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# Impact of China's slowdown on the Global Economy: Modified GVAR Approach

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## Abstract

Asia-Pacific region is much anxious about China's slowdown, but the rest of the world has definite reason to worry about the consequences of the slowdown in China. During last few decades China is strongly integrated with Asia and also with the rest of the World. This paper investigates what the impact of China's slowdown on the global economy is. If any crisis in China, how much does it affect developed and emerging or developing economies? Using modified Global VAR (GVAR) model, this paper focuses on these issues. This study considers more on international linking variables for the period of 2000-2012. Evidence based on GVAR analysis for six developed countries (G6: USA, UK, Germany, Japan, Canada and Australia) and BRICS (G4: Brazil, Russia, India and South Africa) show that the impact of China's slowdown is more on emerging BRICS nations than that of developed economies. Impact of China's GDP growth shock on the rest of emerging Asia is more since it has a strong production network in East and South East Asia. So, China's slowdown certainly affects Asia more than western developed economies.

**Key Words:** Panel data, GVAR, China's economic slowdown, Global linking variable, GDP shock, BRICS, Developing Country, Developed Economy.

**JEL Classification:** C32, O54

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## 1. Introduction

Across the World, researchers and business analytics are closely watching on China's economic performance, especially recent China's economic slowdown. Asia-Pacific region is much anxious about China's slowdown, but the rest of the world has definite reason to worry about the consequences of the slowdown in the World's second largest economy. During last few decades China is strongly integrated with Asia and also with the rest of the World<sup>1</sup>. This paper investigates what the impact of China's slowdown on the global economy is. If any economic crisis in China, how much does it affect developed and emerging or developing economies? Using panel data analysis this paper highlights on these issues. This paper explores Chinese impact on the rest of the world with certain variations among group of similar nature of countries. The estimated impact of Chinese growth is more on emerging nations than that of on developed countries.

The world economy has undergone profound structural change since 1990s. Over last two and half decades China has emerged as a dominant global economic player. With large trade surplus, already China has made *a room* in the world economy (Rodrik 2010). This paper focuses on China that has strong linkage in local as well as global economy. Asia<sup>2</sup> and the USA are the top trading partners of China. Recently, China is also significantly visible in Africa and Latin America. Very recently, China reopens the Silk Route and strengthening linkage with Central Asia and Europe with global value chains (Paul and Khan 2015). Currently, China is present at each and every corner of the world. This success is possible due to openness which starts through China's Cultural Revolution since 1978. In the 21<sup>st</sup> century, China becomes the destination of foreign direct investment and comes to the focus of the global economy with opening several channels.

Interdependency is increasing in this globalised world, and thereby, macroeconomic risk also increases. Now, we examine empirically how shock in China's GDP is transmitted to emerging as well as developed countries. Macroeconomic managers and policy makers should consider the interdependency issues and focus on raising interdependency in the market and national economy. National economy should be analysed in the global

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<sup>1</sup> The integration of China into the global economy in general and East Asia in particular has further deepened international production fragmentation to unprecedented levels (Haddad, 2007; Athukorala, 2007; Ng and Yeats 2003, Kimura and Obashi 2008, World Bank 2005). At the turn of the decade, China's processing exports (that are produced from processing and/or assembly of imported inputs) accounted for nearly half of its total exports. In 2006, 51.5% of China's intra East Asian trade was in machinery products, of which more than half was trade in parts and components. The rate of annual growth was 22.7% in parts and components with its East Asian partners between 1993 and 2006 (Kimura and Obashi, 2008).

<sup>2</sup> Asian countries are Republic of Korea, Japan, Hong Kong, Singapore, Taiwan, Malaysia, Indonesia, Philippines, Thailand, India, etc.

perspective and major source of variability or risk management. Macroeconomic variability emerges through different channels of transmission mechanism that should be incorporated in the accounting measurements.

Each and every economy in this globalised world is interconnected through different channels, such as labour and capital movements across countries, cross-border trade in goods and services, sharing scarce resources, financial assets, political and technological developments etc. All these interlinking variables ultimately affect individual country's economic growth<sup>3</sup>. GDP growth rate of a nation depends on both internal and external factors. This paper emphasises more on external factors, especially trade linkage factors such as export, net inflow of foreign direct investment (FDI) and openness etc.

The growth of Chinese exports in market share over last two decades has remarkably increased. Husted and Nishioka (2012) observe that China's export share growth has come largely at the expense of exporters based in developed countries, especially Japan and the USA. China's rising export market share does not decline the export share of developing economies. China rises at the cost of developed, not developing world (Husted and Nishioka 2012). Hence, export is an important variable that explains economic growth of a nation. Sometimes, FDI may boost up country's economic growth. Pan (2012) examines the FDI determinants for the Chinese provinces during 1993 – 2008 and observes the effects of FDI over time. FDI solves currency problem and also plays an important role in promoting economic growth and development, raising a country's technological level and creating employment and overall quality of life.

The contribution of FDI is crucial for countries where incomes and hence domestic savings are low. They need external capital as an investment for promoting their economic growth and development. FDI also works as a means of integrating under developed countries into the global market and increases availability of capital for investment. Rapidly, worldwide FDI flow has been increasing since the beginning of the twenty first century<sup>4</sup> (UNCTAD 2007). FDI inflow to under developed economy will normally affect foreign exchange rate, price level at the domestic market which helps to mobilize the economic resources for overall

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<sup>3</sup> There is no such model that captures all complex interlinking. So, there are possibilities of residual interdependencies mainly due to unobserved interactions and spill-over effects not taken properly into account by using the common channels of interactions. These channels of interactions pose a major challenge to modelling the global economy. The Global VAR (GVAR) approach provides an effective way of modelling interactions in a complex global economy. The GVAR model is developed in the aftermath of the 1997 Asian financial crisis to quantify the effects of macroeconomic developments on the losses of major financial institutions. Originally, the GVAR is used as a tool for credit risk analysis (Chudik and Pesaran 2014a,b).

<sup>4</sup> The most attractive region is South and South-East Asia (UNCTAD 2007) and the largest FDI flow among developing economies goes to China.

economic development. Trade liberalization or openness is a crucial policy variable through which all other variables may be affected and FDI inflow stimulates overall economic development in the country. FDI inflow certainly helps under developed economy to overcome the bottlenecks or constraints of availability of capital and updated technology. Truly FDI ought to raise economic growth through removing all bottlenecks or constraints in under developed economy. In this context, this study considers FDI as an important factor influencing GDP growth rate of a country. We use trade intensity or openness to quantify the linkages among all the economies that we include in this study.

As per recent experiences, China's economy is expected to continue to grow rapidly, but the pace of credit-fuelled growth in investment (since the global financial crisis 2008) has increased the chance of a sharp slowdown and that starts in this year, 2015. Recognising the risk, China has adopted few reforms in its agenda. It helps to address economic imbalances and support ongoing productivity growth. Recently, China starts to devalue its currency. So, China's export may boost up but the volume of China's import may decline or may be relatively robust in the face of a slowdown in China. Currency devaluation of China has certain impact on the global economy also. So question arises: Is there any impact of China's economic performance on the rest of the world? How do we measure the impact of China's slowdown on other economies?

This paper attempts to estimate the impact of China's growth on other countries or on the rest of the world for the period of 2000 – 2012. This assists to predict other emerging or developed country's growth due to China's slowdown<sup>5</sup>. In this globalised world, every nation is economically integrated with the rest of the world through trade. To conduct the empirical analysis Chudik and Pesaran (2014a,b) suggest to use a variant of the global vector autoregressive (GVAR) model. Initially, Pesaran, Schuermann and Weiner (2004) propose the GVAR model and Dees, di Mauro, Pesaran and Smith (2007) develop it further. This is a newly developed approach to global macroeconomic modelling (Han and Ng 2011, Kendall 2014). Each country is modelled individually as a small open economy by estimating country-specific vector error-correction models in which domestic variables are related to country-specific foreign variables or global variables which are common across all countries. This GVAR model is applicable for large number of cross-sectional and long time series data. With limited data we apply panel data analysis technique for our estimation purpose.

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<sup>5</sup> Since China emerges at a faster rate in the 21<sup>st</sup> century with integrating Asia and the world (Cesa-Bianchi et al. 2011, Dinda 2014), China's slowdown, if any, definitely affect other economies, but how much is it? We have to measure the impact of China's growth on other countries (Kendall 2014).

However, following GVAR model, we adopt the concept of foreign variable in our model, which is discussed in next section. Exogenous shock is incorporated within the GVAR model, where exogenous variable converted to endogenous variable. This study differs from it. This study incorporates China's impact as purely exogenous or foreign variable to individual country.

This paper is organised as the following: Section 2 describes data and methodology. Section 3 discusses the results and analyses with proper interpretation. Finally section 4 concludes.

## 2. Data and Methodology

All data [GDP, GDP growth rate, Population, Export, Import, Merchandise trade, net inflow of foreign direct investment (FDI), etc.] are taken from the World Bank data set of the World Development Indicators for the period of 2000 – 2012. Dividing FDI by population we get net flow of per capita FDI (PCFDI). Including China, we have 20 countries that represent the world. Excluding China, we form three different economic groups – viz., developed country group of six, G6 [USA, UK, Germany, Japan, Canada and Australia]; emerging country group, G4 [Brazil, Russia, India and South Africa]; and other developing country group of nine, G9 [Argentina, Afghanistan, Egypt, Indonesia, Malaysia, Mexico, Pakistan, Turkey, Viet Nam]. Now, China is the reference country in this study. So, excluding China the paper investigates the impact of China's growth on that of the rest of the world (G19), which is divided into G4, G6 and G9 as mentioned above.

**Table 1: Basic Summary Statistics of few variables for China and other groups during 2000-2012**

Variables	China	G4	G6	G9	G19
<b>Growth rate</b>	10.067	4.79	1.86	4.53	3.92
SD	1.808	3.15	2.08	3.94	3.56
<b>PCGDP</b>	2770.28	5049.4	38592.9	4009.4	15149.45
SD	1801.07	3863.8	9528.9	3708.8	17112.9
<b>Openness</b>	51.18	45.09	48.66	74.95	60.36
SD	9.24	14.59	19.4	52.5	40.7

Table 1 provides basic summary statistics of growth rate, per capita income (PCGDP) and openness for all groups for the period of 2000 – 2012. China's average PCGDP during 2000-2012 is 2770.28 USD whereas its average growth rate is 10.067 percent and average openness is 51.18 percent. Average growth rate is high in G4 and low in G6; while openness is the highest in G9 with high variation but it is least in G4 with low variation. With a limited

time series data for the period of 2000 – 2012 we construct a panel data set<sup>6</sup> and estimate the impact applying panel data analysis techniques.

### Econometric Strategy

Now, we formulate the econometric strategy for estimating panel data. Our basic model is:

$$y_{it} = \alpha + \beta x_{it} + u_{it} \quad (1)$$

Where  $y$  is GDP growth rate of  $i^{\text{th}}$  country in  $t^{\text{th}}$  year and  $x$  is the vector of other variables,  $u$  is the disturbance term.

This study constructs a foreign variable which is directly connected with the openness of a country. Here, openness is measured as total of export and import to GDP which is also known as the trade intensity of a country for a given year. Impact of China's growth affects any other country through openness. Here, we construct a foreign variable as the product of China's growth rate weighted with a country's openness; i.e.,  $GrChnOp = w * g$ , where  $w = \text{Openness (Op)}$ ,  $g = \text{China's growth rate (GrChn)}$ .

$$GrChnOp = w * g = \text{Openness} * \text{China's growth rate}$$

So, we modify eq (1) as

$$y_{it} = \alpha + \beta x_{it} + \gamma GrChnOp_{it} + u_{it} \quad (2)$$

Where  $x^*$  is the foreign variable conditional on China's growth effect on the rest of the world. The equation (2) is the model that measures the instantaneous effect but in reality lag value may have strong effect on current economic variables, hence, we introduce lag variables in eq (2),

$$y_{it} = \alpha + \beta x_{it} + \gamma GrChnOp_{it} + \delta GrChnOp_{it-1} + \epsilon GrChnOp_{it-2} + u_{it} \quad (3)$$

and, finally, lag dependent variable is added in eq (3) and modified model is

$$y_{it} = \alpha + \beta x_{it} + \gamma GrChnOp_{it} + \delta GrChnOp_{it-1} + \epsilon GrChnOp_{it-2} + u_{it} \quad (4)$$

In this study our main focus on the coefficients of  $x^*$  variables (both or either in instantaneous or lag value). Equation (3) is the base model for this study. In our limited data, we use the concept of foreign variable,  $x^*$ , as a channel through foreign impact transmitted to domestic economy. This study is not in the framework of GVAR, it is only group of panel data setup<sup>7</sup> and estimates impact for all sub-groups. So, we use panel data analysis techniques for this study. In this context, we concentrate our study only for the period of 2000- 2012.

<sup>6</sup> The economic performance of individual country is observed over time and we also observe that groups of countries evolve over time. Evolution of group of countries is more important than individual country. This panel data analysis provides strong estimated value with higher level of significance.

<sup>7</sup> The question of simultaneity may arise in the panel set up but in VAR structure no question on simultaneity. Problem of endogeneity is also may arise due to export variable which is a part of GDP. To overcome this endogeneity and simultaneity problem, we estimate the panel VAR model using GrChnOp as exogenous variable.

Here, major variables are  $y = [\text{GDP, and GDP growth rate}]$ ,  $x = [\text{export, net per capita FDI inflow}]$ ,  $x^* = \text{GrChnOp}$ .

This paper mainly focuses on the impact of China's growth on other economies in the 21<sup>st</sup> century. This is true that China becomes global player in international trade since 1990s. It is also highly significant that China joins in the World Trade Organisation (WTO) only in the beginning of the 21<sup>st</sup> century. Joining WTO, China emerges with a faster growth rate in the 21<sup>st</sup> century and affects the global economy. In the globalized world, economic performance of individual country depends on its export and also inflow of foreign capital<sup>8</sup>. China's global linking variable is the trade openness through which China is exporting to and importing from the rest of the world. Connecting the rest of the world, China has grown at the fastest rate (more than 10 percent) in the world during 2000-2012. Obviously, GrChnOp transmits China's economic performance to other countries through their openness. GrChnOp is considered here as foreign and exogenous variable that links to individual country that depends on China directly or indirectly. In other way, China influences other economies. This study also considers other international linking variables for the period of 2000-2012.

### **Primary observations**

Preliminary observations suggest that there is a drastic fall of GDP growth rate during 2008-2009 in almost in all countries except Afghanistan. This fall of growth rate is also associated with trade. The economic crisis of 2008-2009 is the global shock that affect all countries but impact varies nation to nation as per their openness and dependency. GDP growth rate and PCFDI are stationary, and export (percentage of GDP) is trend stationary. All our study variables are stationary with a break at 2009.

We examine characteristics of data whether the variables are endogenous or exogenous. Applying Hausman-Taylor regression (random effect model) we observe that GrChnOp is exogenous variable<sup>9</sup>, all others are endogenous variables in our panel data set. Only bilateral trade is not considering here, because directly or indirectly China's growth influence other nations in the globalised world. Chinese economic momentum affects other nation through their trade intensity in this globalised era.

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<sup>8</sup> Foreign direct investment (FDI) inflow is a crucial factor for economic growth of individual country. FDI is more important in capital scare developing economy than that of developed country.

<sup>9</sup> The coefficient of GrChnOp is 0.00445 with t-value of 3.00 that rejects null hypothesis of endogenous. So, alternative hypothesis of exogenous is accepted with 99% confidence. In this study, GrChnOp is exogenous variable in our panel data set.

### 3. Results and discussions

For our analysis purpose, we estimate the growth rate of several country groups. This paper mainly focuses on Random Effect estimates. Using panel data analysis we examine both random effect (RE) and fixed effect (FE) models<sup>10</sup>. Table 2 provides the estimated results of GDP growth rate of emerging (G4), developed (G6) and other developing (G9) countries without global linking variable. The results of G4, G6 and G9 are obtained from panel data analysis and compare estimated results of RE and FE models.

**Table 2: GDP Growth rate of Emerging (G4), Developed (G6) and other developing (G9) economies during 2000 – 2012**

Variables	G4		G6		G9	
	Re	Fe	Re	Fe	Re	Fe
Export <sub>t</sub>	0.1498 (0.99)	0.1872 (1.18)	0.512*** (4.55)	0.6466*** (5.67)	-0.298*** (-3.23)	-0.303*** (-2.81)
PCFDI <sub>t</sub>	0.0165*** (3.68)	0.0175*** (3.97)	0.0005** (2.06)	0.0002 (0.85)	0.0167*** (3.38)	0.0208*** (3.95)
Growth <sub>t-1</sub>	0.192 (1.78)	-0.0043 (-0.04)	0.1977 (1.92)	0.1036 (1.08)	0.1296 (1.46)	-0.0125 (-0.13)
Export <sub>t-1</sub>	-0.1549 (-1.11)	0.1313 (0.94)	-0.514*** (-4.59)	-0.6453*** (-5.82)	0.3066*** (3.36)	0.2727*** (2.66)
PCFDI <sub>t-1</sub>	-0.027*** (-5.55)	-0.0265*** (-5.98)	-0.00045 (-1.82)	-0.00058** (2.52)	-0.026*** (-5.13)	-0.0224*** (-4.07)
Constant	4.913*** (4.11)	4.225 (1.34)	1.253** (2.24)	1.743 (1.11)	4.636*** (6.3)	5.989*** (2.66)
Within R <sup>2</sup>	0.5001	0.5276	0.3689	0.4205	0.1846	0.2145
Between R <sup>2</sup>	0.6622	0.2679	0.0159	0.1772	0.7576	0.0992
Over All R <sup>2</sup>	0.5231	0.4614	0.3106	0.2604	0.2755	0.1710

Note: figures in parentheses are t-value. ‘\*\*\*’ and ‘\*\*’ denote the level of significance at 1% and 5%, respectively.

Table 2 suggests that PCFDI is highly significant and affects GDP growth rate of emerging (G4) and developing countries (G9) but no significant result of FE for developed countries (G6). There is no transmission mechanism in this case, because these estimates do not incorporate foreign variable, GrChnOp. Developed country’s GDP growth rate is directly related to export and highly significant but PCFDI is significant only in RE for G6. Both export and PCFDI are highly significant and affect GDP growth rate of developing countries. PCFDI has significant direct effect on GDP growth of emerging economies. Export is significant in G6 and G9 while it is insignificant in emerging G4 economies in absence of global linking variable.

<sup>10</sup> Houseman Chi-square test suggests RE model compared to FE model. We also examine MLE and PA models and provide similar results. So, we confine with RE model estimation.

Table 3 shows the results of impact of China's growth on GDP growth rate of emerging (G4), developed (G6) and other developing (G9) countries incorporating global linking or foreign variable, GrChnOp. The estimated results are obtained from panel data analysis for G4, G6 and G9. Estimated results of export and PCFDI for all groups are very much similar to the results of Table 2. Table 3 provide the global linking variable, GrChnOp, which is an important additional variable. Impact of Chinese economic performance percolates in the channel of the global linking variable, GrChnOp. The coefficient of GrChnOp is highly significant in G4 and G6, but insignificant in G9. However, the coefficient of GrChnOp (impact of China's growth) is greater on G4 than that of G6. Emerging (G4) economies gain more if China's economy grows at faster rate, and in reverse, huge lose due to China's economic slowdowns. From Table 3 it is clear that China's growth directly affect emerging G4 and developed G6 economies, however no effect on G9. Export and PCFDI truly affect economic growth rate of G9 but global linking variable is insignificant. Hence, Chinese growth slowdown may not affect at all on developing G9 countries unless export and FDI. Lag one values of export, GrChnOp, PCFDI are also significant for respective groups.

**Table 3: Impact of China's growth on GDP Growth rate of Emerging (G4), Developed (G6) and other (G9) Developing Economies during 2000 - 2012**

	G4		G6		G9	
	RE	FE	RE	FE	RE	FE
Export <sub>t</sub>	-0.007 (-0.04)	0.061 (0.39)	0.4105*** (3.4)	0.5537*** (4.6)	-0.332*** (-3.38)	-0.356*** (-3.0)
PCFDI <sub>t</sub>	0.0174*** (4.1)	0.0199*** (4.33)	0.00045 (1.72)	0.00016 (0.62)	0.0152*** (3.06)	0.0191*** (3.38)
GrCHN*Op <sub>t</sub>	0.0136*** (2.94)	0.0157*** (3.86)	0.0071*** (2.71)	0.0064*** (2.64)	0.003 (1.27)	0.0027 (1.1)
Export <sub>t-1</sub>	-0.036 (-0.27)	0.0706 (0.49)	-0.4038*** (-3.6)	-0.5328*** (-4.69)	0.2626*** (2.65)	0.2815** (2.47)
GrCHN*Op <sub>t-1</sub>	-0.011** (-2.27)	-0.0119** (-2.14)	-0.0076*** (-2.58)	-0.0058** (-2.12)	0.0013 (0.56)	-0.00095 (-0.34)
Growth <sub>t-1</sub>	0.2357** (2.2)	-0.0134 (-0.13)	0.2545** (2.56)	0.149 (1.58)	0.068 (0.74)	-0.0136 (-0.14)
PCFDI <sub>t-1</sub>	-0.024*** (-5.3)	-0.0226*** (-5.69)	-0.00025 (-1.02)	-0.0004 (1.65)	-0.0235*** (-4.39)	-0.0207*** (-3.4)
Constant	3.977*** (3.45)	-0.0583 (-0.02)	1.0418 (1.93)	0.7735 (0.5)	4.356*** (5.93)	6.28*** (2.59)
Within R <sup>2</sup>	0.6095	0.6636	0.4450	0.4897	0.1946	0.2254
Between R <sup>2</sup>	0.7398	0.0016	0.1067	0.0840	0.8879	0.1259
Over All R <sup>2</sup>	0.6099	0.3345	0.4010	0.3397	0.3167	0.1695

Note: figures in parentheses are t-value. '\*\*\*' and '\*\*' denote the level of significance at 1% and 5%, respectively.

Results of random effect model are consistent for the whole data set and display in the following Tables (Table 4-7). Table 4 and Table 5 present the estimated results of China's growth impact on the growth rate and per capita income level of the rest of the world (G19),

respectively. Most of the models find that export is highly significant and suggest that export –led growth is dominating in the rest of the world (G19), which is a likely case in this globalized era. Overall PCFDI has no significant impact on economic growth rate (Table 4), while PCFDI significantly affect income level (Table 5). Global linking variable, GrChnOp, plays a crucial role and now we focus on it. GrChnOp is termed as an interactive variable which shows the diffusion of China’s growth. China’s growth impact on the growth rate of the rest of the world (G19) is positive and highly significant (Table 4). China is distributing its performance to the rest of the world through export. More export requires more capital which is fulfilled by FDI inflow. China’s growth affects other country through trade.

**Table 4: Random Effect Estimation of China’s growth impact on growth rate of the rest of the world (G19) during 2000-2012**

Variables	I	II	III	IV
Export	-0.0847*** (-2.27)	-0.0906*** (-3.5)	-0.0854*** (-3.07)	-0.0905*** (-3.49)
PCFDI	-0.0009 (-1.36)	0.000035 (0.09)	-0.00047 (-1.28)	0.00003 (0.07)
GrChnOp	0.00547*** (4.27)	0.0053*** (4.31)	0.0057*** (4.49)	0.0054*** (4.31)
Dc	-	-2.972*** (-4.11)	-	-2.856*** (-3.64)
De	-	-	1.424 (1.63)	0.314 (0.39)
Constant	3.18*** (5.05)	4.203*** (7.3)	2.724*** (4.11)	4.059*** (5.92)
R <sup>2</sup> w	0.0418	0.0471	0.0424	0.0470
R <sup>2</sup> b	0.5175	0.6872	0.5688	0.6927
R <sup>2</sup> o	0.1534	0.2527	0.1793	0.2543

Note: figures in parentheses are t-value. ‘\*\*\*’ and ‘\*\*’ denote the level of significance at 1% and 5%, respectively.

**Table 5: Random Effect Estimation of China’s growth impact on per capita income level (Lnpcgdp) of the rest of the world (G19) during 2000-2012**

Variables	I	II	III	IV
Export	-0.0083 (-1.37)	-0.004 (-0.72)	-0.0086 (-1.43)	-0.0035 (-0.71)
PCFDI	0.000225*** (4.02)	0.000205*** (3.73)	0.00022*** (3.99)	0.0002*** (3.72)
GrChnOp	-0.00009 (-0.47)	-0.000108 (-0.60)	-0.00009 (-0.48)	-0.0001 (-0.55)
Dc	-	2.4336*** (6.88)	-	2.5443*** (6.49)
De	-	-	-0.6974 (-1.22)	0.35 (0.79)
Constant	8.9537*** (32.52)	8.0786*** (33.23)	9.1136*** (29.95)	7.963*** (27.1)
R <sup>2</sup> w	0.0818	0.0778	0.0820	0.0777
R <sup>2</sup> b	0.1744	0.6692	0.1698	0.6773
R <sup>2</sup> o	0.1575	0.6373	0.1699	0.6437

Note: figures in parentheses are t-value. ‘\*\*\*’ and ‘\*\*’ denote the level of significance at 1% and 5%, respectively.

Table 4 shows the estimated random effect results of impact of China's economic performance on GDP growth of group of emerging (de) and developed countries (dc) during 2000-2012. Our constructed international linkage variable, GrChnOp, is highly significant and instantaneously affects GDP growth rates of other countries. So, China's economic slowdown instantaneously affects the rest of the world. The coefficient of dc (developed country) group dummy is negative and highly significant, which suggest that China's growth strongly affects and reduces average growth rate of developed nations. The coefficient of de (BRICS excluding China) dummy is insignificant.

Table 5 displays the results of random effect model estimation of China's growth impact on income level of the rest of the world. PCFDI is the main determining factor of income level of the rest of the world. Here, the coefficient of GrChnOp is insignificant in all cases. The coefficient of dc is significant. Table 6 presents estimated results of income level and its growth rate of G4, G6 and G9 controlling all other variables. China's growth affects both income level and growth rate of G9 developing country group only, whereas China's growth affects only growth of G4 nations. PCFDI determines per capita income level only, not the growth rate of all sub-groups.

**Table 6: Random Effect Estimation of China's growth impact on GDP growth rate and income level of G4, G6 and G9 during 2000-2012**

Variables	lnPCGDP			Growth rate		
	G4	G6	G9	G4	G6	G9
Export	0.01545 (0.9)	-0.0146** (-2.43)	0.00966* (1.68)	-0.1254 (-1.54)	-0.0614 (-1.19)	-0.09398*** (-2.99)
PCFDI	0.00576*** (8.52)	0.00006** (2.01)	0.0045*** (8.35)	-0.0044 (-1.38)	0.00024 (0.96)	-0.0032 (-0.96)
GrChnOp	0.0004 (0.44)	0.0052* (1.66)	-0.00064*** (-2.73)	0.0105** (2.46)	0.0039 (1.53)	0.005944*** (3.75)
Constant	6.872*** (24.57)	10.57*** (147.78)	7.931*** (40.86)	3.55*** (2.69)	1.212 (1.63)	4.108*** (6.45)
R <sup>2</sup> w	0.6107	0.1345	0.2911	0.2037	0.0499	0.0137
R <sup>2</sup> b	0.7070	0.2971	0.9481	0.0966	0.2450	0.8680
R <sup>2</sup> o	0.6176	0.1449	0.6818	0.1628	0.0692	0.1272

Note: Figures in parentheses are t-value. '\*\*\*', '\*\*' and '\*' denote the level of significance at 1%, 5% and 10% , respectively.

In the rest of the world, G19, which includes the USA; now, we re-estimate all excluding the USA. Table 7 provides the results of random effect model for China's growth effect on gdp growth of G18 during 2000-2012. Model 1 (M1) provides the estimated gdp growth of all countries excluding the USA. GrChnOp is positive and statistically significant. So, M1 suggests that China's economic performance directly affects the economic growth rate of G18. M2 and M3 add dummy variables D\_dc and D\_ec for developed and emerging country

groups, respectively. The coefficients of D\_dc are negative and significant, while that of D\_ec are positive but insignificant (Table 5). So, estimated intercept term of developed country group is less than that of emerging country group. M3 – M5 represent autoregressive models with lag one. In all cases (M3 – M5), coefficients of growth lag 1 are positive and highly significant. Here, the estimated impact of China’s economic growth is more on growth rate of emerging economies than developed economies.

**Table 7: Results of Random Effect Model for China’s growth effect on GDP growth of G18 (excluding USA from the rest of the World) during 2000 – 2012**

Variables	M 1	M 2	M 3	M 4	M 5
Export <sub>t</sub>	-0.0676** (-2.27)	-0.0735*** (-2.63)	-0.1052*** (-3.83)	-0.0725** (-2.25)	-0.1416 (-1.85)
PCFDI <sub>t</sub>	-0.0003 (-0.93)	.00013 (0.39)	-0.000002 (-0.01)	0.00009 (0.26)	0.0001 (0.30)
Grchnop <sub>t</sub>	0.0053*** (3.89)	0.0052*** (3.88)	0.0063*** (4.50)	0.0076*** (4.9)	0.0082*** (4.94)
Growth <sub>t-1</sub>			0.202*** (3.17)	0.2345*** (3.57)	0.23278*** (3.55)
Export <sub>t-1</sub>					0.0694 (0.99)
Grchnop <sub>t-1</sub>				-0.0031 (-1.91)	-0.0037** (-2.14)
D_dc		-2.35*** (-3.25)	-1.918*** (-3.41)	-1.9388*** (-3.47)	-1.9479*** (-3.48)
D_ec		0.825 (1.11)	0.6207 (1.19)	0.52686 (1.01)	0.5196 (1.0)
Constant	2.64*** (4.5)	3.31*** (5.14)	2.6956*** (5.17)	2.645*** (5.1)	2.674*** (5.14)
Within R <sup>2</sup>	0.0656	0.0698	0.1062	0.1178	0.1231
Between R <sup>2</sup>	0.2309	0.6711	0.7806	0.7980	0.7974
Over All R <sup>2</sup>	0.1102	0.2334	0.2943	0.3065	0.3098
Observations	234	234	216	216	216
N	18	18	18	18	18

Note: figures in parentheses are t-value. ‘\*\*\*’ and ‘\*\*’ denote the level of significance at 1% and 5%, respectively. It is not included the USA in this data set.

Evidence based on panel data analysis for G6, G4 and G9 show that the impact of China’s growth slowdown is more on emerging BRICS than that of developed nations.

The question of endogenous and simultaneity may arise in the single equation model, even in the panel data in our above exercise. To overcome such problem (if any), we estimate the vector autoregressive (VAR) model in panel data setup and also examine its response function. In this part, we are more interested about the impact of China’s growth on other country group and prediction of future through response function. Considering GrChnOp as an exogenous variable, the estimated VAR results are presented in Table 8.

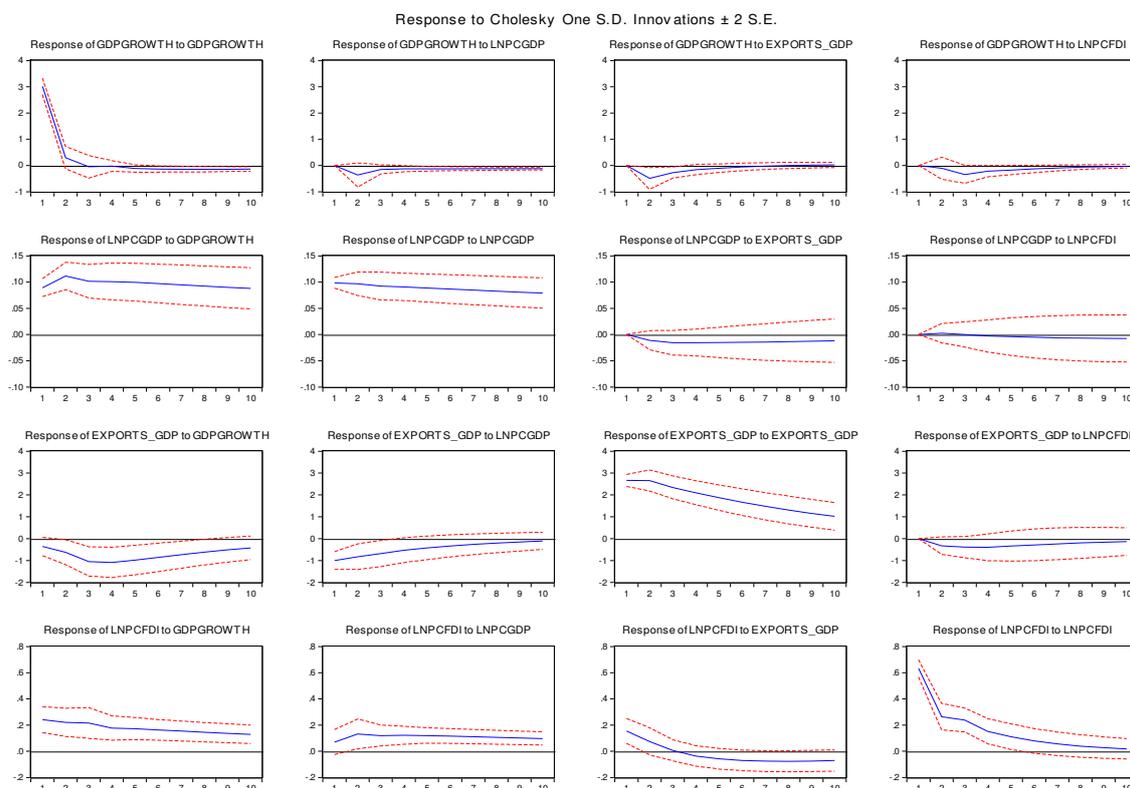
Table 8 shows vector auto regressive estimates of panel of G19 for the period of 2000-2012. From Table 8 it is clear that growth rate, export and PCFDI have positive and statistically significant relation with GrChnOp. So, China's slowdown affect FDI, export and growth rate of the rest of the world (G19). These estimates are also matching our earlier panel results. Specifically, the coefficients of GrChnOp are very similar to that of panel RE estimates and results are consistent. Using this VAR estimate the response function is constructed and predicts the future. Figure 1 presents response functions of the rest of the world (G19).

**Table 8: Vector Auto regression Estimates of G19**

	<b>GDPGROWTH</b>	<b>LNPCGDP</b>	<b>EXPORT</b>	<b>LNPCFDI</b>
GDPGROWTH(-1)	0.250455**	0.008436	-0.113613	0.008185
<i>t</i> -Value	[ 2.49]	[ 1.90]	[-1.188]	[ 0.35]
GDPGROWTH(-2)	0.037409	-0.003614	-0.141813**	0.002864
<i>t</i> -Value	[ 0.55]	[-1.208]	[-2.199]	[ 0.18]
LNPCGDP(-1)	-5.339729**	0.935521***	2.361116	1.087663
<i>t</i> -Value	[-2.14]	[ 8.49]	[ 0.99]	[ 1.88]
LNPCGDP(-2)	5.067629**	0.054014	-1.937078	-0.682531
<i>t</i> -Value	[ 2.003]	[ 0.48]	[-0.805]	[-1.16]
EXPORT(-1)	-0.174793**	-0.004378	1.028581***	0.003983
<i>t</i> -Value	[-2.184]	[-1.24]	[ 13.51]	[ 0.21]
EXPORT(-2)	0.130163	0.004173	-0.150677**	-0.018851
<i>t</i> -Value	[ 1.69]	[ 1.23]	[-2.06]	[-1.06]
LNPCFDI(-1)	-0.171921	0.004254	-0.512925	0.416035***
<i>t</i> -Value	[-0.52]	[ 0.29]	[-1.63]	[ 5.43]
LNPCFDI(-2)	-0.492425	-0.006567	0.094539	0.201679***
<i>t</i> -Value	[-1.58]	[-0.48]	[ 0.32]	[ 2.798]
Constant	8.292014***	0.165739	-1.128793	-1.970947***
<i>t</i> -Value	[ 3.366]	[ 1.52]	[-0.48]	[-3.45]
GRCHNOP	0.003073**	2.63E-05	0.006159***	0.001097***
<i>t</i> -Value	[ 2.29]	[ 0.44]	[ 4.83]	[ 3.527]
<hr/>				
R-squared	0.381737	0.992420	0.984415	0.842690
Adj. R-squared	0.350121	0.992033	0.983618	0.834645
Sum sq. resids	1599.564	3.115870	1446.674	85.89815
S.E. equation	3.014702	0.133056	2.867008	0.698611
F-statistic	12.07427	2560.399	1235.220	104.7563
Log likelihood	-464.0343	116.3766	-454.6912	-192.0722
Akaike AIC	5.097143	-1.143834	4.996680	2.172820
Schwarz SC	5.270571	-0.970407	5.170107	2.346247
Mean dependent	4.198516	8.745706	30.29855	4.779193
S.D. dependent	3.739627	1.490647	22.39997	1.718016
<hr/>				
Determinant resid covariance (dof adj.)	0.251287			
Determinant resid covariance	0.201451			
Log likelihood	-906.6846			
Akaike information criterion	10.17940			
Schwarz criterion	10.87311			

Note: '\*\*\*' and '\*\*' denote the level of significance at 1% and 5%, respectively.

**Figure 1: Response functions [of Group of 19 countries (G19)]**



## Conclusion

This study investigates the impact of China's slowdown on the global economy. This study considers a global linking variable which transmit China's economic growth performance to the rest of the world during 2000 - 2012. Our constructed global linking foreign variable is weighted with individual country's openness. Using panel data techniques, this paper focuses on the estimated impact of China's slowdown on emerging, developed and other developing economies. Evidence based on panel data analysis for developed and emerging countries, estimated results show that the impact of China's slowdown is more on emerging BRICS nations than that of developed economies. Impact of China's GDP growth shock on other developing economies is limited. Chinese economic slowdown has direct impact on emerging and developed economies in the channel of global linkage variable. Impact of China's slowdown may affect other developing countries through export and FDI. So, we conclude that Impact of China's slowdown is more on emerging economies than that of matured developed economies. These findings definitely assist to policy makers to adopt appropriate domestic as well as foreign economic policy.

This study has limitation on data. Quarterly data may provide more data points compare to annual data. Global vector autoregressive (GVAR) approach may provide more accurate results capturing international linking complexities. Our next research agenda is to update data base and applying GVAR analyse sensitivity and forecasting major macro variables for selected economies or group of countries.

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