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THE TRANSMISSION OF U.S. AND EURO AREA SHOCKS TO EMERGING MARKET ECONOMIES

Hem C. Basnet[*] *and Subhash C. Sharma*[**]

Abstract: *This study investigates the transmission of US and Euro area real and monetary shocks to emerging market economies for the time period 1999Q1 to 2011Q4. We develop a structural Vector Autoregression model, where the US and Euro area are treated as two parallel economies. Six largest economies, two from each of three continents i.e. China, and India from Asia; Egypt and South Africa from Africa and Brazil and Mexico from Latin America, represent emerging economies. We find a long term equilibrium between the US, Euro area and each of the emerging economies considered in this study. Our findings indicate that the US and Euro area real shocks are relatively more influential in impacting the emerging economies in all three continents. However, the impact of output shocks varies from country to country, suggesting cross-country differences in responding to the shocks. The analysis indicates that even though the influence of Euro area is growing, especially in the Chinese economy, this study does not find evidence of a clear dominance of US or Euro shocks in explaining the variability in real and monetary variables of these emerging economies. Our results suggest that emerging economies should be cautious about the health of both US and the Eurozone economies.*

JEL Classification*: F41, F60, F68*

Keywords*: International Transmission, Globalization, Emerging markets, Eurozone*

1. INTRODUCTION

Economic and financial interdependence between countries is growing globally. With the wave of globalization and the emergence of technology and communication, countries around the world are experiencing a steady increase in goods, capital, and financial market integration. Consequently, the importance of the emerging markets is growing in both demographic and economic terms. Emerging economies are home to over 80% of the world's population. The economic weight of these economies is also growing significantly. It is estimated that with its current size of the economy if China's economy grows at 7.5% annually it would create an additional $ 1 trillion in wealth in a year (WSJ, 2013). According to the IMF's world economic

[*] Corresponding Author, Associate Professor, Reeves School of Business, Methodist University, 5400 Ramsey Street, Fayetteville, NC 28311, US, *E-mail: hbasnet@methodist.edu*

[**] Department of Economics, Southern Illinois University Carbondale, 1000 Faner Drive, Carbondale, Il 62901, US, *E-mail: sharma@siu.edu*

outlook, emerging economies' share in global output will surpass 50% by the end of 2013, which was less than 20% in the early 1990s.

All this surge on emerging economies reinforces the idea of a strong economic and financial integration of emerging economies into global markets. Economic disturbances transmit from one country to another as a result of such integration and linkages. A small disturbance, say, in the US can create ripples and tides at the same time all over the world. The impact of the 2008 global crisis can be an example of such a disturbance. The crisis, which originated in the US, has had a far reaching consequences for countries around the world. For example, at least 670,000 small and medium sized enterprises have been closed in China as a direct result of the crisis. There was almost 19% less industrial production in Brazil. Likewise, in South Africa, the capital inflows to domestic market dropped quickly and significantly. Know that the majority of foreign direct investments in these emerging economies comes from the US. Baxter and Kouparitsas (2005) point out that a higher bilateral trade between two countries can be robustly correlated with a higher business-cycle correlation between the countries. Hence, it is paramount for emerging economies to understand the international transmission of shocks and their impact on the domestic economy and to identify the best policy responses to international shocks (Mumtaz and Surico, 2009).

The objective of this study is to investigate the significance of the U.S. and the Euro area[1] shocks as sources of business cycle fluctuations in emerging markets and compare them. In other words, do shocks stemming from the U.S. or the Euro area play a key role in driving domestic output fluctuations in emerging markets? Second, this study attempts to quantify the contribution of the US and the Eurozone shocks to domestic fluctuations and the dynamic responses of emerging economies to the shocks? Additionally, we investigate whether the same variable is impacting emerging markets uniformly or the impact varies among continents and countries. For example, interest rates might be relatively more important to Latin America than to Asia or vice versa. Similarly, GDP growth in the Euro zone could be relatively more important for Africa than in Latin America or vice versa.

This study considers two largest emerging market economies from each of three continents i.e. China and India from Asia, Egypt and South Africa from Africa and Brazil and Mexico from Latin America for the time period of 1999Q1 to 2011Q4. These countries are chosen for several reasons. First, despite global economic slowdown most of these countries are growing rapidly and their contributions to the world economy has been a great deal. Second, the council of OECD names some of them "the other non-OECD big players" and invites to participate in an enhanced engagement program with a view to possible membership. In light of this new acknowledgement, it calls for an attention to investigate how they are interacting with the US and Euro area economies. Third, financial interdependencies with the US and Euro bloc are strong and important for all of them. Fourth, since these are the largest emerging economies in the respective continents each of them are strongly interdependent on the periphery of their respective regions. Hence, their selection is representative in terms of business cycle correlation. Put it differently, business cycles are positively correlated across countries. This study will focus on major macroeconomic variables such as real GDP, money supply, and interest rate to establish fundamental channels through which shocks are propagated.

We use structural VAR methodologies to address the research questions outlined above. Researchers have used different approaches to VAR modelling such as global VAR, Bayesian VAR to improve the forecast performance. This study, however, chooses Structural VAR because it allows the use of structural identification based on economic intuitions and provide explicit ways to interpret the transmission (Mackowiak, 2007). In SVAR set up, we calculate the forecast error variance decomposition and the corresponding impulse response function. The variance decomposition helps to determine the degree of forecast error variance explained by shocks. The impulse response function shows the dynamic response of each variable in the estimated model to the shocks.

This research represents an important contribution to the knowledge of the effects of interdependence and policy prescription on the relationship between developed countries and the emerging economies. Since most countries in the world are small open economies they are extremely vulnerable to external shocks. Because shocks originating in one country transmit to other countries, it is imperative for policy makers to understand the cost and benefit of policy changes in other countries. Understanding propagation channel of shocks and its strength is a key for identifying the best policy response to maintain stability. Hence, we hope that the findings of this paper will benefit policy makers of emerging countries to insulate their economies from external shocks. Additionally, while the literature on the impact and transmission of the US economic shocks on emerging markets is extensive, there is a dearth of studies[2] that explore the impact of Eurozone as a single economy on emerging market economies. This study contributes to the literatures by bridging the gap and opens up a discussion for future research with regard to the Euro area impact on emerging economies around the world.

The rest of the paper is organized as follows: Section 2 documents some relevant literature, section 3 describes the methodology and data. Section 4 and 5 report the empirical results. Finally, we make concluding remarks.

2. LITERATURE REVIEW

In the plethora of literature on the transmission of economic shocks from one country to another country or region, a substantial number of studies have been conducted to investigate the propagation channels of shocks between G-7 and OECD countries, and between US and a number of countries in the world region such as Asia, Europe, Latin America etc. (see, e.g., Amhed *et* al., 1993; Canova and Marrinan, 1998; Prasad, 1999; Canova and De Nocoló, 2003; Kim, 2001, Holman and Neumann, 2002). However, there has not been any consensus for a single transmission channel and its magnitude. A recent study by Erten (2012) analyzed the impact of Eurozone shocks on China, emerging Asia and Latin America. The study documents that the health of the Eurozone economy has a significant impact on emerging economies, but the severity and persistence of the impact depends on the response of the US economic growth to the Euro shocks. Canova (2005) investigated the transmission of US shocks to Latin American countries[3] and found that US monetary disturbances compared to real demand and supply shocks generate large and significant responses in several Latin American macroeconomic variables. The interest rate channel is a crucial amplifier of US monetary disturbances, while the trade channel appears to play a negligible role.

In a study of a group of seven Latin American countries (Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela—LAC7), Izquierdo, Romero and Talvi (2008) examined the role of external shocks in causing business cycles and documented that external factors account for a significant share of the variance of LAC7 GDP growth. Raddatz (2007), in a study of 40 low income countries, suggested that the external shocks are not always to blame for the output variance of a typical low-income country. Other factors, most likely, internal causes such as conflicts, political volatility or economic mismanagement could be the main source of fluctuations. A separate literature looks at the transmission of US shocks to European economies. Dees *et. al* (2007) studied the transmission mechanisms of shocks from the U.S. and the rest of the world to the Euro area which has been treated as a single economy. The authors reported that the financial shocks such as interest rates, stock prices and exchange rates vis-à-vis trade and real output are transmitted relatively rapidly and often get amplified as they travel from the US to the Euro area. In contrary, Eickmeier (2007) stressed trade to be the most relevant transmission channel.

The effect of the change in US monetary policy has been studied by a number of researchers. In a recent paper, Neri and Nobili (2010) investigated the effects of changes in the federal funds rates—the monetary policy instrument of the Federal Reserve—on the euro area economy. Their findings concluded that the transmission mechanism works through movements in the trade balance, world commodity prices, the exchange rate and short-term interest rates. They argued that an increase in the federal funds rate causes the euro to depreciate immediately and thereby affected commodity prices, interest rates and trade balance. Pesaran *et al.* (2004), Artis *et al.* (2004), Perez *et al.* (2005), and Neri and Nobili (2010) find similar results that shocks are propagated from US to Euro-area. Utilizing a system of variables that includes output, the price level, money supply, and the interest rate for the USA, the UK, France and Germany, Lastrapes and Koray (1990) concluded that the transmission of monetary shocks depends critically on the country in question. In a recent contribution, Schneider and Fenz (2011) analyzed the transmission of structural shocks between the US and the Euro area with a two-country VAR framework and concluded that in the short-run, the variance of output fluctuation is mainly caused by domestic shocks. The spillover impact increases from the medium run.

Some studies point out that not only do small and developing countries get affected by the US fiscal and monetary shocks, but big and developed countries also suffer from unanticipated disturbances in the US economy. For instance, Arin and Koray (2009) documented that US fiscal policy innovations are communicated to the Canadian economy by international trade and capital flows through interest rate and exchange rate channel but not vice versa. Sosa (2008) examined the potential spillovers and channels of transmission between the U.S. and Mexican economies and concluded that shocks to U.S. demands for Mexico's export— proxied by U.S. industrial production—represent a major factor driving macroeconomic fluctuation in Mexico. In case of US and emerging market economies, Mackowaik (2007) studied the extent to which the macroeconomic fluctuations in emerging markets[4] are caused by U.S. monetary policy shock. The author concluded that "when the U.S. sneezes, emerging markets catch a cold." Dees and Vansteenkiste (2007) also found the results consistent with MacKowiak (2007).

3. METHODOLOGY

The interdependency is investigated by examining the long run relation (cointegration test) among the countries under consideration. The transmission of monetary and real shocks originating in the US and the Euro area to emerging markets are analyzed by utilizing a structural Vector Autoregression model. Following Neri and Nobili (2010) the variables are grouped into three groups: the first includes those of US, the second includes those of the Euro, and finally those of emerging markets. We include the following variables in the vector y_t:

$$\text{Model I: } Y_t = [\Delta y_t^{US}, \Delta y_t^{Euro}, \Delta wcp_t, \Delta i_t^{emkt}, \Delta y_t^{emkt}]'$$

$$\text{Model II: } Y_t = [\Delta i_t^{US}, \Delta i_t^{Euro}, \Delta wcp_t, \Delta i_t^{emkt}, \Delta y_t^{emkt}]'$$

Model I and Model II are respectively utilized to examine the dynamic effects of the US and the Euro area real and monetary shocks in the economies under consideration. The Model I consists of real output from the US $\left(y_t^{US}\right)$ and Euro area $\left(y_t^{Euro}\right)$, and interest rate $\left(i_t^{emkt}\right)$ and real GDP $\left(y_t^{emkt}\right)$ of emerging market economies. The Model II includes the US and Euro area interest rate as a monetary policy and the same real and monetary variables from the Model I for emerging economies. In order to capture the effect of the world economy on the multi country model the world commodity price *(wcp)* which serves as a common factor is included. Thus, the SVAR model is as follow:

$$A_0 Y_t = A_1(L) Y_t + \varepsilon_t \tag{1}$$

where Y_t is an (n x 1) vector of variables in the Models I and II above. $A_1(L)$ is a matrix of polynomials in the lag operator and ε_t is the vector of the structural shocks denoted and they are assumed to be independent and identically distributed (*iid*). The coefficients of the structural equation in (1) can be obtained from the following reduced form:

$$Y_t = B(L) Y_t + \mu_t \tag{2}$$

where $B(L)Y_t = A_0^{-1} A_1(L)$ with $A_0 \mu_t = \varepsilon_t$. The residuals μ_t is the reduced form VAR; are also assumed to be *iid*. The following matrix represents our identification scheme in the SVAR:

$$A_o = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & a_{35} \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} y^{US} \\ y^{Euro} \\ wcp \\ i^{emkt} \\ y^{emkt} \end{bmatrix} = \begin{bmatrix} \varepsilon_{us}^{y} \\ \varepsilon_{euro}^{y} \\ \varepsilon_{wcp} \\ \varepsilon_{emkt}^{i} \\ \varepsilon_{emkt}^{y} \end{bmatrix}$$

This study bases its identification restrictions on different economic theories and intuitions. The short run restrictions mainly control for the contemporaneous feedback effect among the

variables in the model. Since this study treats the US and the Euro area as two parallel economies the variables of each other country are assumed not to respond contemporaneously. On the other hand, each of the emerging economies is small open economies, thus they are expected to respond to shocks in the US and the Euro area contemporaneously but not vice versa (first two rows in the matrix). We do not impose any restrictions with respect to world commodity price (*wcp*), implying that *wcp* reacts to changes in all variables in the model (third row in the matrix). In case of domestic variables, neither interest rate nor output responds to each other contemporaneously. A potential weakness of our model is that both the US and the Euro area blocs are limited to one variable, real GDP in the Model-I and the interest rate in the Model-II. A simultaneous identification of real and monetary shocks within a single model could be a new experiment for future research.

The empirical work is carried out by examining the stochastic properties of each time series in the models. We employ the Dickey-Fuller, Augment Dickey-Fuller, the Phillips-Perron (PP), and KPSS [(Kwiatkowski, Phillips, Schmidt and Shin] tests to test for unit roots. Since the tests are very common in the literature no detail explanation is offered here.

Data

Quarterly data from 1999:Q1 to 2011:Q4 for Brazil, China, Egypt, Euro, India, Mexico, South Africa, and US are gathered from the World Development Indicator (WDI), the International Financial Statistics (IFS), and the official websites of some countries. Real GDP is in constant 2000 U.S dollar obtained from WDI. Interest rates, and world commodity prices are collected from IFS. Due to the lack of availability of data we have used different types of interest rates for different countries such as money market rate for Brazil, and South Africa, call money rate for India (it is obtained from the official website of the Reserve Bank of India), treasury bill rate for Egypt, bank rate (end of period) for China, interbank rate (3-month maturity) for Euro area, and federal fund rate for US. All commodities index from IFS is used as world commodity prices. A potential weakness of our data set could be that the VDC and IRF responses of emerging market interest rates may produce some variations due to the use of different form of interest rates for different countries.

4. EMPIRICAL RESULTS

The unit roots results are reported in Table-1. The results indicate that the series are non-stationary in log level and stationary in its first difference.

4.1. Variance decomposition

We investigate the dynamic interrelationship as per our hypothesis by estimating variance decomposition and the corresponding impulse response function under the SVAR set up explained in section 3. The variance decomposition (VDC) enables us to measure the relative importance of each variable in generating fluctuations in other variables in the estimated models. The impulse response complements our VDCs analysis by mapping out the dynamic response of the system of variables to a one unit shock in endogenous variables in the models.

Table 1
Unit roots tests (First difference)

Country	*Variables*	*ADF Test*		*DF Test*		*Phillips-Perron Test*					
		t_{μ}	t_{τ}	t_{α^*}	$t_{\alpha}\sim$	$Z(\Phi_1)$	$Z(\Phi_2)$	$Z(\Phi_3)$	$Z(\tau_{\alpha^*})$	$Z(\tau_{\alpha\sim})$	*KPSS Test*
China	*y*	-1.42	-3.12	-0.12	-1.12	0.55	1.54	1.68	-0.19	-1.16	0.41
	i	-8.00	-7.88	-7.57	-7.48	62.18	20.67	30.47	-8.04	-8.01	0.25
India	*y*	-0.50	-1.24	-0.49	-1.26	0.34	1.63	2.13	-0.52	-1.19	0.33
	i	-6.65	-6.58	-6.28	-6.21	1090.74	12.077	19.15	-6.47	-6.47	0.09
Egypt	*y*	-1.01	-1.37	-0.99	-1.36	0.99	1.09	1.20	-1.14	-1.52	0.26
	i	-6.81	-6.72	-7.73	-7.64	79.26	25.60	38.40	-9.10	-9.11	0.50
S-Africa	*y*	-0.34	-1.08	-0.34	-1.09	0.84	1.23	1.02	-2.10	2.00	0.43
	i	-4.16	-4.04	-3.00	-2.91	12.93	2.88	4.32	-3.06	-2.97	0.12
Brazil	*y*	-2.60	-2.27	-2.04	-2.26	2.24	1.89	2.57	2.08	-2.14	0.27
	i	-7.55	-7.34	-3.81	-3.96	6.54	4.38	6.35	-3.76	-3.66	0.34
Mexico	*y*	-2.79	-2.75	-2.82	-2.78	4.96	3.50	4.34	-2.90	-2.95	0.37
	i	-7.54	-7.54	-4.78	-4.72	14.73	7.15	10.62	-4.82	-4.79	0.50
US	*y*	-1.48	-1.80	-1.50	-1.82	2.33	2.03	1.99	-1.63	-2.08	0.54
	i	-2.83	-2.80	-3.67	-3.67	7.39	4.57	6.85	-3.84	-3.89	0.07
Euro	*y*	-1.54	-1.81	-1.56	-1.82	2.47	2.04	1.92	-1.66	-2.03	0.49
	i	-4.32	-4.38	-4.89	-4.94	12.57	8.46	12.67	-5.15	-5.24	0.10
wcp	*wcp*	-5.74	-5.65	-4.75	-4.68	17.07	6.35	9.53	-4.64	-4.61	0.08

S-Africa = South Africa, M2 = Money supply, i = interest rate, and y = real GDP, wcp = world commodity prices. The null hypothesis for the ADF test [t_{μ} and t_{τ}], the DF test [t_{α^*} and $t_{\alpha}\sim$] and the Phillips-Perron (PP) tests [$Z(\Phi_1)$, $Z(\Phi_2)$, $Z(\Phi_3)$, $Z(\tau_{\alpha^*})$, and $Z(\tau_{\alpha\sim})$] is that the series contain unit roots. The null hypothesis for the KPSS test is that the series is stationary. The lag length for the ADF is chosen by minimizing the AIC.

The variance decomposition of real GDP and interest rates in emerging markets as explained by changes in real and monetary stances in US and Euro area are reported in Tables 2, 3 and 4. We primarily focus on the influence of the US and Euro area real and monetary shocks on the real GDP and interest rates of emerging markets. Therefore, we do not intend to discuss the forecast error variances explained by domestic factors in details. In doing so, we believe that our focus stays only on the role of US and Euro area shocks and their impact on the emerging markets under consideration[5].

Impact on Chinese and Indian economies: The variance of forecast error in real GDP and interest rate of Asian emerging markets due to innovations in US and Euro real GDP is reported in Table 2. For the comparison purpose, the VDC statistics from the Eurozone shocks are placed in the parenthesis next to the US in each Table. We see a cross country variations between emerging markets in Asia in responding to the US and the Euro real GDP shocks. The VDCs results in Table 2 indicate that innovations in US output contribute a small variation to Chinese interest rate (3.08%) at the 12 quarters, which accounts for16.4% due to the Euro output shock. The real GDP of China appears to be equally responsive to the US and the Euro output shocks. They account for about 11% at the 12 quarters (Table 2, first column). About 54.80% variance in interest rate of India can be explained by Euro output shock at the 12 quarter horizon. Output, however, seems equally responsive to both shocks (38.09% by US & 29.15% by the Euro) in the longer horizon. This suggests that a sustained and strong interrelationship, whether through trade, FDI or Financial market, is growing between emerging markets in Asia and Euro zone economy, which increases the sensitivity in those emerging economies.

Table 2
VDCs of real GDP and interest rate due to US and Euro shocks

Asian Markets: Due to real GDP shock				
	Real GDP		*Interest rate*	
Period	*CHN*	*IND*	*CHN*	*IND*
1	17.13(9.58)	1.23(6.33)	0.85(0.00)	10.22(33.78)
4	7.05(30.16)	19.86(26.00)	4.29(1.10)	5.43(34.19)
8	9.86(25.27)	33.04(34.71)	3.67(3.29)	4.58(51.43)
12	10.72(10.76)	38.09(29.15)	3.08(16.40)	5.13(54.80)
		Due to interest rate shock		
1	7.71(0.70)	0.46(0.56)	4.14(0.36)	22.16(15.84)
4	4.76(1.56)	25.65(11.79)	6.69(7.51)	18.12(15.88)
8	3.88(13.88)	24.71(2.68)	12.16(18.52)	24.40(15.97)
12	5.12(22.96)	16.60(1.84)	7.36(22.28)	22.53(14.19)

The effect of change in US interest rate on Chinese interest rate fades away in the long run (12.16% at the 8th quarter and 7.36% at the 12 quarters). Likewise, Chinese output seems to be less sensitive to US interest rate shock compared to Euro area. The Euro area explains almost 4 times greater (22.96%) than the US shock does (5.12%) at the 12 quarter horizon. The picture is quite different for India. US monetary shock is always dominant in explaining the variation in its output fluctuations. The VDCs results suggest that 16.60% variation in Indian real GDP can be attributed to changes in US interest rate as opposed to 1.84% to Euro interest rate at the 12 quarters. This finding suggests the economies of China and India cannot ignore the real and monetary disturbances both in the US and the Euro area. The results are consistent with the existing theories that policy decisions in large economies spill over into small open economies through real and monetary channels.

Impact on Egyptian and South African economies: Comparing the effect of US and Euro output shocks with respect to African economies, South African output is more responsive to the disturbances in US output as the VDC results indicate that it explains almost 76% of the forecast error variance in South African output as opposed to less than 2% due to the Euro output shock (Table 3, upper panel) at the 12 quarters. There has been increasing trade integration between the US and South Africa, especially after the African Growth and Opportunity Act was signed into law by these two countries in 2000 (Ncube, Ndou, and Gumata, 2012). The significant US influence in South African economy may be attributed to the agreement. The Egyptian output on the other hand is more sensitive to Euro area output shock (50%) compared to US shock (26.04%). Likewise, Euro output shock plays greater role in influencing Egypt's interest rate as opposed to its counterpart. More than 55% of variance in forecast error of interest rate at a horizon of the 12th quarters is due to Euro GDP shock.

When compared the transmission impact of the US and Euro monetary shocks, the results indicate that the US shocks are dominant over the Euro shocks in explaining the larger variance of both countries' interest rates and real GDP. The US interest rate shock accounts for 18.14% and 24% of variance in Egyptian and South African output respectively at the 12 quarters. The Euro shock accounts for much lower than that of the US (Table 3, lower panel). Likewise, respectively 7.45% and 11.48% of variance in the interest rates of Egypt and South Africa can

Table 3
VDCs of real GDP and interest rate due to US and Euro shocksAfrican Markets: Due to real GDP shock

African Markets: Due to real GDP shock				
	Real GDP		*Interest Rate*	
Period	*EGY*	*SAF*	*EGY*	*SAF*
1	30.75(29.09)	77.22(5.53)	1.06(38.88)	0.83(9.50)
4	12.68(39.66)	69.41(5.50)	4.58(41.89)	11.84(34.99)
8	19.22(51.68)	73.27(3.59)	7.31(51.17)	19.47(54.83)
12	26.04(49.92)	75.61(1.97)	8.22(55.36)	14.97(60.03)
		Due to interest rate shock		
1	0.51(0.06)	8.16(10.38)	0.44(0.99)	19.40(0.01)
4	14.11(1.02)	21.16(5.68)	0.36(4.17)	28.35(0.42)
8	19.63(6.57)	20.12(1.76)	2.03(1.87)	15.68(0.25)
12	18.14(11.15)	24.00(1.23)	7.45(0.96)	11.48(0.54)

be attributed to US interest rate shock. The Euro interest rate shock contributes less than 1% for both Egypt and South Africa. This finding indicates that while the Euro area's influence is increasing the US monetary shock is still dominant in emerging economies in Africa.

Impact on Brazilian and Mexican economies: The transmission of US output shock to Latin American countries is much more pronounced compared to its counterpart (Table 4, upper panel). The results indicate that the major variation in Brazilian output stems from US output shock. It accounts for 66.03% at the 12 quarter horizon, which is just 6.94% by the Euro output shock. US output shock plays dominant role in Mexican economy too. It explains 85.03% of variation in Mexican output at the 1st quarter, after that it slowly declines. However, it never goes below 41.15% at the12 quarter horizon. Both the US and the Euro output shocks have a mild impact on Brazilian interest rate. US output shock impacts the Mexican interest rate strongly compared to the Euro output shock. This result is not that surprising because Mexico has a

Table 4
VDCs of real GDP and interest rate due to US and Euro shocks

Latin American Markets: Due to real GDP shock				
	Real GDP		*Interest Rate*	
Period	*BRL*	*MEX*	*BRL*	*MEX*
1	51.82(10.02)	85.03(0.10)	22.34(18.17)	14.94(4.25)
4	45.55(14.61)	65.67(9.42)	9.38(19.97)	17.88(6.17)
8	59.23(11.92)	46.12(15.78)	6.87(19.04)	31.21(4.56)
12	66.03(6.94)	41.15(20.92)	5.42(17.39)	30.84(8.23)
		Due to interest rate shock		
1	17.66(1.75)	0.49(6.80)	4.48(0.02)	2.29(26.58)
4	41.13(0.24)	0.50(29.38)	5.53(3.03)	12.22(60.61)
8	17.95(0.10)	0.83(39.19)	15.48(4.49)	6.94(52.74)
12	10.56(0.04)	2.09(43.95)	17.32(1.35)	5.36(47.85)

CHN=China, IND = India, EGY= Egypt, SAF= South Africa, BRL = Brazil, MEX = Mexico
VDCs from Euro variables shocks are in the parenthesis
Periods are measured in quarters

strong economic tie with NAFTA partners—US and Canada whereas Brazil's trade share within the Latin American region is almost 4 times larger (23%) than that of Mexico (6%). As a result, Brazil may be less susceptible to US shocks as opposed to Mexico.

Comparing US and Euro interest rate shocks in Latin American Countries, we found somewhat mixed results. The Mexican economy is more sensitive to Euro interest rate. At the 12-quarter horizon, in innovation Euro interest rate accounts for 47.85% and 43.95% of Mexican interest rate and real GDP respectively. Brazilian economy, on the other hand, is more influenced by US interest rate. It accounts for17.32%, and 10.56% in interest rate, and output of Brazil at the 12 quarters respectively. The impact of Euro interest rate shock is almost negligible as it accounts for only 1.35%, and 0.04% of variation in Brazilian interest rate and real GDP at the same horizon respectively. The results may suggest a growing financial integration of the Mexican economy with the Euro area.

5. IMPULSE RESPONSE ANALYSIS

The impulse response functions (IRF) examine the dynamic response of a variable to a one standard deviation shock to another variable. This study analyzes the reaction of emerging market economies as a result of one time positive shock to the U.S. and Eurozone real and monetary variables. Each figure traces the reaction of the system evolves over time when there is an unexpected change in the US or Eurozone. The confidence intervals are reported at the 95% confidence level. The middle solid line with dot marks (see the graphs) represents the actual impulse response, while the dotted lines are the upper and lower band confidence intervals. When the horizontal line falls into the confidence interval, then the null hypothesis that there is no effect of the US or Euro real and monetary shocks on emerging markets' real or monetary variables cannot be rejected.

Asian Markets: The IRFs with their upper and lower bands are reported for a horizon of 12 quarters in Figures1.1 through 6.2. The Figure-1.1 reports the responses of Chinese interest rate and real GDP to a one standard deviation innovation in US and Euro area output. The figure depicts that the impulse response of Chinese interest rate to US GDP shock is statistically insignificant as the mean response is not significant from zero. This result echoes the findings of Mackowiak (2007) that concludes that US monetary policy shocks were not important for emerging markets relative to other kinds of external shocks. As expected, a positive US and Euro real GDP shocks on Chinese output is expansionary, leading to an increase in Chinese output. It persistently increases following US output shocks while it responds positively to Euro output shock until the 7^{th} quarter and then reverses the course thereafter.

Figure 1.2 reports the response of Chinese interest rate and real GDP following US and Euro interest rate shocks. The contemporaneous response of Chinese interest rate is positive to US interest rate and negative to Euro interest rate shock. It reacts negatively to both the shocks over time. The response of Chinese output to monetary shocks is statistically insignificant as the mean response falls into the horizontal line (last row in Fig 1.2). Intuitively, this result makes sense that the sensitivity of output primarily comes from disturbances in aggregate demand. While the response of Chinese output is positive to Euro interest rate shocks, its impact is still very low.

Figure 1.1: Asian economies

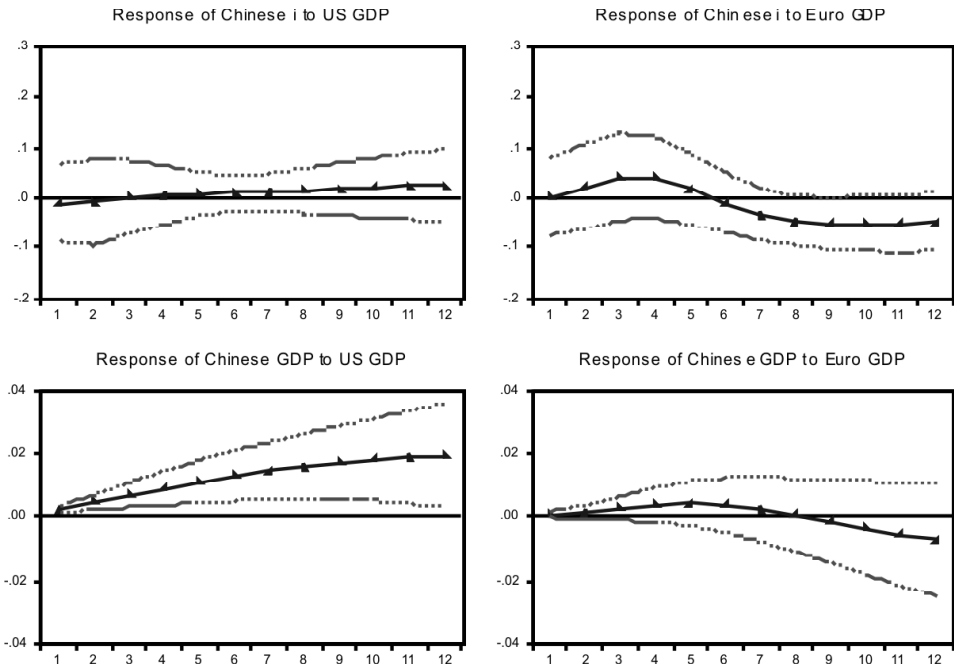


Figure 1.1

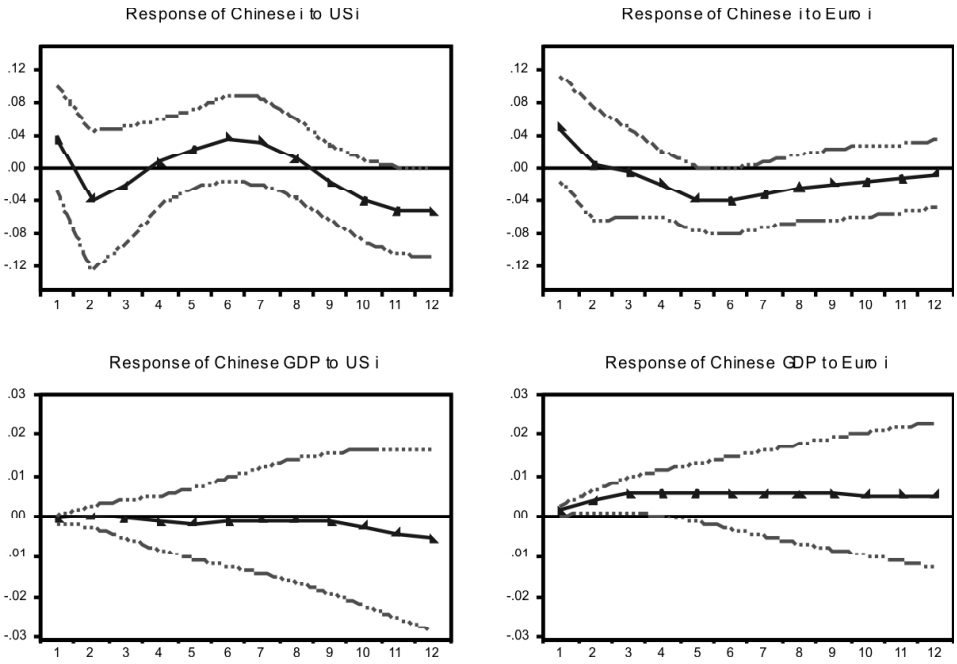


Figure 1.2

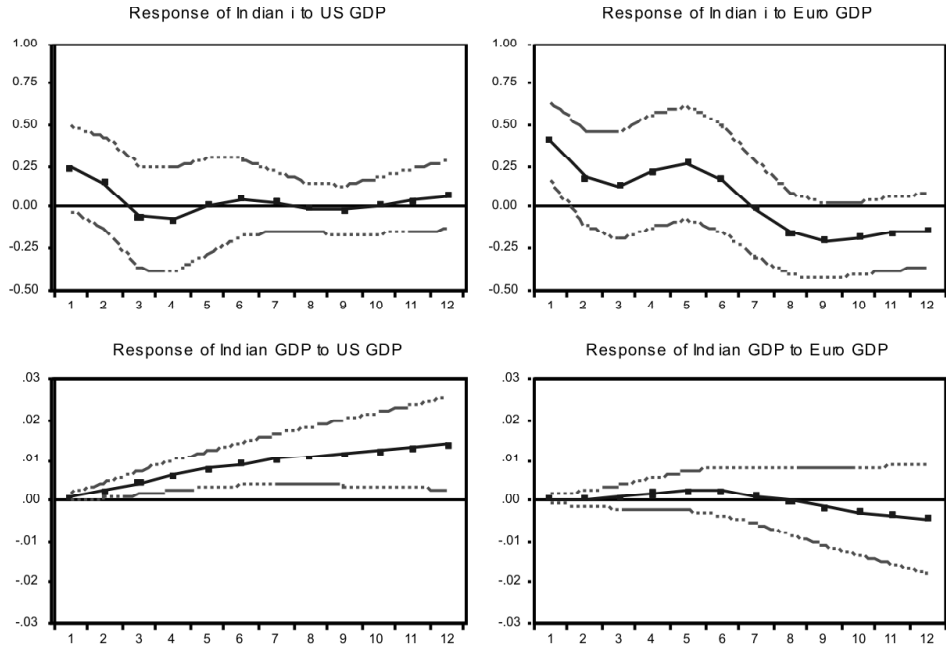


Figure 2.1

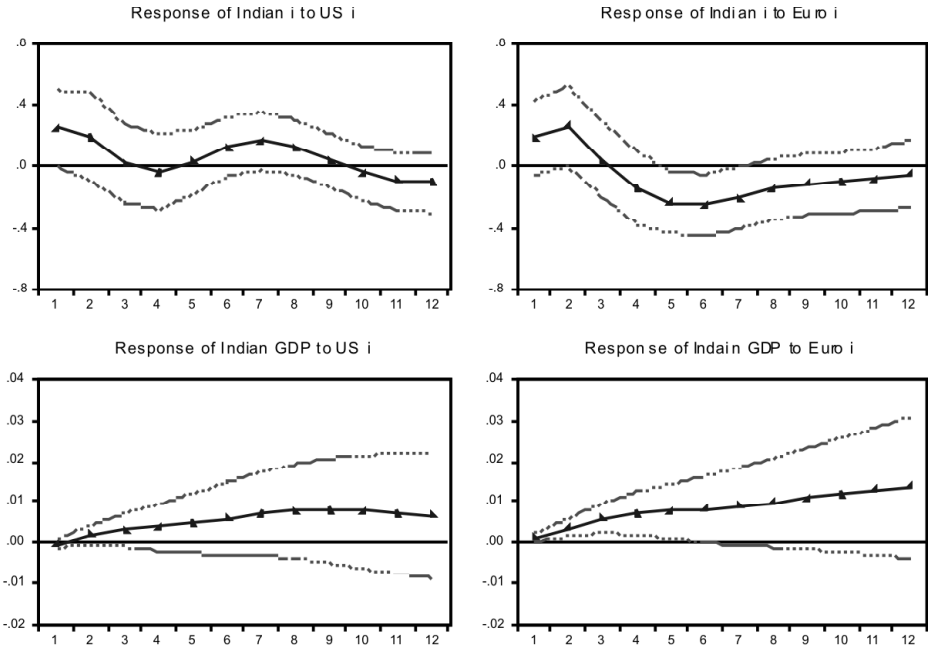


Figure 2.2

Shocks are measured at the forecast horizon of 12 quarters.

The contemporaneous response of Indian interest rate (Fig 2.1) to US output shock is positive, which becomes statistically insignificant after the 6th quarter. However, the response to Euro GDP shock is positive up to the 7th quarter and becomes negative, which resembles to that of Chinese interest rate to the Euro output. Similar to Chinese output response, Indian output is also more responsive to US output shock vis-à-vis Euro shock. The Euro area economy is more open compared to the United States. Its trade openness has significantly risen since 1998. As a result of this, many emerging economies are extending their trade with the Eurozone. However, India's exports to Euro area has declined in its share, down to 19% in 2011-2012 from 24.8% in 2001-2002. On the other hand, US is still the number one export destination for Indian. A possible reason for the lesser impact of the Euro area could be the declining share of India's international trade with the Euro area. The Indian interest rate response to US monetary shock resembles to that of Chinese response, which is again in line with Mackowiak (2007) findings. The response is very erratic to Euro interest shocks. The Indian output seems more responsive to innovations in both the US and Euro interest rate.

African markets: The IRF in Figure 3.1 shows that the response of Egyptian interest rate to both US and Euro output shocks is not significant, which is consistent with the response of the Asian economies. This result indicates that the transmission of US and Euro area monetary shocks to Egyptian economy is weak. Output, however, responds positively to US output shock. A positive response is also observed to Euro output shock until the 10th quarter, the response reverses thereafter. This finding suggests that the real sector shocks are significant and more likely to transmit to the Egyptian economy. Figure 3.2 displays the dynamic reaction of Egyptian real and monetary variables to the shocks in the US and Euro interest rates. The interest rate is responsive and significant at first up to the 6th quarter. The effects die out gradually and becomes insignificant in the longer time horizon. The effect of Euro interest rate shock is insignificant throughout the estimated horizon. The Egyptian output, on the other hand, responds to the shock in US positively and significantly. The response to Euro area shock is also positive at the beginning, but the effect dies out after the 10th quarter (Fig 3.2). Interesting enough, this is akin to the response of Indian output to monetary disturbances in US and Euro area.

Figure 4.1 reports the impulse response of the South African economy due to shock in US and Euro GDP and interest rates. The shock in the US real sector has a positive impact on South African interest rate up to the 6th quarter; the impact becomes insignificant thereafter. Similarly, the response to Euro area GDP is also positive, but it begins to decline sharply after the 6th quarter. From macroeconomic perspective the response is symmetric for both US and Euro output shocks. The impulse response results indicate that a shock to US real GDP leads to a positive response of South African output and it remains persistent throughout the 12th quarters horizon. While South Africa is the largest trading partner for both US and Euro area in the African continent, its bilateral trade relationship with US has been expanding since 1994. The expansionary response of the South Africa economy may be attributed to the growing trade relationship. The counter effect of Euro output shock is miniscule. In response to US and Euro interest rate, South African output shows a similar negative reaction and the impact is pronounced (Fig 4.2). However, the response of interest rate to US interest rate is negligible in all horizons. In contrary, the response of interest rate to Euro interest rate shock is positive.

Figure 3.1: African economies

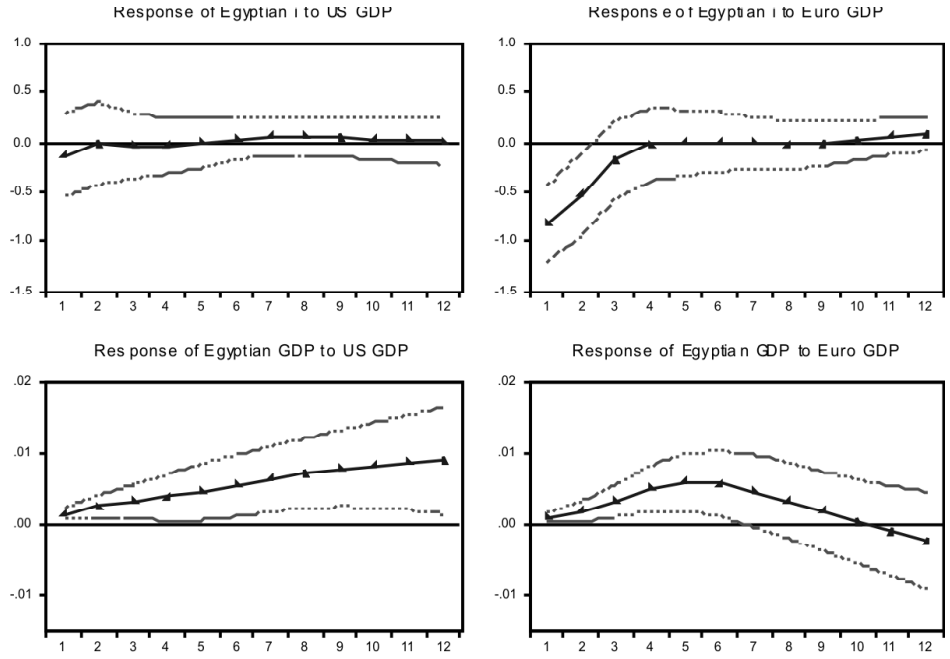


Figure 3.1

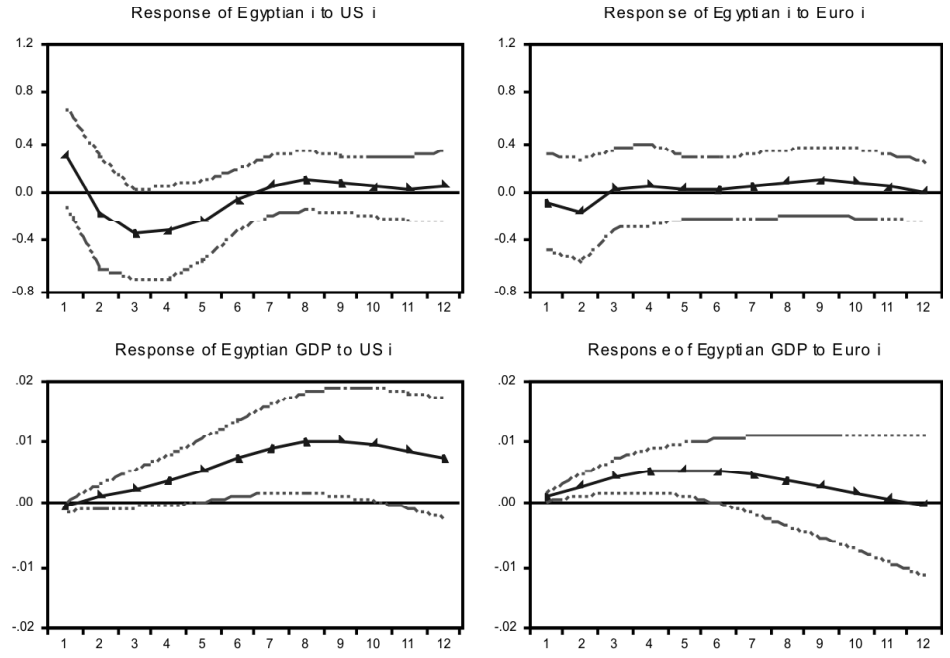


Figure 3.2

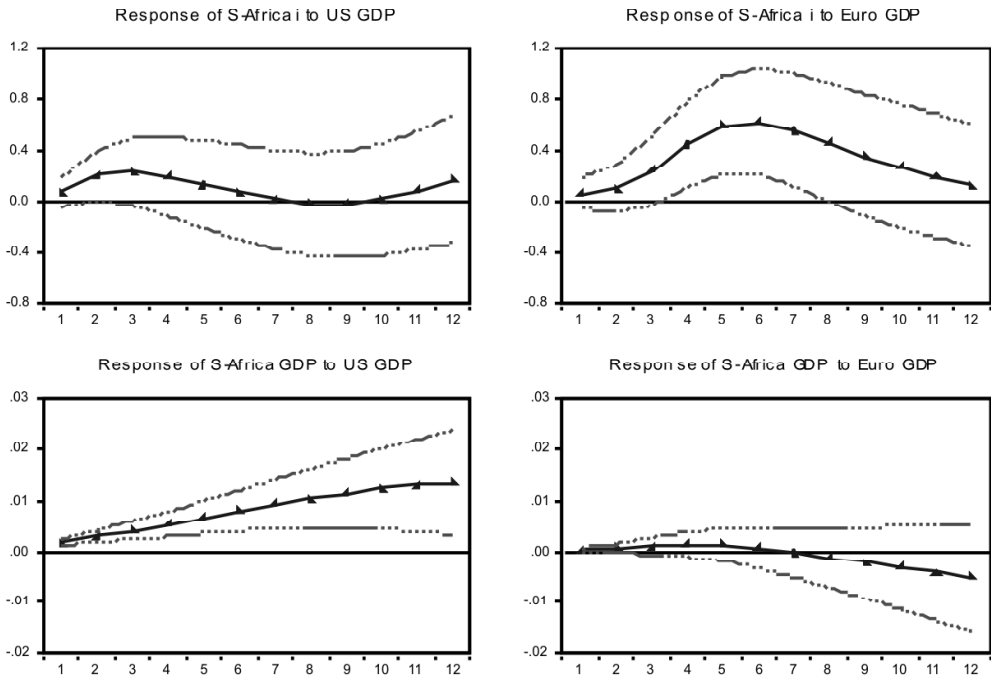


Figure 4.1

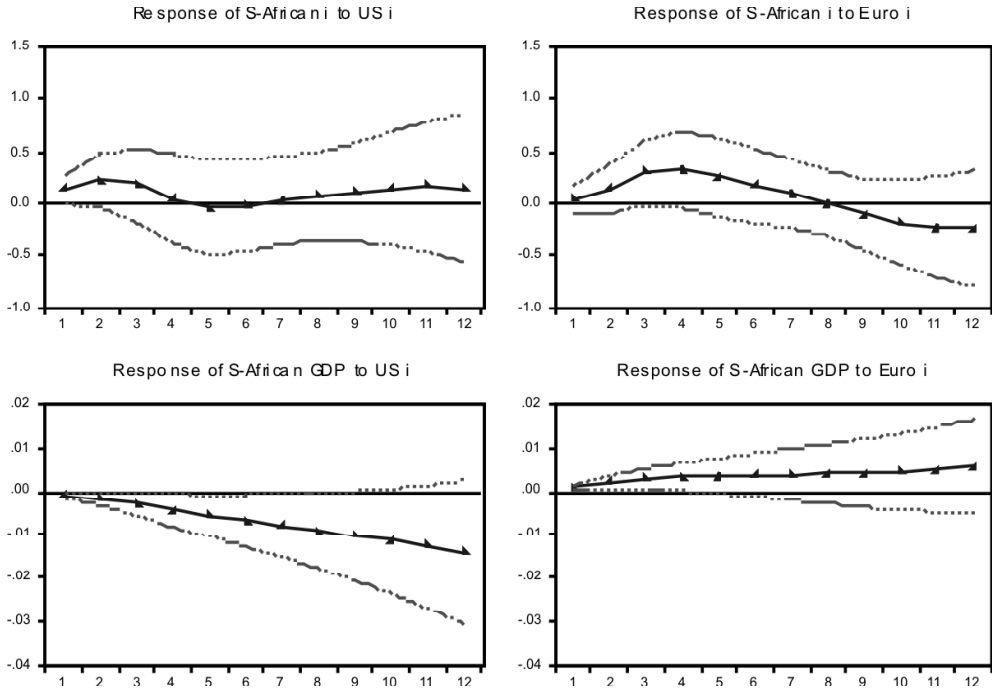


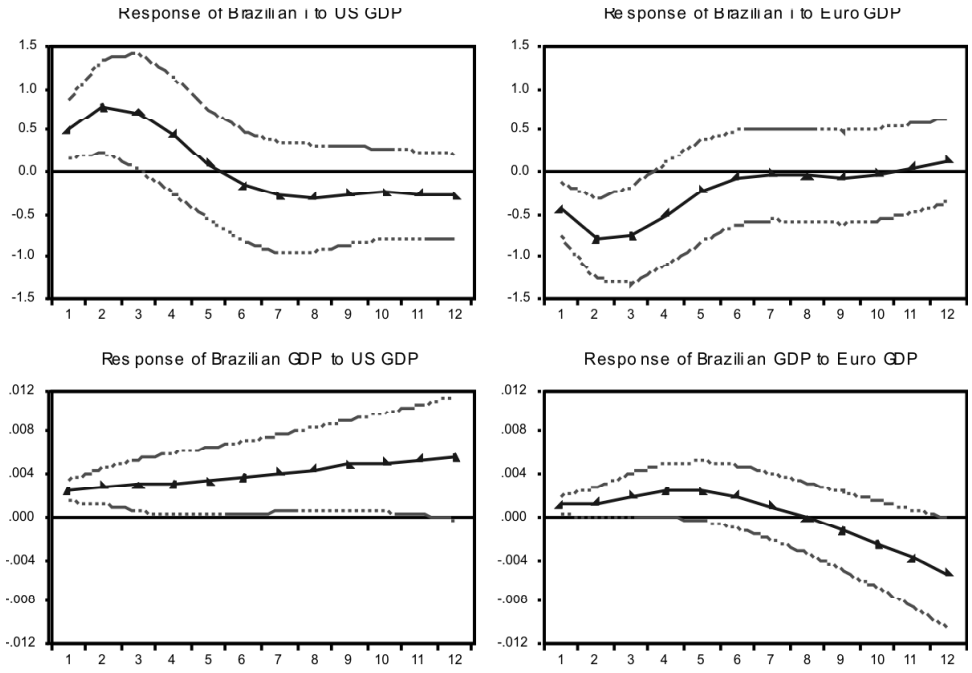
Figure 4.2

Latin American markets: The Figure 5.1 reports the response of Brazilian interest rate and real GDP to one S.D. innovation in US and Euro output. Contemporaneously, a shock to the US real GDP leads to a positive response of interest rate, the response turns negative after the 5th quarter. The response of the same variable to Euro output shock is not significant after the 5th quarter. In fact, the first five quarters, it creates a mirror image of the response to US output shocks. The IRFs indicate that innovation in US output has a positive impact on Brazilian output throughout the 12 quarters. Note that the bilateral trade between Brazil and the United States has nearly tripled in the past decade to more than $100 billion in 2011. Thus, given its growing trade link, an expansionary impact may be expected. In case of Euro shock, it generates an expansionary impact at first up to the 8th quarter and the response reverses thereafter.

Similar to the response of other emerging economies, innovation in US interest rate does not have a greater impact on the Brazilian real sector vis-à-vis on the monetary sector (Fig 5.2). Both the contemporaneous and the long run response of the Brazilian money market rate is positive. The reaction of the Brazilian real sector to US federal fund rate is contractionary throughout the 12 quarter horizon. The impact of the Euro interest rate shock is positive contemporaneously, the impact is inconsequential though (last row in Fig 5.2).

The impulse response results of the Mexican economy are reported in Figures 6.1 & 6.2. In responding to US output shock, Mexican interest rate reacts negatively contemporaneously and shows a sign of positive response until the 8th quarter. The response appears to be insignificant in the longer horizon. While the impact is miniscule, the response of the same variable to Euro

Figure 5.1: Latin American economies



Shocks are measured at the forecast horizon of 12 quarters.

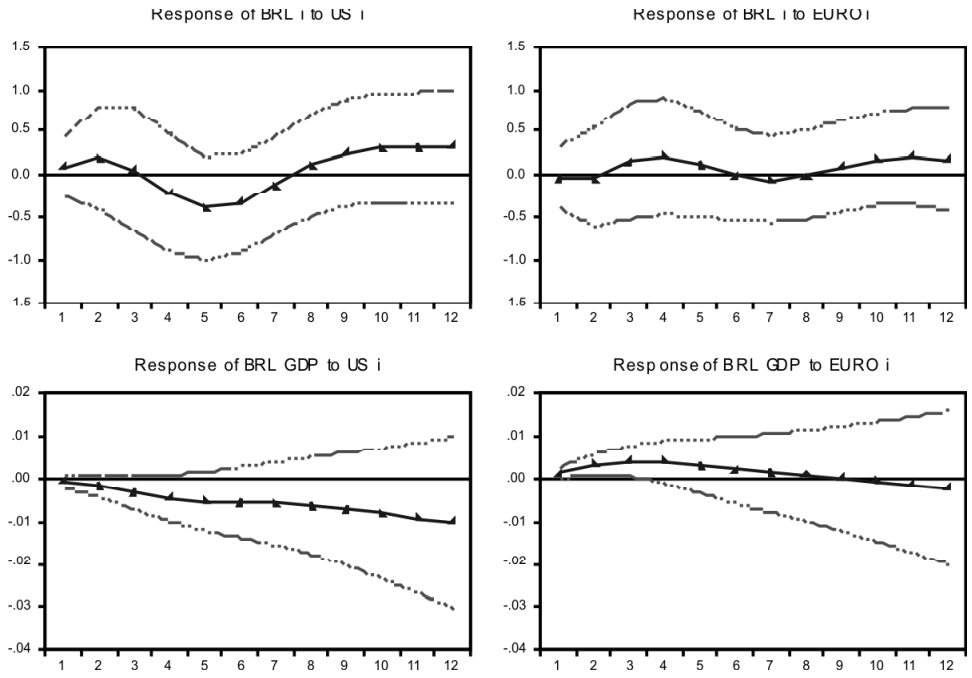


Figure 5.2

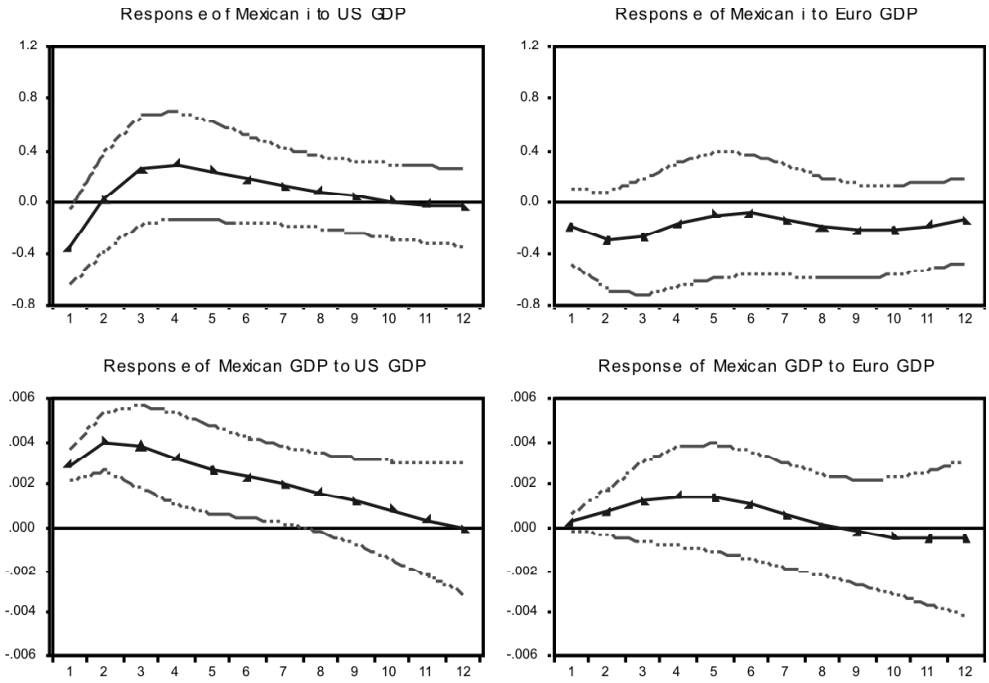


Figure 6.1

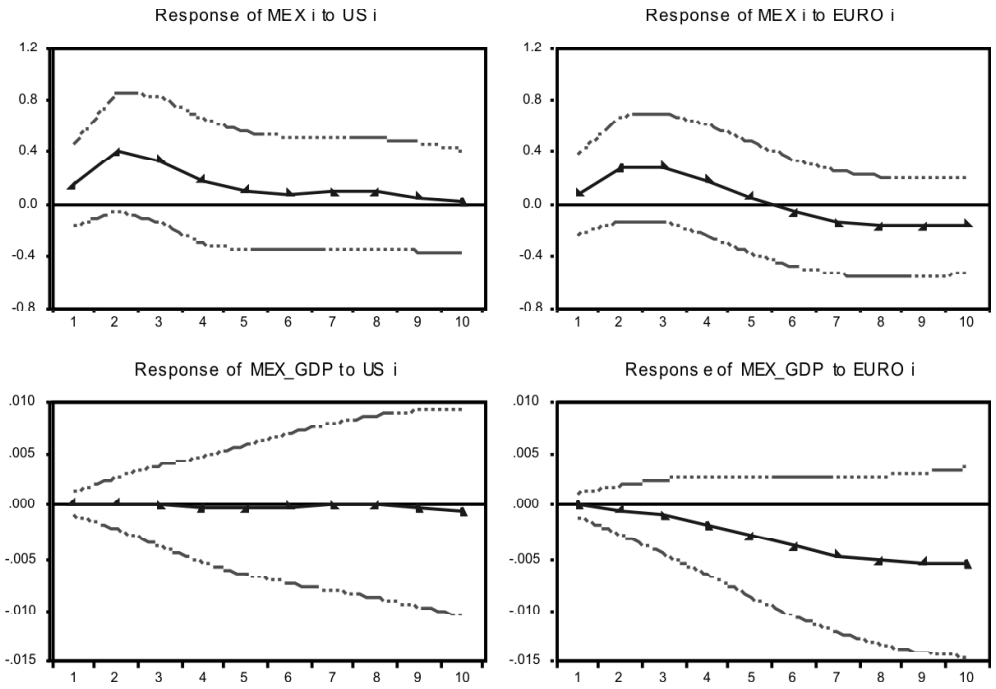


Figure 6.2

output is negative throughout the 12 quarter horizon. The response of Mexican output, on the other hand, shoots up as a result of a positive shock in US output. The expansionary impact declines steadily over time (last row in Fig 6.1). Likewise, economic prosperity in the Euro area also results in an expansionary impact in the Mexican economy, but the impact dies out in the longer horizon. Observing the reaction of Mexican monetary variable to the US and the Euro monetary shock, it responds positively to both the US and the Euro area monetary shocks contemporaneously (Fig 6.2). The positive response to the US declines over time and the response turns negative to the Euro in the longer horizon. Given its economic tie with the US, a greater contemporaneous response of the Mexican real sector to shocks in the US real sector is expected. Interestingly, the impact of the US federal fund rate is insignificant on the Mexican output. The response of Mexican GDP to the innovation in Euro interest rate is negative from the beginning and is persistent.

6. CONCLUSION

This study analyses the transmission of US and Euro area real and monetary shocks to emerging market economies. More importantly, this study investigates the linkage between the world two largest economies—US and Euro zone—and the selected emerging economies around the world. Towards this goal, we establish the long run relation and short-run dynamics of these economies. The Johansen cointegration analysis indicates the existence of a long-term equilibrium relationship between US, Euro area, and each of the emerging economies considered in this study.

The IRFs and the VDCs results reveal interesting facts. The results indicate that the transmission of real and monetary shocks varies among countries, suggesting cross-country differences in policy (and market) responses to insulate economies from external shocks. The observed VDC results suggest that given the growing trend of globalization, no country in this study can ignore the disturbances originating from either the US or the Euro area. The supportive evidence in our findings is that almost 55% of forecast error variance in Indian interest rate is explained by a shock in Euro area GDP which is 5.13% by US GDP. But, the major forecast error variance in Indian GDP is explained by US output shock (38.09%) as opposed to 29% by the Euro output shock. Our empirical results assert that this is the case in all economies considered in this study. We do not see any persistent dominance of either US or Euro area influence in any of the economies investigated. The results suggest that the emerging economies have a fair amount of trade and financial diversification in both US and the Euro zone. Hence, they seem to be equally sensitive to innovations in US and Euro real and monetary sectors.

The analysis of impulse response functions demonstrates that the US and the Euro area output shocks are relatively more pronounced in impacting the emerging economies, suggesting that shocks are transmitted to emerging economies through the aggregate demand channel. While the responses of the economies to the interest rate shocks are largely symmetric, the responses to output shocks are mixed and depend on the forecast horizon. We found that the response of Indian interest rate to a one S.D. shock in US and Euro output is symmetric (positive/positive), whereas the response of real output is asymmetric after the 8th quarter (negative for US and positive to Euro). Similarly, the Chinese real and monetary variables demonstrate similar symmetric/ asymmetric responses to innovations in US and Euro area real and monetary variables. We also observe a similar pattern of responses in African and Latin American Countries. While identifying the policy similarities and differences in beyond the scope of this study, the asymmetric responses from these economies may be attributed to differences in macroeconomic fundamentals.

Our results suggest that the health of US and Euro zone economies is crucial to newly emerging market economies. Shocks are transmitted through real and monetary channels but our results reveal that the output channel seems stronger. The influence of Euro shocks is growing in emerging markets considered in this study. The supportive evidence could be, for example, US interest rate shock has much less influence on Chinese real and monetary variables as opposed to Euro interest rate shock which is clearly dominant in influencing them. Likewise, US output shock does not generate much variation in Chinese interest rate while the corresponding results due to Euro output shocks are much larger. As indicated in the methodology section, real GDP and the interest rate respectively represent real and monetary sectors of the US and Euro area and our estimation is restricted to those two variables in an effort to see the transmission of real and monetary shocks from the US and the Euro area to emerging markets. A simultaneous identification model with other potentially relevant variables such as exchange rate or the trade balance may have produced different results. Therefore, a cautionary move is recommended in the process of the implementation of the findings.

Notes

1. The Euro area is treated as a single economy. The Euro area has a single currency, the Euro, which came into existence in 1999. The Euro is the official currency in 18 (Austria, Belgium, Cyprus, Estonia, Finland,

France, Germany, Greece, Ireland, Italy, Latvia, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain) out of 28 EU member countries.

2. Erten (2012) analyzes the impact of Eurozone shocks on China, emerging Asia and Latin America. The findings of the paper is discussed in the literature review section.
3. Mexico, Panama, Brazil, Chile, Ecuador, Argentina, Uruguay and Peru.
4. This study considers eight emerging markets from East Asia (Hong Kong, Korea, Malaysia, Philippines, Singapore, Thailand) and Latin America (Chile and Mexico). The model assumes that the emerging market is a small open economy.
5. We do not report forecast error variances of domestic variables.

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