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CURRENCY CRISES, TRADE AND GEOGRAPHY: SPATIAL DIMENSIONS OF CONTAGION

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Abstract. Using spatial econometric techniques to decompose the magnitude of contagion for currency crises, currency stabilities and exchange market pressure, I estimate the extent to which shocks in a country's exchange market can affect other countries'. There is a consensus among researchers on trade and geography as possible channels. However, while trade linkages have been investigated empirically, geographic linkages have not. This study help explain why, during crises, some geographic regions are affected while others are not. I also find that contagion is not only crises phenomenon; while trade spreads currency crises, it has a much larger positive spillover during strong and stable currency periods.

Keywords: contagion; currency crises; geography; trade; spatial econometrics; weight matrix.
2010 AMS Subject Classification: 15B15, 62P20, 62J65, 91G40, 91G70.

1. Introduction

The endemic nature of currency crises has widely been given opulent attention by researchers. This follows the increasing regional experience of currency crises around the world. For example, the Russian Crisis of 1998 followed the Asian Crisis of 1997, which started with an attack on the Thailand baht and spread to South Korea, Indonesia, Malaysia and the Philippines.

Economic contagion can be defined as global disturbances that affect most countries in the world (Edwards, 2000). Currency crisis is a speculative attack on a country's currency brought about by agents attempting to alter their portfolio by buying another currency with the currency of the domestic country (Chiodo and Owyang, 2002). There are three generations of currency crises. Krugman (1979), Flood and Garber (1984) and Dooley (1997) develop the first generation

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models; Obstfeld (1994) develops the second generation models, and Krugman (1999) and Aghion, Bacchetta, and Banerjee (2000) develop the third generation models. Four factors, namely domestic debt, pegged exchange rate, expectations, and the state of financial markets, cause and exacerbate currency crises (Pesenti and Tille, 2000; Krugman, 1999; and Obstfeld, 1994).

Edwards (2000) employ VAR to investigate volatility contagion while Eichengreen, Rose and Wyplosz (1996) and Glick and Rose (1999) employ probit models to address contagion in currency crises. However, no paper has incorporated geography empirically in their analysis or controlled for the spatial dependence inherent in a currency crisis, and this could underestimate contagion captured in previous literature.

This paper fills the gap by empirically investigating both trade and geographic channels of currency crises, currency stability and exchange market pressure using two spatial econometric models for the first time. The results suggest that the hypothesis that trade and geography are contagion channels of currency crises is not just true but that the magnitude of the contagion is a lot higher than reported in previous studies. Second, this paper finds that contagion is not only crises phenomenon, but is more present in regions where some countries are experiencing a stable or strong currency regimes. In section 2, I explain the channels of contagion, then methodology and theoretical framework in section 3, followed by the results and interpretation in section 4 and conclusion in section 5.

2. Channels of Transmission

2.1. Geography

Geographic channels of currency crises include common events affecting geographic neighbors. Some of these events are wars, oil price shocks and other events common to a geographical location that could affect the exchange markets of countries located in that region. For example, when there is war in one or two West African countries this may lead not only to speculative attack on the currencies of the countries involved but on the currencies of neighboring countries as well (Chiodo and Owyang, 2002).

Moreover, countries in the same region tend to belong to economic unions and may be easily infected by events from a member country. For instance, if Mexico devalues and a diversified investor sells his equity and bond holdings, he may do the same with respect to Argentina. This could be classified as a geographic channel since it originates from the effect of a common factor (lender in this case) on that region (Kaminsky and Reinhart, 2000).

2.2. Trade

Another channel identified as a transmission mechanism of currency crises is trade. Though researchers have been incongruous about the effect of trade in the spread of currency crises, most agree that the trade linkage may hold even if the countries involved do not engage in bilateral trade. Bilateral trade in itself has not been a major force behind recent crises. An example is the Asian Crises, in which the bilateral trade between the countries involved was relatively very small (Kaminsky and Reinhart, 2000). This notwithstanding does not overrule the fact that bilateral trade may magnify the spread of currency crises. This will happen when a trade partner's currency devalues during crises and competition for exports necessitates the other to devalue its currency as well.

The most widely accepted trade channel is the competition for exports in a third country's market by other countries. If one of these countries devalues, it is most likely to trigger devaluation in the other countries. However, it is not always so unless the competitors are all exporting same products to this third market.

A more general way to see this will be a competition for exports (of all export goods produced by each country) in a global market. Devaluation in some countries can increase their export or export growth and cause countries that produce similar exports to devalue as well. With increasing globalization, the effect of a global market may even be more pronounced as this covers competition for all export goods and services. What is necessary here is same or similar export goods for the countries involved.

Thus this trade linkage may work if there is a high bilateral trade between two countries, one of which is experiencing a crisis, and or a competition (for exports) between countries hit by currency crises and other countries in a third-party market (or global market) or both trade forms.

2.3. Financial Markets

First, a common bank creditor, which serves as a regional block to other countries, can transmit currency crises. This is linked with trade, as countries, which engage in trade, need strong financial market interconnections and facilities. When this common creditor country is faced with huge nonperforming loans in one country it may lend less in that country as well as the other customer countries (Kaminsky and Reinhart, 2000).

The second financial market channel has to do with mutual funds and cross-market hedging in which globally diversified investors decide to sell their bond and equity holding of one country as the other country (related by geography or some other common characteristic) devalues its currency. Research has shown that there is an evidence of cross-border contagion in currency and equity markets (Baig and Ilan, 1999).

Empirical investigation of this channel, however, has posed a problem: mutual fund and cross hedging were not in existence until the 90's. To address this, this paper uses the trade channel as a proxy for the financial markets channel. By national income accounting identities, net trade flows are equivalent to net capital flows. In other words, trade in goods and services are equivalent to trade in financial assets. Thus based on this identity, both channels should produce similar results.

3. Methodology

3.1. Model

This study uses spatial econometric techniques namely, spatial autoregressive model (SAR) and spatial error model (SEM). These are similar to the traditional time series ARMA and MA models except that they use distance or spatial lags rather than time lags. In this study, SAR specifies a country's currency crisis (or the corresponding dependent variable) as a function of the weighted value of the currency crises of its neighbors or partners. SEM models the error term of a country's currency crisis as a function of the weighted value of its trade partners' or geographic neighbors' currency crises. These models have the advantage of accounting for multi-directional effects as opposed to unidirectional effects captured in the conventional econometrics models (LeSage and Pace, 2004; Anselin, and Moreno, 2003; and Anselin, 1988).

These models are specified below:

SAR:

$$Y_t = \alpha + \rho W Y_t + \beta X_t + \upsilon_t \tag{1}$$

SEM :

$$Y_t = \alpha + \beta X_t + \varepsilon_t;\ \varepsilon_t = \lambda W \varepsilon_t + \eta_t \tag{2}$$

And, for regressions that use dummy dependent (latent) variables like equation (5) below

Probit SAR:

$$Y_t = \beta X_t + \rho W Y_t + \varepsilon_t, \text{ OR}$$

$$Y_t = (I - \rho W)^{-1} X_t \beta + (I - \rho W)^{-1} \varepsilon_t; \quad \varepsilon_t \sim N(0, \sigma^2 I) \tag{3}$$

where W is an NXN weight matrix with respect trade or geography; X_t is a vector of controls variables, Y_t is an NX1 vector of measures of the dependent variables, ρ and λ are the spatial autoregressive and spatial error coefficients respectively, υ_t and ε_t are NX1 matrixes of *iid* random errors, $\sigma^2 I$ is spherical variance-covariance, and σ^2 is normalized to 1 as in probit models.

3.2. Measuring the Dependent Variables

The index of exchange market pressure (EMP) used to compute the dependent variables is constructed as a weighted average of reserve changes and exchange rate changes similar to the way it is constructed in Kaminsky and Reinhart (1999). The most common measure of exchange market pressure (EMP) is a weighted average of changes in exchange rate, changes in international reserves and changes in interest rate differential. During speculative attacks, international reserves are depleted and interest rates are usually raised to offset the attack. The above measure is used by Eichengreen, Rose and Wyplosz (1997). However, due to insufficient interest rate data for most of the countries for the sample period the index of EMP in this paper is constructed as a weighted average of the changes international reserve and interest rate differential. Thus:

$$EMP_{it} = [\theta(\%\Delta e_{it}) - \delta(\%\Delta r_{it} - \%\Delta r_{Git})] \tag{4}$$

where e_{it} represents the price of a Deutsche Mark (DM) in country i's currency at time t; r_{it} is country i's international reserves, r_{Git} is German international reserves and θ and δ are weights (for simplicity, both receive equal weight). The choice of Germany as the center country follows the reasoning in the literature that the DM had been strong throughout the post war era.

Previous literature finds a benchmark EMP value for each year and assign a currency crisis dummy when a country's EMP in a particular year exceeds this threshold EMP as shown below. This index is also employed in this study to help compare the results with similar papers:

$$Crisis_{i,t} = \begin{cases} 1 & if\ EMP_{it} > 1.5\sigma_{EMP} + \mu_{EMP} \\ 0 & otherwise \end{cases} \tag{5}$$

where, μ_{EMP} is the sample mean and σ_{EMP} is the sample standard deviation for each year. One limitation with this index is that it does not tell much about the severity of the crisis, since it gives the same value (one) to all countries experiencing high EMP's and another (zero) to all countries with low EMP's. To make up for this, this study expresses currency crisis as the actual excess EMP over the threshold, or as the excess EMP as a percentage of the threshold as shown in equation (6) and (7) respectively.

$$Crisis_{it} = EMP_{it} - (1.5\sigma_{EMP} + \mu_{EMP}) \tag{6}$$

$$Crisis_{it} = \frac{[EMP_{it} - (1.5\sigma_{EMP} + \mu_{EMP})]}{(1.5\sigma_{EMP} + \mu_{EMP})} * 100 \tag{7}$$

Only years with currency crises of five or more were studied because the literature documents that contagion is not likely to take effect when just one or a few speculative attacks have occurred. The paper also constructs currency stability indexes as another dependent variable in addition to exchange market pressure and currency crisis. Every year in which the excess EMP over the threshold is negative, it is interpreted as a stable and strong currency. These indexes are constructed as:

$$Stability_{it} = \left| EMP_{it} - (1.5\sigma_{EMP} + \mu_{EMP}) \right| \tag{8}$$

$$Stability_{it} = \left| \frac{[EMP_{it} - (1.5\sigma_{EMP} + \mu_{EMP})]}{(1.5\sigma_{EMP} + \mu_{EMP})} * 100 \right| \tag{9}$$

3.3. Constructing the Weight Matrices

The weight matrix for the geographic channel is based on first order contiguity. A country will only give a positive weight to another country if they are neighbors, otherwise zero. Below is the matrix:

$$W_0 = \begin{bmatrix} \frac{\mu_{1j}}{\sum \mu_{1j}} & . & . & . & \frac{\mu_{1n}}{\sum \mu_{1j}} \\ . & & . & & . \\ . & & & . & . \\ . & & & . & . \\ \frac{\mu_{nj}}{\sum \mu_{nj}} & . & . & . & \frac{\mu_{nn}}{\sum \mu_{nj}} \end{bmatrix} \quad for\ j = 1, 2, \ldots.n. \tag{10}$$

$$Where,\ \mu_{ij} = \begin{cases} 1 & if\ \ country\ \ i\ and\ j\ are\ neighbors \\ 0 & otherwise \end{cases} \tag{11}$$

Thus each country gives a weight of one or zero to other countries. The weights are then row standardized so that each row sums up to 1. For example, if a country has 4 neighbors, it assigns a weight of ¼ to each, and zero (0) to non-neighbors. The principal diagonal has zero elements since countries cannot be their own neighbors.

The first trade weight matrix is bilateral trade matrix where a country gives weights to other countries by expressing its export to each of those countries as a fraction of its total exports. Below is the matrix:

$$W_1 = \begin{bmatrix} \frac{X_{11}}{\sum X_{1j}} & \cdot & \cdot & \cdot & \frac{X_{1j}}{\sum X_{1j}} \\ \cdot & & \cdot & & \cdot \\ \cdot & & \cdot & & \cdot \\ \cdot & & & \cdot & \cdot \\ \frac{X_{nj}}{\sum X_{nj}} & \cdot & \cdot & \cdot & \frac{X_{nn}}{\sum X_{nj}} \end{bmatrix} \quad \text{for } j=1, 2, \ldots.n. \tag{12}$$

where, $X_{i,j}$ is country i's export to country j. The second trade matrix is as follows:

$$W_2 = \begin{bmatrix} \frac{X_1 - X_1}{\sum(X_i - X_1)} & \frac{X_2 - X_1}{\sum(X_i - X_1)} & \cdot & \cdot & \frac{X_n - X_1}{\sum(X_i - X_1)} \\ \frac{X_1 - X_2}{\sum(X_i - X_2)} & \frac{X_2 - X_2}{\sum(X_i - X_2)} & \cdot & \cdot & \frac{X_n - X_2}{\sum(X_i - X_2)} \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot & \cdot \\ \frac{X_1 - X_n}{\sum(X_i - X_n)} & \frac{X_2 - X_n}{\sum(X_i - X_n)} & \cdot & \cdot & \frac{X_n - X_n}{\sum(X_i - X_n)} \end{bmatrix} \quad for\ i=1, 2\ldots n \tag{13}$$

Where X_i is a country's export share of GDP (or the growth rate of). Country i finds the difference between its export share of GDP and other countries'. If the deviations are positive, it gives them a weight directly proportional to these deviations. If the deviation is negative it gives them a weight that equals to the inverse of the absolute value of the deviation (to maintain positive weights). The weights are then row standardized so that each row sums up to 1.

Let $X_i - X_j = d_{ij}$, so that $X_1 - X_1 = d_{11}$ and $\sum(X_i - X_j) = \sum d_{ij}$

Then for

$$X_i - X_j \geq 0$$
$$d_{ij} = X_i - X_j$$

And for

$$X_i - X_j < 0$$
$$d_{ij} = \left| X_i - X_j \right|^{-1}; X_i \neq X_j$$

Thus this weight matrix rules out the possibility of two countries having exactly the same export share of GDP. It is only on the principal diagonal that we must have zeroes since each country's exports share of GDP deviation with respect to itself is zero ($d_{ii} = 0$). The above weight matrix thus simplifies to:

$$W_2 = \begin{bmatrix} \frac{d_{11}}{\sum d_{i1}} & \frac{d_{21}}{\sum d_{i1}} & \cdot & \cdot & \frac{d_{n1}}{\sum d_{i1}} \\ \frac{d_{12}}{\sum d_{i2}} & \frac{d_{22}}{\sum d_{i2}} & \cdot & \cdot & \frac{d_{n2}}{\sum d_{i2}} \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot & \cdot \\ \frac{d_{1n}}{\sum d_{in}} & \frac{d_{2n}}{\sum d_{in}} & \cdot & \cdot & \frac{d_{nn}}{\sum d_{in}} \end{bmatrix} \quad \text{for } i=1, 2, \ldots n$$

This captures global trade (export) competition ignored in previous literature. Exports are used since currency crises devalue currencies and increase a country's trade competitiveness. The final trade weight matrix is a linear combination of the global and bilateral trade weights.

3.4. Independent Variables

In line with the theoretical framework and based on availability of data the control variable chosen includes the current account as a share of GDP, growth rate of domestic credit, the CPI, real GDP growth rate, money stock (M2) and unemployment rate. All these variables were included as deviations from the center country's values.

3.5. Data

The study covers a period of twenty years from 1985 to 2005. The choice of this period is a result of the bandwagon of currency crises that hit the world in recent years. A panel of 119 countries is chosen for this study. Data is taken from the World Bank Databases, the IMF databases and the World Fact Book.

4. Results

4.1. Main Results

The results are presented in Tables 1, 2 and 3. Though the study produce results for both models, based on LM tests SEM results are suitable except for the dummy dependent variables, which use SAR. Thus in Table1 and Table 2 the SAR regressions are reported for robustness analysis but since the results are similar to the SEM results, those are not discussed in the ensuing analysis.

Table 1. *Dependent Variable*: Currency Crisis (% excess EMP)

Geography:	SAR	SEM	*Trade*: SAR	SAR	SEM	SEM
Independent Variables			Export growth and bilateral trade weight	Exports and bilateral trade weight	Export growth and bilateral trade weight	Exports and bilateral trade weight
Constant	-0.134	-0.138	-0.139	-0.267	0.321	0.310
	(0.044)	(-0.045)	(-0.045)	(-0.086)	(0.103)	(0.100)
Lambda		0.151***			0.141***	0.167***
		(9.682)			(4.035)	(2.452)
Rho	0.143***		0.146***	0.166***		
	(9.402)		(4.26)	(2.471)		
Lagged Crises						
Current Account per GDP (annual %)	0.021	0.021	0.028	0.024	0.027	0.026
	(0.279)	(0.262)	(0.361)	(0.314)	(0.354)	(0.340)
Domestic Credit per GDP growth (annual %)	-0.0003	-0.0004	-0.0004	-0.001	-0.0004	0.001
	(-0.055)	(-0.089)	(-0.077)	(-0.090)	(-0.082)	(-0.087)
M2 – money and quasi money per total reserve	0.021**	0.021**	0.022***	0.022**	0.022***	0.022**
	(2.065)	(2.073)	(2.039)	(2.066)	(2.044)	(2.049)
CPI (annual %)	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	(-0.063)	(-0.072)	(-0.079)	(-0.084)	(-0.099)	(-0.083)
GDP growth (annual %)	0.0208	0.019	0.005	0.003	0.003	0.006
	(0.271)	(0.249)	(0.042)	(0.041)	(0.042)	(0.074)
Unemployment (annual %)	0.175*	0.175*	0.175*	0.175*	0.175*	0.176*
	(1.839)	(1.821)	(1.825)	(1.827)	(1.818)	(1.837)
Regional Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Island	-1.248	-1.621	-1.432	-1.158	-1.294	-1.443
	(-0.730)	(-0.930)	(-0.830)	(-0.379)	(-.426)	(-0.838)
Observations	119	119	119	119	119	119
R-squared	0.024	0.053	0.026	0.078	0.031	0.114
Log-likelihood	-3061.872	-3061.244	-3067.801	-3544.898	-3068.015	-3544.407

Notes: t-statistics in parentheses; asterisks indicate significance as follows: ***=1%, **=5%, *=10%. Variable description, descriptive statistics, and sources can be found in Appendix 1.

Table 2. *Dependent Variable*: Currency Stability (% shortfall EMP)

Geography:	SAR	SEM	*Trade:* SAR	SAR	SEM	SEM
Independent Variables			Export growth and bilateral trade weight	Exports and bilateral trade weight	Export growth and bilateral trade weight	Exports and bilateral trade weight
Constant	83.552	97.033***	58.280***	48.339***	98.666***	93.410
	(5.317)	(6.233)	(3.558)	(8.784)	(6.167)	(5.877)
Lambda		0.165***			0.454***	0.489***
		(4.681)			(6.180)	(6.821)
Rho	0.176***		0.455***	0.522***		
	(5.113)		(6.620)	(3.592)		
Lagged Crises						
Current Account per	-0.429	-0.458	-0.436	-0.760***	-0.702*	-0.745***
GDP (annual %)	(-1.105)	(-1.149)	(-1.136)	(-2.039)	(-1.775)	(-1.904)
Domestic Credit per	-0.0169	-0.017	-0.019	-0.020	-0.020	-0.018
GDP growth (annual %)	(-0.597)	(-0.616)	(-0.711)	(-0.729)	(-0.715)	(-0.667)
M2 – money and quasi	0.042	0.028	0.0344	0.052	0.043	0.051
money per total reserve	(0.799)	(0.537)	(0.660)	(1.010)	(0.822)	(0.987)
CPI (annual %)	0.019***	0.019***	0.019***	0.018***	0.018***	0.018***
	(4.064)	(4.011)	(4.035)	(3.961)	(3.932)	(3.969)
GDP growth (annual %)	0.103	0.085	0.333	0.274	0.466	0.356
	(0.266)	(0.215)	(0.868)	(0.728)	(1.197)	(0.901)
Unemployment	1.467***	1.446***	1.546***	1.367***	1.401* **	1.340***
(annual %)	(3.074)	(2.964)	(3.281)	(2.940)	(2.931)	(2.814)
Regional Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Island	9.520	-1.874	-3.799	-2.209	-1.009	-0.724
	(1.066)	(-0.212)	(-0.446)	(-0.262)	(-0.118)	(-0.086)
Observations	119	119	119	119	119	119
R-squared	0.139	0.162	0.132	0.141	0.185	0.191
Log-likelihood	-4410.159	-4412.832	-4401.9933	-4396.5019	-4403.8768	-4401.0794

Notes: t-statistics in parentheses; asterisks indicate significance as follows: ***=1%, **=5%, *=10%. Variable description, descriptive statistics, and sources can be found in Appendix 1.

Table 3. *Dependent Variable:* Dummy

	Dependent Variables			
	Currency Crisis	Currency Stability	Currency Crisis	Currency Stability
Geography:	SAR	SAR *Trade:*	SAR	SAR
Independent Variables			Exports and bilateral trade weight	Exports and bilateral trade weight
Constant	0.159**	0.711***	0.160**	0.537***
	(2.051)	(8.500)	(2.055)	(5.167)
Lambda				
Rho	0.066***	0.126***	0.053***	0.308***
	(6.540)	(3.852)	(3.404)	(4.107)
Lagged Crises				
Current Account per	0.003*	0.003*	0.003*	-0.004*
GDP (annual %)	(1.679)	(-1.556)	(1.722)	(-1.879)
Domestic Credit per	0.00002	-0.00003	0.00003	-0.00003
GDP growth (annual %)	(0.199)	(-0.199)	(0.201)	(-0.176)
M2 – money and quasi	-0.00006	0.0002	-0.00006	0.0002
money per total reserve	(-0.229)	(0.881)	(-0.233)	(0.728)
CPI (annual %)	-0.00002	0.00003	-0.00002	0.00003
	(-0.844)	(1.271)	(-0.867)	(1.315)
GDP growth (annual %)	-0.008***	0.012***	-0.009***	0.012***
	(-4.304)	(6.169)	(-4.424)	(6.420)
Unemployment	-0.010***	0.011***	-0.010***	0.011***
(annual %)	(-4.225)	(4.615)	(-4.275)	(4.615)
Regional Dummies	Yes	Yes	Yes	Yes
Island	-0.017	0.133 ***	-0.026	0.049
	(-0.402)	(2.761)	(-0.601)	(1.153)
Observations	119	119	119	119
R-squared	0.090	0.126	0.089	0.131
Log-likelihood	-0.45343073	6.4585471	-1.643789	7.4175162

Notes: t-statistics in parentheses; asterisks indicate significance as follows: ***=1%, **=5%, *=10%. Variable description, descriptive statistics, and sources can be found in Appendix 1.

Table 1 presents the results for currency crisis. The study shows that countries catch 0.15 of their currency crisis from geographic neighbors (shown as lambda). For trade, this coefficient is 0.17. This suggests that trade linkages may be higher than geographic measures in explaining contagion in currency crises.

Table 2 presents the results of currency stability. For the measure of currency stability (based on equation 9), lambda for the geography regression is 0.17. It implies that countries catch 0.17 of the strength of the currency of their geographic neighbors. For trade contagion, lambda is between 0.45 and 0.49. Comparing the trade linkages for currency crises and currency stabilities it is obvious that the latter is almost three times larger (0.49 against 0.17). This is because countries like China, for example receive direct pressure from others in the form of calls for import barriers to allow the yuan to appreciate (Bown, Crowley, McCulloch, and Nakajima 2005). Currency crises, however, spread by indirect competition and thus have lower magnitude.

Also, the result for the geographic channel and its lower magnitude than the trade channel is quite intuitive; when trade is very large it can be enough to spread currency crises regardless of distance but the combination of the geography and the trade effects produces a synergy that makes currency crises more regional. However, compared to former studies, especially Eichengreen, Rose and Wyplosz (1996) the results differ significantly using the new measures of currency crises but similar to theirs when dummy dependent variables are employed as in those studies. In Table 3, rho for trade is 0.053 for currency crisis, which is close to the 0.08 produced by Eichengreen, Rose and Wyplosz (1996).

4.2. Robustness Checks

This section compares the alternate models employed in this paper. The sensitivity analysis show that, whether SEM or SAR models are used or whether export growth differential or just export share of GDP differentials are used to construct the trade weight matrix, the results are identical as shown in Table 1 and Table 2. Thus the findings and conclusion of the paper will not be altered by what spatial model (or trade weight matrix) are used even though an LM test conducted shows a slight preference for the SEM model in some cases.

To show that the methodology employed in this study improves the outcome of the results compared to other studies that use OLS, I also use OLS on my data to compare with the spatial econometric model. The following equation is also estimated by OLS. The only difference here is that the weight matrices are computed differently (with a different dimension) suited for OLS regression.

$$Y_{i,t} = \alpha + gW_i + \tau \mathrm{T}_{i,t} + \beta X_{i,t} + \vartheta_{i,t}$$

Where W_i is an NX1 geographic weight matrix. Each country is assigned a weight equal to the inverse of the number of neighbors it has. A negative coefficient would indicate that the fewer the number of neighbors a country has the more likely it is that a crisis in each will severely affect it. For example, it suggests that Canada stands a higher chance of inheriting a currency crisis from the US than Mexico since the latter has another neighbor that may not be experiencing economic turbulences. $\mathrm{T}_{i,t}$ is also an NX1 trade weight matrix based on export differential or export growth differential, similar to the one in equation (13). For each country the sum of its export (or export growth) differential with each and every country in the sample plus its bilateral trade with them is computed. A high value for this indicates that the country's exports is competitive which is a sign of devaluation or currency crisis, and hence a smaller value would suggest that its trade partner (s) devalues or experiences crisis. For conformity with the geographic weight matrix, the above values are inverted so that a negative coefficient would indicate a crisis in the domestic country.

These results are represented in Table 4 and Table 5 below.

Table 4. *Dependent Variable:* Currency Crisis (OLS)

Independent Variables	I	II	III	IV
Geography	-0.758	0.812	0.829	
	(-0.32)	(0.37)	(0.38)	
Trade	-0.014***	-0.009**		-0.009***
	(-2.22)	(-1.97)		(-2.63)
Lagged Crises				
Current Account per	0.022	0.056	0.056	0.061
GDP (annual %)	(0.38)	(0.88)	(0.88)	(1.04)
Domestic Credit per	-0.024	-0.020	-0.020	-0.021
GDP growth (annual %)	(-1.17)	(-0.98)	(-0.97)	(-1.00)
M2 – money and quasi	0.019	0.018	0.018	0.017
money per total reserve	(1.41)	(1.32)	(1.33)	(1.31)
CPI (annual %)	-0.0002	-0.0004	-0.0004**	-0.0004*
	(-1.10)	(-1.98)**	(-1.98)	(-1.94)
GDP growth (annual %)	0.025	0.019	0.021	0.021
	(0.41)	(0.33)	(0.36)	(0.34)
Unemployment	0.178	0.184	0.184	0.188*
(annual %)	(1.59)	(1.61)	(1.61)	(1.67)
Regional Dummies	Yes	No	Yes	No
Island	-1.379	-1.073	-1.061	-1.385
	(-0.99)	(-0.79)	(-0.78)	(-1.32)
Observations	119	119	119	119
R-squared	0.023	0.010	0.010	0.010
	1.086	1.445	1.427	1.807***
Constant	(0.73)	(1.32)	(1.31)	(3.32)

Notes: t-statistics in parentheses; asterisks indicate significance as follows: ***=1%, **=5%, *=10%.

Table 5. *Dependent Variable:* Currency Stability (OLS)

Independent Variables	I	II	III	IV
Geography	-2.426	-2.225	-2.430	
	(-0.77)	(0.69)	(0.76)	
Trade	0.001***	0.001**		0.001***
	(2.208)	(2.13)		(2.20)
Current Account per	-0.068	-0.062	-0.043	-0.049
GDP (annual %)	(-0.68)	(-0.59)	(-0.41)	(-0.42)
Domestic Credit per	0.017	0.008	0.010	-0.021
GDP growth (annual %)	(0.50)	(0.24)	(0.31)	(-1.00)
M2 – money and quasi	0.003	0.008	0.007	0.007
money per total reserve	(0.49)	(0.72)	(0.64)	(0.21)
CPI (annual %)	-0.0008***	-0.001***	-0.001**	-0.001***
	(-2.20)	(-2.85)	(-2.50)	(-2.80)
GDP growth (annual %)	0.241***	0.260***	0.261***	0.263
	(2.72)	(2.90)	(2.94)	(2.94)***
Unemployment	0.048	-0.059	-0.043	-0.501)
(annual %)	(0.49)	(-0.56)	(-0.68)	(-0.47)
Regional Dummies	Yes	No	No	No
Island	1.341	1.781	2.015	0.927
	(0.52)	(0.79)	(0.36)	(0.56)
Observations	119	119	119	119
R-squared	0.021	0.012	0.009	0,011
Constant	3.561	13.709***	12.230***	14.731***
	(1.22)	(5.67)	(5.99)	(5.94)

Notes: t-statistics in parentheses; asterisks indicate significance as follows: ***=1%, **=5%, *=10%.

The results of the OLS regressions in Tables 4 and 5 indicate that not accounting for spatial dependence in currency crisis or currency stability largely underestimates the magnitude of contagion. The tables show that in all the regressions (whether we control for continent dummies or not, or whether we control for geographic weight matrix only – regressions I, II, and III respectively) the coefficient of the geographic weight matrix is insignificant, suggesting that geography is not a channel of contagion. Similarly, the coefficient of trade is just about 1% for currency crisis and 0.1% for currency stability, which are not statistically significant (though economically significant at 1% level in most cases). Since these findings defy the theory of contagion, the results of this paper suggests that OLS regressions are limited in estimating contagion in currency crisis compared to spatial models.

5. Conclusion

This study attempts to study contagion in currency crises and exchange market pressure by incorporating the geography weight matrix and also introducing a new dependent variable, currency stabilities, to the already existing empirical work. The results both confirm and improve upon the former studies in this area of study. Second, though trade spreads currency crises, the positive effect it has during stable currency periods are much larger than the adverse effects during crises. It also explains that while the summation of geographic and trade channels of currency crises are responsible for the contagion in certain regions (which accounts for why the larger percentage of the contagion is regional), the high magnitude of the trade channel accounts for the spread of currency crises to other trade competitors outside the geographic location of the initial attack. The paper also finds that spatial models are better suited for estimating contagion in currency crisis than are alternate models such as OLS or probit models.

For policy recommendation, this would suggest that trade should be encouraged. For geography, since countries cannot choose their neighbors, the only thing to do is to realize that what happens in the exchange market "next door" can affect you and hence the need to be prepared for it. One way to do this, the findings of this paper suggests, is to encourage and form strong economic unions with healthy policies that could help deal with such common adverse or favorable events as well as other unmeasured common shocks that hit the exchange markets of regions around the world.

Conflict of Interests

The author declares that there is no conflict of interests.

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Appendix 1: Variable Description, Descriptive Statistics, and Sources

Variable Name (source)	Description	Mean (std)
Dependent Variables:		
EMP - Exchange market Pressure (2)	A linear combination of exchange rates and international reserves	0.767 (25.484)
Currency Crises (2)	Excess EMP (%)	2.400 (13.822)
Currency Stability (2)	Absolute Value EMP shortfall (%)	0.013 (0.020)
Exchange Rate (2)	Official exchange rate (LCU per DM, period average)	
Independent Variables:		
Current Account (2)	Annual current account per GDP (%)	-3.418 (6.359)
Domestic Credit (1)	Annual growth rate of Domestic credit provided by banking sector per GDP (%)	-3.681 (83.069)
M2 (1)	Money and quasi money to total reserve ratio	11.155 (45.362)
CPI (1)	Annual growth of consumer Prices (%)	
GDP Growth (1)	Annual growth rate of GDP (%)	0.375 (6.192)
Unemployment (1)	Unemployment, total (% of total labor force)	4.203 (5.527)
Geographic Neighbors(4)	Number of neighbors a country has based on first-order contiguity	

1. World Development Indicator; *The World Bank Databases*
2. Direction Of Trade; *IMF Databases*
3. International Financial Statistics, *IMF Databases*
4. CIA*, The World Fact Book*

Appendix 2: List of Countries

Afghanistan, Islamic Republic of
Albania
Algeria
Argentina
Australia
Austria
Bangladesh
Belgium
Benin
Bolivia
Brazil
Bulgaria
Burkina Faso
Burundi
Cameroon
Canada
Chile
China, P.R.: Mainland
Colombia
Congo, Democratic Republic of
Congo, Republic of
Costa Rica
Côe d'Ivoire
Cuba
Cyprus
Czech Republic
Denmark
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Estonia
Ethiopia
Fiji
Finland
France
Gabon
Gambia, The
Georgia
Germany
Ghana
Greece
Guatemala
Guinea
Guyana
Haiti
Honduras
China, P.R.: Hong Kong
Hungary
Iceland
India
Indonesia
Iran, Islamic Republic of
Iraq
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kenya
Korea, Democratic People's Rep. of
Korea, Republic of
Lebanon
Liberia
Madagascar
Malawi
Malaysia
Mali
Mauritania
Mauritius
Mexico
Mongolia
Morocco
Mozambique
Myanmar
Nepal
Netherlands
New Zealand
Nicaragua
Niger
Nigeria
Norway
Oman
Pakistan
Panama
Paraguay
Peru
Philippines
Poland
Portugal
Romania
Russian Federation
Rwanda
Saudi Arabia
Senegal
Serbia and Montenegro
Sierra Leone
Singapore
Somalia
South Africa
Spain
Sri Lanka
Sudan
Sweden
Switzerland
Tanzania
Thailand
Togo
Trinidad and Tobago
Tunisia
Turkey
United Kingdom
United States
Uruguay
Venezuela
Zambia
Zimbabwe