila Mchirgui et al. "Contagion of Financial Crisis: Evidence of ARDL Model" *International Journal of Managerial Studies and Research (IJMSR)*, vol 10, no. 5, 2022, pp. 1-7. doi: <https://doi.org/10.20431/2349-0349.1005001>.

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