

NBER WORKING PAPER SERIES

TRANSMISSION OF THE U.S. SUBPRIME CRISIS TO EMERGING MARKETS:
EVIDENCE ON THE DECOUPLING-RECOUPLING HYPOTHESIS

Michael P. Dooley
Michael M. Hutchison

Working Paper 15120
<http://www.nber.org/papers/w15120>

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2009

This paper was prepared for the JIMF/Warwick Conference on April 6, 2009. We thank Mahir Binici and Gurnain Pasricha for data collection and helpful comments from participants at the conference, especially Duncan Shand, Michael Melvin and Mark Taylor. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

NBER working papers are circulated for discussion and comment purposes. They have not been peer-reviewed or been subject to the review by the NBER Board of Directors that accompanies official NBER publications.

© 2009 by Michael P. Dooley and Michael M. Hutchison. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Transmission of the U.S. Subprime Crisis to Emerging Markets: Evidence on the Decoupling-Recoupling Hypothesis

Michael P. Dooley and Michael M. Hutchison

NBER Working Paper No. 15120

June 2009

JEL No. F3,F36,F41

ABSTRACT

We find that emerging markets appeared to be somewhat insulated from developments in U.S. financial markets from early 2007 to summer 2008. From that point on, however, emerging markets responded very strongly to the deteriorating situation in the U.S. financial system and real economy. Policy measures taken in emerging markets to insulate themselves from global financial developments proved inadequate in the face of the credit crunch and decline in international trade that followed the Lehman bankruptcy in September 2008.

Michael P. Dooley
Department of Economics
Engineering II
University of California, Santa Cruz
Santa Cruz, CA 95064
and NBER
mdooley@cabezoncapital.com

Michael M. Hutchison
Department of Economics
E2
University of California
Santa Cruz, CA 95064
hutch@ucsc.edu

1. Introduction

In this paper we evaluate the transmission of the U.S. subprime crisis to emerging markets. Our interest in this topic is partly related to the widespread view that prior to the current crisis many emerging market countries had undertaken reforms that were designed to, and would in fact, insulate them from adverse shocks from the rest of the world. These policies included substantial increases in reserve assets and substantial reductions in net government debt. Moreover the currency exposure of EM governments was reduced in some cases to long dollar positions, commercial bank net foreign exchange borrowings were strictly limited and nonfinancial firms foreign currency debt was monitored and, in many cases, strictly controlled. Finally, emerging markets were generally experiencing current account and primary fiscal surpluses.

As recently as October 2008 the Mexican government argued forcefully that the Mexican economy was sufficiently insulated from the U.S. to get through the crisis without a significant recession.¹ More generally, the view that the emerging financial markets would not be directly affected by the subprime crisis suggested that growth in China and other emerging markets would carry the world economy for several years while the United States and Europe recovered.² These hopes evaporated quickly by fall 2008 and the question is did something about the U.S. crisis change or was the decoupling hypothesis too optimistic from the outset?

We address these questions empirically in several ways. In the next section we provide an informal narrative of the when, how and why emerging markets responded to the U.S. subprime financial crisis. In this section we distinguish three phases of the financial crisis transmission to emerging markets. We argue that emerging market asset prices were largely insulated or decoupled from the crisis for some months, but then fell even harder than prices for US assets as expectations about GDP growth in the United States and other industrial countries deteriorated in the summer of 2008. Finally, the Lehman bankruptcy in September 2008 generated a very direct financial shock to emerging

¹ Carstins (2008)

² Bergsten (2008), IMF (2008).

markets as trade credit evaporated and international trade declined sharply and uniformly around the world. In section 3 we analyze formally how U.S. subprime “news” transmitted to CDS spreads in emerging markets³. We are interested in the types of “news” that moved CDS spreads, how common was the reaction across emerging markets, and in the magnitude of the response.⁴ We identify events that others have claimed were important sources of information about the nature and intensity of the crisis for U.S. markets. We use one official data source (time line for important events published by the Federal Reserve Bank of Saint Louis) and one market source (timeline for events published by Bloomberg) for these events. We distill these very detailed data sets into a set of 15 types of events that were thought to influence expectations in U.S. markets. Using a regression “event study” approach, we test whether these U.S. events were important in the evolution of debt (CDS spreads) in 14 selected emerging markets, if there was a common reaction across emerging markets, and the size of the response.

Our event study finds that a range of financial and real economic news emanating from the US has statistically and economically large impacts on emerging markets and several news events uniformly moved markets. However, it is not clear whether the structural linkages between the U.S. and emerging markets have changed or whether the frequency, importance and magnitude of the events emanating from the U.S. have changed. To address this “decoupling-recoupling” issue, in section 4 we review developments in selected equity, debt and foreign exchange markets for a sample of emerging market countries during the three phases of the financial crisis identified in our narrative description (beginning of 2007 through February 2009). This analysis focuses on the

³ Credit-default swaps protect bondholders against default by paying the buyer face value in exchange for the underlying securities or the cash equivalent should a borrower fail to adhere to its debt agreements. The contracts rise as perceptions of credit quality deteriorate and a basis point is worth \$1,000 on a contract protecting \$10 million of debt.

⁴ Eichengreen et al. (2009), in a related study, investigate the common factors influencing international bank CDS spreads during different phases of the subprime crisis. They find that the importance of common factors rose substantially after the outbreak of the subprime crisis. They employ principal component time-series analysis rather than focus on news announcements emanating from the U.S. as in our event study. Longstaff et al. (2007) also finds that EM CDS spreads can mostly be explained by a global factor over the 2000-2007 period.

timing of changes in these markets during the financial crisis for selected emerging markets relative to the U.S. and compares market dynamics. In section 5 we further address whether linkages changed or whether the frequency and magnitude of the shocks emanating from the U.S. changed. We focus on one emerging market with especially strong linkages with the U.S. economy—Mexico—and investigate the transmission of disturbances between equity markets and how they've changed between the different phases of the financial crisis. We conclude our discussion in section 6.

Our conclusion is that there is some support for the decoupling hypothesis through mid 2008. But as expectations for a severe downturn in economic activity in the U.S. and Europe took hold and early warnings about the effects on world trade volumes took center stage, financial markets recoupled dramatically. Looking forward there is some support for the idea that emerging markets remain better prepared for less violent financial shocks from the rest of the world. Moreover it seems to us likely that they will redouble their efforts to insure against shocks.

2. Three Phases of the Subprime Crisis

In this section we provide an informal narrative of three phases of the transmission of the subprime crisis to the emerging markets. During the whole period reviewed, February 2007 to March 2009, cumulative losses in the dollar or domestic currency values of emerging markets' debt and equity market were remarkably similar to those in industrial countries. But there are interesting differences in the relative behavior of emerging markets' assets within the crisis period.

The 18 months from February 2007 to May 19, 2008, appear to have been a brief golden age of a decoupling of emerging markets from industrial countries. During this first phase of the U.S. subprime crisis EM equity markets outperformed the broad U.S. equity indices by about 40% (Chart 1). During this interval EM currencies appreciated against the dollar by about 10 percent and so accounted for about one quarter of EM equities outperformance.

As discussed at length in other papers in this volume, several EM currencies were supported by the carry trade as investors chased high yields in emerging markets. Nevertheless, it is clear that investors did not expect the financial difficulties unfolding in the U.S. and Europe to have a negative impact on dollar earnings in emerging markets nor did they apply a higher discount rate to those earnings. This was a remarkable performance for countries where collapse of equity values and sovereign defaults had been the usual response to credit crunches in industrial countries.

This does not mean that important events in the U.S. and other industrial countries did not affect emerging markets. Quite the contrary, as we show in detail below, day-to-day movements and volatility of emerging debt and equity markets were strongly related to developments in the United States and Europe. Nevertheless it is clear that in its early stages the subprime crisis had much less influence on the outlook for economic performance in emerging markets relative to the United States and other industrial countries.

The relative performance of credit markets in the U.S. and emerging markets during phase one tells a similar story. As shown in Chart 2, CDX EM, an index of credit default spreads for emerging market sovereign bonds, declined steadily during 2007 before rising in early 2008. EM spreads declined on balance during phase one. Spreads on an index of US investment grade corporate bonds over benchmark Treasuries were little changed during 2007 but rose by about the same amount as EM spreads in early 2008. Perhaps the important thing to take away from this experience is that neither of these credit markets seemed to reflect expectations that the subprime crisis would have a negative impact on default rates for U.S. or EM bond markets until early 2008. Moreover, in 2007 as EM currencies appreciated and EM central banks accumulated international reserves it seemed increasingly unlikely that sovereign bonds were vulnerable to default risk.

Phase 2 is much shorter than phase one, from May 19, 2008 to “Lehman Day,” September 15, 2008. Over this interval the EM equity index shown in Chart 2 fell from 165 to 109 giving up three quarters of its outperformance relative to the U.S. equity index accumulated over phase one. As in phase 1, the decline in the domestic currency value of the EM index was reinforced by a decline in the value of EM currencies relative to the U.S. dollar.

A remarkable feature of this phase of the crisis was the apparent “decoupling” of credit and equity markets. As shown in Chart 2, spreads in EM and U.S. markets widened in phase 2 but, in contrast to equity markets, the deterioration in credit markets was very similar in magnitude.

Clearly something important changed several months before the Lehman bankruptcy sent all the markets into a new panic. The events that generated this very different intensity of sell offs are not easy to pinpoint. Nevertheless we think a good case can be made for the idea that this critical three-month interval leading up to Lehman was dominated by revised expectations about the real effects the crisis would have on output in industrial countries and emerging markets.

A remarkable feature of the macro data for the U.S. during phase 2 is that it gave no hint that a disaster was just around the corner. High frequency data for U.S. economic activity such as industrial production, exports and retail sales did not turn down until after the Lehman disaster in September. While there were several prophets of doom for the U.S. real economy, the experts’ consensus forecast for the fourth quarter of 2008 and 2009 declined only by a few tenths during phase 2. The IMF’s forecast for world economic activity that was published in October still called for world GPP growth of 6% for all of 2009.

There were, however, two sources of early warnings -- both of which were probably responding to the same shift in expectations. First, commodity and oil prices also turned down sharply at the beginning of phase two. The fall in oil prices was good for some

EMs and bad for others but we can probably relate the break in the oil market to changes in the outlook for world economic activity. The downturn in commodity prices was probably related to the same reduction in the outlook for world GDP growth and is clearly bad for EM equity and exchange rates.

Second, the similar increase in default spreads both in the U.S. and in emerging markets in phase 2 probably reflected expectations that what had to that point been a financial crisis in the U.S. and Europe could also turn into a long and deep decline in economic activity. The admission of the Federal Reserve on August 17 that “the downside risks to growth have increased appreciably” was an important and probably delayed acknowledgment of this shift in expectations.

Our interpretation of phase one and two is that during phase one emerging markets were plausibly decoupled from the financial crisis that was developing in the U.S. and Europe. EM banks held very little subprime exposure and in most cases recent crises had led to very strict regulation of their banking systems. But in phase 2 there was no plausible reason to believe that emerging markets had decoupled from a potential collapse in economic activity in the U.S. and other industrial countries.

From Lehman Day to year end 2008, EM and U.S. equity markets fell together to levels forty percent below their pre-crisis levels. During this third phase of the crisis EM currencies also declined by about ten percent. EM and US credit spreads increased very sharply after September and by late October had reached crisis levels.

As discussed elsewhere in this issue, phase 3 was largely unanticipated and quite different as compared to phases one or two or any previous historical experience. In particular, the freezing of credit markets that reached crisis proportions with runs on U.S. money market funds in late October appears to have had a direct effect on EM domestic credit markets. Anecdotal evidence strongly suggests that this freeze included

international trade financing.⁵ The contraction of world trade after September 2008 was remarkable both for its severity and for its uniformity across developed and emerging markets. Most countries saw a decline in both imports and exports of about 30% from September 2008 to January 2009.

One plausible explanation is that in the post-Lehman phase even trade credit to support exports and imports was disrupted by the counter party risk and deleveraging generated by the bankruptcy of a major player in international credit markets. If this was indeed the case then the third phase of the crisis was a spectacular recoupling of financial markets in the U.S. and emerging markets. An optimistic interpretation of developments in 2009 is that as U.S. financial markets have unfrozen there is some hope that recovery of world trade will support economic recovery programs in industrial countries and emerging markets.

3. Transmission of U.S. Real and Financial Shocks to Emerging Markets

We now turn to daily data for news from the United States and debt, equity and exchange rates in emerging markets. In this section we focus on daily CDS spreads (5-year sovereign bonds) in 14 selected emerging markets, and regress changes in these spreads on a host of financial, real and political news announcements that have emanated from the U.S. since the beginning of 2007 through early 2009. Our objective is to evaluate which types of announcements have the most effect on emerging markets, evaluate the magnitude of these events, and identify those shocks which uniformly appear to move markets.

A. Data

CDS Spreads in Emerging Markets

⁵ The link between trade credit and trade during the subprime and previous financial crises is far from clear. We consider this a plausible conjecture. See IMF (2003), Auboin and Moritz Meier-Ewert (2008).

Our objective is to evaluate how financial markets in emerging markets respond to U.S. news during a period of intense financial turmoil. To this end, we consider fourteen emerging markets geographically distributed across the world: five emerging markets in Latin America (Argentina, Brazil, Chile, Colombia and Mexico), three in Asia (China, South Korea and Malaysia), four in central Europe (Czech Republic, Poland and Hungary) and three from other regions (Russia, South Africa and Turkey). This group of countries provides a broad geographic representation of emerging markets, with a range of levels of economic development and financial depth.

We focus on 5-year CDS spreads on sovereign bonds over the sample period, January 1, 2007 – February 19, 2009. All of the countries in our sample have consistent CDS series over this time period. The CDS spreads are shown in Chart 4 and discussed further in Section 4.

U.S. Financial and Real “News” Events

Our other key data component is U.S. “news” events. For the purposes of this study it is important that we capture major news announcements emanating primarily from the U.S. market and test which of these events transmit to emerging markets. We want to cast our net widely over a broad set of news announcements but not so widely as to include events of marginally important information value.

We consider the Bloomberg news announcements on the U.S. economy and the financial crisis as well as the Federal Reserve Bank of St. Louis’s comprehensive time line on developments on the financial crisis. We code these news announcements into fifteen categories: bankruptcies (BR), write-downs (WD), credit events (CRD), Federal Reserve swaps with developed economies (FSD), Federal Reserve swaps with emerging markets (FSE), direct housing market policy actions (HD), Lehman Brother Bankruptcy (LEHMAN), major U.S. political developments (POL), recapitalization of financial institutions (REC), the decision by Treasury Secretary Paulson not to use the Troubled Asset Recovery Program to purchase mortgage-related securities (TARP_CANCEL),

events and programs substantially expanding the U.S. Treasury's balance sheet (TBS), events and programs substantially expanding the Federal Reserve's balance sheet (FBS), new regulatory actions (REG), positive economic developments in the U.S. (REALPLUS) and negative economic developments in the U.S. (REALMINUS).

Table 1 gives a more detailed explanation of the description and coding of the events as well as illustrative examples of events included in each category. Table 2 shows the number of events in each category for the full sample (total number of events) and for two sub-sample periods—the combined first and second phases of financial problems that emerged in the U.S but had a limited effect on emerging markets (January 2007 through August 2008) and the third phase of very intense financial problems in emerging markets (September 2008 – February 2009). Not surprisingly, the great majority of events occurred in the third and final phase.

B. Methodology and Results

The dependent variable that we wish to explain is the daily change in the CDS spread for each emerging market of our sample. Unit root tests suggest that the change in the CDS spread is a stationary variable. In addition to the “news” variables and a constant, we also include a lagged dependent variable to effectively absorb residual autocorrelation in the equation. The sample period was January 1, 2007 to January 19, 2009, giving a common sample of 533 observations except for the central European countries where the sample is more limited due to data constraints on reported CDS spreads. A regression methodology (OLS) is employed.

Table 3 presents the results of the regression analysis. The adjusted R-square ranges from a low of 0.04 (Argentina) to a high of 0.41 (South Korea). The mean of the dependent variable (average daily increase in the CDS spread over the sample period) ranges from lows of around 0.34-0.35 (China and Chile, respectively) to highs of around 1.26-6.25 (Russia and Argentina, respectively). The coefficients in bold represent significance

levels at 90% or higher (‘***’ denotes 99% level of significance or higher; ‘**’ denotes 95% level; ‘*’ denotes 90% level).

Our sample consists of a very diverse set of emerging market economies with a variety of idiosyncratic economic and political developments influencing CDS spreads and with quite different degrees of financial linkages with U.S. markets. Nonetheless, the transmission of news announcements to these markets was rapid and there are several factors that affected CDS markets almost uniformly. One event that was common to all emerging markets in our sample was Lehman Brothers bankruptcy (LEHMAN) news and associated announcements. LEHMAN is associated with four news announcements in the sample. Each LEHMAN announcement (on average) raised CDS immediately by between 7 basis points (China) to over 100 basis points (Argentina), with all 14 countries being significantly affected. China and Chile were the least affected, and Argentina and Russia were the most affected.

Write downs of equity (WD) in U.S. financial institutions, housing market developments in the U.S. (HD) and the cancellation of the TARP plan to purchase mortgage-related securities also were important factors that systemically raised CDS spreads. WD news adversely affected CDS markets (rise in spreads) in all 14 countries and the effect was statistically significant in 10 cases. HD news adversely affected CDS spreads in all 14 countries (statistically significant in 7 cases). TARP_CANCEL news also adversely affected emerging market CDS spreads in 13 of 14 cases, with Argentina as the outlier, of which the coefficients in 9 countries are statistically significant.

On the positive side, announcements of the two Federal Reserve swap arrangements with emerging markets (FSE) and developed countries (FSD), as well as positive real-side developments in the U.S. economy had the effect of lowering CDS spreads. In particular, FSE announcements significantly lowered CDS spreads in 13 of the 14 countries (with Argentina as the exception). The drop in CDS spreads ranged from 22 basis points in Chile and the Czech Republic to a drop of 183 basis points in South Korea. Results are similar with FSD. Positive real-side economic developments in the U.S. (REALPLUS)

are also associated with lower CDS spreads in emerging markets in 13 instances, of which 7 coefficients are statistically significant. Argentina is again the exception.

Three types of news announcements in the U.S. which surprisingly did not uniformly play a role in emerging market CDS spreads were major policy actions taken by the U.S. Treasury and Federal Reserve to shore up the financial system (TBS, FBS and REG). These events attracted much news attention but did not generally transmit to emerging markets. In particular, CDS spreads in only three of the eleven countries were significantly reduced by TBS announcements (Brazil, Mexico and Turkey). Surprisingly, CDS spreads rose significantly in response to FBS announcements in China and Malaysia-- presumably providing bad news to the market about the extent of the liquidity problems facing U.S. banks and credit markets rather than good news about the Fed program-- and were not significantly affected elsewhere.⁶ Similarly, important changes in financial system regulations (REG) lowered spreads significantly in only one case (Chile) and significantly raised spreads in four cases.⁷

On balance, news about the financial crisis and real economic activity emanating from the U.S. have played a significant role in moving CDS spreads in emerging markets. A series of write-downs, reported losses and downgrades of U.S. financial institutions, as well as the Lehman bankruptcy announcement, caused significant jumps in the CDS spreads, while positive news announcements on real economic activity in the U.S. buoyed emerging markets and lowered spreads. The critical policy developments moving these spreads downward have been a series of news announcements of foreign exchange swap agreements with emerging markets. But the major program announcements by the Treasury, Federal Reserve and other U.S. government agencies, including increases in deposit insurance coverage, the Fed's commercial paper funding facility (CPFF), the FDIC's new Temporary Liquidity Guarantee Program and dozens of other

⁶ Taylor and Williams (2008a,b) also do not find robust evidence of a significant negative effect of the Fed's term auction facility (TAF) on term inter-bank lending rates.

⁷ It is possible that official policy announcements were anticipated by the markets and therefore did not have a systemic contemporaneous impact. Other "news" announcements were largely unanticipated.

announcements supporting the financial system, did little to reduce CDS spreads in emerging markets.

4. Market Dynamics: Emerging Markets in the Financial Crisis

The preceding section demonstrated that news events from the U.S. have had large impacts on CDS spreads in emerging markets, effectively transmitting the financial crisis in the U.S. to markets abroad. It is not clear, however, whether the channels of transmission are stronger or whether the frequency, nature and import of the U.S. shocks has changed around mid-year 2008. Further insights on this issue may be gained by evaluating the dynamics of financial market changes in emerging markets, and the interaction amongst markets, in relation to several big news events in the U.S.

Equity Prices

The behavior of levels of broad stock indices is shown in Chart 3. National stock indices are shown in each panel together with the U.S. Standard and Poor's 500 index. The indices are local currency values normalized so each series starts at a base equal to one on February 27, 2007. To provide perspective on the timing of some key events in the U.S., we again mark three dates in the chart (denoted by vertical lines) that separates the three phases of the subprime crisis: May 19, 2008 and September 15, 2008 (Lehman bankruptcy). The first phase of the subprime crisis runs from February 27, 2007 to May 18, 2008; the second phase runs from May 19, 2008 to September 14, 2008; and the third phase runs from September 15, 2008 to February 2009.

As discussed in the introduction three features of this data stand out. First, the start of the subprime crisis in mid 2007 is also the start of a long but gentle decline in U.S. equities through September 2008. A spectacular decline in September is then followed by extreme volatility since then but no clear trend. In contrast most of the emerging markets had recovered by August 2007 and continued to perform quite well for another 12-14 months. This is true across regions and for emerging markets that are quite different in

terms of economic structure. If there was a time when decoupling seemed a reasonable idea it was during this year-long interval.

An interesting exception is Argentina. Argentina depends on foreign trade but is largely closed to international capital flows. Yet of all the countries in our sample it moved most closely with the United States. An intriguing possibility is that countries are linked through trade but open capital markets allow or generate different dynamics across countries.

Second, in late May 2008, the equity markets again start to move together. In the next section we will show that this was associated with increasing expectations that the decline in economic activity would be much larger than had been anticipated. This close relationship is even more pronounced in mid September when the Lehman crisis proceeds a spectacular fall in all the markets through mid October. In the next section we will look for news associated with these broad trends but for now it seems clear that something important occurred in June-July 2008 and again in September 2008.

Finally in the first three months of this year extreme volatility continues and markets have moved together but with no clear trend as of this writing.

In terms of the net move over the whole time period there does not seem to be any pattern. If we look at the whole sample, Brazil and China outperform the U.S. by substantial margins. The volatility of equity prices is much higher for Brazil and China as compared to the U.S. and, as we discuss in more detail below, the day-to-day correlation for Brazil is quite high and for China quite low. Can we draw any conclusions about the interdependence of these markets? It could be argued that Brazil and China are completely integrated with the U.S. market and subject to the same shocks but are more volatile. Clearly if this pattern was reliable it would be trivial to mimic any market by another by adjusting the leverage to increase or reduce volatility.

One additional summary statistic useful for shedding light on this issue is correlations between price movements (percentage changes) in these markets, and how they've changed over time⁸. Table 4 presents correlations between (percent changes) in the U.S. SP500 and (percentage changes) in national equity markets for selected emerging markets for the three phases of the subprime crisis. The last two columns of the table show the difference (percentage change) in the correlation between the second and third phases.

Correlations increased markedly between the second and third phases of the crisis (from September 15 onwards) for most emerging markets (11 of 14), indicating stronger linkages between the markets or more common shocks. (The correlation decreased in two countries, Korea and Malaysia, and was unchanged in Russia). For example, the correlation with Colombia, Turkey and Poland jumped 210%, 115% and 103%, respectively, at the high end of the spectrum. The correlation with Argentina, Brazil and Hungary also rose by very substantial amounts (38% or higher). Surprisingly, the correlation with the Asian countries in the sample (China, Korea and Malaysia) was either unchanged or fell slightly between the second and third phases of the crisis, suggesting greater insulation. Overall, however, changes in the correlations confirm our observations from the charts that the linkages generally increased substantially after mid-September 2008.

Credit markets

Chart 4 shows daily credit default spreads for the U.S. and selected emerging markets. The similarity of the changes and timing in the CDS spreads across emerging markets over the period is remarkable. Also there was almost no movement in CDS spreads until the Lehman failure. Only in a very tough environment would governments be expected to default. Clearly the Lehman bankruptcy was a different kind of problem and it was transmitted across all kind of countries in remarkably similar ways.

⁸ There are statistical problems in interpreting correlations of financial data when volatility is changing over time. We view these correlations as a descriptive statistic supplementing our other measures of linkages over the three phases of the subprime crisis.

Volatility also appears to take a distinct shift upwards starting around mid-September 2008 (phase 3). Again, the same pattern of initial decoupling from the bad financial news emanating from the U.S. is evident until late summer 2008. However, hopes that emerging markets were decoupled from the financial crisis and that their economies would be insulated were dashed by early fall 2008.

Exchange rates

Exchange rate developments for selected emerging markets (Mexico, Argentina and Russia) are shown in Chart 5. Exchange rates follow a similar general pattern to equity prices in that they generally appreciated relative to the dollar, at times rapidly, until summer 2008 and then depreciated very sharply. Emerging markets on balance appeared to be initially decoupled from the U.S. financial crisis and then experienced large depreciations that greatly exceeded the initial appreciations of their currencies from early 2007 through mid-2008. Russia, for example, started 2007 trading at above 26 rubles per dollar, appreciated to 23 rubles per dollar by June 2008 and then started to depreciate, reaching almost 34 rubles per dollar by February 2009. Mexico followed a very similar pattern to Russia: peso appreciation from January 2007 to August 2008, followed by a sharp depreciation from September 2008 to February 2009. Argentina was trading between 3.1-3.2 pesos per dollar from May 2007 to May 2008, followed by several months of strong appreciation and then a sharp depreciation beginning in September 2008. By February 2009 the Argentine currency had depreciated markedly and was trading close to 3.5 pesos per dollar.

5. Linkages: More News or Decoupling-Recoupling?

The preceding empirical analysis demonstrates that some U.S. news significantly moved CDS spreads in selected emerging markets. How does this empirical finding fit with the graphical analysis indicating that emerging markets were seemingly decoupled for a number of months from the adverse developments in the U.S. market, and suddenly were moving in tandem with U.S. markets from early fall 2008 to early 2009 (phase 3)? Two

candidate explanations are (1) the decoupling-recoupling linkage explanation, suggesting that market forces were moving these markets apart for the early part of the sample (phases 1 and 2) and then linkages reemerged in the latter part (phase 3) of the sample; or (2) news announcements emanating from the U.S. were more frequent, and were more important for emerging markets in the later sample compared to the early sample.

These are not necessarily competing hypotheses. Clearly, the worst financial and economic news emanating from the U.S. was concentrated in the period from early fall 2008 (post-Lehman) onwards. However, it also appears that emerging markets were more sensitive to U.S. news announcements in the latter part of the sample. To shed further light on the decoupling hypothesis, we investigate the linkage between the U.S. equity market and the Mexican equity market.⁹ We investigate how these markets are linked using a simple VAR model, Granger-causality tests and impulse response functions for the two sub-sample periods. Differences in the estimates between the two periods, 1/07 to 8/08 for the early period (phases 1 and 2) and 9/08 to 2/09 for the late period (phase 3), should highlight differences in the responsiveness of daily percent changes in Mexican equity prices and daily percent changes in U.S. equity prices.

We employ a simple bivariate VAR model with U.S. and Mexican equity prices and three lagged values. Equity prices are in log first differences to ensure that stationary series are employed in the VAR model. Three lags are indicated by most of the lag length statistical tests shown in Table 5. Table 6 shows part of the Granger causality tests for each sample period, namely the effect of lagged percent changes in U.S. equity prices (SP500) on percent changes in Mexican equity prices. The upper panel shows the full sample period (all three phases of the subprime crisis), the middle panel shows phases 1 and 2 of the crisis and lower panel shows phase 3 of the crisis.

The Granger causality results for the full sample (upper panel) indicate a strong linkage between the U.S. equity market and the Mexican equity market. The null hypothesis that

⁹ One empirical approach would be to divide our sample into two parts and test for structural change in the responsiveness of emerging markets to news emanating from the U.S. We cannot follow this approach, however, due to the relative paucity of news announcements in the first sub-sample period.

U.S. equity prices do not “Granger cause” Mexican equity prices is rejected at the 1% level. This simply means that lagged values of the U.S. equity prices are a good leading indicator of Mexican equity prices (in percentage changes) over the full sample. In the early sample period representing phases 1 and 2 of the crisis, by contrast, U.S. equity prices add no (statistically significant) information in predicting Mexican equity prices. Phase 3 of the crisis suggests that U.S. equity prices are marginally significant (12% level of significance) predictors of Mexican equity prices. There appears to be more information available over the full sample period to make the judgment that U.S. equities are a good leading indicator of Mexican equities, but this information appears to be derived mainly from the period encompassing the third phase of the crisis (post-Lehman). This again provides some evidence of the “decoupling” hypothesis for phases 1 and 2 of the crisis with linkages reemerging during the third phase of the crisis.

This observation is supported by impulse response functions derived from the 3-lag bivariate VAR model which underlie the Granger causality results of Table 6. The impulse response functions are reported in Chart 6. These are based on a Choleski decomposition of the VAR residuals and a shock of one standard deviation. The dashed lines represent confidence intervals (± 2 standard errors) around the impulse response. A 10-day period is investigated and the accumulated response is reported since the model is estimated in percent changes. The accumulated response gives the accumulated percent change in Mexican equity prices from a shock in U.S. equity prices. The upper panel shows the impulse response from the full sample period, the middle panel shows the impulse response from phases 1 and 2, and the lower panel shows the impulse response from phase 3.

Not surprisingly, the impulse responses derived from estimating the model over the three sample periods are consistent with the Granger causality results. The impulse response from the full sample shows a significant positive response from U.S. equity prices to the Mexican market. A 2 percent positive shock (one standard deviation) in the U.S. market causes an impact effect of about 1.5 percent in the Mexican market, falling off to about 1.3 percent after a few days. During phases 1 and 2 of the crisis, by contrast, the impact

effect is much less and stabilizes at about 0.9 percent. The response is largest in phase 3 with an impact effect of 2.5 percent, stabilizing at about 2.0 percent after a few days.

In sum, the Granger causality results and the impulse response functions indicate that Mexico has been more closely linked with the U.S. market since fall 2008 than previously. The Mexican equity market is closely linked with the U.S. market and integrated with the U.S. economy and may not be representative of the broader group of emerging markets. Nonetheless, the results are suggestive and provide support for the “recoupling” hypothesis.

6. Conclusion

Our review of the financial indicators lends support to the view that markets were decoupled from the U.S. for a period of time, but linkages dramatically reemerged (recoupled) by late summer or early fall 2008, with a remarkably uniform timing across most emerging markets. Volatility also rose dramatically starting in fall 2008. Simple correlations between (percent) price changes in the U.S. equity market (SP500) and those in emerging markets also show an increase after August 2008, oftentimes substantially so, in 9 of the 11 selected emerging markets investigated.

It is clear that U.S. financial and real news transmitted strongly to emerging markets over the whole sample period, as reflected in 5-year CDS spreads on sovereign bonds. We identified a wide set of U.S. news announcements such as write-downs of financial institutions and news on the U.S. real economy that systemically moved CDS spreads in most emerging markets. We also identified several types of news announcements, such as the Lehman bankruptcy and swap arrangements, that had uniformly large effects across all of the emerging markets in our sample. By contrast, major news announcements by the Federal Reserve and U.S. Treasury on plans to stabilize the U.S. financial system had little effect on emerging market CDS spreads.

But has this responsiveness changed since fall 2008? We can not investigate this issue using news announcements since there is a relative paucity of news in the early part of the sample. Rather, we consider the linkages between U.S. equity markets and the equity market in one emerging market—Mexico—with close financial and economic ties with the U.S. Using VAR methods, we find that the linkages between these two equity markets have become much stronger since fall 2008 when the U.S. financial crisis grew to critical proportions.

On balance, we find evidence for the decoupling-recoupling hypothesis. Using several approaches to investigate this issue, we find that emerging markets appeared to be largely insulated and decoupled from developments in U.S. financial markets from early 2007 to summer 2008. From that point on, however, emerging markets responded very strongly to the deteriorating situation in the U.S. financial system and real economy. Policy measures taken in emerging markets to insulate themselves from global financial developments proved inadequate in the face of strong international recoupling of the international financial system.

References

Auboin, Marc and Moritz Meier-Ewert (2008). “[Improving the Availability of Trade Finance during Financial Crises](#),” WTO.

Bergsten, Fred (2008) <http://blogs.ft.com/economistsforum/2008/07/trade-has-saved-america-from-recession/>

Carstins, Augustin (2008)
http://www.bloomberg.com/apps/news?pid=20601086&sid=aiKO7Y7_6pHE&refer=latin_america

Diamond, Douglas W and Raghuram Rajan (2009) “Credit Crisis: Conjectures about Causes and Remedies,” NBER WP 14739, February.

Eichengreen, Barry, Ashoka Mody, Milan Nedeljkovic and Lucio Sarno (2009), “How the Subprime Crisis went Global: Evidence from Bank Credit Default Swaps,” NBER Working Paper 14904 (April).

IMF (2003). “[Trade Finance in Financial Crises: Assessment of Key Issues](#)”, December 9, 2003.

IMF (2008). *World Economic Outlook October 2008*.
<http://www.imf.org/external/pubs/ft/weo/2008/02/pdf/text.pdf>

Longstaff, Francis A., Jun Pan, Lasse Heje Pedersen and Kenneth J. Singleton (2007), “How sovereign is sovereign credit risk?” NBER Working Paper 13658 (December).

Taylor, John B. and John C. Williams (2008a), “A Black Swan in the Money Market,” Federal Reserve Bank of San Francisco Working Paper 2008-4, April 2.

Taylor, John B. and John C. Williams (2008b). “Further Results on a Black Swan in the Money Market” Federal Reserve Bank of San Francisco mimeo May 23, 2008.

Table1 : Variable Definitions and Example of Events

Event Variable	Definition of Event	Event Example: Date and Description
REG	Important changes in US financial regulations	3-Dec-08 SEC approves measures to increase transparency and accountability at credit rating agencies.
TBS	Policy announcements that will affect the US Treasury's balance sheet	5-Dec-08 Treasury purchases \$4 billion in preferred stock in US banks under the Capital Purchase Program.
REALMINUS	Negative news about US growth	11-Dec-08 NBER announces that the economic activity peaked in December 2007 and that the economy has since been in recession.
REALPLUS	Positive news about US growth	11-Dec-08 House approves \$14 billion automaker bailout.
FBS	Policy announcements that will expand the Federal Reserve's balance sheet	25-Nov-08 Fed to buy \$600 billion of GSE debt, set up ABS program.
HD	Policy announcements directly affecting US residential housing market	20-Nov-09 Fannie Mae and Freddie Mac announce that they suspend mortgage foreclosures until January 2010.
CRD	Adverse news from US credit markets	9-Jan-09 US consumer borrowing falls by record \$7.9 billion; credit freeze deepens.
REC	Announcement of recapitalization of US financial institutions	10-Oct-08 GE raises \$15 billion; Buffett invests \$5 billion in preferred shares and warrants.
BR	Bankruptcy or forced merger of US financial institutions	25-Sep-08 Washington Mutual seized by FDIC, JPMorgan buys its deposits.
WD	Announcements of write downs of US financial institutions assets	6-May-08 Fannie Mae reports Q1 loss of \$2.19 billion.
FSD	Expansion of Federal Reserve Swap lines to industrial countries	13-Oct-08 Fed lets European Central banks offer unlimited dollars, removes swap limits.
FSE	Expansion of Federal Reserve Swap lines with emerging markets	29-Oct-08 The FOMC establishes swap lines with Banco Central do Brazil, Banco de Mexico Bank of Korea, and the Monetary Authority of Singapore for up to \$30 billion each.
POL	Political developments in US	29-Sep-08 Rescue plan rejected.
LEHMAN	Lehman Brothers	15-Sep-08 Lehman Brothers declares bankruptcy.
TARP_CANCEL	Troubled Assets Relief Program	12-Nov-08 Treasury Secretary Paulson announces that the Treasury has decided not to use TARP funds to buy mortgage related assets.

Table 2: Number of “News” Events Emanating from the U.S.

Number of Events During Phases of the Subprime Crisis			
	Phases 1 and 2	Phase 3	Full Sample (Total Events)
		September 2008–	
Event	January 2007– August 2008	February 2009	January 2007- February 2009
REG	4	12	16
TBS	5	25	30
REALMINUS	1	28	29
REALPLUS	2	6	8
FBS	11	13	24
HD	0	4	4
CRD	0	5	5
REC	13	18	31
BR	16	14	30
WD	34	12	46
FSD	0	8	8
FSE	0	2	2
POL	0	2	2
LEHMAN	0	4	4
TARP_CANCEL	0	1	1

Table 3: Response of Emerging Market CDS Spreads to U.S. Events

Variable	Argentina	Brazil	Chile	Colombia	Mexico
C	2.74	0.05	0.18	0.24	0.31
D(CDS5Y(-1))	0.12***	0.29***	0.25***	0.24***	0.29***
BR	-18.56	-0.77	-0.97	-2.44	-2.98
WD	15.41	6.63***	2.04**	6.12***	7.41***
CRD	75.72**	11.19*	-7.82**	5.91	7.15
FSD	-44.33	-31.62***	-4.29	-32.37***	-29.65***
FSE	112.01*	-57.78***	-22.48***	-33.78**	-44.31***
HD	101.80**	11.4	12.58***	12.06	14.21
LEHMAN	100.99***	32.73***	8.11**	25.62***	29.09***
POL	-3.16	19.65**	-6.15	15.75	14.19
REC	8.07	2.05	-0.01	1.66	-1.036
TARP_CANCEL	-126.32*	63.47***	13.80*	63.76***	66.43***
TBS	2.047	-8.48***	0.28	-3.22	-8.07**
FBS	19.94	1.57	0.44	-0.93	0.31
REG	-26.69	-1	-3.81**	-3.14	1.52
REALPLUS	38.73	-11.04**	-8.28***	-15.83***	-13.04**
REALMINUS	0.42	1.74	3.87***	2.1	2.78
Observations	533	533	534	533	533
Adjusted R-squared	0.043	0.258	0.13	0.16	0.2
S.E. of regression	67.035	14.87	7.18	14.6	13.95
Mean depend. Var	6.245	0.43	0.35	0.41	0.54
Log likelihood	-2989	-2106	-1763	-2176	-2152
Durbin-Watson stat	2.08	2.07	1.99	2.09	2.04

Notes: * denotes significance at 90%; ** denotes significance at 95%; *** denotes significance at 99%. Values noted in bold are statistically significant at the 90% level or higher. Sample: January 1, 2007 – February 19, 2009.

Table 3: Response of Emerging Market CDS Spreads to U.S. Events (continued)

Variable	China	Korea	Malaysia	So. Africa	Turkey
C	0.05	-0.3	-0.02	0.2	-0.04
D(CDS5Y(-1))	0.13***	0.19***	0.37***	0.29***	0.27***
BR	-1.17	-2.54	-3.18*	-2.32	-3.81
WD	1.80**	5.56***	4.27***	1.54	5.46**
CRD	-0.49	4.88	3.15	0.6	4.23
FSD	-2.96***	-9.16*	0.01	-27.38***	-22.00***
FSE	-66.82***	-183.16***	-106.51***	-46.14***	-73.76***
HD	7.04*	15.87*	1.64	10.16	35.26***
LEHMAN	7.30***	25.68***	11.78***	26.29***	34.83***
POL	10.47**	23.11***	21.90***	9.24	2.66
REC	-0.6	-2.49	-4.20**	4.31*	4.09
TARP_CANCEL	7.42	26.15**	8.91	95.32***	34.66**
TBS	1.97	8.70***	-0.53	0.5	-6.83**
FBS	3.21**	4.2	5.93***	-3.14	-2.46
REG	1.791	6.63**	2.77	7.17**	8.84**
REALPLUS	-3.04	-5.99	-2.41	-14.87***	-10.31*
REALMINUS	0.13	-1.6	0.65	1.95	2.9
Observations	533	533	533		
Adjusted R-squared	0.24	0.412	0.37	0.28	0.23
S.E. of regression	5.86	11.32	8.61	11.47	14.43
Mean depend. Var	0.34	0.54	0.37	0.62	0.46
Log likelihood	-1690	-2040	-1895	-2048	-2162
Durbin-Watson stat	1.89	1.83	1.875	2.02	2.1

Notes: * denotes significance at 90%; ** denotes significance at 95%; *** denotes significance at 99%. Values noted in bold are statistically significant at the 90% level or higher. For China, Korea and Malaysia: all independent variables are lagged one day to take into time differences between U.S. and Asian markets. Sample: January 1, 2007 – February 19, 2009.

Table 3 (continued): Response of Emerging Market CDS Spreads to U.S. Events

Variable	Russia	Czech Republic	Hungary	Poland
C	0.38	0.87	0.36	2.00
D(CDS5Y(-1))	0.34***	0.07	0.27***	0.06
BR	-4.88	-3.88*	-9.98	-6.28**
WD	2.11	2.05	21.65**	8.78**
CRD	-1.76	5.31	16.97	6.00
FSD	-34.08***	-3.92	-14.62	-17.79***
FSE	-66.49***	-22.43***	-69.16***	-43.17***
HD	63.40***	13.53**	3.21	6.76
LEHMAN	38.64***	8.07*	42.45***	12.93**
POL	-22.41	-16.98***	15.00	4.29
REC	2.96	-1.83	2.74	1.72
TARP_CANCEL	158.09***	-5.04	47.72	24.53*
TBS	-1.04	0.80	-9.97	-2.04
FBS	-8.00	-2.56	1.82	-0.98
REG	17.93***	4.19	1.69	1.31
REALPLUS	-16.37**	-5.07	-10.75	-8.17
REALMINUS	6.41	3.66	9.96	3.62
Observations	533	180	94	133
Adjusted R-squared	0.32	0.13	0.29	0.24
S.E. of regression	20.49	8.51	24.82	11.32
Mean depend. Var	1.26	0.81	3.11	1.66
Log likelihood	-2357	-632	-426	-502
Durbin-Watson stat	2.09	2.11	2.17	2.21

Notes: Dependent variable: change in CDS spread. * denotes significance at 90%; ** denotes significance at 95%; *** denotes significance at 99%. Values noted in bold are statistically significant at the 90% level or higher. Sample: January 1, 2007 – February 19, 2009 except for Czech Republic, Hungary and Poland where samples vary depending on data availability.

Table 4 Equity Market Linkages During the Three Phases of the Financial Crisis

Correlations of USA SP500 with Stock Index in:	Phase 1 2/27/2007 to 5/18/2008	Phase 2 5/19/2008 to 9/14/2008	Phase3 9/15/2008 to 1/19/2009	Phase 2 to Phase 3 Change in Correlation	Phase 2 to Phase 3 % Change Correlation
ARGENTINA	0.64	0.42	0.66	0.24	57%
BRAZIL	0.73	0.60	0.83	0.23	38%
CHILE	0.53	0.62	0.64	0.03	4%
CHINA	0.16	0.23	0.24	0.01	4%
COLOMBIA	0.32	0.16	0.50	0.34	210%
CZECH	0.28	0.26	0.38	0.12	45%
HUNGARY	0.21	0.28	0.50	0.22	78%
KOREA	0.47	0.39	0.34	-0.05	-13%
MEXICO	0.72	0.77	0.83	0.06	8%
MALAYSIA	0.46	0.42	0.40	-0.02	-5%
POLAND	0.36	0.24	0.49	0.25	103%
RUSSIA	0.24	0.29	0.29	0.00	0%
SOAFRICA	0.22	0.39	0.46	0.07	17%
TURKEY	0.33	0.21	0.44	0.24	115%

Note: Correlations shown are between percent changes in the SP500 and percent changes in local currency stock market price indices. Korea, China and Malaysia are one-day ahead.

Table 5: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1748.27	NA	6.90e-08	-10.81	-10.79	-10.80
1	1770.17	43.38	6.18e-08	-10.92	-10.85*	-10.90
2	1778.39	16.19	6.02e-08	-10.95	-10.83	-10.90
3	1790.67	24.04	5.72e-08*	-11.00*	-10.84	-10.94*
4	1792.62	3.79	5.79e-08	-10.99	-10.78	-10.90
5	1795.54	5.64	5.83e-08	-10.98	-10.72	-10.88
6	1798.09	4.89	5.88e-08	-10.97	-10.67	-10.85
7	1804.02	11.32*	5.81e-08	-10.98	-10.63	-10.84
8	1807.58	6.73	5.83e-08	-10.98	-10.58	-10.82
9	1809.24	3.14	5.92e-08	-10.97	-10.52	-10.79
10	1811.55	4.31	5.98e-08	-10.96	-10.47	-10.76

* indicates lag order selected by the criterion.

Endogenous variables: DLOG(SP500INDEX) and DLOG(STOCKINDX_MEXICO),

Sample: 1/01/2007 to 1/19/2009, Included observations: 323

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 6: VAR Granger Causality Tests

Excluded	Chi-sq	df	Prob.
<i>a. Full Sample (1/07–2/08)</i>			
DLOG(SP500INDEX)	10.572	3	0.014
<i>b. Phases 1 and 2 (1/07–8/08)</i>			
DLOG(SP500INDEX)	2.221	3	0.528
<i>c. Phase 3 (9/08–2/09)</i>			
DLOG(SP500INDEX)	5.767	3	0.124

Dependent variable: DLOG(STOCKINDX_MEXICO)

Chart 1 U.S. and Emerging Market Equity Prices

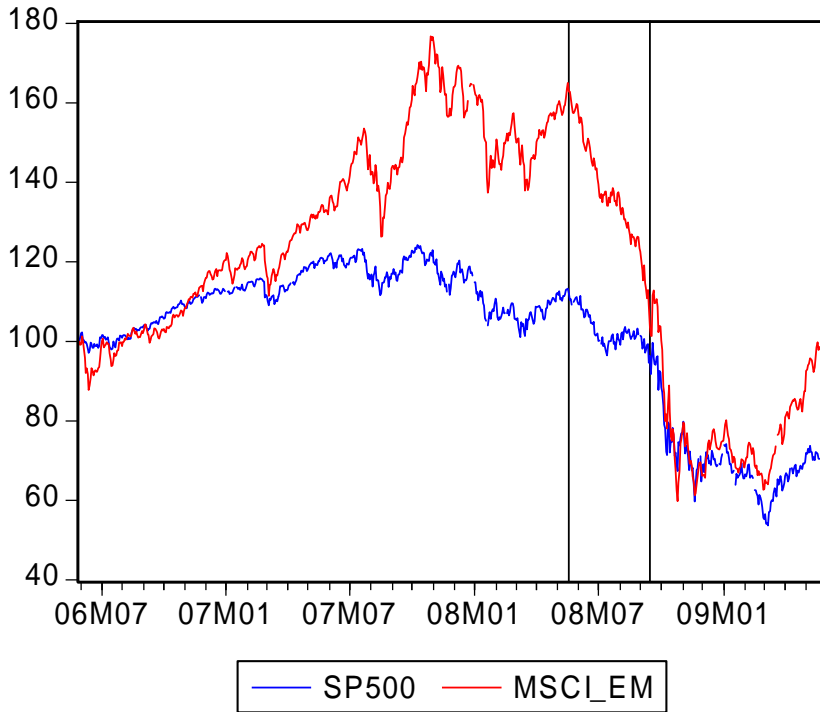
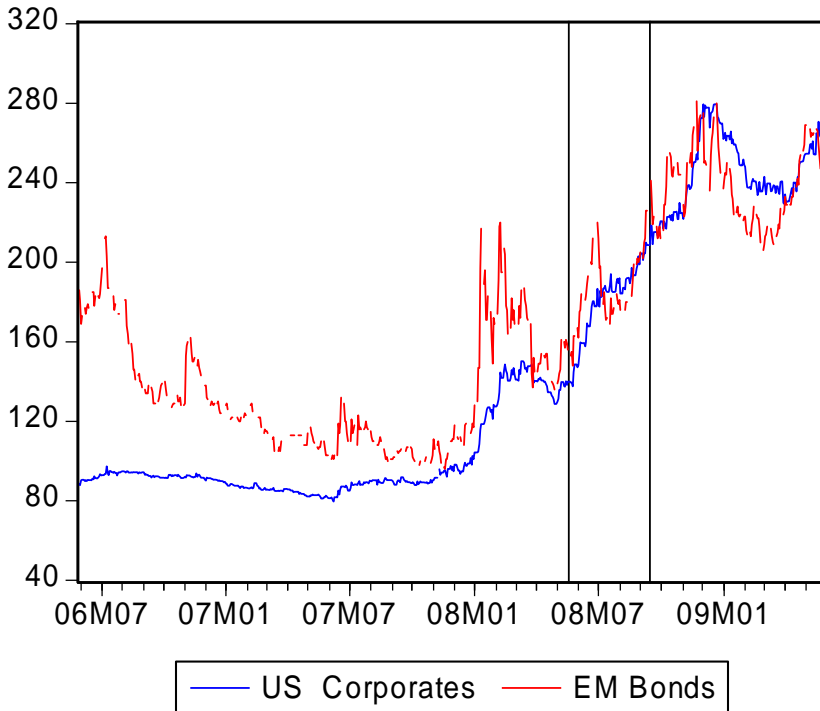
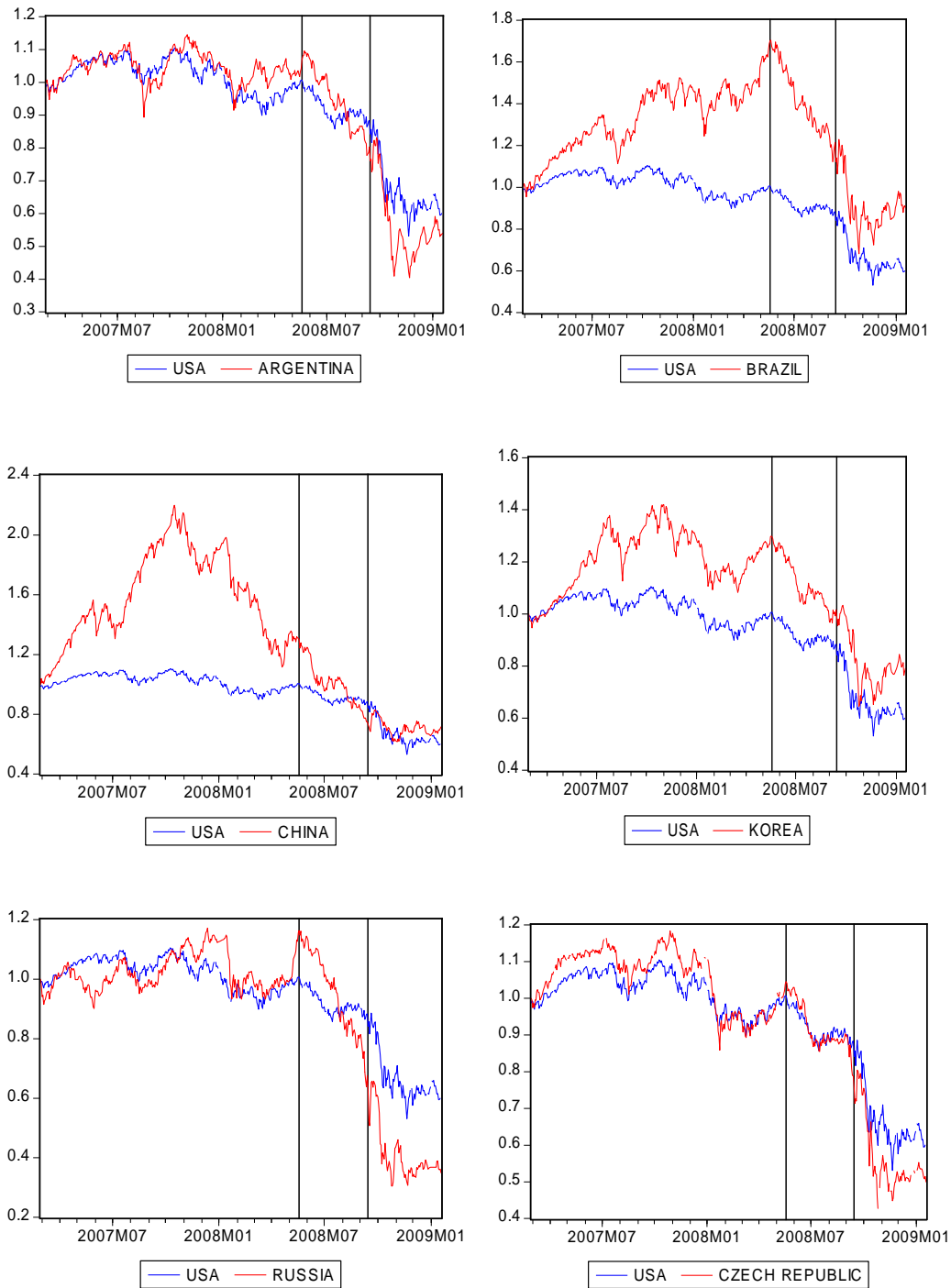


Chart 2 U.S. Corporate and Emerging Market Bond Spreads



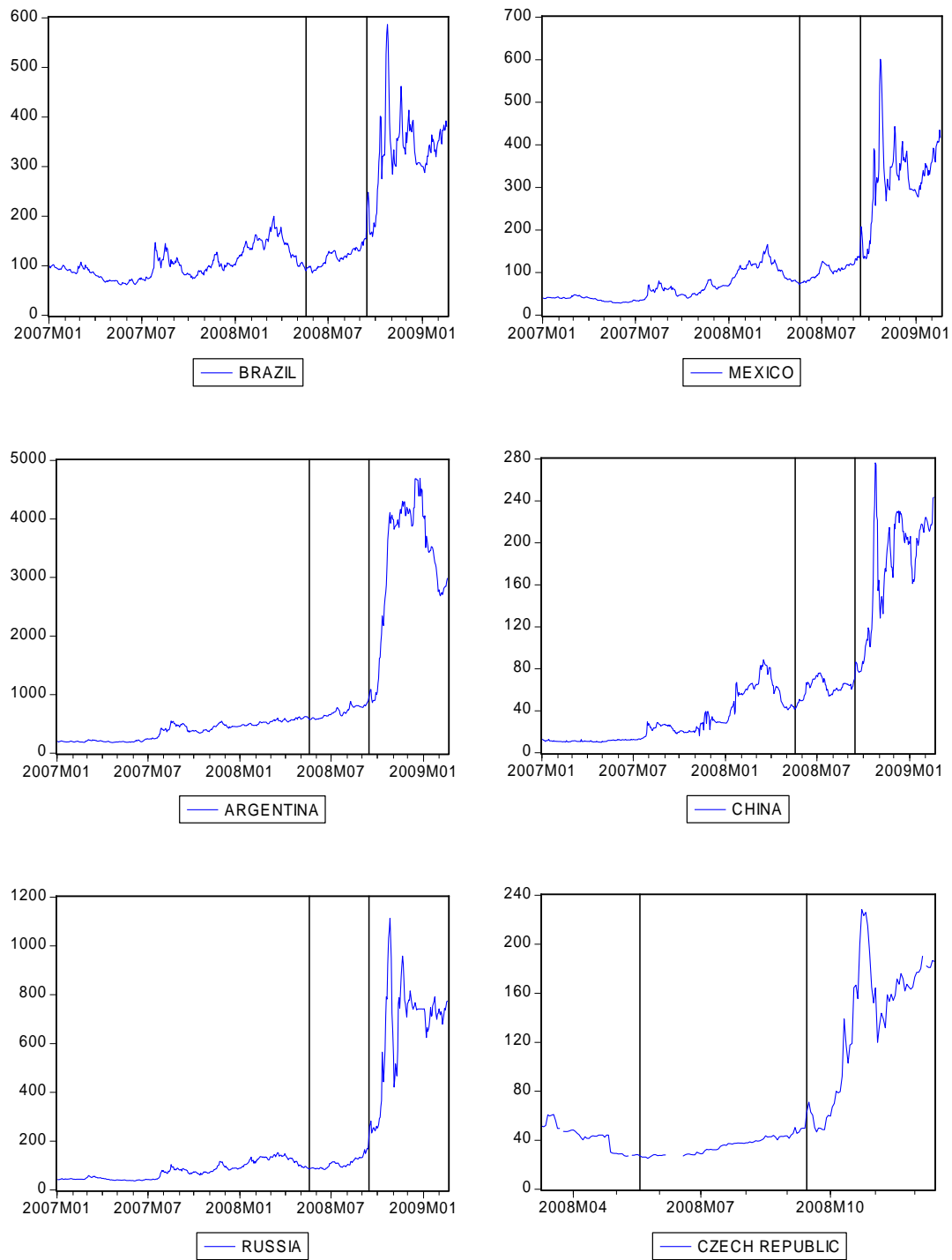
Note: the two vertical lines mark the dates (May 19, 2008 and September 15, 2008) that separate the three phases of the sub-prime crisis.

Chart 3 Equity Markets in the U.S. and Selected Emerging Markets



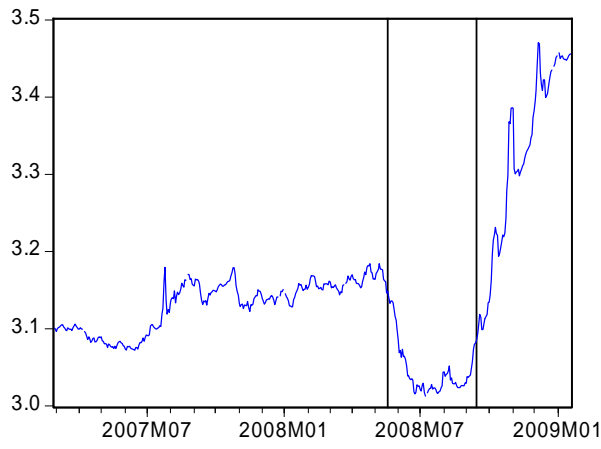
Note: the two vertical lines mark the dates (May 19, 2008 and September 15, 2008) that separate the three phases of the sub-prime crisis. The stock index for the USA is the SP500. Stock indices for EM are in local currency values. Indices normalized to unity on February 27, 2007.

Chart 4 CDS Spreads in Selected Emerging Markets

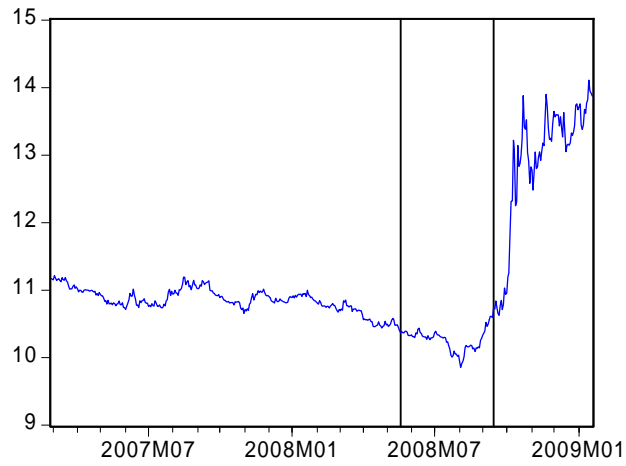


Note: the two vertical lines mark the dates (May 19, 2008 and September 15, 2008) that separate the three phases of the sub-prime crisis.

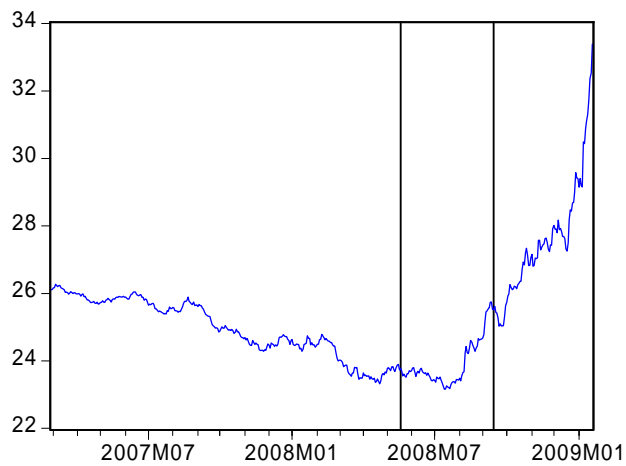
Chart 5 Exchange Rates in Selected Emerging Markets



— ARGENTINA



— MEXICO



— RUSSIA

Chart 6 VAR Model Impulse Responses (One standard deviation shock)

