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ON THE MEASUREMENT OF THE INTERNATIONAL PROPAGATION OF SHOCKS

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ABSTRACT

In this paper I offer an alternative identification assumption that allows one to test for changing patterns regarding the international propagation of shocks when endogenous variables, omitted variables, and heteroskedasticity are present in the data. Using this methodology, I demonstrate that the propagation mechanisms of 36 stock markets remained relatively stable throughout the last three major international crises which have been associated with "contagion" (i.e., Mexico 1994, Hong Kong 1997, and Russia 1998). These findings cast considerable doubt upon theories that suggest that the propagation of shocks is crisis contingent, and driven by endogenous liquidity issues, multiple equilibria, and political contagion. Rather, these findings would seem to support theories that identify such matters as trade, learning, and aggregate shocks as the primary transmission mechanisms in this process.

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1 Introduction

The Mexican, Asian, and Russian crises generated a sequence of stock market and exchange rate collapses in several emerging markets. These collapses, and the processes that generated them, have driven the literature to ask exactly how these shocks were transmitted internationally and why with such intensity. Was it because, as some believe, the linkages between countries grew stronger during these crises? Or was it because they were already strong before the crises took place?

This question is important, at least from a theoretical point of view, because the answer allows us to discriminate between two competing classes of theory regarding the international propagation of shocks: namely, those for which the transmission mechanism is crisis contingent, and those for which it is not. The first set of theories are based, primarily, on multiple equilibrium, endogenous liquidity and political contagion viewpoints. In general, they imply that the propagation of shocks is exacerbated by, and contingent upon, crises. The second set of theories, however, addressing such matters as trade, learning, herding, and aggregate shocks, imply that the transmission mechanism is symmetric and stable through time.

In this paper, therefore, I develop a procedure with which one can test for changes in the way in which shocks are propagated. Using daily data from a total of 36 stock market indices, I show that, on average, the transmission mechanism during the turmoil was significantly different from that during tranquil periods in only ten percent of cases. These findings clearly cast considerable doubt upon the validity of the "first" set of theories.

The test is based on a new identification assumption that solves the problem of endogenous variables under heteroskedasticity and omitted variables. It is rooted in the assumption that, during crises, the degree of variance exhibited by disturbances is likely to increase.[1] Consequently, I demonstrate herein a test in which the joint null hypothesis is that if the degree of variance exhibited by only one of the structural shocks increases, the transmission mechanism is stable. The test is then rejected if either the transmission mechanism changes (the scenario of most interest to this paper), or if two or more disturbances increase their degree of variance. This identification assumption has an instrumental variable interpretation, and the test is implemented as a Hausman-type specification test.

The paper is organized as follows: in section 2, the theories and the empirical evidence regarding the measurement of the international propagation of shocks is summarized. In section 3, the problems with the standard measures are highlighted and a new procedure is advanced. In addition, the instrumental variables interpretation is developed, and its relationship with the existing literature on changes in regime is examined. In section 4, this new identification procedure is applied to the daily data, produced between 1993 and 1998, of 36 stock markets. Finally, in section 4 conclusions and extensions are discussed.

[1] For example, during the Mexican crisis, the daily innovations in stock market returns in the month following December 19th, 1994 were 16 times more volatile than those in the month prior to it.

2 A Review on the international propagation of shocks.

In this section, I first summarize the theories regarding the international propagation of shocks that have been advanced in the literature, indicating as I do so the effect they may have on the transmission channel. Finally, I review some of the empirical literature available.

2.1 Theories

As mentioned above, theories concerning the propagation of shocks can be divided into two broad classes: namely, the crisis contingent, and the non crisis contingent.

Within the first class, three basic frameworks have been discussed in the literature. The first of these proposes that multiple equilibrium is responsible for the transmission of crises, i.e., that a crisis in one country will be used as a sunspot by those in other countries. (Masson, 1997). The basic idea is simply that the crisis in the first country affects investors' expectations in the second, upsetting the equilibrium of the latter economy and causing a crash. This theory not only explains the bunching of crisis, but also speculative attacks to economies that look, in principle, to be healthy.[2] From the propagation point of view, then, during the period of crisis the transmission of the shock is governed by a change of investors' expectations rather than by real linkages. In other words, the change in the price of the second market relative to that of the first is exacerbated during the shift in the equilibria: an excess degree of co-movement should be expected and, therefore, the measured propagation is different.

The second framework is built around the theory that liquidity shocks affecting market participants will lead to a sell-off causing excess co-movement in asset's prices.[3] Valdés [1996] analyses the impact of a liquidity shock upon the portfolio recomposition across emerging market, and he shows that a crisis in one country, leading to a liquidity shock in investor's capital, can in turn drive resources out of other assets. The bottom line is that investors require capital in order to operate in the market, whether to satisfy margin calls, meet regulatory requirements, or because they are credit rationed. Therefore, a crisis in one country generates a capital loss that increases the degree of rationing taking place and, in turn, forces investors to sell their other holdings. If there are price effects in those markets, further crashes are realized. Therefore, once again, from the propagation point of view, the collapse of prices is driven by the presence of a severe liquidity shock.[4]

In addition, Calvo [1999] studies an economy in which there exists asymmetric information among investors. Informed investors receive signals about the fundamentals of the

[2]This point has been raised by Radelet and Sachs [1998a, 1998b], Sachs, Tornell and Velasco [1996], among others.

[3]Liquidity issues have been raised as an important component of the contagion in the recent Russian crisis. See Calvo [1999].

[4]In the case of Valdes[1996], it is the increase in the degree of rationing at the investors side what generates the comovement in the stock markets. Several other mechanism can be thought: margin calls (as in Calvo[199]), or debt rollover (as in Cole & Kehoe[1996]).

country and are hit by liquidity shocks. The liquidity shock (in Calvo's case it is a margin call) forces informed investors to sell their holdings. However, uninformed investors cannot distinguish between the liquidity shock and a bad signal and, therefore, they charge a premium on the asset when the informed investors are net sellers. In this case, the increase in the relative asymmetric information generates a co-movement across all the asset-class. Once again then, the propagation of shocks across assets is governed by the liquidity shock.

Finally, Drazen [1998] studies the European devaluations of early 199o's, argues that political economy issues could explain the bunching of those crises. His model assumes that there are political pressures upon the Central Bank Presidents to maintain the exchange regime. When one country decides to abandon the peg, it reduces the political costs (of similarly abandoning the standard) for the next country in line. Consequently, a sequence of exchange rate crises occur.

In conclusion, these theories have two important empirical implications: Firstly, the effects on the propagation mechanism are, clearly, short lived (It is hard to argue that liquidity shocks or sunspot dynamics can last for long periods). Secondly, the theories imply that crises are inherently different from periods of tranquility. In particular, the models predict an increase in the propagation of international shocks during crises.[5]

The second class of theories study the propagation of shocks as independent of the existence of crises. These theories are based around the role of trade[6], monetary policy coordination, learning[7], and aggregate shocks, such as international interest rates, aggregate shifts in risk aversion, random liquidity shocks, and world demand. These theories have two main implications: Firstly, stock market indexes tend to be integrated with one another. Thus, they are endogenous variables and, therefore, the tests have to be designed to take care of this problem. Secondly, these theories imply that the methods by which shocks are transmitted, during both tranquil periods and periods of crisis, are similar. Moreover, they argue that positive and negative shocks have symmetric effects. This is because there is no reason to assume, for example, that trade will change during the period of the crisis (typically a month) in such a way that the propagation mechanism is significantly affected.[8]

2.2 Empirical literature

The empirical literature addressing the transmission of international shocks can be divided in four strands.

[5]Important exceptions to this remark are the theories based on liquidity, if and only if those shocks are uncorrelated with the markets. In other words, they are exogenous and symmetric shocks and not margin calls. In this case, the transmission mechanism is stable through time.

[6]For the first paper (as far as I know) that deals with this issue see Gerlach and Smets [1995]. A recent paper (based on microfoundations with all the bells and whistles) see Corsetti et.al. [1998] .

[7]Here I call learning all those papers in which there is pure learning (Rigobon [1998]), as well as the theories of hearding and informational cascades (Chari & Kehoe [1999], and Calvo & Mendoza [1998]).

[8]These theories have been identified in the literature with real linkages, even though some of them are not.

Firstly, the propagation has been measured in terms of the correlation between stock markets. The main hypothesis is to test whether or not the propagation changes before and after the crisis. King & Wadhwani [1990] study the correlation between U.S., U.K. and Japan around the time of the 1987 stock market crash. They find that the degree of correlation increases after October of 1987. Similarly, Lee & Kim [1993] analyze twelve major markets during the same period, and also find that the average weekly correlation increased from 0.23 to 0.39. Finally, Bertero & Mayer [1990] show that while stock markets in some countries reacted sharply to the U.S. stock market crash, others appeared unaffected. The market's vulnerability was not significantly related to the market size, nor its average volume. They find that the propagation is larger to those markets in which there existed circuit breakers and/or capital controls, and they also report that correlations across major regional indices increase after the crash and remain above-average for several months.[9]

Secondly, the transmission of crisis is instead measured as the propagation of volatility using an auto-regressive conditional heteroskedasticity (ARCH) framework. Such papers find significant spillovers taking place across major stock markets during the October 1987 crisis (see Chou, Ng & Pi [1994], and Hamao, Masulis & Ng [1990]). Additionally, Edwards [1998] studies whether there had been volatility propagation in the bond market to Argentina or Chile following the Mexican crisis, and he concludes, using an augmented GARCH model, that there had been considerable spillover from Mexico to Argentina, but not to Chile. Edwards is, in this paper, more concerned with the properties of the propagation mechanism when capital controls are imposed; however, his evidence supports the existence of significant interrelationships between countries.

Third, changes in the long run relationship between two stock markets are measured as shifts in the cointegrating vector. Longin & Slonik [1995] consider seven OECD countries from 1960 to 1990 and report that average correlations in stock market returns between the U.S. and other countries have risen by about 0.36 over this thirty-year period.[10] However, most of the contagion events observed since Mexico have been short run events (at most 3 months) and cointegrating techniques are unlikely to detect such dynamics.

Finally, several papers concentrate upon the estimation of the propagation of news across countries, separating regular channels (such as trade) from channels that are related to crisis contingent theories (country similarities and multiple equilibria, for example). Eichengreen, Rose & Wyplosz [1996] estimate the probability that a crisis in one country would affect the probability that a second coming under attack. To do this, they study the collapse of the fixed exchange rates in Europe at the end of 1992, and find that the probability that a country would suffer a speculative attack increases when another one in the union was under pressure. They also find that the propagation mechanism is based primarily upon trade and not upon any similarities between the countries in question. Likewise, Glick and Rose [1998] study several crises (1971, 1973, 1992, 1994, and 1997) and show, as above, that

[9]See Karolyi & Stulz [1996] for another application to the US-Japan markets. See also Pindyck & Rotemberg [1993] for testing comovements in individual stock prices, and Pindyck & Rotemberg [1990] for commodity prices. See Masson [1997] for an application regarding speculative attacks.

[10]See also Cashin, Humar & McDermott [1995].

trade linkages drive a substantial proportion of the transmission mechanism of crises.[11]

In summary then, there is some evidence that suggests the existence of shifts in the propagation mechanism (specially when it is measured as excess co-movements during periods of crisis); however, the evidence is, at best, mixed.

3 Measuring changes in the propagation mechanism

In this section, I discuss the main limitation of the standard measures of the propagation mechanism when the data exhibits the following three problems: heteroskedasticity, endogenous variables, and omitted variables. Secondly, I offer a procedure, based on a new identification assumption, with which to test for the stability of the transmission mechanism. I analyze its instrumental variable interpretation, as well as its asymptotic properties. Finally, its relationship with the standard literature regarding regime shift is discussed.

Assume that there are two countries whose stock markets returns (x_t and y_t) are described by the following model:

$$
\begin{aligned}
y_t &= \beta x_t + \gamma z_t + \varepsilon_t && (1)\\
x_t &= \alpha y_t + z_t + \eta_t && (2)\\
E\left[\eta_t' \varepsilon_t\right] &= 0, \quad E\left[z_t' \varepsilon_t\right] = 0, \quad E\left[z_t' \eta_t\right] = 0 && (3)\\
E\left[\varepsilon_t' \varepsilon_t\right] &= \sigma_{\varepsilon_t}^2, \quad E\left[\eta_t' \eta_t\right] = \sigma_{\eta_t}^2, \quad E\left[z_t' z_t\right] = \sigma_{z_t}^2 && (4)
\end{aligned}
$$

where z_t is an unobservable aggregate shock (which has been normalized for simplicity), ε_t and η_t are the country specific shocks - assumed to be independent but not necessarily identically distributed. Without loss of generality assume that the returns have mean zero.

This model is rich enough to encompass several of the aspects discussed in the theory, and the three problems indicated above. Firstly, given the theories discussed above stock markets are, in general, endogenous variables ($\alpha, \beta \neq 0$). Secondly, there are common shocks to both markets, here summarized as z_t, which includes shocks such as the international interest rate, international demand, market attitudes toward risk, and liquidity shocks, etc. Note that it has been assumed that z_t is independent of x_t and y_t. However, if this is not the case, the equations (1) and (2) should be interpreted as a reduce form and z_t should be seen as the innovation to the third equation, which here it has been omitted. Thirdly, the variance of the idiosyncratic shocks changes through time to reflect the conditional heteroskedasticity in the data. Finally, no specific assumption on the functional form of the distribution of the errors is made, other than that the first two moments satisfy equations (3) and (4).

[11] See Kaminsky & Reinhart [1998] for a similar approach. Also see Baig & Goldfajn [1998]. They study the recent Asian crises and compute the effect of news in one country upon another's stock market. They find that a sizeable propagation of such news is to neighbor countries. See also Calvo & Reinhart [1995] for another procedure based on principal components with similar conclusions.

The goal of the test is to determine whether α, β, or γ change during the crises. However, in this setup, the standard measures of the propagation mechanism, as well as the tests of stability, are either biased or, alternatively, do not allow for the short run nature of the more recent crises.

First of all, estimations of the cointegrating vector will be biased if the omitted variable is also integrated. Bearing in mind that the omitted variable includes aggregate demand as well as the stock prices in other markets this problem is likely to be present. Moreover, cointegrating tests require long series, and the recent crises have, in general, been short run events. For example, the longest was the Mexican crisis, lasting less than 4 months. Secondly, GARCH models estimate excessive volatility propagation in the presence of endogenous variables. In other words, there is an identification problem in which the change in the variance can result from shifts in the coefficients, or heteroskedasticity of the structural shocks. The GARCH model estimates a reduce form and, consequently, excess variance spillover is likely to be obtained. Thirdly, Probit regressions are biased when heteroskedasticity has not been properly taken into account. As is shown by Lomakin & Paiz [1999] adjusting the thresholds regarding the definition of a crisis, by considering the conditional variance, diminishes the importance of linkages across countries. However, this adjustment is far from desirable and, further research is needed in this area. Finally, the correlation estimate is biased if the variances shift. This is because the correlation does not belong to the class of unbiased estimators and, therefore, changes in the variance of residuals will tend to bias the estimates upward.

In the first three cases, the problem cannot be solved unless more information is provided. In the last case, there are some circumstances (restrictive though) in which it is possible to correct the bias.[12] Assume, for example, that $\alpha = 0$, $z_t = 0$ for all t, and $\sigma^2_{\varepsilon_t} = \sigma^2_{\varepsilon}$ for all t. The model is then simplified to:

$$y_t = \beta x_t + \varepsilon_t \tag{5}$$

$$x_t = \eta_t \tag{6}$$

$$E[\eta_t \varepsilon_t] = 0, \quad E[\varepsilon_t \varepsilon_t'] = \sigma^2_{\varepsilon}, \quad E[\eta_t \eta_t'] = \sigma^2_{\eta} \tag{7}$$

Under these conditions, equation (5) can be estimated by OLS. Assume the sample is split according to the variance of η_t. Also assume that the variance of the residual can be written as

$$var(\eta^h_t) = (1+\delta) var(\eta^l_t)$$

[12] This has been highlighted before by Ronn [1998]. As is indicated there, this result was proposed by Rob Stambaugh in a discussion of the Karolyi & Stulz [1995] paper at the May NBER Conference on Financial Risk Assessment and Management. In the mathematical literature, the oldest reference I have found is Liptser & Shiryayev [1978], chapter 13. There, the result is known as the theorem on normal correlation.

for some positive δ, and where l (h) stands for low (high) variance sample.

This split does not affect condition (7), therefore the estimates of β are consistent in each of the sub-samples. Formally, $plim\,\beta^h = plim\,\beta^l$. However, by construction, the variance in the h sample is larger than the variance in the l sample. Consequently, to assure consistency in the estimates of β, the asymptotic covariance has to increase by exactly in the same proportion:

$$cova\left(x_t^h, y_t^h\right) = (1+\delta) cova\left(x_t^l, y_t^l\right).$$

Substituting in equation (5) it can be shown that the relationship between the variances of y_t in the two samples is

$$var(y_t^h) = var(y_t^l) \cdot \left[1 + \delta \rho^{l^2}\right],$$

where ρ^l is the correlation between x_t and y_t in the low variance sample. Finally, the correlation in the high variance sample can be written as,

$$\rho^h = \rho^l \left[\frac{1+\delta}{1+\delta\rho^{l^2}}\right]^{1/2}. \tag{8}$$

Note that equation (8) is a strictly increasing function of δ. Therefore, during crises when the variance of the underlying shocks increases, the estimated correlation is larger than is the case in periods of tranquility. The tests on changes in the propagation mechanism, consequently, must be performed on the unconditional moments, as oppose to on the conditional ones.[13]

The intuition of why this bias exists is simple. Assume in equation (5) the variance of x_t goes to zero. In this scenario, all the innovations in y_t are explained by its idiosyncratic shock and the correlation between x_t and y_t is zero. Now assume the variance of x_t starts to increase and, clearly, more fluctuations in y_t can then be explained by x_t. In the limit, when the variance of x_t is so large that makes the innovations of ε_t negligible, all the fluctuations in y_t are explained by x_t. Thus, the correlation is one. Note that in this exercise the propagation

[13] Forbes & Rigobon [1998] use a two step estimator to compute the implied unconditional correlation in crises. During the crisis both the conditional correlation (ρ^h) and the relative increase in the conditional variance (δ^h) are computed. Using equation (8), the implied unconditional correlation was determined. The test is whether or not the unconditional correlation during crises times is larger than (or different from) the unconditional correlation in tranquil periods. They compare the correlation coefficients for stock market indexes at the time of the Mexican and the Asian crises. They use daily data on 28 stock markets from 1993 to 1998, and show that, if the test is performed on conditional moments substantial contagion is present in the data (measured as a statistically significant increases in the correlation during crises). When the estimates are adjusted, however, few cases are found.

(β) between x_t and y_t has remained constant. Changes in the relative variance of the two shocks modifies the noise/signal ratio, thereby biasing the estimates of the correlation.

The derivation of equation (8) assumes that there are no problems of endogeneity or omitted variables. If they are present, however, condition (7) is not satisfied and the adjustment in the correlation estimate can not be performed without further information.

3.1 A new methodology to test for changes in the transmission channel

In this section, I discuss a new procedure to test for changes in regime in the face of problems of endogenous variables, omitted variables, and/or heteroskedasticity. First, I describe the general characteristics of the test. Second, I discuss its instrumental variables interpretation and its asymptotic distribution. Finally, I highlight its relationship with the current tests on changes of regime.

Solving for x_t and y_t from equations (1) and (2), the following reduce form is obtained.

$$y_t = \frac{1}{1-\alpha\beta}\left[(\beta+\gamma) z_t + \beta\eta_t + \varepsilon_t\right] \tag{9}$$

$$x_t = \frac{1}{1-\alpha\beta}\left[(1+\alpha\gamma) z_t + \eta_t + \alpha\varepsilon_t\right] \tag{10}$$

In this model only the variance covariance matrix can be computed:

$$\Omega = \frac{1}{(1-\alpha\beta)^2}\begin{bmatrix} (\beta+\gamma)^2\sigma_z^2 + \beta^2\sigma_\eta^2 + \sigma_\varepsilon^2 & (\beta+\gamma)(1+\alpha\gamma)\sigma_z^2 + \beta\sigma_\eta^2 + \alpha\sigma_\varepsilon^2 \\ . & (1+\alpha\gamma)^2\sigma_z^2 + \sigma_\eta^2 + \alpha^2\sigma_\varepsilon^2 \end{bmatrix}$$

To show how the identification problem is solved, first assume that σ_η^2 increases by $(1+\delta)$ at time t, and that all the other variances and parameters in the model remain constant. The conditional variance covariance matrix (conditional at t) is then:

$$\Omega_t = \frac{1}{(1-\alpha\beta)^2}\begin{bmatrix} (\beta+\gamma)^2\sigma_z^2 + \beta^2\sigma_\eta^2(1+\delta) + \sigma_\varepsilon^2 & (\beta+\gamma)(1+\alpha\gamma)\sigma_z^2 + \beta\sigma_\eta^2(1+\delta) + \alpha\sigma_\varepsilon^2 \\ . & (1+\alpha\gamma)^2\sigma_z^2 + \sigma_\eta^2(1+\delta) + \alpha^2\sigma_\varepsilon^2 \end{bmatrix}$$

Computing the change in the variance covariance matrix as the difference between the conditional and unconditional, the following is obtained

$$\Delta\Omega_t = \Omega_t - \Omega = \frac{\delta\sigma_\eta^2}{(1-\alpha\beta)^2}\begin{bmatrix} \beta^2 & \beta \\ \beta & 1 \end{bmatrix}. \tag{11}$$

There are two important remarks about equation (11): First, the determinant is equal to zero for any change in the variance (δ), any variance of the structural shocks ($\sigma_z^2, \sigma_\eta^2$, and σ_ε^2) and any parameter α, β, and γ. This will be true for all the cases in which there is only one shock whose variance increases. Second, β is fully identified either by dividing $\Delta\Omega_{12}$ by $\Delta\Omega_{22}$, or $\Delta\Omega_{11}$ by $\Delta\Omega_{22}$. This is the overidentifying restriction that allows to derive the IV test in the next section.

Let's summarize these properties in a proposition:

Proposition 1 *If two stock market indexes satisfy a reduce form model described by equations (1) to (4), and if ONLY one variance of a structural shock (ε_t, η_t, or z_t) increases, then the change in the variance covariance matrix has determinant equal to zero.*

$$\Delta\Omega_t = \frac{\delta\sigma_\eta^2}{(1-\alpha\beta)^2}\begin{bmatrix} \beta^2 & \beta \\ \beta & 1 \end{bmatrix} \qquad \textit{when } \sigma_\eta^2 \textit{ changes}$$

$$\Delta\Omega_t = \frac{\delta\sigma_\varepsilon^2}{(1-\alpha\beta)^2}\begin{bmatrix} 1 & \alpha \\ \alpha & \alpha^2 \end{bmatrix} \qquad \textit{when } \sigma_\varepsilon^2 \textit{ changes}$$

$$\Delta\Omega_t = \frac{\delta\sigma_z^2(1+\alpha\gamma)^2}{(1-\alpha\beta)^2}\begin{bmatrix} \left(\frac{\beta+\gamma}{1+\alpha\gamma}\right)^2 & \frac{\beta+\gamma}{1+\alpha\gamma} \\ \frac{\beta+\gamma}{1+\alpha\gamma} & 1 \end{bmatrix} \qquad \textit{when } \sigma_z^2 \textit{ changes}$$

In each case, some parameter (or combination of parameters) from the original model can be identified. Furthermore, and independently of the parameter to be estimated and the shock variance that changed, the coefficient can always be computed using the same procedure:

$$\theta^1 = \frac{\Delta\Omega_{12}}{\Delta\Omega_{22}} = \frac{cov(x^h y^h) - cov(x^l y^l)}{var(x^h) - var(x^l)}, \tag{12}$$

$$\theta^2 = \frac{\Delta\Omega_{11}}{\Delta\Omega_{12}} = \frac{var(y^h) - var(y^l)}{cov(x^h y^h) - cov(x^l y^l)}. \tag{13}$$

These two estimators have the same limit under the null hypothesis. Thus, they can be used to set either an overidentifying test or a Hausman specification test. This identification procedure is in the spirit of the original IV estimation of Haavelmo [1947] and Koopmans, et. al. [1950]. This IV interpretation is discussed in the next section.

3.2 An Instrumental Variables interpretation

In Figure 1, I have depicted the typical problem faced when attempting to estimate with endogenous variables. There is both a supply and a demand curve together with some realizations of the shocks. Assume that the coefficient of interest is the slope of the demand curve. In the top panel, it is impossible to estimate the slope of the demand curve because the shocks are to both the demand and the supply curve. The solution, therefore, is to find an instrument that shifts the supply curve, thereby enabling the slope of the demand curve to be computed.

In the bottom panel, an increase in the variance of the supply disturbances is shown. This rise in the variance has a similar effect as to find a valid instrument for the demand equation. In this case, on average, the supply curve is moving relatively more in the sub-sample with the higher variance than the demand curve.[14] In other words, the increase in the variance in the supply curve is equivalent to allowing a variable, present only in that equation, to move more; consequently, we can achieve identification.

Furthermore, this interpretation allows to provide a simple intuition to which parameter is being estimated in each of the three cases discussed in proposition (1). When the variance in the equation x_t increases the instrumental variable estimates are the "total" effect of country x_t on country y_t, where "total" indicates both the direct and the indirect effects (for example, the effect of trading in a common third market). Conversely, if the variance in the y_t equation is the one that increases, then the parameter estimated is the effect from y_t to x_t. Both these cases are measuring the propagation of shocks from one country to the other. Finally, the last case is when the variance of the common shock increases. This is probably the most interesting one. The parameter estimated is $\frac{\beta+\gamma}{1+\alpha\gamma}$. Note that this is the ratio between the coefficients of z_t in equations (9) and (10). This is a measure of how sensitive is country y_t with respect to country x_t when there is an aggregate shock (z_t). In other words, this is a measure of how "vulnerable" the former is relative to later.

3.2.1 Definition of the instruments

To fix the intuition, assume that there is an increase in the variance of η_t. The null hypothesis is, of course, that all the parameters and the rest of the variances, remain the same. The equation to be estimated is the following:

$$y_t = \beta x_t + \gamma z_t + \varepsilon_t$$

As before, let's split the sample between high and low variance:

$$y_t = \left\{ \begin{array}{c} y_t^h \\ y_t^l \end{array} \right\}, \text{ and } x_t = \left\{ \begin{array}{c} x_t^h \\ x_t^l \end{array} \right\}$$

Assume the instruments w_t^1 and w_t^2 are defined as follows:

[14] I owe this graphical interpretation to several fruitful conversations with Irineu Carvalho.

$$w_t^1 = \left\{ \begin{array}{c} \frac{1}{T^h} x_t^h \\ -\frac{1}{T^l} x_t^l \end{array} \right\} \tag{14}$$

$$w_t^2 = \left\{ \begin{array}{c} \frac{1}{T^h} y_t^h \\ -\frac{1}{T^l} y_t^l \end{array} \right\} \tag{15}$$

where T^h and T^l are the sample sizes of the high and low variance respectively. These parameters are needed only in small samples - in large samples they are irrelevant- however, in the empirical implementations it does make a difference to include them.

Let's first check that the instruments indeed reproduce equations (12) and (13). The IV estimators are the following:

$$\begin{aligned} \hat{\beta}^1 &= \left(w_t^{1\prime} x_t\right)^{-1} w_t^{1\prime} y_t = \frac{\frac{1}{T^h} x_t^{h\prime} y_t^h - \frac{1}{T^l} x_t^{l\prime} y_t^l}{\frac{1}{T^h} x_t^{h\prime} x_t^h - \frac{1}{T^l} x_t^{l\prime} x_t^l}, \\ \hat{\beta}^2 &= \left(w_t^{2\prime} x_t\right)^{-1} w_t^{2\prime} y_t = \frac{\frac{1}{T^h} y_t^{h\prime} y_t^h - \frac{1}{T^l} y_t^{l\prime} y_t^l}{\frac{1}{T^h} y_t^{h\prime} x_t^h - \frac{1}{T^l} y_t^{l\prime} x_t^l}, \end{aligned}$$

which are exactly equations (12) and (13) respectively.

Additionally, these instruments are valid if they are correlated with the right hand side: $plim\,[w_t^{i\prime} x_t] \neq 0$, and not correlated with the disturbances: $plim\,[w_t^{i\prime} \varepsilon_t] = 0$ and $plim\,[w_t^{i\prime} z_t] = 0$. Substituting with the definitions of the variables, the first set of conditions are:

$$plim\left[w_t^{1\prime} x_t\right] = plim \frac{1}{T^h} x_t^{h\prime} x_t^h - plim \frac{1}{T^l} x_t^{l\prime} x_t^l = var(x_t^h) - var(x_t^l) \tag{16}$$

$$plim\left[w_t^{2\prime} x_t\right] = plim \frac{1}{T^h} y_t^{h\prime} x_t^h - plim \frac{1}{T^l} y_t^{l\prime} x_t^l = cov(y_t^h, x_t^h) - cov(y_t^l, x_t^l) \tag{17}$$

Both instruments are correlated with the right hand side under the null hypothesis that the variance of η_t increases.

Meanwhile, the second set of conditions imply:

$$\begin{aligned} plim\left[w_t^{1\prime} \varepsilon_t\right] &= plim \frac{1}{T^h} x_t^{h\prime} \varepsilon_t^h - plim \frac{1}{T^l} x_t^{l\prime} \varepsilon_t^l \\ &= \frac{\alpha}{1-\alpha\beta} \left(plim \frac{1}{T^h} \varepsilon_t^{h\prime} \varepsilon_t^h - plim \frac{1}{T^l} \varepsilon_t^{l\prime} \varepsilon_t^l \right) \\ &= \frac{\alpha}{1-\alpha\beta} \left(var(\varepsilon_t^h) - var(\varepsilon_t^l) \right) = 0 \end{aligned} \tag{18}$$

which is equal to zero (under the null hypothesis) if the variance of the structural shock in the y-equation remains constant, and

$$
\begin{aligned}
plim\left[w_t^{1\prime} z_t\right] &= plim\frac{1}{T^h} x_t^{h\prime} z_t^h - plim\frac{1}{T^l} x_t^{l\prime} z_t^l \\
&= \frac{1+\alpha\gamma}{1-\alpha\beta}\left(plim\frac{1}{T^h} z_t^{h\prime} z_t^h - plim\frac{1}{T^l} z_t^{l\prime} z_t^l\right) \\
&= \frac{1+\alpha\gamma}{1-\alpha\beta}\left(var(z_t^h) - var(z_t^l)\right) = 0
\end{aligned}
\tag{19}
$$

It is easy to show, too, that the conditions for the second instrument are similar, up to a constant, to equations (18) and (19):

$$
plim\left[w_t^{2\prime} \varepsilon_t\right] = \frac{1}{1-\alpha\beta}\left(var(\varepsilon_t^h) - var(\varepsilon_t^l)\right) = 0 \tag{20}
$$

$$
plim\left[w_t^{2\prime} z_t\right] = \frac{\beta+\gamma}{1-\alpha\beta}\left(var(z_t^h) - var(z_t^l)\right) = 0 \tag{21}
$$

In conclusion, under the null hypothesis both instruments are valid. In order to develop an overidentification test or a Hausman specification test, these instruments have to be invalid under the alternative hypothesis. This is the topic of the next section.

3.2.2 The instruments under the alternative hypothesis

There are two circumstances in which the instruments are invalid: Firstly, when two or more structural shock variances increase, and secondly, when the transmission mechanism changes.

To address the first case, note that if there are two shocks increasing their variances, then at least two of conditions (16), (17), (18), (19), (20), or (21) will fail. In particular, two out of the last four will definitely not be satisfied.

As regards of the second, if there is a change in α, β or γ, conditions (16) and (17) will probably be satisfied because the variances and covariances are likely to be different in the two samples. However, (18), (19), (20), and/or (21) will not be satisfied. In order to illustrate this case, assume the variance of the idiosyncratic shocks remain constant. The conditions are as follows:

$$
\begin{aligned}
plim\left[w_t^{1\prime}\varepsilon_t\right] &= \sigma_\varepsilon^2\left[\frac{\alpha^h}{1-\alpha^h\beta^h}-\frac{\alpha^l}{1-\alpha^l\beta^l}\right]\\
plim\left[w_t^{1\prime}z_t\right] &= \sigma_z^2\left[\frac{1+\alpha^h\gamma^h}{1-\alpha^h\beta^h}-\frac{1+\alpha^l\gamma^l}{1-\alpha^l\beta^l}\right]\\
plim\left[w_t^{2\prime}\varepsilon_t\right] &= \sigma_\varepsilon^2\left[\frac{1}{1-\alpha^h\beta^h}-\frac{1}{1-\alpha^l\beta^l}\right]\\
plim\left[w_t^{2\prime}z_t\right] &= \sigma_z^2\left[\frac{\beta^h+\gamma^h}{1-\alpha^h\beta^h}-\frac{\beta^l+\gamma^l}{1-\alpha^l\beta^l}\right]
\end{aligned}
$$

Note that if only one coefficient changes (for example β) the set of parameters that satisfy all four conditions has measure zero. If all three parameters change, still is the case that the set has measure zero.

Finally, note that equations (16) to (21) imply that the bias in the estimator is different for each of the two instruments. This allows us to define a test in which under the null hypothesis, the two estimators have the same limit, but under the alternative hypothesis they are inconsistent and with different limits. This test is somewhat like the Hausman specification test.

$$
\begin{aligned}
H_0;\ \hat{\beta}^1 &= \hat{\beta}^2\\
H_1;\ \hat{\beta}^1 &\neq \hat{\beta}^2
\end{aligned}
$$

Now, let's summarize these results in a proposition.

Proposition 2 *w_t^i defined in equations (14) and (15) are valid instruments for:*

- *β if and only if there is an increase in the variance of x_t which is **only** the result of changes in the variance of η_t.*
- *α if and only if there is an increase in the variance of y_t which is **only** the result of changes in the variance of ε_t.*
- *$\frac{\beta+\gamma}{1+\alpha\gamma}$ if and only if there is an increase in the variance of x_t and y_t which is **only** the result of changes in the variance of z_t.*

Under the alternative hypothesis the instrumental variables estimators are inconsistent.

3.2.3 Asymptotic properties of the instruments

Given the IV characteristic of the estimators, it becomes straight forward to derive their asymptotic properties. Firstly, as it was shown in the previous section, the estimators are consistent in each of the three cases under the null hypothesis. Secondly, the estimators are asymptotically normal, but not efficient. Again, for simplicity assume that we are studying the first case in which the variance of η_t increases. The asymptotic distribution of the estimator is

$$\sqrt{T}\left(\hat{\beta}^i - \beta\right) \underset{p}{\longrightarrow} N\left(0, W^{i^{-1}} \Sigma^i W^{i^{-1}}\right)$$

where,

$$\begin{aligned} W^i &= \lim \frac{1}{T} w_t^{i\prime} x_t, \\ \Sigma^i &= \lim \frac{1}{T} w_t^{i\prime} w_t^i \left(z_t + \varepsilon_t\right)' \left(z_t + \varepsilon_t\right). \end{aligned} \tag{22}$$

Finally, the two estimators have an asymptotic covariance given by,

$$\left(\hat{\beta}^1 - \beta\right)\left(\hat{\beta}^2 - \beta\right) \underset{p}{\longrightarrow} W^{1^{-1}} \Sigma^{1,2} W^{2^{-1}},$$

where W^i is defined as equation (22) and $\Sigma^{1,2}$ is

$$\Sigma^{1,2} = \lim \frac{1}{T} w_t^{1\prime} w_t^2 \left(z_t + \varepsilon_t\right)' \left(z_t + \varepsilon_t\right).$$

Using these asymptotic distributions it is possible to define a test whether or not the estimators (using the two instruments) are equal. Under the null hypothesis they have the same limit, but under the alternative hypothesis their bias is different.

3.3 Relationship with the existing literature

The test developed here is in the spirit of the standard structural change tests, however, it differs in at least one important dimension: it does not requires the estimation of the parameter of interest in order to determine if it has changed or not. This characteristic of the test is, perhaps, the most important aspect. The standard methodologies have to estimate the parameters and, therefore, they cannot be implemented if there are problems of endogenous or omitted variables.

To illustrate the intuition, let's simplify equation (1) by eliminating the problem of endogeneity ($\alpha = 0$). Assume that the variance of the aggregate shock is allowed to increase. The standard test of structural change estimates the coefficient β in two separate samples. In this case, the OLS estimate of β is biased and will be given by:

$$\hat{\beta} = \beta + \gamma \frac{\sigma_z^2}{\sigma_z^2 + \sigma_\eta^2}$$

Note that the bias increases when σ_z^2 rises. Therefore, the standard tests of structural change could detect an increase in the estimated value of $\hat{\beta}$ because there is a rise in the variance of the omitted variable in one of the sub-samples, and not because the true β has changed. Without further structure, however, it is impossible to solve the problem of identification.

The IV test described here has been constructed to deal with these problems. The only additional information it requires is that the tranquil and crises periods are known. Usually, of course, the starting days in those crises are obvious; however, it is often the case that pinpointing the final day is somewhat more difficult. Consequently, sensitivity analysis must be performed to evaluate the robustness of the results obtained.

4 Empirical Evidence

In this section, an application of the procedure developed previously is presented. The identification assumption requires a shift in the second moments at some point in time. The recent financial crisis is a relatively clean example of those shifts.

The data was collected from Datastream, and it consists of daily stock market returns (both in dollars and in domestic currency) for 36 countries, covering the period from January 1993 to December 1998. The countries studied were: Argentina, Australia, Austria, Brazil, Canada, Chile, Columbia, Denmark, Finland, France, Germany, Greece, Hong Kong, India, Indonesia, Italy, Japan, Malaysia, Mexico, Netherlands, Norway, Peru, Philippines, Portugal, Russia, Singapore, Korea, South Africa, Spain, Sweden, Swiss, Taiwan, Thailand, UK, USA, and Venezuela. Short term interest rates covering the same period and frequency were also collected.

4.1 Testing for Changes in the Transmission Mechanism

In order to allow for trends, lags and aggregate shocks (at least partially) the following VAR specification was estimated in the full sample.

$$\begin{aligned} s_t &= c + \phi(L) s_t + \Phi(L) i_t + \varepsilon_t \\ s_t &\equiv \{s_t^n, s_t^m\}' \\ i_t &\equiv \{i_t^n, i_t^m, i_t^{US}\}' \end{aligned} \tag{23}$$

where n and m represent a pair of countries in the sample, $\phi(.)$ and $\Phi(.)$ are lag operators, s_t are the stock market returns, i_t are the daily interest rates, and ε_t are the reduce form residuals. The preferred estimation is one in which s_t is defined as the two days returns in dollars, where one day lag is allowed, and all three interest rates are included. Nevertheless, several sensitivity analyses were performed.

Three crises are studied: The Mexican crisis in December 1994, the Hong Kong crisis in October 1997, and the Russian crisis in August 1998.[15]

Two days returns are used because there are different times in which the markets are open, and the consequent possibility that a shock in one country occurs while another is closed, meaning that the effect is observed a day later. One lag is used to control for the serial correlation implied by the construction of the two day returns. The interest rates are included to partially offset for aggregate shocks $\left(i_t^{US}\right)$ and domestic monetary policies (i_t^n, i_t^m). The tranquil period is defined as the 60 working days prior to each crisis, while the turmoil period is defined as ending 10 working days after the crisis commences. The tranquil period of 3 months is short enough to assure that two crisis are not present in the sample; however, for the Asian crises, the tranquil period was defined as January to June. The turmoil period of two weeks usually includes most of the action observed in the stock markets (except during the Mexican crash where the collapse took more than three months). In the robustness section several of these parameters are altered in order to evaluate the sensitivity of the results.

Finally, note that in equation (23) it has been assumed that the trend as well as the parameters $\phi(.)$ and $\Phi(.)$ remain constant between tranquil and crisis periods. If there is a shift in these coefficients, then they are captured in changes in the variance covariance matrix of the residuals. Thus, the procedure is able to reject in those circumstances, too.

The residuals obtained from the first step VAR are used to run the test proposed in the previous section: Given the tranquil and crisis windows, the two instrumental variables estimators are computed. These instruments are defined by equations (14) and (15) and the estimates are obtained using equations (12) and (13). The test is thus to determine if the two estimators are statistically the same. Their joint asymptotic variance-covariance matrix is described in section 3.2.3.

In the next three sections, each of the crises is analyzed. The robustness check and the measures of propagation as well as the relative vulnerability are discussed later.

4.1.1 Mexican Crisis: Tequila Effect

The Mexican crisis started with the abandonment of the exchange rate regime in December 19, 1994. There are two other important events to account for, though. In January 9, the news that part of the debt was not going to be rollover was announced, and the next day the negotiations for a bailout program started. The fact that the crisis was not resolved faster produced a long period of deterioration and negative returns (of around three months). In the robustness section, I look at how the results change when this window is modified;

[15]The exact date for each crisis is as follows: Mexico abandoned the regime in December 19, 1995, Hong Kong occurred in October 17, 1997, and Russia crashed in August 13, 1998. Sensitivity analysis were performed on the starting date of the crisis (plus or minus 5 days) and the results were qualitatively the same.

however, it is important to remember that extending the period of crisis will capture the additional shocks in January.

The crisis window covers a period of two weeks (10 days) and the tranquil window are the three months prior to the crash (60 days).

The first step regression is implemented using 2 day returns and 1 lag. After obtaining the residuals, the instrumental variables estimates are computed. Table (1), shows the estimation of the parameter using the two instruments. The missing countries are absent due to a lack of information, usually regarding interest rates. The upper triangular matrix are the results obtained by using the first instrument only, while the lower half are the estimates using the second instrument.

The results of testing if the parameters are stable are shown in table (2). The upper half is the standard deviation of the difference of the two estimated coefficients, and the lower half indicates whether or not the coefficients are statistically different at a 95 percent confidence; a 1 indicates the pair of countries in which the test is rejected.

[Insert table here]

Table 1: Estimation of beta for the 1994 Mexican crisis.

[Insert table here]

Table 2: Results of Hausman Specification Test. 1994 Mexican crisis.

As was indicated previously, if the country that has the crisis is among the pair analyzed, the instruments identify the direct propagation mechanism. In the upper half of table (1), the column country represents the base country (the x_t in our model, equations 1 and 2). For example, this means that the coefficient corresponds to β when it is under the Mexican column, and it is $1/\beta$ when it is on the Mexican row.

On the other hand, when the country under crisis is not one of the pair, the instrumental variable identify the vulnerability of the two countries with respect to the common shock. This implies that the rest of the coefficients in the upper triangle indicates how vulnerable is the row country relative to the column country.

Finally, the lower half of the matrix is symmetric to the upper half, which allows to make direct comparisons between the two estimates of the coefficients.

In order to fixed ideas lets see three examples: Mexico-Argentina, Mexico-Peru, and US-Argentina.

1. On table (1) on the Argentinean row, the coefficient below the Mexican column is 0.31. This is the direct transmission mechanism from Mexico to Argentina. Under the Argentinean column and in the Mexican row, the coefficient is 0.26. The previous

estimate was obtained using the first instrument, while the last one was computed using the second instrument. These two estimates have to be compared in order to determine if the parameters are stable. In table (2) the standard deviation is 0.02, and under the Argentinean column and Mexican Row a 1 indicates that the test that these estimates are statistically the same is rejected at the 95 percent confidence.

2. Regarding Mexico and Peru, in the upper half the coefficient is found under the Peru column and on the Mexican row. This means that the coefficient is $1/\beta$. Using the first instrument the estimate is 33.2 which corresponds to a transmission equal to 0.031, while the estimate using the second instrument is 9.47, which implies a coefficient equal to 0.106. The standard deviation is 59.8. Note that the standard deviation is for the difference between the inverse of the two coefficients. As can be seen, it is not possible to reject the hypothesis that the two coefficients are the same, implying that in this case, it is not possible to reject the hypothesis that the transmission from Mexico to Peru is stable.

3. Finally, under the US column, the Argentinean coefficient is 3.1[16], using the first instrument, and -11 using the second one. The standard deviation is 8.88, which implies that it is not possible to reject the hypothesis that the two estimates are the same.[17]

In table (2), only in 2.4 percent of the cases (12 out of 496) the test is rejected. However, one of these 12 pairs is of particular interest to us: Mexico-Argentina. In fact, it was this relationship that initiated most of the public discussion on this literature. It is indeed true that one explanation of this result could be that Argentina suffered another shock during the period in question; however this is unlikely given the short span of the windows used. Consequently, the results suggest that, at least as regards to Mexico and Argentina, the transmission mechanism was not entirely stable during the Tequila crisis.

Unfortunately, aside from this case, the other 10 pairs in which the test is rejected do not show any pattern.

Finally, it is possible to argue that the problems in the propagation mechanism should be more important in less developed markets. Concentrating upon non-OECD countries (plus Mexico and Korea) there are 15 countries with data (which implies 105 pairs). Among these pairs in only 3 cases (2.9 percent) a rejection is found: Mexico-Argentina, Mexico-Malaysia, and Singapore-Korea. Again, there does not seem to be more rejections in this sub-sample, and there is no clear pattern on the rejections either.

4.1.2 Hong Kong Crash: Asian Flu

The Hong Kong crisis started October 17, 1997. This crisis is particularly difficult to isolate because the Korean crisis occurred at the end of December, and the whole region was in crisis

[16]This should be read as Argentina been three times more vulnerable than US to a Mexican shock.

[17]Interestingly, the 3.1 coefficient is significantly different from zero, but not the -11 estimate.

from June until September. Therefore, the period of tranquility is defined from January 1997 and ends prior to the Thailand's abandonment.[18]

On the other hand, one of the nice properties of the Hong Kong crisis is that it was a sharp shock and most of the fluctuation occurred within two weeks. This contrasts with the Mexican crisis that extended for more than three months.

It is possible, then, to isolate the crisis period (at least) by concentrating the crisis window only around the two weeks after the initial crash. As will be discussed in the robustness section, when the crisis window is extended to include the Korean crisis, substantial rejections occur.

Table (3) shows the estimates using the two instrument under the preferred specification. This table should be interpreted in the same manner as before - the direct propagation mechanism is the one in the Hong Kong column and row, and the rest of the coefficients represent the relative vulnerability of countries to Hong Kong shocks. The upper half are the estimates using the first instrument, while the bottom half are the results using the second instrument.

Because of the sharpness and the size of this crisis, in this case the proportion of coefficients that are significant is larger than in the Mexican crisis: more than 1/3 of the coefficients are statistically different from zero, while only 11 percent are significantly different from zero in the Mexican crisis.

The main reasons why this is the case are twofold: First, during the Mexican crisis pinpointing the end of the crisis is difficult. In the Hong Kong crash most of the action occurs within two weeks improving the quality of the instrument even though the size of the sample is small. Second, the importance of the Hong Kong stock market in the world is larger than the Mexican stock market, both in terms of size and as regional indicators. Therefore, it should be expected that the transmission from Hong Kong should be larger than from Mexico.

In table 4, the results from testing if the coefficients are the same are shown. In this case, 6.7 percent of the pairs are rejected (42 out of 630). From this 42 cases, Colombia accounts for 7, and Malaysia for 8. Again, there does not seem to be a pattern in the rejections.

[Insert table here]

Table 3: Estimation of beta for the 1997 Hong Kong crisis.

[Insert table here]

Table 4: Results of Hausman Specification Test. 1997 Hong Kong crisis.

[18]Several sensitivity analysis were performed to test the importance of the ending date of the tranquil period. There was no difference in the results if the data was stopped before June 6. As soon as the Thailand crisis is included, then substantial rejection in the test is found.

In the sample there are 18 non-OECD countries (including Mexico and Korea) which implies 153 pairs (at most) that include two developing economies only. In this sub-sample there are 13 cases (8.5 percent) where there is a significant change in the transmission mechanism. These pairs are: Argentina-Brazil, Argentina-South Africa, Colombia with Russia, Singapore and South Africa, Indonesia-South Africa, Malaysia with Russia, Singapore, South Africa and Taiwan, Mexico-Peru, and Philippines with Russia and South Africa. As can be seen, most of the changes involve countries that indeed suffer significant speculative attacks during the Hong Kong crisis; however, the proportion of rejections still is too small, and several of these pairs are missing if indeed they changed (for example, Argentina-Mexico, Brazil-Mexico, etc.)

4.1.3 Russian Crisis: Siberian Cold.

On August 13, 1998 the Russian crisis occurred. Even though in the bond market, the initial shock takes place on the 6th, there is no reaction in the stock market until the 13th. There are two additional events that have to be considered in the determination of the tranquil and crisis windows: First, the tranquil window should end at most in August 1st to avoid including the shocks in the bond market. Second, the crisis window should end before October given that a massive speculative attack to Brazil took place then.[19]

As in the Hong Kong crisis, most of the fluctuation occurs within two weeks following the crisis. Thus, the crisis window is defined as 10 days.

The results are presented in tables 5 and 6. In this case, 37.4 percent of the coefficients are statistically different from zero, but in only 6.2 percent of the pairs (37 out of 595) the test is rejected.

[Insert table here]

Table 5: Estimation of beta for the 1998 Russian crisis.

[Insert table here]

Table 6: Results of Hausman Specification Test. 1998 Russian crisis.

In the sub-sample of non-OECD countries (17 countries with data implying 136 pairs) there are 5 rejections (4.4 percent). The pairs are Argentina-Brazil, Chile-Venezuela, Brazil with Peru and South Africa, and Colombia-Mexico. All these countries suffered important speculative attacks after the Russian crisis, but again very few cases were found and all the cross ones are also missing.

[19] As before, several sensitivity analysis were performed to test the importance of the ending date of the tranquil period. It was found that the general conclusion was qualitatively the same.

In summary, in all the three crises studied, the test rejects that the propagation mechanism is stable through time in sensible cases (specially when we concentrate upon developing countries). However, there are three problems with these rejections: First, the percentage of rejections is very small, even in the non-OECD cases. This means that, at most, the theories in which the transmission is crisis contingent explains very few cases. Second, the pattern of rejections does not have a clear pattern, nor in the whole data, neither in the smaller sample of only developing countries. Third, when rejections are found, all the combinations do not show up in the rejections. For example, during the Russian crisis, Argentina, Brazil, Chile, Colombia, Mexico, South Africa, and Venezuela appeared in at least one pair in which the transmission changed. This means that there should be 21 pairs rejected and not only 5.

These results cast doubts on the empirical importance of theories where the transmission mechanism is crisis contingent. However, before claiming this problems of misspecification and power should be addressed.

4.2 Robustness

In this section, several sensitivity analysis are performed to determine how robust the previous conclusions are. Misspecification can occur because either the first step is misspecified (returns and lags), or the windows are wrongfully defined (width of windows, as well as starting dates).

The sensitivity analysis implied changes in the specification of the first step regression: the number of returns days (2 or 1), and the number of lags (1 or 5). Additionally, in the second step the different specifications implied changes in the crisis window (10, 20, 30 and 60 days) and the tranquil window (60, 120, and 240 days), as well as changes in the starting dates (plus or minus.

Several other alternatives were studied, including changing the date of the crisis, omitting interest rates in the first step, and concentrating upon indexes in domestic rather than foreign currency. In all these cases the results were similar and, therefore, I will not report them here.

In tables 7, 8, and 9 the results are summarized as follows: Column one to four indicate which simulation is run; column five indicate the number of pairs that were admitted using both instruments; columns six and seven are the number and the percentage of those coefficients that were statistically different from zero; and columns eight and nine show the number of times the test is rejected and the percentage of rejections over the total tests performed.

The first table is for the Mexican crisis, the second one is for the Hong Kong crisis, and the third one is for the Russian crisis.

There are four remarks that can be extracted from these tables. First of all, the coefficients are better estimated during the Hong Kong and Russian crises than in the Mexican crisis. At most 14 percent of the parameters are significantly different from zero during the Mexican crisis, while more than 40 percent of them are significant in the other two crises. Three explanations can be advanced of this: Firstly, Mexico's importance in the world economy is smaller than Hong Kong or Russia; secondly, the Mexican crisis may not have been as large as the other two, and thus the instruments are weaker; or, finally, the Mexican crisis was followed by several other shocks (such as the rollover of the debt during January of 1995) that have reduced the power of the test. If this is indeed the case, then this implies that, ex-ante, very few cases of rejection will be found during the Mexican crisis, and in fact, this does turn out to be the case. Significantly more cases of rejection are found during Hong Kong and Russia than are discovered during the Mexican crisis. For example, in the Mexican crisis, there are at most 7 percent of cases in which the test is rejected. This contrasts markedly with the Russian crisis, in which more than one third of the pairs suffered a significant change. Unfortunately, however, there is little that can be done without further information to improve the estimation for the Mexican case.

Secondly, when the crisis window is 10 days (two weeks), the proportion of significant changes is relatively small in all the cases. There are only two simulations in which the percentage of rejection is higher than 10 percent, and these are cases in which the tranquil period extends for at least one year prior to the crisis. As regards Hong Kong and Russia, however, there was another crisis in the world within that time, consequently, it should be expected that the amount of rejections would rise.

Thirdly, when the crisis window is enlarged (from 10 to 60) the percentage of cases in which the test is rejected also increases. Similarly to the above, the enlargement of the crisis periods inevitable incorporates further crises elsewhere. The results are more sensible for Hong Kong and Russia. And we know that the Korean crisis occurred within 60 days after Hong Kong, and the first Brazilian attack started two months after Russian collapse. This can be easily seen in the case of Hong Kong, in which the percentage of rejections doubles when the window is increased from 30 to 60.

Finally, an increase in the length of the tranquil period has only a minor effects on the results. In general the percentage of rejections increase, but not significantly

In summary, there are some changes in the propagation mechanism, specially during Hong Kong and Russian's crises. However, very few cases (almost always less than 10 percent of the cases) are found within the month after the crisis started. This casts doubt upon those theories that are crisis contingent, and supports those theories within which the transmission mechanism is stable through time.

4.3 Power of the test

The test developed here can be thought as an overidentification test. These tests, in general, are rejected on several alternative hypothesis and studying their power is cumbersome. In this particular case there are 31 alternative hypothesis. For reasons of brevity it is impossible to discuss the power in each of the cases. In this section, the power of the test is studied only against one of those hypothesis: β changes as well as the variance of the idiosyncratic shocks. I compare the results of the test with a standard test for changes in regime (an F-test).

The assumptions in the Monte-Carlo simulation are the following: it is assumed that the variance of the common shocks is zero ($\sigma_{z_t} = 0$); the two idiosyncratic shocks have the same variance, which were normalized to one; and the tranquil periods consist of 60 observations, while the crises are 10.

As should be expected, the power of the test depends crucially on the variance increase during the periods of crisis. Three cases are analyzed, when it increases in 5, 15 and 25 times.[20] The test was evaluated under several parameters: α and β vary from 0.1 to 0.4. Finally, three alternative hypothesis are studied, when β increases by 10, 20 and 30 percent.

One questions that immediately arises is if the increases in variance are reasonable. Indeed in the two weeks after the Mexican crisis in 1994, the variance of the stock market increased in more than 16 times. Moreover, the week of Hong Kong crisis implied an increase in its variance of almost 25 times, and during the same week, the US market increased its variance in 16 times. The Russian crisis has similar implications. On the other hand, the Korean and Brazilian crises only increased the volatility in 2 to 5 times. Some explanations have been given to this events (such that the world was already in crisis). As will become clear from the discussion below, when the increase in the variance is small the power of the test declines significantly. This is the main reason why these two crises are not analyzed in the present paper.

In tables 10, 11, and 12 the results of 1000 simulations are shown. The first three columns indicate which simulations is run. The first column indicates the value of β during the tranquil time, the second one is the value of α, and the third one is the increase in the variance of η_t during the crisis period.

The fourth column is the estimate of β using the first instrument. The fifth column is the proportion of times in which the test was rejected even though it was true that the parameters did not changed. The next three columns reflect the percentage of times in which the test was accepted even though β indeed changed during the crisis. Each column indicates in which percentage β changed. The last four columns reflect the results of running an F-test that the parameters are the same. Remember that it is possible to run this last test because α is known and, therefore, the structural shocks can be recuperated from the simulations. In practice, this test cannot be performed in the data. However, they are shown here to compare the power of the test presented with a standard test.[21]

In table 10 the results when the variance of η_t is increased in five times are shown, in table 11 it is augmented in 15 times, and finally, in table 12 it is risen in 25 times.

The consistency of the test in small samples can be evaluated by looking at the fourth column. As can be appreciated, the test lowers its small sample bias when the variance during crisis is much larger than the variance during periods of tranquility. The reason is that when the crisis times are similar to tranquil times, the instruments become weaker. In fact, in the limit, when the two regimes are identical, the instruments are invalid.

[20] Several other simulations were performed: when the variance increased by only 2 times and when it increased by 50 times. The conclusions share the same properties as the ones indicated here.

[21] It is important to remember that F-tests do not perform very well in small samples specially under heteroskedasticity.

The fifth column in all three tables indicate the percentage of times in which the test was rejected even though β did not change during the crisis. When the variance increases by five times, the test has relatively good type one errors. In general, they are below 14 percent. As can be seen, the test performs similarly to the F-test that always is below 7 percent. Notice that when the variance is increased in 15 and 25 times, the type one errors increase significantly. Moreover, the percentage of rejections increase with the change in the variance and with the value of β. In other words, the larger is the change in the variance or the larger is the value of β the higher the proportion of rejections even though the null hypothesis is true. It is important to highlight that the Chow test is not affected by this change in the variance (as it should be the case).

Finally, the type two errors indicate the percentage of times in which the test was accepted when β increased during the crisis. As is shown in the tables (and it should be expected) the test is able to reject the hypothesis more often when the change in β is larger. Moreover, note that the test performs badly when the increase in the variance is small. In general the type two errors are close or superior to 90 percent, indicating that in nine out of ten times the test is unable to reject the null hypothesis even though it was false. However, it is important to point out that the standard methods to test structural change also have problems with their power in these circumstances. Comparing the power of the two tests, it is possible to conclude that when β increases in 10 percent, both tests are equally bad, and that only the F-test is superior when the change in β is large.

When the variance increases in 15 to 25 times, the test proposed here improves its power, and in some circumstances it is even better that the F-test. However, in those circumstances, the test rejects too often. For example, if β and α equal to 0.3, β changed by 30 percent, and there is an increase in the variance of 25 times, the test rejects the hypothesis 90 percent of the time, while the F-test only rejects on 67 percent of the time. However, in those cases, the test rejects the null hypothesis when it is true in 39 percent of the cases, while the F-test only rejects on 5 percent of the simulations.

It can be concluded, then, that the power of the test is similar or close to what an F-test would obtain in similar circumstances. In other words, the deterioration in power that this test of structural change will have, in comparison to the standard methodologies, does not seem to be extreme. This does not mean, however, that the power of the test is good. On the contrary, this results should be interpreted as how bad the two tests perform in small samples. This is an important caveat that should be developed further in future research.

4.4 Measuring the propagation mechanism and vulnerability.

As was indicated above, if the source of the crisis is known, the parameter estimated has one of the two following interpretations: First, if the crisis is generated in one of the countries in the regression (n), then the parameter estimated is the total effect of this country on the other one (m). This is a direct measure of the propagation mechanism from country n to country m. Second, if the crisis occurs in a country that has been omitted from the first step regression, then the parameter estimated is the relative vulnerability between the two countries: how vulnerable is country n relative to country m. In this section, I summarize these results concentrating on the measures of direct propagation and the relative vulnerability with respect to US.

In tables 13, 14, and 15 the results for the Mexican, Hong Kong and Russian crises are shown respectively. The first three columns report the direct propagation (β) with its standard deviation, and a test if it is different from zero. The second group of three columns is the relative vulnerability of the country with respect to the US.

During the Mexican crisis, there are only four coefficients that are statistically different from zero. The propagation from Mexico to Argentina is 30 percent; while to Chile is only 6 percent. Both estimates are significantly different from zero, and it is easy to reject the hypothesis that the Chilean coefficient is larger than, or equal to, the Argentinean. This might not be surprising, however, the fact that one coefficient is five times larger than the other, certainly is.[22] The other two parameter that are significantly different from zero are Philippines (41 percent) and US (20 percent). The coefficient for Philippines, however, is not statistically different from the Chilean one.

The measures of relative vulnerability (between countries and US) show 7 out of 34 coefficients as being significantly different from zero: Argentina is 3 times more vulnerable than US; Chile, Korea and Peru are around 40 percent more vulnerable than US; and Canada and the Netherlands are relatively less vulnerable than US to Mexican shocks. The rank of countries in relative vulnerability is close to what our priors would suggest, however, again, Argentina might be too sensible to Mexican shocks.

The results in the Mexican crisis are hard to interpreted given that a small fraction of parameters are significantly different from zero. Let us turn our attention, therefore, to the Hong Kong and Russian crises.

During the Hong Kong crisis 18 out of 35 of the propagation coefficients and 13 out of the 35 measures of vulnerability are significantly different from zero. The negative signs are the result of when the returns are measured, thus lets concentrate on the absolute values.[23] From the 18 significant coefficients note that 6 are larger than 40 percent (Argentina, Brazil, Russia, Singapore, South Africa, and Spain), 8 are between 20 and 30 percent (Australia, Austria, Colombia, Finland, Germany, Norway, UK, and US), and only 4 are below 20 percent (Denmark, France, Portugal, and Sweden). Clearly, the transmission from Hong Kong to the rest of the world is stronger than the case from Mexico.

Singapore is a definite candidate for possessing a higher coefficient because of its similarities to, and trade relationships with, Hong Kong. Furthermore, excluding Spain, the other countries with the highest coefficients are those that suffer disproportionately more during the crisis: namely, Argentina, Brazil, Russia and South Africa. However, their trade relationships with Hong Kong are not large. The currency board has been blamed as the main source of the transmission between Hong Kong and Argentina, but this does not explains

[22] This is similar to what Forbes & Rigobon [1998] call "excess interdependence".

[23] Usually crisis are accompanied by short run rebounds. If the crises are reported in different days, then a negative coefficient is found in the estimation.When weekly returns are used, negative coefficients that are significant are not found.

the other three cases. Further research is needed in this area to understand what determines the size of this propagation.

The relative vulnerabilities can be divided as follows: there are 5 countries that are more than 100 percent more vulnerable than US (Argentina, Brazil, Hong Kong (obviously), Mexico, and Russia); whereas the rest of the countries are either equally or less vulnerable than US.

It is possible to test whether or not the relative vulnerability of Argentina is the same with regard to both the Mexican and Hong Kong shocks. The estimate during Mexico is 3.08 with a standard deviation of 1.17 while the estimate during Hong Kong is 2.28 with standard deviation of 0.33. If we assume that the two estimates are independent we reject the hypothesis that they are different. Similar test can be performed for Canada, Chile, and Peru. In all these cases, if it is assumed that the estimates are independent, then it is not possible to reject the hypothesis that they are the same. This assumption of independence is not correct in practice, however, without further structure, it is impossible to estimate the relationship between the two estimates. Therefore, these results should be interpreted more as suggestive rather than definite.

Finally, in the Russian crisis, 14 out of 34 of the coefficients of propagation and 18 out of 34 of the vulnerabilities are significantly different from zero. In fact, the average propagation of shocks in the Russian case are similar to those obtained during the Mexican crisis. In this case, there are 6 countries that have a propagation that is larger than 20 percent (Brazil, Italy, South Africa, Spain, Sweden, and Switzerland). Indeed Brazil and South Africa, suffered important speculative attacks within two weeks of the Russian crisis. However, the appearance of Italy and Switzerland in this list is somewhat surprising.

There are 4 countries that have vulnerability coefficients larger than 2 (Colombia, Italy, Portugal, and South Africa). In this case, the coefficients of Portugal and South Africa are different from those estimated during the Hong Kong crisis. On the other hand, in the rest of the coefficients it is not possible to reject the hypothesis that the rest of the coefficients are the same in the two crises.

5 Conclusions and Extensions

The recent crises have driven the literature to further examine the theories regarding the international propagation of shocks. These theories can be broadly divided in two classes: those that are crisis contingent, and those that are not. In this paper, I offer an alternative identification assumption that allows us to measure, and test for, changes in the international propagation of shocks even in the presence of problems of heteroskedasticity, endogenous, and omitted variables. Using this methodology, I show that the pair-wise propagation mechanism during crisis times and tranquil periods for 36 countries is relatively stable. If changes in the propagation mechanism are to be expected within the month of the crisis, then during the Mexican crisis, on average, less than 7 percent of the pairs changed, during the Hong Kong crisis between than 10 to 15 percent shift, while during the Russian crisis always less than 15 percent of them changed. In section 4.2, several sensitivity analysis were performed and, though there are some circumstances in which the percentage of rejection is higher, it would also appear that, in those cases, it is somewhat difficult to argue that there was only one crisis affecting the sample. Therefore, the reasons behind the rejection counld be the misspecification of the windows and not the change in the propagation of shocks.

These findings cast some doubt on the theories of the propagation of shocks that are "crisis contingent", such as those related to endogenous liquidity issues, multiple equilibria, and political contagion; and favors of those based on trade, learning, and aggregate shocks as the main transmission channel. Nonetheless, further research in this area is still necessary in order to fully understand the complexities behind the propagation mechanism.

The main caveats of the test presented here are: First, the instruments might be weak under some circumstances, thus reducing the power of the test. This certainly seems to be the case during the Mexican crisis (and definitely during the Korean crisis), where a small proportion of coefficients are significantly different from zero. As was argued before though, without further information this problem cannot be solved. Second, the power of the test might be low against some alternatives that were not covered in Section 4.3. In the particular case in which the alternative is a change in β, however, the power of the test is similar to a standard F-test for structural change. This does not mean that the test has good power, instead that using it does not deteriorate the power dramatically from the techniques that already available.

Three immediate extensions can be derived from the present discussion. First of all, the moethodology to estimate structural changes and solving the problem of endogeneity can be applied in other circumstances in which there exists prior knowledge about a shift in the second moments. For example, changes in policies (such as exchange rate regimes, taxes, regulation, etc.) may have implications on the volatility of the disturbances, even though they might not have an impact on only one of the equations. With the standard methods of identification when endogenous variables are present, those changes would have been disregarded as instruments. The methodology proposed here illustrates how they could be used to identify the system of equations. The only assumption required is to know which variance is going to be mainly affected by the shift of policy.

Secondly, the methodology proposed here implies that the propagation mechanism, as well as, the relative vulnerability can be estimated directly estimated. In section 4.4, those results are shown. The preliminary conclusions indicate that there are some pair of countries in which the propagation mechanism is too large for what trade, learning, and/or country similarities, could explain. This is what has been called by Forbes & Rigobon [1998] "excess interdependence", but it might just as well be called "contagion". More research in this area is crucial for both theoretical purposes and in order to formulate policy advise.

Thirdly, this paper has concentrated on the behavior of prices around the crises. It does not say anything concerning quantities. Research on portfolio flows indicates that capital flows tend to have excess co-movement across countries in the same region (See Froot, et.al. [1998] and Stulz [1999]). It is possible that prices do not change their behavior during crisis, whereas capital flows do. Therefore, contagion might be found more strongly on the quantity side, rather than on the pricing side. In fact, most of the new theories go in this direction.[24] Again, this is an area where more theoretical and empirical work should be carried out.

[24]For example, see Calvo [1999](Calvo, 1999), Chari & Kehoe [1999](Chari and Kehoe, 1999), Rigobon [1998](Rigobon, 1998),among others.

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Crisis: 19941219 Optimal IV Adjusting for small sample, Allowing for rolling window and Interest rates included								
Returns	Lags	Tranquil Period	Turmoil Period	Total Admissible Pairs	Total Significant Coefficients	%	Total Significant Rejections Hausman Test	%
2	5	60	10	992	48	4.8%	4	0.8%
2	5	60	20	992	88	8.9%	16	3.2%
2	5	60	30	992	97	9.8%	17	3.4%
2	5	60	60	992	79	8.0%	16	3.2%
2	5	120	10	870	39	4.5%	8	1.8%
2	5	120	20	870	62	7.1%	14	3.2%
2	5	120	30	870	57	6.6%	18	4.1%
2	5	120	60	870	62	7.1%	11	2.5%
2	5	240	10	930	68	7.3%	5	1.1%
2	5	240	20	930	114	12.3%	24	5.2%
2	5	240	30	930	128	13.8%	27	5.8%
2	5	240	60	930	128	13.8%	28	6.0%
2	1	60	10	992	109	11.0%	12	2.4%
2	1	60	20	992	120	12.1%	19	3.8%
2	1	60	30	992	96	9.7%	20	4.0%
2	1	60	60	992	85	8.6%	25	5.0%
2	1	120	10	870	62	7.1%	6	1.4%
2	1	120	20	870	79	9.1%	11	2.5%
2	1	120	30	870	68	7.8%	9	2.1%
2	1	120	60	870	69	7.9%	16	3.7%
2	1	240	10	930	104	11.2%	19	4.1%
2	1	240	20	930	131	14.1%	24	5.2%
2	1	240	30	930	132	14.2%	27	5.8%
2	1	240	60	930	105	11.3%	19	4.1%

Table 7: Mexican crisis. Robustness Check

Crisis: 19971017 Optimal IV Adjusting for small sample, Allowing for rolling window and Interest rates included								
Returns	Lags	Tranquil Period	Turmoil Period	Total Admissible Pairs	Total Significant Coefficients	%	Total Significant Rejections Hausman Test	%
2	5	60	10	1260	214	17.0%	35	5.6%
2	5	60	20	1260	252	20.0%	19	3.0%
2	5	60	30	1260	271	21.5%	16	2.5%
2	5	60	60	1260	304	24.1%	27	4.3%
2	5	120	10	1260	304	24.1%	40	6.3%
2	5	120	20	1260	383	30.4%	31	4.9%
2	5	120	30	1260	384	30.5%	45	7.1%
2	5	120	60	1260	418	33.2%	72	11.4%
2	5	240	10	1260	510	40.5%	55	8.7%
2	5	240	20	1260	579	46.0%	71	11.3%
2	5	240	30	1260	561	44.5%	95	15.1%
2	5	240	60	1260	608	48.3%	151	24.0%
2	1	60	10	1260	433	34.4%	42	6.7%
2	1	60	20	1260	437	34.7%	62	9.8%
2	1	60	30	1260	428	34.0%	61	9.7%
2	1	60	60	1260	444	35.2%	88	14.0%
2	1	120	10	1260	488	38.7%	56	8.9%
2	1	120	20	1260	498	39.5%	73	11.6%
2	1	120	30	1260	502	39.8%	94	14.9%
2	1	120	60	1260	522	41.4%	128	20.3%
2	1	240	10	1260	580	46.0%	90	14.3%
2	1	240	20	1260	607	48.2%	99	15.7%
2	1	240	30	1260	592	47.0%	143	22.7%
2	1	240	60	1260	677	53.7%	190	30.2%

Table 8: Hong Kong crisis. Robustness Check

Crisis: 19980813 Optimal IV Adjusting for small sample, Allowing for rolling window and Interest rates included								
Returns	Lags	Tranquil Period	Turmoil Period	Total Admissible Pairs	Total Significant Coefficients	%	Total Significant Rejections Hausman Test	%
2	5	60	10	1190	189	15.9%	19	3.2%
2	5	60	20	1190	281	23.6%	19	3.2%
2	5	60	30	1190	331	27.8%	19	3.2%
2	5	60	60	1190	373	31.3%	82	13.8%
2	5	120	10	1260	336	26.7%	37	5.9%
2	5	120	20	1260	440	34.9%	42	6.7%
2	5	120	30	1260	483	38.3%	54	8.6%
2	5	120	60	1260	488	38.7%	161	25.6%
2	5	240	10	1260	467	37.1%	41	6.5%
2	5	240	20	1260	509	40.4%	73	11.6%
2	5	240	30	1260	500	39.7%	128	20.3%
2	5	240	60	1260	531	42.1%	197	31.3%
2	1	60	10	1190	445	37.4%	37	6.2%
2	1	60	20	1190	505	42.4%	54	9.1%
2	1	60	30	1190	503	42.3%	116	19.5%
2	1	60	60	1190	485	40.8%	181	30.4%
2	1	120	10	1260	592	47.0%	59	9.4%
2	1	120	20	1260	610	48.4%	111	17.6%
2	1	120	30	1260	619	49.1%	180	28.6%
2	1	120	60	1260	572	45.4%	218	34.6%
2	1	240	10	1260	605	48.0%	76	12.1%
2	1	240	20	1260	608	48.3%	149	23.7%
2	1	240	30	1260	591	46.9%	191	30.3%
2	1	240	60	1260	562	44.6%	226	35.9%

Table 9: Russian crisis. Robustness Check

		Increase	Estimate		T2 errors (beta+)			Ftest	T2 error (beta+)		
Beta	Alfa	Variance	Beta	T1 error	10%	20%	30%	T1 error	10%	20%	30%
0.1	0.1	5	0.391	1%	99%	98%	97%	6%	91%	80%	67%
0.1	0.2	5	0.747	2%	99%	98%	95%	7%	89%	80%	66%
0.1	0.3	5	-8.219	4%	96%	95%	95%	6%	89%	80%	63%
0.1	0.4	5	-0.153	7%	94%	93%	93%	6%	91%	78%	63%
0.2	0.1	5	0.850	3%	97%	97%	93%	6%	90%	83%	66%
0.2	0.2	5	0.081	5%	96%	94%	93%	7%	90%	77%	61%
0.2	0.3	5	0.088	7%	93%	92%	91%	7%	91%	81%	62%
0.2	0.4	5	0.401	10%	89%	90%	88%	6%	91%	79%	60%
0.3	0.1	5	-5.479	4%	95%	94%	92%	7%	90%	79%	63%
0.3	0.2	5	0.238	7%	92%	91%	89%	6%	89%	81%	65%
0.3	0.3	5	1.959	10%	91%	87%	87%	6%	90%	78%	60%
0.3	0.4	5	-0.511	11%	87%	85%	83%	5%	89%	79%	60%
0.4	0.1	5	9.200	7%	91%	91%	90%	5%	91%	81%	60%
0.4	0.2	5	-6.328	11%	90%	86%	86%	6%	89%	77%	61%
0.4	0.3	5	3.693	14%	84%	84%	82%	5%	90%	77%	57%
0.4	0.4	5	0.939	13%	83%	82%	80%	7%	89%	71%	53%

Table 10: Comparison of the type one and two errors for the test (and a Chow test).

		Increase	Estimate		T2 errors (beta+)			Ftest	T2 error (beta+)		
Beta	Alfa	Variance	Beta	T1 error	10%	20%	30%	T1 error	10%	20%	30%
0.1	0.1	15	0.133	4%	78%	51%	33%	7%	88%	72%	50%
0.1	0.2	15	3.498	3%	88%	61%	38%	6%	91%	71%	48%
0.1	0.3	15	-2.471	5%	88%	69%	44%	4%	88%	72%	45%
0.1	0.4	15	0.077	8%	92%	76%	52%	6%	89%	71%	45%
0.2	0.1	15	0.001	12%	69%	42%	27%	5%	90%	69%	46%
0.2	0.2	15	-0.199	8%	74%	51%	36%	6%	88%	71%	47%
0.2	0.3	15	0.061	6%	78%	55%	39%	6%	88%	70%	43%
0.2	0.4	15	-0.223	4%	84%	63%	40%	6%	89%	67%	39%
0.3	0.1	15	0.223	22%	55%	38%	28%	5%	90%	76%	49%
0.3	0.2	15	0.093	16%	65%	43%	30%	7%	89%	72%	45%
0.3	0.3	15	-0.099	11%	70%	47%	34%	6%	89%	66%	43%
0.3	0.4	15	0.605	9%	74%	56%	36%	6%	88%	65%	34%
0.4	0.1	15	0.425	33%	49%	33%	24%	6%	91%	75%	48%
0.4	0.2	15	0.270	26%	55%	37%	23%	5%	91%	69%	41%
0.4	0.3	15	0.265	21%	63%	42%	27%	5%	88%	66%	37%
0.4	0.4	15	0.301	16%	70%	47%	30%	5%	89%	64%	31%

Table 11: Comparison of the type one and two errors for the test (and a Chow test).

		Increase	Estimate		T2 errors (beta+)				Ftest	T2 error (beta+)		
Beta	Alfa	Variance	Beta	T1 error	10%	20%	30%		T1 error	10%	20%	30%
0.1	0.1	25	0.055	9%	58%	27%	12%		4%	89%	73%	44%
0.1	0.2	25	-0.036	6%	66%	35%	15%		6%	88%	69%	41%
0.1	0.3	25	-0.138	6%	71%	39%	18%		5%	89%	67%	38%
0.1	0.4	25	-0.134	6%	77%	42%	22%		4%	88%	67%	36%
0.2	0.1	25	0.135	29%	37%	15%	8%		6%	89%	70%	43%
0.2	0.2	25	0.092	26%	43%	21%	12%		6%	88%	67%	42%
0.2	0.3	25	0.092	18%	50%	25%	13%		5%	87%	68%	33%
0.2	0.4	25	0.089	18%	56%	33%	15%		6%	88%	65%	32%
0.3	0.1	25	0.252	53%	25%	10%	6%		5%	91%	70%	43%
0.3	0.2	25	0.250	48%	29%	16%	8%		6%	89%	63%	37%
0.3	0.3	25	0.271	39%	35%	20%	10%		5%	87%	64%	33%
0.3	0.4	25	0.179	34%	40%	24%	13%		7%	86%	63%	29%
0.4	0.1	25	0.852	66%	18%	10%	5%		6%	90%	70%	43%
0.4	0.2	25	0.258	58%	21%	12%	7%		7%	89%	66%	37%
0.4	0.3	25	0.260	54%	28%	16%	8%		5%	87%	63%	33%
0.4	0.4	25	0.234	46%	35%	20%	9%		7%	87%	59%	26%

Table 12: Comparison of the type one and two errors for the test (and a Chow test).

	Mexican			Country vs US		
	Propagation	Stdev	Z	Vulnerability	Stdev	Z
Arg	**0.3115**	**0.0468**	**6.65**	**3.0823**	**1.1699**	**2.63**
Aus	0.0097	0.0286	0.34	0.4083	0.2972	1.37
Aust	0.0154	0.0216	0.71	0.2979	0.2556	1.17
Bra						
Can	0.0006	0.0200	0.03	**0.7302**	**0.1457**	**5.01**
Chi	**0.0610**	**0.0312**	**1.96**	**1.3911**	**0.6297**	**2.21**
Col	-0.0067	0.0764	-0.09	-0.9840	0.9588	-1.03
Den	0.0170	0.0192	0.88	0.0245	0.2345	0.10
Fin	-0.0283	0.0311	-0.91	0.2239	0.3713	0.60
Fra	-0.0114	0.0267	-0.43	0.4470	0.2477	1.80
Ger	-0.0092	0.0303	-0.30	0.4496	0.2861	1.57
Gre	-0.0016	0.0519	-0.03	0.0887	0.4416	0.20
Hon	-0.0386	0.0496	-0.78	0.7308	0.5308	1.38
Ind	0.0123	0.0208	0.59	0.2496	0.3647	0.68
Indo						
Ita	0.0051	0.0817	0.06	0.4163	0.9711	0.43
Jap	0.0206	0.0226	0.91	0.0581	0.2477	0.23
Mal	-0.0521	0.0393	-1.33	0.3029	0.5568	0.54
Mex				**5.0584**	**1.9596**	**2.58**
Net	-0.7560	2.2876	-0.33	**0.4655**	**0.1848**	**2.52**
Nor	-0.2072	0.2180	-0.95	0.2001	0.2586	0.77
Per	0.0301	0.0634	0.48	**1.5507**	**0.6753**	**2.30**
Phi	**0.4143**	**0.1457**	**2.84**	-0.7219	0.4897	-1.47
Por						
Rus	-12.2475	23.1403	-0.53	-2.3101	1.5876	-1.46
Sin	0.7772	0.4456	1.74	0.0341	0.4336	0.08
Kor	2.3624	1.7669	1.34	**1.3775**	**0.6467**	**2.13**
Sou	-0.1576	0.0864	-1.82	-0.0815	0.3285	-0.25
Spa	0.0610	0.0811	0.75	1.0707	0.8578	1.25
See	1.0889	0.9788	1.11	0.2637	0.3468	0.76
Swi	0.1161	0.0762	1.52	0.1142	0.2782	0.41
Tai	-30.3518	485.9495	-0.06	-0.1524	0.9606	-0.16
Tha	0.5952	0.3895	1.53	-0.3255	0.5360	-0.61
UK	-5.9344	35.2315	-0.17	0.4146	0.2217	1.87
USA	**0.1977**	**0.0766**	**2.58**			
Ven						

Table 13: Mexican crisis. Measures of the transmission mechanism and Vulnerability.

	Hong Kong			Country vs US		
	Propagation	Stdev	Z	Vulnerability	Stdev	Z
Arg	**-0.5448**	**0.1641**	**-3.32**	**2.2582**	**0.3328**	**6.79**
Aus	**0.2578**	**0.0331**	**7.79**	0.1700	0.1979	0.86
Aust	**0.3198**	**0.0627**	**5.10**	-0.3042	0.2576	-1.18
Bra	**-0.4432**	**0.1652**	**-2.68**	**2.0595**	**0.4765**	**4.32**
Can	-0.0602	0.0391	-1.54	**0.5060**	**0.0996**	**5.08**
Chi	-0.0023	0.0297	-0.08	**0.3428**	**0.1489**	**2.30**
Col	**0.3790**	**0.1102**	**3.44**	**-1.2530**	**0.5946**	**-2.11**
Den	**0.1741**	**0.0374**	**4.65**	-0.2671	0.1829	-1.46
Fin	**0.2254**	**0.0481**	**4.68**	-0.1197	0.2558	-0.47
Fra	**0.1225**	**0.0478**	**2.56**	0.2124	0.2063	1.03
Ger	**0.3327**	**0.0721**	**4.61**	-0.3928	0.2633	-1.49
Gre	-0.1389	0.0718	-1.93	0.4893	0.2730	1.79
Hon				**-3.3197**	**1.2722**	**-2.61**
Ind	0.6301	0.3296	1.91	0.0821	0.2067	0.40
Indo	-60.3574	145.2007	-0.42	0.7520	2.9635	0.25
Ita	-2.8662	1.8609	-1.54	0.7841	0.9257	0.85
Jap	0.1229	0.2680	0.46	0.0575	0.2738	0.21
Mal	-0.4626	0.3039	-1.52	-0.3475	0.6444	-0.54
Mex	-0.7856	0.7891	-1.00	**2.3485**	**0.3831**	**6.13**
Net	-0.0029	0.1481	-0.02	0.2484	0.2233	1.11
Nor	**0.2244**	**0.0541**	**4.15**	**-0.5416**	**0.2192**	**-2.47**
Per	0.2477	0.2469	1.00	**0.6665**	**0.2086**	**3.20**
Phi	-0.0759	0.1701	-0.45	-0.5715	0.6161	-0.93
Por	**0.1727**	**0.0859**	**2.01**	-0.2118	0.2238	-0.95
Rus	**0.9721**	**0.1434**	**6.78**	**-2.0326**	**0.9913**	**-2.05**
Sin	**0.4650**	**0.0586**	**7.93**	**-0.7942**	**0.3749**	**-2.12**
Kor	-4.7836	4.9351	-0.97	-1.0186	0.8271	-1.23
Sou	**0.6470**	**0.0770**	**8.40**	-0.6033	0.3258	-1.85
Spa	**0.5184**	**0.1635**	**3.17**	-0.0405	0.2631	-0.15
See	**0.1632**	**0.0552**	**2.95**	-0.0321	0.2165	-0.15
Swi	0.0120	0.0992	0.12	0.0103	0.2313	0.04
Tai	1.3424	0.8237	1.63	-0.4046	0.3415	-1.18
Tha	-2.3077	3.6384	-0.63	-0.3299	0.4845	-0.68
UK	**0.2278**	**0.1097**	**2.08**	**0.4002**	**0.1826**	**2.19**
USA	**-0.3012**	**0.1154**	**-2.61**			
Ven	0.0831	0.0869	0.96	**0.3928**	**0.1998**	**1.97**

Table 14: Hong Kong crisis. Measures of the transmission mechanism and Vulnerability.

	Russia			Country vs US		
	Propagation	Stdev	Z	Vulnerability	Stdev	Z
Arg	0.1370	0.1035	1.32	0.1431	1.2691	0.11
Aus	**0.1083**	**0.0467**	**2.32**	**1.2147**	**0.5701**	**2.13**
Aust	**0.1246**	**0.0486**	**2.56**	**1.7897**	**0.6579**	**2.72**
Bra	**0.2127**	**0.0854**	**2.49**	1.0188	0.9659	1.05
Can	-1.9361	7.4089	-0.26	41.6332	782.5453	0.05
Chi	**0.1114**	**0.0408**	**2.73**	**0.6759**	**0.2961**	**2.28**
Col	0.2450	0.1534	1.60	**4.3456**	**2.0088**	**2.16**
Den	0.0288	0.0338	0.85	**0.7993**	**0.3204**	**2.50**
Fin	0.0692	0.0599	1.15	**1.9362**	**0.6486**	**2.99**
Fra	**0.1007**	**0.0458**	**2.20**	**1.7035**	**0.5291**	**3.22**
Ger	0.0882	0.0461	1.91	**1.7793**	**0.6668**	**2.67**
Gre	0.0600	0.0711	0.84	**1.7292**	**0.7669**	**2.25**
Hon	**0.1774**	**0.0868**	**2.04**	-0.0988	0.8104	-0.12
Ind	0.0599	0.0729	0.82	-0.5727	0.8470	-0.68
Indo						
Ita	**0.2779**	**0.1166**	**2.38**	**3.3377**	**1.6981**	**1.97**
Jap	-0.0300	0.0600	-0.50	1.1326	0.6416	1.77
Mal	0.0088	0.1030	0.09	0.6407	1.1133	0.58
Mex	0.0149	0.1196	0.12	0.1572	1.9309	0.08
Net	0.0298	0.0400	0.75	**1.6709**	**0.5562**	**3.00**
Nor	**0.1925**	**0.0571**	**3.37**	**1.9818**	**0.9579**	**2.07**
Per	**0.1698**	**0.0491**	**3.46**	**1.3329**	**0.5819**	**2.29**
Phi	0.0793	0.0695	1.14	-0.5633	0.7547	-0.75
Por	**0.1382**	**0.0441**	**3.14**	**2.1750**	**0.8761**	**2.48**
Rus				7.8243	5.6642	1.38
Sin	0.3785	0.2887	1.31	0.1767	0.6040	0.29
Kor	-6.8118	6.2723	-1.09	0.4640	2.5686	0.18
Sou	**0.3138**	**0.1411**	**2.22**	**2.2467**	**0.9972**	**2.25**
Spa	**0.4036**	**0.1624**	**2.48**	5.3435	4.6202	1.16
See	**0.2948**	**0.1275**	**2.31**	**1.3241**	**0.4153**	**3.19**
Swi	**0.3283**	**0.1382**	**2.38**	**1.4630**	**0.5108**	**2.86**
Tai	0.7867	2.2046	0.36	-0.3353	0.4484	-0.75
Tha	0.1858	0.2848	0.65	-0.0299	0.8650	-0.03
UK	0.3536	0.1931	1.83	**1.3974**	**0.4232**	**3.30**
USA	0.1278	0.0925	1.38			
Ven	0.9461	0.4927	1.92	10.2451	8.9486	1.14

Table 15: Russian crisis. Measures of the transmission mechanism and Vulnerability.

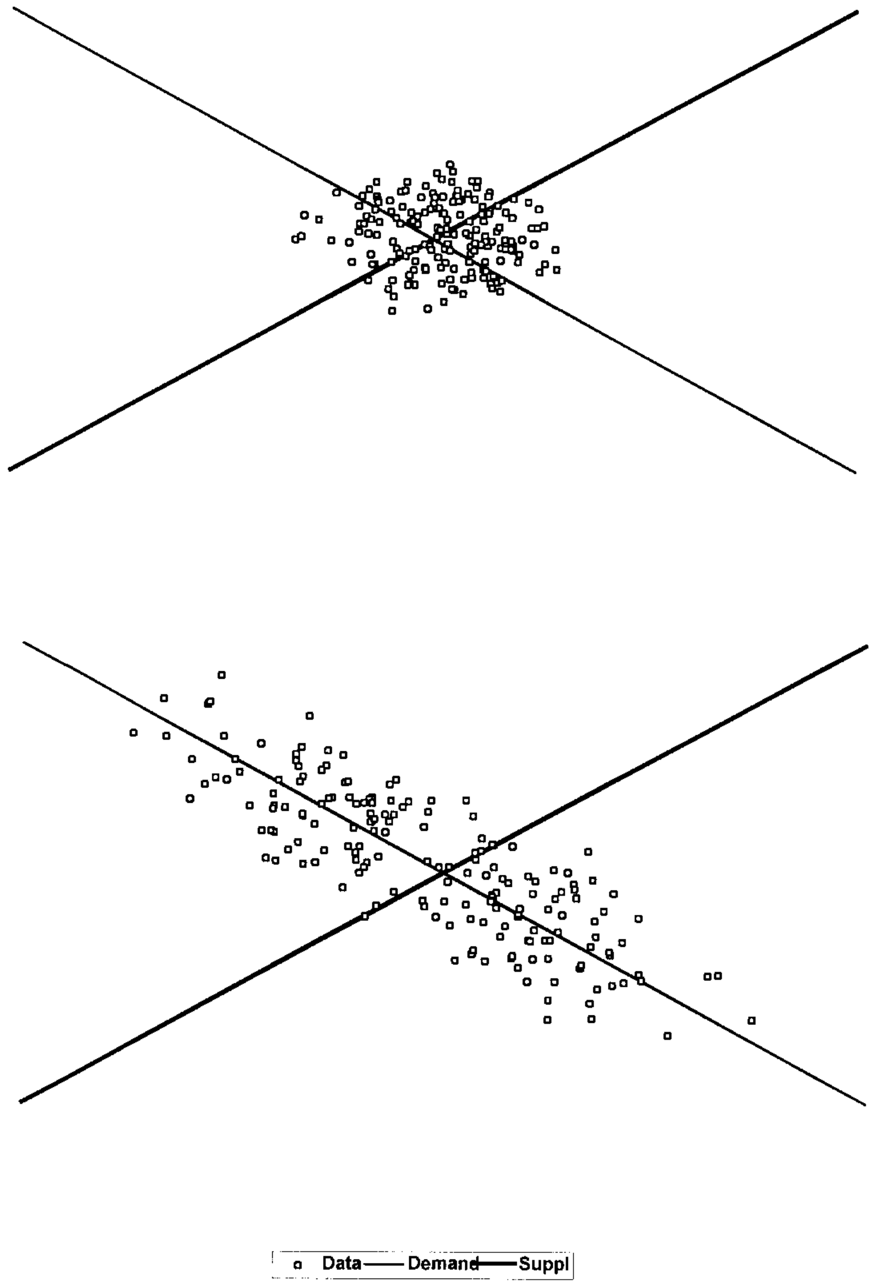

Figure 1: Identification (demand schedule) when there is an increase in the variance of supply disturbances.

Beta	Arg	Aus	Aus	Bra	Can	Chi	Col	Den	Fin	Fra	Ger	Gre	Hon	Ind	Ind	Ita	Jap	Mal	Mex	Net	Nor	Per	Phi	Por	Rus	Sin	Kor	Sou	Spa	See	Swi	Tai	Tha	UK	USA	Ven
Arg		0.34	0.26		1.91	-8.3	0.35	3.44	1.84	2.19	1.82	-0.3	13.2	-0.8		0.14	-2.4	3.5	0.31	3.46	6.85	-22	2.76		-0.2	1.06	0.14	1.05	2.1	0.91	17.7	-0	0.78	1.32	3.08	
Aus	-50		-0.4		0.86	-1.7	-0	0.93	0.1	1.09	0.66	-0.3	5.2	0.25		0.07	-0.3	2.19	0.01	1.78	-0.9	-1.6	0.43		-0.1	0.53	0.02	0.31	-0.3	0.85	0.71	0.4	0.44	0.58	0.41	
Aus	-161	-3.1			0.22	-0.5	-0.1	1.06	0.7	0.21	0.22	-0.1	0.13	0.06		-0	-0.2	0.24	0.02	-0.5	-0.7	-0.3	-0		0.02	0.09	0.07	-2.3	0.02	0.12	0.4	-0.2	0.15	0.33	0.3	
Bra																																				
Can	-34	1.91	5.56			-0.2	-0.1	-1.2	0.14	0.27	0.01	-0	0.3	0.19		0.03	-0.1	0.42	0	1.67	-2.4	0.07	-0.5		-0	0.02	0.09	-1.1	0.16	0.09	-2.2	-0.1	-0.2	-0.1	0.73	
Chi	5.79	0.47	0.54		0.76		-0	-1.6	0.25	0.74	0.53	0.71	10.3	-0.3		0.07	-0.7	3.35	0.06	7.22	3.33	0.66	1.36		-0	0.54	0.15	1.53	0.66	0.32	3.19	0.29	0.75	0.94	1.39	
Col	-5.4	-0.8	-0.8		-0.5	2.23		2.97	-0.3	-0.8	-0.3	0.42	-1.2	-2.1		-0	1.55	0.54	-0	-4.6	0.03	0.81	0.24		0	-0.4	-0.1	-4.3	-0.9	0.6	-3.1	-0	-0.5	0.36	-1	
Den	33.2	-1	-0.6		1.2	-0.7	-18		0.74	0.63	0.52	-0.5	3.37	0.36		0.06	-0.8	0.65	0.02	-0.2	-0.2	-0.8	-0		0.02	0.05	0.03	-3.2	-0.1	0.53	1.35	-0.1	0.28	0.16	0.02	
Fin	-9.4	0.5	0.73		2.14	-3.8	-63	-0.6		0.43	0.82	-0.1	-6.3	-0.1		0.03	0.91	0.86	-0	2.48	2.5	-1.3	0.46		0.05	0.53	0.06	3.67	-0.3	0.77	4.11	0.26	0.46	0.32	0.22	
Fra	-8.1	0.46	-0.5		1.62	-2.1	-12	-1.2	2.34		0.58	0.69	3.25	0.44		0.08	-0.2	-0.4	-0	4.37	9.65	-0.1	-0.1		-0	0.11	0.1	0.93	0.01	0.22	2.36	0.11	0.21	0.61	0.45	
Ger	-8	0.5	0.86		22.1	-1.8	-24	-0.5	1.27	1.21		-0	1.2	0.76		0.06	1.86	0.64	-0	1.79	4.53	-0.1	-0.1		0.01	0.78	0.2	-0.7	0.07	0.76	3.23	-0.3	0.37	0.76	0.45	
Gre	-43	0.28	0.91		6.83	0.45	-7.1	-0.3	3.8	-0.5	11.1		0.38	0.05		-0.1	2.46	-0.1	-0	-3.5	11.9	2.91	-0.1		0.21	0.05	0.23	-22	0.64	-0.3	-5.2	-0.5	-0.1	-0.4	0.09	
Hon	-4	0.32	3.26		-0.2	-0.5	-10	-0.6	0.61	0.9	2.05	-8.7		1.35		0.1	1.12	-0.2	-0	2.74	0.51	-0.4	-0.1		-0	0.94	0.28	-2.8	0.13	0.61	-2.4	-0.1	0.41	0.76	0.73	
Ind	28.9	2.57	8.3		2.44	4.56	-7.2	-1.8	-20	2.72	2.82	-88	0.22			0.02	0.42	1.2	0.01	2.66	9.48	0.18	0.44		0	0.28	0.01	0.85	0.19	0.35	1.76	1.01	0.12	0.13	0.25	
Ind																																				
Ita	-10	0.43	-5.8		0.69	-1	-108	-0.5	2.06	0.67	1.82	1.63	0.2	3.46			-1.9	-2.2	0.01	5.98	4.7	-1	-0.1		-0.3	-0.1	0.1	3.78	0.07	0.83	1.9	0.92	0.19	0.61	0.42	
Jap	17.2	-3	-3.4		-9.1	2.66	16.1	1.47	2.77	-18	10	-2.5	1.19	5.29		-20		0.8	0.02	0.06	-0.5	0.51	0.29		0.07	0.31	0.13	-1.5	0.18	0.12	0.26	0.02	0.38	0.27	0.06	
Mal	-3.8	0.22	1.01		-1.3	-1	17.4	-0.7	1.53	-1.9	3.14	38.8	3.8	0.93		-6.4	0.35		-0.1	-0.1	5.26	-0.1	-0.4		0.08	0.6	0.26	-3	0.22	-0.1	-3.2	-0.4	0.3	0.83	0.3	
Mex	0.26	-0.8	-0.2		-5.3	0	7.72	-0.1	0.32	0.47	0.96	-8.3	0.23	-0.3		-15	-0.1	0.2		-1.3	-4.8	33.2	2.41		-0.1	1.29	0.42	-6.3	16.4	0.92	8.61	-0	1.68	-0.2	5.06	
Net	-19	0.57	-2.7		6.12	-1.4	-11	9.89	1.29	1.31	2.08	4.27	1.03	2.05		13.2	19	-84	418		1.33	-0	-0.1		-0	0.14	0.06	-1	-0.1	0.32	0.57	-0.2	0.09	0.38	0.47	
Nor	-43	-1.8	-1.6		-2.3	-0.2	1133	7.74	1.11	0.89	3.2	-1.8	6.81	2.84		24	-4	1.52	81.3	0.37		-0.2	0.04		0.05	0.42	0.02	-0.5	0.03	0.9	1.64	0.11	0.29	0.43	0.2	
Per	4.17	0.33	0.68		-1.1	0.55	-5.8	-0.3	0.76	2.54	4.92	0.6	-0.4	-1.7		7.17	-0.5	3.62	9.47	4.06	0.79		0.4		-0	0.5	0.09	0.69	0.93	-0.3	0.4	-0.1	0.28	0.18	1.55	
Phi	-1.6	0.85	-28		-0.3	0.14	17.2	43.5	0.88	-2.4	-17	6.51	3.52	1.14		-47	1.16	-1.3	-11	-1	3.79	1.14			-0.1	0.37	0.19	0.65	-2.2	0.15	-1.4	-0	0.43	0.56	-0.7	
Por																																				
Rus	3.59	-0.1	0.6		-0.6	0.76	49.6	-0.8	0.66	-0.6	3.82	-0.6	-0.4	9.17		-1.4	0.23	0.39	60.1	-0.2	0.1	3.76	-0.8			0.63	0.44	-13	-1.2	1.24	-1.9	-0.8	-0.1	-1.5	-2.3	
Sin	-11	0.26	3.19		7.96	-0.8	-14	-4.5	1.1	3.62	1.03	-31	0.09	1.36		-51	0.79	0.86	-62	0.5	0.27	-1.8	2.87		27.7		0.24	0.03	0.06	0.44	3.93	0.11	0.74	0.75	0.03	
Kor	-20	4.02	0.77		0.84	-1.5	-12	-1.3	2.5	1.2	1.28	-1.6	0.61	8.92		20.9	0.4	0.56	-55	0.5	0.44	-1.2	1.35		13.8	1.29		-2.3	0.16	0.34	1.02	-0.5	0.48	0.82	1.38	
Sou	-68	3.56	-0.5		-0.4	-1.4	-12	1.34	2.09	2.27	-20	3.7	0.31	4.16		15.8	-1.7	-2.6	48.3	-0.7	0.59	-12	17.1		-28	183	-30		-0	-0.1	-1.7	0.39	0.07	-0	-0.1	
Spa	3.82	0.51	-5.5		-0.4	0.53	2.48	-1.4	0.75	-12	-4.9	0.95	-0.6	-1		-39	-0.3	-1	6.99	0.46	-1.9	0.45	-2.1		6.55	-8	-16	5.37		-0.3	76.3	-0.4	0.19	0.3	1.07	
See	-18	0.34	0.7		2.87	-2.5	16	-0.8	0.87	2.75	1.46	7.93	-0.2	1.44		13.8	2.07	-0.7	-112	0.43	0.16	4.58	8.38		24.5	2.77	13.2	-2.7	12.8		2.42	-0.3	0.2	0.71	0.26	
Swi	-6	2.24	2.55		-1	-0.9	-8.3	-1	1.51	2.05	4.93	5.86	-0.5	1.44		26.7	4.81	-1.4	-42	1.24	0.53	-16	-5		-272	12.3	15.3	-0.6	-4.4	2.31		-0.2	-0.1	0.23	0.11	
Tai	109	0.24	-0.4		-0.8	-0.9	-	1.37	1.15	2.36	-1.6	1.49	0.15	1.32		6.31	6.2	-0.9	1079	-0.2	0.49	4.41	-13		-15	5.47	-4.4	0.24	4.98	-1.2	-0.5		-0.3	-0.2	-0.2	
Tha	-7	0.3	1		-1	-0.6	-9	-0.8	0.97	1.77	1.3	15	1.28	2.17		33.9	0.61	2.29	-42	0.78	0.45	-3.2	2.3		-292	1.39	4.23	1.42	-8	1.37	-1	-5.9		0.67	-0.3	
UK	-16	0.6	0.95		-3	-1.3	25.8	-1.7	2.94	1.5	2.43	10.6	1.46	5.95		23.4	1.52	3.52	1001	0.68	0.56	-10	4.52		-27	3.24	8	-19	-11	1.6	1.51	-19	4.75		0.41	
USA	-11	1.43	1.29		0.69	-1.6	-14	-24	6.58	1.87	2.82	-39	-1.9	5.37		47.4	8.36	3.03	-51	-0	0.8	-2.3	-3.2		-23	58.6	6.9	-3.3	-9	6.24	2.57	-39	-7.2	1.84		
Ven																																				

Table 1: Estimation of beta for the 1994 Mexican crisis. Returns 2 days, Lags = 1, Crisis window = 10 days, Tranquil window = 60 days

Test	Arg	Aus	Aus	Bra	Can	Chi	Col	Den	Fin	Fra	Ger	Gre	Hon	Ind	Ind	Ita	Jap	Mal	Mex	Net	Nor	Per	Phi	Por	Rus	Sin	Kor	Sou	Spa	See	Swi	Tai	Tha	UK	USA	Ven
Arg		266	1851		75.8	20.4	7.58	81.3	10.8	6.6	7.46	341	60.5	62.5		29.6	22	3.62	0.02	24.8	160	120	2.55		6.12	14.4	80.6	331	2.8	35.8	34.9	2118	8.23	21.8	8.88	
Aus	0		7.38		2.19	1.74	2.8	1.55	5.36	0.86	0.52	0.5	23.8	4.49		0.75	9.21	2.97	0.68	1.93	5.86	1.69	0.82		0.17	0.5	23.8	17.8	0.41	0.73	4.75	0.52	0.46	0.77	1.71	
Aus	0	0			13.1	1.15	1.23	0.61	0.55	2.1	1.01	1.34	15.1	51.3		84.9	9.85	2.09	0.14	8.92	4.47	1.02	858		1.48	6.13	1.13	5.43	107	2.91	4.32	0.51	1.19	0.77	1.73	
Bra																																				
Can	0	0	0			0.8	0.43	2.26	4.1	1.5	409	49.6	0.23	3.39		1.27	56.7	2.66	57.4	20.3	16.9	2.12	0.55		1.31	81.1	0.59	1.99	0.29	5.98	6.03	1.51	1.14	8.62	0.22	
Chi	0	0	0		0		11.5	1.9	12.8	3.4	2.28	0.4	82.8	9.9		2.16	4.95	10.2	0.05	14.3	3.02	0.25	1.32		2.28	1.18	3.18	2.11	0.33	5.47	3.56	1.47	0.91	1.51	1.8	
Col	0	0	0		0	0		20.1	254	11.7	38.9	8.61	15.9	2.79		2789	16.4	32.7	26.1	9.37		5.06	45.2		1391	19.3	24.4	11.5	1.35	22.7	5.81		7.15	65.3	12.7	
Den	0	0	0		0	0	0		0.92	1.58	0.68	0.4	22.2	2.7		0.83	2.27	1.13	0.08	65.1	44.3	1.05	3192		2.71	28.7	5.56	12.3	2.9	0.83	2.27	3.69	0.96	3.98	438	
Fin	0	0	0		0	0	0	0		2.26	0.43	9.27	41.9	122		6.59	2.83	1.72	0.11	2.2	2.25	1.93	0.81		0.68	0.56	4.86	7.86	0.59	0.43	8.22	1.27	0.38	2.9	12.4	
Fra	0	0	0		0	0	0	0	0		0.57	0.47	13	1.99		0.54	103	3.28	0.37	5.15	39.3	6	5.13		0.86	7.49	1.23	3.1	116	3.39	3.79	4.24	1.75	0.56	1.41	
Ger	0	0	0		0	0	0	0	0	0		56.7	2.37	1.29		2.34	19.9	4.12	0.86	0.6	13.6	9.28	110		21.1	0.44	0.67	81.8	11.8	0.46	9.56	1.34	0.48	0.79	2.03	
Gre	0	0	0		0	0	0	0	0	1	0		57.4	2001		3.07	2.91	686	147	7.74	32.2	2.4	32.5		0.67	430	2.63	184	1	21.9	19.8	2.05	119	27.1	419	
Hon	0	0	0		0	0	0	0	0	0	0	0		1.45		0.91	11.1	16.2	0.22	2.63	51.7	2.92	17.5		14.6	0.67	0.62	15.6	2.91	1.78	7.24	5.66	1.17	1.54	3.78	
Ind	0	0	0		0	0	0	0	0	0	0	0	0			10.2	6.7	2.44	0.18	4.33	117	1.33	0.69		247	0.63	45.6	5.07	0.64	0.75	1.9	3.98	2.55	8.36	6.63	
Ind																																				
Ita	0	0	0		0	0	0	0	0	0	0	0	0	0			14.2	3.47	50.8	8.39	26.7	4.32	198		0.43	141	49.1	10.3	146	8.49	27.1	3.42	72.8	20.6	81.4	
Jap	0	0	0		0	0	0	0	0	0	0	0	0	0		0		0.71	0.09	379	14	0.63	0.88		0.16	0.48	0.38	4.25	0.51	4.72	17.2	68.7	0.41	1.5	48.2	
Mal	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0		0.09	3398	13	13.2	2.45		0.48	0.46	0.49	9.04	1.53	17.1	8.12	1.09	2.31	2.5	8.31	
Mex	1	0	0		0	0	0	0	1	0	0	0	0	0		0	0	1		3312	158	59.8	8.18		495	134	187	51.5	17.6	391	41.5		76.8		54.4	
Net	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0		0.88	42	1.99		0.36	1.02	0.79	2.52	0.81	0.4	1.35	0.45	1.59	0.4	0.62	
Nor	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0		1.97	31.7		0.22	0.38	3.21	3.65	12.1	0.35	1.23	1.49	0.45	0.66	2.55	
Per	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0		1.61		26.6	2.65	4.63	55.1	0.18	10.4	121	17.7	7.73	43	2.57	
Phi	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0			0.89	2.81	1.58	46.5	12.5	26.9	9.18	99.9	2.03	3.64	3.61	
Por																																				
Rus	0	0	0		0	0	0	0	0	0	0	0	0	0		1	0	0	0	0	0	0	0			32.7	13.5	40.9	3.73	21.7	2053	14.6	3919	19.5	12.8	
Sin	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0		0		0.53	6569	24.4	1.53	40	13	0.44	1.04	836	
Kor	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0		0	1		44.9	34.4	12.9	14.5	2.74	2.31	3.87	2.34	
Sou	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0		0	0	0		45.6	13.9	3.92	0.42	3.85	188	18.6	
Spa	0	0	0		0	0	1	0	0	0	0	0	0	0		0	0	0	0	0	0	1	0		0	0	0	0		44.3	1961	10.1	30.5	36	13.7	
See	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	1	0	0		0	0	0	0	0		2.38	1.2	1.68	0.57	9.31	
Swi	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0		0	0	0	0	0	0		0.88	2.05	1.67	9.02	
Tai	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0		0	0	0	0	0	0	0		10	70.4	285	
Tha	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0		2.69	13.9	
UK	0	0	0		0	0	0	0	0	0	1	0	0	0		0	0	0	0	0	0	0	0		0	1	0	0	0	0	0	0	0		1.09	
USA	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0		0	0	1	0	0	0	0	0	0	0		
Ven																																				

Table 2: Results of Hausman Specification Test: 1 means rejection. 1994 Mexican crisis. Returns 2 days, Lags = 1, Crisis window = 10 days, Tranquil window = 60 days

Beta	Arg	Aus	Aus	Bra	Can	Chi	Col	Den	Fin	Fra	Ger	Gre	Hon	Ind	Ind	Ita	Jap	Mal	Mex	Net	Nor	Per	Phi	Por	Rus	Sin	Kor	Sou	Spa	See	Swi	Tai	Tha	UK	USA	Ven
Arg		-1.1	-3.7	1.23	3.35	3.22	-8.8	-4.5	-0.9	-0.4	-1.4	4.06	-0.5	-0.4	-0	0.23	-0.7	0.33	0.77	1.44	-3.4	5.95	3.07	-6.7	-1.2	-1.6	0	-1.1	-0.9	-1.8	3.7	-0.7	0.35	1.42	2.26	12.4
Aus	-9.6		1.09	-0.2	1.19	2.16	1.24	1.71	0.94	1.8	0.84	-2.1	0.26	-0.3	-0	0.06	2.29	-0.9	0.26	3.28	1.3	1.57	3.69	1.77	0.28	0.69	0.04	0.38	0.95	1.48	9.83	0.26	-0.5	1.12	0.17	0.6
Aus	-4.7	1.21		-0.2	0.23	0.89	1.47	1.83	0.83	1.38	0.85	-1.1	0.32	0.4	-0	0.04	2.45	-1.4	-0	2.37	1.53	0.18	-1.1	2.63	0.3	0.7	0.05	0.54	0.9	1.13	4.41	0.49	-0.8	0.74	-0.3	-0.9
Bra	0.95	-1.1	-0.7		1.14	-1.1	-2.4	-3.3	-1.3	-1	-1.2	4.77	-0.4	-1.3	-0	0.21	-0.5	0.87	0.57	0.04	-2.8	3.49	-13	-4.4	-0.6	-1.1	-0.1	-0.6	-0.8	-1.7	-12	-0.8	1.06	2.23	2.06	-70
Can	4.77	2.7	8.24	7.05		1.19	-0.4	0.13	0.18	0.59	-0	0.21	-0.1	-0.2	-0	0.04	0.53	-0.1	0.29	0.88	-0.3	1.59	-16	0.7	-0	0.05	-0	-0	0.3	0.48	1.79	-0	-0.1	0.38	0.51	1.56
Chi	27.7	3	5.43	-11	1.07		0.39	0.5	0.28	0.6	0.17	-1.7	-0	-0.1	-0	0.07	0.36	-0.4	0.19	1.19	0.22	1.38	0.5	0.56	0.05	0.11	0.04	0.02	0.39	0.46	1.31	0.07	-0.2	0.6	0.34	0.86
Col	-1.8	0.98	0.89	-1.2	-2.8	0.39		2.38	0.97	1.97	1.2	-3.2	0.38	-0.5	-0	0.05	6.17	-1.7	-0.2	4.63	1.86	-1.2	4.15	2.1	0.43	0.77	0.12	0.42	1.01	1.34	57.7	0.63	-3.3	-0.2	-1.3	-4.8
Den	-6.7	1.76	1.47	-4.3	9.95	1.03	1.23		0.64	0.6	0.65	-1.3	0.17	0.08	-0.1	0.09	1.87	-0.5	-0	2.44	0.98	0.29	-1.1	1.07	0.22	0.41	0.07	0.3	0.58	0.98	-12	0.35	-2.5	0.28	-0.3	-0.4
Fin	-13	1.15	0.99	-5.1	1.94	0.47	1.14	0.6		2.95	0.93	-0.6	0.23	0.16	-0	0.18	3.26	-1.2	-0	-5.1	1.14	1.61	2.64	1.5	0.3	0.53	0.13	0.46	0.77	1.56	81.6	0.65	-0.9	0.3	-0.1	0.49
Fra	-44	1.52	2.01	-8	1.11	0.67	1.39	0.9	2.17		0.41	-0.9	0.12	-0.1	-0.1	0.12	1.27	-0.5	0.24	5.62	0.68	1.34	9.19	1.03	0.15	0.37	-0	0.25	0.62	0.84	4.72	0.21	0.34	1.02	0.21	0.54
Ger	-4.2	1.12	0.84	-3.8	-17	0.92	0.81	0.54	0.97	0.58		-1.7	0.33	0.12	-0	0.23	3.35	-1.1	-0.1	-10	1.5	0.13	-2.3	1.42	0.33	0.66	0.13	0.54	0.91	1.27	-6.4	0.75	-1.3	0.41	-0.4	-0.2
Gre	4.03	-2.9	-2.8	3.29	7.92	-1.3	-1.5	-1	-5.1	-2.8	-2.3		-0.1	-0.3	-0	0.04	-1.1	0.22	0.05	-0.2	-0.6	0.59	-5.9	-1.1	-0.1	-0.3	-0	-0	-0.5	-0.3	-1.6	-0.3	0.21	0.46	0.49	0.99
Hon	-1	0.27	0.29	-0.9	-0.2	-0.5	0.25	0.2	0.31	0.11	0.44	-0.2		1.59	-0	-0.3	8.14	-2.2	-1.3	-343	4.46	4.04	-13	5.79	1.03	2.15	-0.2	1.55	1.93	6.13	83.5	0.74	-0.4	4.39	-3.3	12
Ind	76.5	53.1	-15	22.6	8.71	16.6	13	-26	-38	26.8	-78	7.01	-29		0.03	0.02	-0	0.34	0.05	0.16	-0.1	0.29	-1.1	0.02	-0	-0.1	0	-0.1	0.02	0	0.2	-0.1	0.59	0.09	0.08	0.38
Ind	1.85	1.35	0.81	9.64	0.69	0.47	21.7	0.96	1.02	0.95	3.44	0.19	10.7	0.1		0.34	6.31	-1.9	0.3	1.74	-0.3	1.94	-8.1	0.59	-0.2	0.55	-0.1	1	-0.7	0.82	6.22	-0.1	-2.6	0.73	0.75	6.81
Ita	2.08	3	3.02	2.29	0.95	0.39	2.85	0.49	0.89	0.59	0.64	1.1	-3.5	-1	-13		10.4	-0.1	0.17	3.01	1.25	1.44	-7.3	1.16	0.21	-0.4	0.52	0.17	1.25	0.86	-3.1	1.18	-4.3	-2.1	0.78	6.82
Jap	-53	3.62	1.93	-149	3.2	2.82	1.6	1.16	1.92	1.3	2.05	-2	16.6	42.6	-46	4.05		-0.3	-0	4.55	0.67	0.98	1.27	0.48	0.13	0.15	0.08	0.29	0.32	0.61	-1.2	0.22	-0.7	1.03	0.06	0.31
Mal	-6.5	1.35	0.88	-3.1	3.22	0.65	0.94	0.86	1.3	1.08	1.09	-1.3	3.63	0.33	-19	49.6	0.72		0.04	1.41	1.21	-0.1	0.77	1.21	0.24	0.52	0.02	0.58	0.53	0.84	4.28	0.51	1.22	1.09	-0.3	-0.7
Mex	1.28	0.79	-3.3	0.9	0.28	0.2	-0.1	-2	-116	0.43	-2	-0.8	-13	-0.9	-45	12	-1.6	-2.9		3.01	-1.1	6.06	-2.5	3.13	-0.2	0.19	-0.2	-0.2	1.01	1.24	16.6	-0.6	0.87	2.11	2.35	7.64
Net	23.3	1.88	2.46	487	1.31	0.95	2.63	1.17	2.97	1.37	4	-4.1	12.5	-3.5	-9	13.9	0.91	-2.5	4.63		0.4	1.3	4.82	0.68	0.09	0.25	-0	0.21	0.41	0.56	1.63	0.15	0.2	0.85	0.25	0.82
Nor	-4.2	1.41	1.31	-3.4	-2.3	0.73	1.2	0.67	1.21	0.44	1.51	-1.4	4.88	4.31	322	15.2	0.41	-1.5	-6.1	-0.2		-1.3	-4.4	1.67	0.26	0.46	0.04	0.32	0.52	1.22	-3.6	0.37	-0.4	0.06	-0.5	-4
Per	4.48	3.15	17.4	6.27	0.95	0.83	-5.3	7.05	4.34	1.76	36.1	2.4	-30	-1.7	-94	24.1	0.73	45	3.4	1.05	-4.1		2.6	0.47	0.01	0.06	-0	0.01	0.19	0.41	0.94	-0.2	0.41	0.65	0.67	1.68
Phi	-3	1.01	1.05	-1.8	1.71	1.07	0.71	0.66	1.12	0.59	1.12	-0.8	2.5	1.88	27.5	-17	0.98	-3.3	5.56	0.29	0.59	1.09		1.68	0.32	0.74	-0.1	0.55	0.89	1.41	211	-0	0.96	1.63	-0.6	-2.5
Por	-5.9	1.57	1.88	-3.1	2.25	0.88	1.15	1.02	1.61	1.07	1.59	-0.5	7.51	-19	-162	13.7	0.79	-1.5	17.4	0.47	0.88	1.35	0.18		0.21	0.38	0.06	0.17	0.71	0.93	3.92	0.26	-0.5	0.23	-0.2	-0.4
Rus	-1.2	0.33	0.29	-0.9	-2.4	0.2	0.26	0.2	0.31	0.16	0.37	-0.2	1.19	1.69	22.6	4.18	0.13	-0.5	-1.6	-0.1	0.22	0.86	-0.1	0.22		1.91	0.39	1.31	2.48	5.65	-156	2.23	-2.9	0.6	-2	-3.1
Sin	-2.5	0.75	0.66	-1.6	3.56	0.66	0.4	0.48	0.81	0.6	0.96	-0.6	2.09	1.51	-29	-7.2	0.52	-1.1	10.1	0.48	0.43	1.75	0.36	0.42	2.16		-0	0.8	0.94	1.7	5.39	0.29	-0.6	1.35	-0.8	-20
Kor	129	2.89	1.42	-2.3	-7.2	0.45	0.56	0.39	0.87	-1.6	0.78	-0.4	-6.8	-11	44.9	1.19	0.18	-4.9	-1.5	-0.3	1.02	-1	0.25	0.52	1.96	-37		-0.3	0.67	0.42	69.4	1.88	-8.2	-5.5	-1	6.65
Sou	-2.8	0.44	0.4	-3.5	-5.7	0.75	-0	0.22	0.6	0.25	0.51	1.77	1.71	0.78	-19	11.4	0.26	-0.7	-6.2	0.17	0.43	7.66	-0.5	0.03	1.62	0.84	-4.8		5.67	2.8	-11	0.72	-0.6	2.03	-0.6	-2.1
Spa	-5.9	1.17	1.39	-3.3	1.66	0.47	0.75	0.68	1.31	0.68	1.13	-0.5	5.61	-6.1	49.6	5.22	0.51	-2.1	10.4	0.23	0.93	1.18	0.02	0.62	3.54	2.13	14.3	6.04		1.17	21.5	0.66	0.22	0.15	-0	-0.3
See	-14	1.32	1.43	-4.8	1.41	0.59	1.14	0.86	1.45	0.79	1.62	-1.6	6.11	-46	-73	12.3	0.63	-1.5	6.14	0.2	0.98	0.74	0.15	0.77	4.99	2.19	38.9	3.15	1.47		6.21	0.37	-0.3	0.31	-0	0.35
Swi	-18	2.63	2.65	-18	4.15	2.2	2.87	2.23	4	2.21	4.37	-2.9	9.13	-11	-68	81.3	1.34	-3.8	11.6	1.84	2.9	3.78	0.37	2.44	11.2	4.1	-18	4.71	3.14	2.78		0.16	0.49	0.67	0.01	0.07
Tai	-3.9	3.03	0.93	-3	-8.2	1.86	0.88	0.53	1.17	0.85	0.83	-0.4	7.81	1.37	343	3.6	0.4	-1.1	-3.9	0.25	0.68	-1.1	-0.5	0.81	3.45	5.16	4.74	3.27	0.77	1.12	-0		-1.9	-0.7	-0.4	-0.9
Tha	-15	6.08	2.79	-4.9	8.9	1.88	1.88	1.75	2.62	-4.4	2.87	-3.2	31.7	0.79	-102	6.12	0.76	3.16	-7.9	-3.3	2.3	-1.6	-1.1	3.29	8.03	7.56	4.85	5.8	-12	5.23	-0	2.61		-0.7	-0.3	0.06
UK	9.59	3.04	2.46	5.87	2.52	2.13	-15	2.39	15.4	1.23	9.34	2.43	14.1	-5.4	-155	-18	0.18	-6.4	4.72	0.68	15.4	1.11	-0.1	3.57	70.1	5.45	-13	4.33	21.3	4.33	-0.1	-8	2.57		0.4	13.7
USA	2.28	6.94	-3	2.18	0.65	0.62	-0.6	-1.2	-8.8	1.74	-2.5	0.92	-5.9	-2.9	-87	14	3.07	4.82	2.54	0.5	-0.8	0.49	0.39	-0.3	-5.7	-3.2	-17	-5.9	-21	-13	5.88	-5.9	1.58	1.5		2.55
Ven	3.99	17.7	-7.9	5.31	1.2	1.65	-3.9	-8	15	9.21	-43	2.38	-9.9	-2.2	-45	8.73	2.82	10.1	5.21	3.13	-1.7	1.25	-1.2	-8.4	-23	-8.2	19.9	-12	-31	14	5.98	-16	-87	1.95	1.33	

Table 3: Estimation of beta for the 1997 Hong Kong crisis. Returns 2 days, Lags = 1, Crisis window = 10 days, Tranquil window = 60 days

Test	Arg	Aus	Aus	Bra	Can	Chi	Col	Den	Fin	Fra	Ger	Gre	Hon	Ind	Ind	Ita	Jap	Mal	Mex	Net	Nor	Per	Phi	Por	Rus	Sin	Kor	Sou	Spa	See	Swi	Tai	Tha	UK	USA	Ven
Arg		6.75	2.69	-	1.04	41.4	12.4	3.19	15	173	1.71	1.54	0.29	447	3.92	1.49	279	10.7	0.24	52.1	1.18	1.7	5.83	6.37	0.31	0.74	4558	0.82	3.57	15.4	30.7	2.04	41.1	6.12	0.14	9.88
Aus	0		0.18	0.58	0.67	0.49	0.21	0.24	0.12	0.07	0.17	1.58	0.02	329	3.41	5.31	2.57	1.13	0.21	1.04	0.25	1.11	5.1	0.11	0.03	0.05	4.36	0.05	0.15	-	15.9	2.27	11.2	1.05	9.69	41.6
Aus	0	0		0.39	10.5	3.39	0.38	0.03	0.08	0.51	0.05	2.04	0.03	39.3	1.59	7.85	1.8	1.75	6.13	1.28	0.17	54.6	1.45	0.85	0.03	0.09	1.34	0.03	0.35	0.18	3.6	0.28	3.28	1.16	2.45	13.5
Bra	1	0	0		4.92	13.4	0.63	1.72	3	8.54	1.77	1.49	0.32	43.2	117	2.26	2544	3.09	0.25	-	1.07	3.33	56.4	1.83	0.32	0.55	1.99	1.65	1.82	2.67	84.1	1.46	5.47	2.49	0.31	511
Can	0	1	0	0		0.09	6.14	28.4	1.48	0.3	115	21.6	0.12	23.6	1.92	1.14	4.07	8.91	0.01	0.45	2.25	-	844	1.71	10.2	6.4	59.9	17.6	0.92	0.55	5.84	31.5	53.8	1.61	0.09	0.54
Chi	0	0	0	0	0		0.24	0.39	0.12	0.12	0.45	1.67	4.28	102	1.09	0.25	3.98	0.6	0.04	0.4	0.5	0.32	1.34	0.27	0.09	0.33	0.32	1.02	0.11	0.1	2	2.29	3.22	1.55	0.24	1.07
Col	0	0	0	0	0	0		0.14	0.29	0.57	0.15	1.22	0.08	31.3	1332	7.22	7.37	2.08	0.52	6.22	0.22	8.45	5.82	0.21	0.04	0.09	0.33	0.21	0.2	0.33	862	0.36	8.54	62.7	0.47	8.36
Den	0	0	1	0	0	0	1		0.04	0.3	-	0.66	0.03	193	2.39	0.29	1.09	0.83	3.93	3.46	0.02	14.8	1.57	0.13	0.01	0.09	0.17	0.04	0.12	0.08	88.2	0.14	10.3	2.53	0.74	20.1
Fin	0	0	1	0	0	0	0	0		0.56	0.06	5.16	0.04	216	2.26	0.52	1.93	1.68	5999	9.27	0.15	2.7	3.14	0.26	0.02	0.15	0.42	0.06	0.23	-	1959	0.33	2.7	36.7	19.7	39.3
Fra	0	1	0	0	0	0	0	0	0		0.13	2.46	0.06	155	2.07	0.41	0.74	1.06	0.11	10.5	0.24	0.61	53.8	0.2	0.04	0.15	3.26	0.11	0.09	0.06	5.76	0.55	11.5	0.33	1.32	20.8
Ger	0	0	0	0	0	0	1	1	0	0		1.25	0.07	816	25.3	0.31	2	1.17	2.1	51.4	0.2	214	3.69	0.26	0.03	0.2	0.35	0.06	0.17	0.23	20.9	0.15	3.55	14.3	1.61	312
Gre	0	0	0	0	0	0	0	0	0	0	0		0.14	17	0.24	2.11	3.12	1.85	0.85	10.3	0.96	2.16	54.9	0.42	0.14	0.32	0.41	47.6	0.21	1.12	4.2	0.24	11	2.23	0.55	1.98
Hon	0	0	0	0	0	0	0	0	1	0	0	0		45.6	88.8	2.81	23.8	3.07	15.5	-	0.78	42.5	33.7	2.84	0.11	0.07	8.11	0.1	1.92	1.3	666	5.6	118	7.65	2.12	16.7
Ind	0	0	0	0	0	0	0	0	0	0	0	0	0		0.06	1.55	850	0.46	0.71	4.64	5.6	1.75	11.2	151	3.49	0.97	86	0.43	21.2	824	51	1.1	1.28	8.8	3.45	1.9
Ind	0	0	0	0	0	0	0	0	0	0	0	0	0	0		11.9	41.4	21.9	48.8	18.3	1303	112	56	411	34.2	32.2	105	8.42	49.9	88.7	94.9	3485	324	463	125	31.5
Ita	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		6.77	507	21.2	17.1	15.2	30.9	85.8	14.2	3.99	6.31	0.31	18.4	2.56	10.9	487	1.41	8.5	20.7	15.1	6.11
Jap	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1.02	7.36	7.54	0.49	0.76	5.28	0.56	0.1	0.46	0.17	0.2	0.43	0.34	2.4	0.36	1.77	0.75	10.9	8.58
Mal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		10.8	2.4	1.16	289	8.46	1.03	0.25	0.7	12.4	0.39	1.17	1.09	5.72	0.71	3.33	5	4.79	16.5
Mex	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1.85	4.53	0.68	9.2	27.1	1.1	15.9	0.88	6.7	11.2	3.3	76.4	2.41	12.1	1.31	0.23	5.18
Net	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0.68	0.4	17.8	0.34	0.12	0.23	0.44	0.19	0.19	0.23	0.79	0.49	13.1	0.35	0.5	3.84
Nor	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0		5.75	17.1	0.14	0.02	0.07	0.98	0.07	0.24	0.11	10.8	0.22	3.28	77.5	0.3	5.87
Per	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		19	1.06	3.18	2.21	1.63	46	0.81	0.29	5.95	0.81	2.6	0.51	0.12	0.79
Phi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0.52	0.17	0.23	0.58	0.33	0.47	0.48	8025	14	3.55	1.42	1.58	3.77
Por	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1		0.03	0.08	0.34	0.16	0.08	0.07	6.36	0.41	6.61	4.68	0.63	19.7
Rus	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		0.27	0.75	0.17	0.64	0.22	2940	0.96	8.34	219	2.79	32.7
Sin	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		508	0.08	0.6	0.39	4.23	4.79	13.6	2.62	1.57	119
Kor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0		3.53	13.8	78	705	1.35	11.7	6.37	16.7	17.8
Sou	1	0	1	0	0	0	1	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0		6.83	0.61	25.1	1.62	7.29	1.35	3.97	15.8
Spa	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		0.19	108	0.18	52	77.6	123	150
See	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0		12.4	0.47	12.7	4.57	81.3	42.5
Swi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0.3	0.8	0.39	82	81.8
Tai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0		2.85	7.33	5.26	33.6
Tha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		2.58	2.29	1768
UK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0.69	97.4
USA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0.62
Ven	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	

Table 4: Results of Hausman Specification Test: 1 means rejection. 1997 Hong Kong crisis. Returns 2 days, Lags = 1, Crisis window = 10 days, Tranquil window = 60 days

Beta	Arg	Aus	Aus	Bra	Can	Chi	Col	Den	Fin	Fra	Ger	Gre	Hon	Ind	Ind	Ita	Jap	Mal	Mex	Net	Nor	Per	Phi	Por	Rus	Sin	Kor	Sou	Spa	See	Swi	Tai	Tha	UK	USA	Ven
Arg		1.28	0.76	1.04	0.09	5.82	1.61	2.76	1.04	1.32	1.63	0.82	0.6	0.54		3.07	0.57	0.18	0.35	1.08	0.66	1.09	-0	1.36	0.14	0.46	-0	2.26	3.08	1.27	1.83	0.49	-2.3	1.55	0.14	0.66
Aus	0.98		0.66	0.66	0.77	1.95	0.43	1.21	0.77	0.88	0.73	1.07	0.48	0.24		1.87	1.24	0.32	0.35	0.95	0.54	0.78	1.8	0.75	0.11	0.3	0.03	1.02	0.79	0.97	0.92	-1.4	-7	1.04	1.21	0.16
Aus	0.83	0.55		1.09	1.97	2.88	0.6	1.54	1.15	1.39	1.1	1.02	0.46	0.11		1.83	3.67	0.66	1.81	1.36	1.06	1	7.51	1.26	0.12	0.05	0.02	1.72	1.25	1.74	1.56	-1.2	-3.8	1.48	1.79	0.32
Bra	0.41	0.71	1.37		-0.8	3.06	2.13	1.84	0.98	1.31	1.03	0.95	0.79	1.38		5.11	0.48	-0.2	0.55	1.36	0.76	1.32	-1.6	1.28	0.21	1.2	0.04	1.19	1.52	1.39	1.58	0.95	-0.7	1.53	1.02	0.44
Can	13	0.76	2	0.67		1.34	-0.6	0.76	0.7	0.75	0.41	2.07	-0	0.69		-0.1	13.5	0.11	0.26	0.99	-0.3	0.2	5.26	0.94	-1.9	-0.2	-0	5.31	0.67	0.93	0.84	-0.1	-0.1	0.77	41.6	0.07
Chi	1.42	1.78	2.79	2.66	2.84		0.57	0.56	0.39	0.51	0.43	0.39	0.22	0.38		0.54	0.88	0.1	0.22	0.58	0.36	0.46	0.26	0.55	0.11	0.41	-0	0.7	0.49	0.5	0.61	-0.3	2.89	0.61	0.68	0.22
Col	0.2	0.54	1.31	0.34	0.54	0.2		2.59	1.74	1.84	1.47	4.52	0.27	0.8		2.99	1.45	0.23	0.94	2.69	1.12	1.69	0.62	2.07	0.25	-6.7	-0	1.68	1.39	1.99	2.03	0.05	-357	2.74	4.35	1.01
Den	0.91	1.43	2.61	1.05	0.98	0.64	1.34		0.56	0.59	0.55	0.62	0.31	0.83		0.39	1.75	0.15	0.46	0.75	0.16	0.54	0.28	0.53	0.03	0.07	0.02	0.62	0.62	0.71	0.69	-0.2	-3.3	0.84	0.8	0.33
Fin	0.46	0.6	1.17	0.98	0.51	0.32	1.04	0.65		1.16	0.9	1.57	0.36	0.43		1.4	3.58	0.36	0.73	1.37	0.53	0.87	1.88	1	0.07	0.02	0.05	1.31	1.07	1.26	1.23	-0.6	-1.8	1.37	1.94	0.39
Fra	0.67	0.67	1.35	1.12	0.72	0.49	1.26	0.67	1.09		0.83	1.33	0.4	0.56		2.26	2.8	0.21	0.69	1.24	0.66	0.87	-0.3	1.05	0.1	0.25	-0	1.25	0.89	1.22	1.18	-0.2	-1	1.2	1.7	0.27
Ger	0.73	0.73	1.22	1.14	0.55	0.4	0.98	0.58	1	0.89		1.17	0.46	0.65		2.49	1.52	0.33	0.88	1.33	0.54	0.93	0.52	1.12	0.09	0.2	0.01	1.23	1.11	1.28	1.28	-0.9	-3.3	1.43	1.78	0.47
Gre	1.09	1.07	2.83	1.96	0.96	0.92	1.17	1.37	1.32	1.65	2.63		0.16	1.48		8.47	3.81	0.02	0.29	0.92	0.21	0.44	0.14	0.69	0.06	0.51	0.01	0.57	0.55	0.96	0.61	0.52	0.38	0.8	1.73	-0
Hon	0.58	0.92	2.46	1.91	-23	0.55	2.83	0.91	2.14	2.33	2.03	1.53		-0.5		-0.5	0.54	0.35	0.36	0.4	0.3	0.96	1.79	0.48	0.18	0.53	0.07	0.4	0.65	0.58	0.46	-1.3	3.06	0.58	-0.1	0.22
Ind	-3	-7.6	-24	-2.3	-0.7	-1.4	-7.4	-1.4	-4.7	-3.5	-4.6	-0.6	19.7			0.37	-0	0.13	-0.6	-0.4	-0.1	-0	0.43	-0.1	0.06	0.18	0.03	-1.3	-0.2	-0.6	-0.3	-1.5	-0.5	-0.3	-0.6	-0.1
Ind																																				
Ita	0.42	0.82	1.76	0.66	1.46	0.39	0.82	1.07	1.37	1.02	1.83	0.76	5.73	-1.1			1.36	0.24	0.03	1.21	1.03	0.95	0.8	1.06	0.28	-0.2	0.13	1.2	0.61	1.05	0.89	0.11	-2.1	1.27	3.34	0.28
Jap	1.86	1.34	1.91	12.3	0.64	1.15	2.42	0.97	1.3	1.63	1.89	1.57	5.45	4.78		1.11		0.3	0.1	0.99	0.17	0.37	0.58	0.35	-0	0.03	-0	0.32	0.51	0.7	0.53	-0.3	-3	0.85	1.13	0.03
Mal	0.6	0.44	0.92	-1.2	0.6	0.28	2.46	0.52	0.93	1.12	0.69	8.42	0.84	-0.4		0.85	0.32		-0.4	1.26	0.21	0.88	1.88	0.63	0.01	-1.1	0.01	1.26	1.49	0.86	1.04	-3.4	-2.1	1.05	0.64	0.25
Mex	0.01	0.53	1.26	0.16	1.05	0.09	-0.9	0.39	0.48	0.47	0.9	0.33	1.25	0.72		-37	-0.2	-5.8		2.54	-1.5	1.33	0.55	1.93	0.01	1.02	0.03	3.62	1.68	2.31	1.99	-0.9	-1	2.71	0.16	0.5
Net	1.21	0.86	1.85	1.91	0.7	0.63	1.34	0.84	1.27	1.22	1.57	0.94	5.74	2.19		0.72	0.29	3.69	2.51		0.34	0.54	1	0.64	0.03	-0	0.02	0.97	0.66	0.9	0.84	-0.2	-3.1	1.03	1.67	0.25
Nor	-0.5	0.63	1.28	0.37	14.3	0.15	0.92	1.02	0.78	0.75	1.11	-1	3.79	8.79		-0.9	0.31	13	2.88	0.91		1.24	-3.7	1.47	0.19	0.44	0.04	-4.3	3.47	1.57	1.58	0.81	0.11	1.52	1.98	0.29
Per	0.6	0.74	1.4	0.92	2.59	0.39	1.09	0.7	1.14	0.97	1.18	0.7	1.4	7.5		0.19	0.78	4.32	1.63	0.91	1.49		2.29	1.06	0.17	0.45	-0	1.02	1.14	1.12	1.16	-0.9	-4.2	1.21	1.33	0.38
Phi	-141	1.54	4.83	-6.8	-2.3	1.2	4.26	2.2	8.21	25.1	7.16	11	1.35	-0.3		0.91	1.52	2.64	-7.6	6.37	-1.8	3.28		-0.1	0.08	-1	-0	-0.5	0.38	-0.1	0.03	-2	-0.9	0.22	-0.6	-0
Por	1.59	0.67	1.31	1.01	0.69	0.47	1.22	0.75	0.85	0.86	1.28	0.34	3.35	3.18		0.37	-0.5	5.06	1.47	0.76	1.31	1.23	0.39		0.14	0.53	0.04	0.99	1	1.51	1.28	0.27	-0.4	1.26	2.18	0.29
Rus	0.24	0.31	0.64	0.23	-0.1	0.14	0.2	0.59	0.73	0.41	0.64	0.15	0.5	0.23		0.07	-0.5	22.3	7.02	0.73	0.24	0.29	0.62	0.28		2.64	-0.1	3.19	2.48	3.39	3.05	1.27	5.38	2.83	7.82	1.06
Sin	-3.4	-5	-65	-2	2.85	-1.2	5.6	-9.6	-128	-7.3	-15	-1.6	-6.2	-1.5		12.9	-41	10.7	-3.1	66.5	-3.8	-4.8	4.17	-3	-22		0.02	-0.5	-0	-0.3	-0.2	1.33	2.26	-0.2	0.18	-0.1
Kor	0.9	-1.9	-5.2	-1.6	5.25	1.23	9.18	-1.9	-1.8	13.1	-7.1	-5	-1.3	0.53		-0.4	2.03	-51	-2.6	-2.3	-1.2	10.5	5.8	-1.4	10.2	0.51		-0.2	-0	-0.2	-0.1	4.06	-25	0.37	0.46	-0.2
Sou	0.79	0.76	1.13	0.68	0.72	0.41	0.8	0.63	0.8	0.74	1.02	0.39	1.22	0.59		-0	0.65	7.5	1.1	0.7	1.18	0.76	0.05	0.67	4.82	0.82	80.5		1.14	1.68	1.52	0.22	-0.8	1.65	2.25	0.34
Spa	1.02	0.67	1.27	1.41	0.63	0.39	0.54	0.69	1.08	0.9	1.13	0.92	1.97	3.3		-1.2	0.16	3.05	2.67	0.71	3.67	1.19	0.3	0.9	8.6	18.2	379	0.48		1.59	1.16	-1.1	-5.6	1.36	5.34	0.46
See	1.21	0.85	1.73	1.27	0.79	0.57	1.42	0.9	1.27	1.22	1.58	0.88	3.5	1.38		0.53	0.21	7.87	1.6	1.07	2.25	1.55	1.86	1.36	12.1	2.98	143	1.03	1.49		0.93	0.06	-0.5	0.95	1.32	0.16
Swi	0.97	0.86	1.55	1.38	0.82	0.52	1.42	0.81	1.33	1.08	1.37	0.93	3.45	1.72		0.77	0.45	5.39	1.81	1.07	2.02	1.32	-0.5	1.06	10.4	3.09	220	1.02	1.08	0.92		-0.3	-0.9	0.98	1.46	0.26
Tai	-4.4	4.29	8.16	-10	15.9	4.77	-828	11.5	14.4	27.9	9.99	-8.3	8.73	-2.2		-32	5.69	7.85	10.5	23.9	-5.9	7.91	3.06	-18	-121	2.85	32.4	-28	5.6	-55	12.1		0.13	-0	-0.3	-0
Tha	0.25	1.18	2.5	2.95	6.43	0.49	1.22	0.93	2.19	2.38	1.82	15	1.35	0.39		2.12	1.29	4.41	2.73	1.81	-7.5	1.25	2.12	4.67	11.2	0.81	11.6	3.29	1.37	2.81	1.91	-1.5		0.62	-0	0.28
UK	1.1	0.81	1.86	1.4	0.71	0.59	1.35	0.77	1.26	1.24	1.45	1.05	3.05	2.81		0.66	0.37	5.53	1.43	0.98	1.99	1.45	2.31	1.32	13.2	5.59	-65	0.92	1.4	1.06	1.16	8.62	-0.4		1.4	0.3
USA	19.1	1.53	3.12	5.26	1.7	1.12	1.69	1.63	1.96	2.02	2.78	1.32	-50	2.77		0.5	0.4	18.1	-138	1.19	2.99	3.31	-1.3	1.97	19.7	-9.9	-107	1.59	2.71	1.77	1.84	1.71	46.7	1.44		0.1
Ven	0.3	0.68	1.58	0.36	1.04	0.16	0.69	0.42	1.02	0.74	0.68	-2.8	1.83	0.92		0.65	-0.1	3.88	1.28	0.6	1.28	0.67	-5.9	0.65	5.26	0.9	24.4	0.33	0.69	1.31	0.61	8.79	-1.2	0.5	0.6	

Table 5: Estimation of beta for the 1998 Russian crisis. Returns 2 days, Lags = 1, Crisis window = 10 days, Tranquil window = 60 days

Test	Arg	Aus	Aus	Bra	Can	Chi	Col	Den	Fin	Fra	Ger	Gre	Hon	Ind	Ind	Ita	Jap	Mal	Mex	Net	Nor	Per	Phi	Por	Rus	Sin	Kor	Sou	Spa	See	Swi	Tai	Tha	UK	USA	Ven
Arg		0.63	0.59	0.32	127	1.93	1.09	0.75	0.46	0.52	0.36	1.11	0.46	8.12		4.53	2.32	0.61	1.1	0.89	1.32	0.42	-	1.03	0.2	8.27	2.21	2.81	0.61	0.91	0.6	14.4	8.25	0.6	148	0.15
Aus	0		0.07	0.35	0.58	0.39	0.26	0.27	0.07	0.11	0.1	0.57	0.27	26.6		2.09	0.37	0.09	0.27	0.15	0.26	0.1	1.22	0.13	0.13	10.2	5.94	0.35	0.11	0.19	0.17	4.97	48.1	0.11	0.66	0.34
Aus	0	0		0.64	0.4	0.61	0.86	0.49	0.09	0.08	0.07	1.97	1.51	153		1.99	2.39	0.22	0.68	0.27	0.19	0.2	34.2	0.11	0.29	836	25.7	0.64	0.07	0.16	0.1	9.05	13.5	0.27	1.08	0.72
Bra	0	0	0		3.88	0.8	1.24	0.72	0.49	0.36	0.48	1.28	1.21	3.42		8.57	48.7	1.9	0.43	0.88	0.47	0.16	22.4	0.38	0.09	2.24	4.62	0.25	0.44	0.51	0.38	19.1	5.03	0.61	4.44	0.31
Can	0	0	0	0		2.26	1.29	0.27	0.03	0.11	0.1	3.13	443	0.76		2.36	124	0.48	0.96	0.04	129	2.44	59.2	0.17	7.01	5.32	80.4	32.8	0.1	0.06	0.15	105	39.1	0.13	759	0.98
Chi	0	0	0	0	0		0.25	0.17	0.08	0.08	0.07	0.61	0.31	2.28		0.24	1.01	0.17	0.12	0.18	0.14	0.06	1.4	0.09	0.04	1.4	4.4	0.32	0.08	0.18	0.09	11	13.1	0.13	0.44	0.05
Col	0	0	0	0	0	0		1.23	0.72	0.77	0.7	3.3	6.69	20.5		2.16	2.2	3.22	0.66	0.89	1.16	0.6	5.65	0.7	0.23	17.4	125	0.92	0.84	1.34	0.87	-	-	0.75	1.13	0.27
Den	0	0	1	0	0	0	0		0.09	0.1	0.04	0.88	0.4	1.46		0.84	1.24	0.32	0.1	0.11	0.65	0.12	2.6	0.15	0.66	45.8	6.96	0.23	0.09	0.14	0.13	35.9	15.5	0.06	0.63	0.1
Fin	0	1	0	0	1	0	0	0		0.04	0.04	0.76	1.38	8.2		1.38	1.99	0.45	0.14	0.04	0.28	0.2	19.4	0.09	0.58	4500	3.94	0.24	0.08	0.08	0.1	35	5.21	0.05	0.45	0.38
Fra	0	0	0	0	0	0	0	0	1		0.05	0.92	1.8	5		2.88	2.22	0.76	0.08	0.08	0.17	0.13	194	0.02	0.18	15.7	243	0.24	0.05	0.04	-	152	3	0.07	0.46	0.25
Ger	1	0	0	0	0	0	0	0	1	0		1.8	1.04	6.92		4.48	0.79	0.22	0.23	0.14	0.39	0.14	13.3	0.13	0.36	53.8	56.7	0.3	0.05	0.17	0.09	15.1	10.3	0.08	0.93	0.16
Gre	0	0	0	0	0	0	0	0	0	0	0		2.32	1.33		53.2	7.03	81.8	0.48	0.48	2.06	0.49	72.5	0.43	0.23	3.18	77.6	0.33	0.45	0.4	0.57	23.5	239	0.54	0.53	21.5
Hon	0	0	0	0	0	0	0	0	0	0	0	0		110		13.5	7.67	0.27	0.8	5.7	3.85	0.39	0.25	2.11	0.23	11.8	2.13	0.65	0.72	2.04	2.53	14.6	2.41	1.85	415	1.36
Ind	0	0	0	0	0	0	0	0	0	0	0	0	0			2.33	681	0.69	0.56	1.7	23.7	29.2	0.71	6.76	0.29	16	1.35	1.8	3.72	1.14	1.68	4.78	1.83	2.57	2.77	2.46
Ind																																				
Ita	0	0	0	0	0	0	0	0	0	0	0	0	0	0			1.6	0.84	251	0.77	0.5	0.46	1.05	0.53	0.08	89.1	0.56	0.63	0.83	0.98	0.93	569	10.7	0.78	0.92	0.74
Jap	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0.11	1.5	0.19	1.38	0.52	1.34	0.63	0.77	958	11.1	0.75	0.3	0.42	0.46	16.2	17.4	0.27	0.55	1.49
Mal	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0		10.7	1.93	27	2.03	0.81	4.1	263	15.6	1608	14.5	0.95	7.52	3.5	7.34	6.02	4.36	35.1	4.72
Mex	0	0	0	0	0	0	0	0	0	1	0	0	0	0		0	0	0		1.12	4.41	0.3	16	0.33	56.5	2.61	8.97	4.47	1.3	0.07	0.33	16.2	3.12	0.61	2832	0.54
Net	0	0	0	0	1	0	0	0	1	0	0	0	0	0		0	1	0	0		0.36	0.18	13.7	0.11	0.88	1627	8.66	0.26	0.07	0.13	0.12	143	15.1	0.03	0.16	0.22
Nor	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1	0	0	0	0		0.37	10.2	0.15	0.06	4.66	2.58	13.8	5.74	0.62	0.67	7.34	28.3	0.53	1.23	0.76
Per	0	0	1	1	0	0	0	0	0	0	0	0	0	0		0	0	0	0	1	0		4.61	0.13	0.08	6.22	134	0.17	0.13	0.28	0.17	10.8	12.3	0.24	1.51	0.15
Phi	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0		3.12	0.48	5.85	48.6	1.06	0.5	5.5	9.45	3.63	3.53	2.99	2.56	63.5
Por	0	0	0	0	0	0	0	0	0	1	0	0	0	0		0	0	0	0	0	0	0	0		0.08	2.91	2.72	0.11	0.05	-	-	68.1	10	0.16	0.5	0.22
Rus	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1	0	0	0	0	0	0	0	0		30.6	29.5	1.89	3.25	5.37	4.35	653	13.1	7.23	13.9	2.54
Sin	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0		1.89	0.67	93.2	1.82	1.94	2.6	3.99	5.19	16.8	0.48
Kor	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		291	4237	382	971	19.7	243	92.8	181	27.8
Sou	0	0	0	1	0	0	0	0	1	1	0	0	0	0		0	0	0	0	0	0	0	0	1	0	1	0		0.39	0.25	0.28	211	6.38	0.24	0.73	0.44
Spa	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	1	0	0	0	0		0.11	0.03	5.66	25.3	0.15	2.94	0.17
See	0	0	0	0	1	0	0	0	0	0	0	0	0	0		0	0	0	1	0	0	0	0	1	0	0	0	1	0		0.04	739	4.23	0.08	0.45	1
Swi	0	0	0	0	0	0	0	0	0	1	0	0	0	0		0	0	0	0	1	0	0	0	1	0	0	0	0	1	0		31.4	2.59	0.11	0.51	0.2
Tai	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		6.62	25.2	1.45	76.9
Tha	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1.04	842	1.06
UK	0	1	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0		0.27	0.14
USA	0	0	0	0	0	0	1	0	0	0	0	0	0	0		1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0.4
Ven	1	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Table 6: Results of Hausman Specification Test: 1 means rejection. 1998 Russian crisis. Returns 2 days, Lags = 1, Crisis window = 10 days, Tranquil window = 60 days