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Transmission of China's Shocks to the BRIS Countries

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Transmission of China's Shocks to the BRIS Countries*

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July 22, 2014

Abstract

This paper investigates the impact of China on the BRIS countries, namely Brazil, Russia, India and South Africa. We identify Chinese supply and demand shocks and assess their transmission to BRIS in a structural dynamic factor model framework estimated over the period 1995Q2-2009Q4. The findings show that Chinese supply shocks are more important than its demand shocks. Supply shocks produce positive and significant output responses in all BRIS countries. While supply shocks have a permanent impact on the BRIS countries, the effects of demand shocks are short-lived. Both supply and demand shocks are transmitted through trade rather than financial linkages. However, the responses of BRIS countries are heterogeneous and therefore they require different policy responses.

JEL Classification Numbers: C3, E32, F40, O57

Keywords: Dynamic factor model, Supply and demand shocks, Sign restrictions, BRICS

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1 Introduction

Increasing economic integration, especially through trade and financial flows among countries, has been one of the most remarkable events in the world over the last two decades. Many emerging economies have gained in prominence as their economic activities now have significant ripple effects in other countries including the developed ones (Akin and Kose, 2008). In as far as geo-politics is concerned, five emerging economies - Brazil, Russia, India, China and South Africa (SA) (henceforth, BRICS) - are rapidly becoming integrated and important to the world economy (see Çakır and Kabundi, 2013a, b). These countries intend to strengthen their mutual cooperation by way of the alliance of the BRICS group. China is obviously the dominant actor among this emerging group.

This paper is closely related to that by Eickmeier and Kühnlenz (2013). Unlike these authors, who focus on the role of the Chinese demand and supply shocks on global inflation dynamics, the current study emphasizes the overall impact of Chinese demand and supply shocks on the economy of BRIS countries. The reason for assessing the impact of China's shocks to BRIS is based on the fact that in general China has become the first trading partner of many countries, but in particular of BRIS countries (Siklos and Zhang, 2010).[1] China has become an economic powerhouse and has contributed somewhat to economic recoveries after meltdowns. Even after the U.S. subprime crisis, which triggered a global financial crisis in 2008, coupled with a weak global economic growth, China's economy grew by 9.1% in 2009. China's growing importance as an assembly platform for exports of manufactures, a destination for foreign investment, and a consumer of imported technology, raw materials and industrial goods is not a one-time shock. Rather, it is an ongoing process that continually shapes the balance of global supply and demand (Eichengreen and Tong, 2006).

The empirical framework used is somewhat related to Eickmeier (2007), Kabundi and Nadal De Simone (2011), and Eickmeier and Kühnlenz (2013). It involves the identification of these shocks using a structural dynamic factor model instead of the traditional vector autoregressive (VAR) model. The rationale for adopting this framework is motivated by the fact that the factor models can handle many variables and hence turn the *curse of dimensionality*, commonly observed in small VAR, into the *blessing of dimensionality*. The analysis includes 161 quarterly series of BRICS countries observed from

[1] China's real GDP growth rate has averaged around 10% over the past two decades. Its share of global output in 2012 stands at 8.7% measured by current prices, making it the second-largest economy after the U.S. (IMF, 2012). As Perkins (2005) notes, this rate of growth could be sustained in the ranges of 8% to 10% a year for the next couple of decades. As a strategic power that is intent on rivaling the U.S., China is projected to surpass the U.S. in 2030 to become the world's largest economy (Maddison, 2006).

1995Q2 to 2009Q4. In addition, we adopt the sign restrictions identification strategy, instead of short- or long-term restrictions techniques, which appear to be too restrictive. This identification is based on the IS-LM framework, which is usually used in macroeconomics. Demand and supply shocks are identified in such a way that they explain a larger proportion of the Chinese GDP. In so doing, we are confident that these shocks have their origin in China instead of other BRICS countries. We then assess their effects on a set of BRIS variables.

There is a great deal of literature on China's economic influence on other countries. Studies in this area have been conducted at different levels. On regional level, Jenkins and Edwards (2006) examine the impact of China and India on Sub-Saharan Africa, looking at the channels through which the growth of the Asian Drivers is affecting Sub-Saharan Africa. Lederman, Olarreaga and Perry (2009) is another related study that focuses on the impact of the emergence of China and India on Latin America. Freund and Ozden (2006) undertook a similar exercise and find that export growth from China is hurting Latin America and the Caribbean region exports to third markets but only in some industries such as textiles, electronics and electrical appliances, and telecommunications equipment. Jenkins, Peters and Moreira (2008) investigate the impact of China on Latin American trade and foreign direct investment flows, and the results demonstrate that there are winners and losers in the region, both at the country and sector level.

On country level, Jenkins (2012) analyses the economic impacts of China's re-emergence on Brazil and finds that Brazil has benefited from trading with China in the short-run especially from the high prices of primary commodities, but has lost export markets to China in manufactures. Rangasamy and Swanepoel (2011) investigate China's impact on South African trade and inflation and the result suggests that the impact of China on South African trade balance is positive, but in terms of inflation the paper does not provide any convincing empirical results that inflation in China leads to domestic prices. More recently, Edwards and Jenkins (2013) undertook a similar study looking at the China's imports on manufacturing industry, employment and inflation in SA. Their results show that China's imports had negative impact on SA labour-intensive industries, which implies a negative impact on employment and its imports from SA increases in consumer prices.

Other studies such as those by Villoria (2012) and Eickmeier and Kühnlenz (2013) investigate the impact of China's growth on the international markets of agricultural products and its role in global inflation dynamics, respectively. Eickmeier and Kühnlenz (2013) find evidence of the impact of Chinese supply and demand shocks on global commodity prices. The results point to the important role played by demand shocks in

explaining recent dynamics in the rise in commodity prices and subsequently the effects of these shocks on global inflation. Finally, Bloom, Draca and Van Reenen (2011) study the impact of China on developed economies, and Hsieh and Ossa (2011) assess the welfare impact of the observed pattern of sector-level growth in China on fourteen major countries and four broad world regions. However, few studies have been done on the impact of China on BRIS countries, specifically looking at the impact of the Chinese demand and supply shocks on these countries.

The main feature of China's high performance is higher labour productivity as well as policy reforms. According to Eickmeier and Kühnlenz (2013), the demand shock in China is driven by massive domestic investments, which boosts exports of goods and services, and increase imports of commodities, and which in turn puts an upward pressure on export prices and commodity prices. Initially state-owned enterprises were the engine of the economy with large government support. However, recently private enterprises have overtaken state-owned enterprises as the environment has become more market friendly. Besides promoting trade, demand shocks have also put pressure on import prices domestically and globally (see Siklos and Zhang, 2010 and Eickmeier and Kühnlenz, 2013). On the other hand, the supply shock in China is mainly due to higher productivity (He, Chong and Shi, 2009; Gong and Li, 2010, and Autor, Dorn and Hanson, 2013) and the inception of China in The World Trade Organization (WTO) since 2001 (Gong and Li, 2010). Unlike demand shocks, supply shocks also have a deflationary effect as a result of low cost of production. Cargill and Parker (2004) argue that supply shock was behind deflation that China experienced in 2000. Consequently, the aggregate supply curve shifts downward and generates a permanent increase in domestic output coupled with a decrease in inflation. The impact of supply shock is not confined to China, but it is transmitted to the rest of the world via trade. As a result inflation declines globally due to supply of cheap products (Rangasamy and Swanepoel, 2011; Eickmeier and Kühnlenz, 2013; Diao, Zhang, and Chen, 2012; Barsky and Kilian, 2004; and Cargill and Parker, 2004). But more recently with the increase in middle income population, the cost of production in China has shown a rising trend.

The main findings of the paper are as follows. First, China's supply shocks are transmitted more forcefully than demand shocks to BRIS countries. Second, the reaction of BRIS to China's shocks varies across countries. For example, supply shocks have positive, permanent and significant effects on the output of all BRIS countries except India. Demand shocks have positive and significant effects on BRIS output, but the effects are temporary. Finally, the main channels of transmission for all shocks are exports and imports. The financial linkages are non-existent, which implies that the transmission channels are trade rather than financial. The responses of BRIS countries

are heterogeneous and therefore they require different policy responses. The BRIS should find a way tape into the Chinese market for their manufactured goods. This can be achieved through promotion of industrial policies that make companies, products, and labour market more competitive. Finally, China should open up its market to the other BRICS countries through bilateral trade agreements.

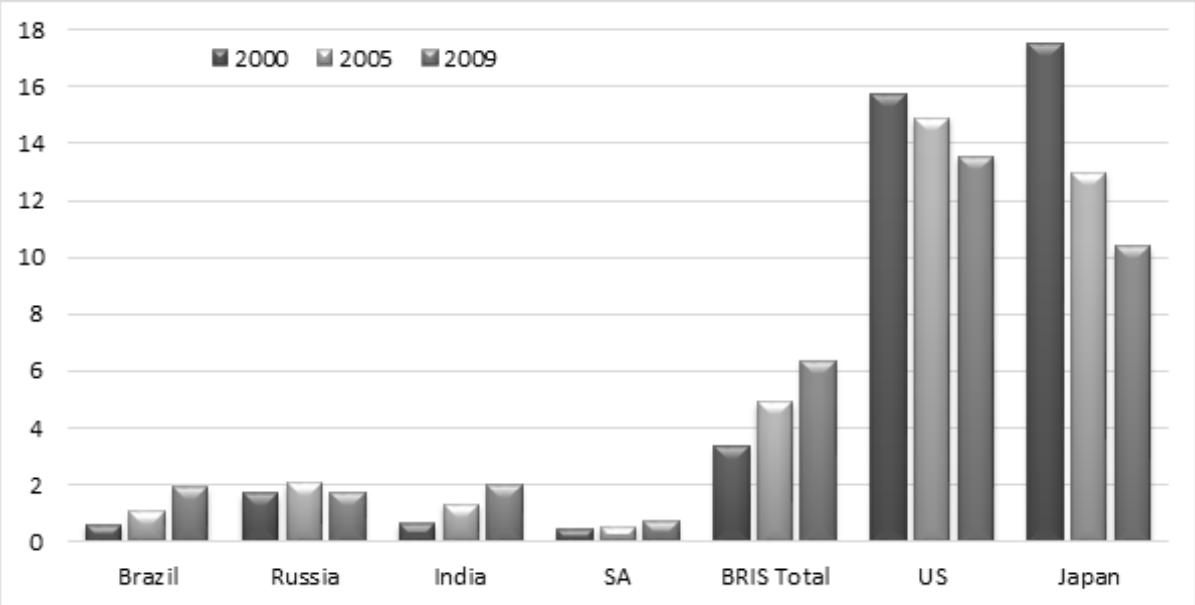
The rest of the paper is organized as follows. Section 2 describes the current patterns of China's economic integration with the world. Section 3 outlines the empirical model and discusses the identification of shocks. Section 4 analyses the data, their transformations and the estimation technique. Section 5 discusses the empirical results and the transmission channels. Section 6 concludes the paper.

2 China's economic integration with the world economy

There is already rich literature that focuses on China's trade and financial integration with the world (Cheung, Chinn and Fujii, 2005; Francois and Wignaraja, 2008; Bussiere and Schnatz, 2009; Ghosh and Rao, 2010, and Tokarick, 2011). The expansion of international trade has been a particularly remarkable aspect of China's rising prominence in the world economy.[2] International trade, and especially exports, is a major driver of economic growth of China. Taken together, exports and imports amount to a significant proportion of its GDP. China's largest trading partners in terms of total exports and imports are the U.S. and Japan (Figure 1). However, its trade with Japan and the U.S. has decreased somewhat over the last decade. For instance, its total trade with Japan and the U.S. decreased from around 17.5% to 10.3% and 15.7% to 13.5%, respectively. On the other hand, the importance of China for BRIS countries' trade has increased significantly over the past decade, from around 3.5% in 2000 to 6.4% in 2009. Over time, China's trade with Brazil and India has increased the most among the BRIS countries. SA and Russia have also managed to maintain and accelerate their trade ties with China (Figure 1).

[2]Between 1995 and 2009, China's exports and imports grew at an average rate of around 20% and 18%, but in 2009 they both decreased at around 16% and 11%, respectively. As a results China's share of world trade in 2012 is almost 11%, which makes the nation the world largest trading economy (IMF, 2012).

Figure 1: China's foreign trade with the BRIS (percentage)



Source: Direction of Trade Statistics, IMF, 2012.

This high growth in trade has been supported by large investment flows to China (Eichengreen and Tong, 2006). As the foreign direct investment (FDI) plays an important role in the globalization process and in promoting economic growth in host countries, especially developing countries (Hermes and Lensink, 2003; Melitz, 2005; Andreas, 2006; and Ndikumana and Verick, 2008), it can be argued that an important aspect of rapid emergence of China as an important player in the global economy is FDI. No other country in the world, besides the U.S., receives more FDI than China. China's efforts to attract FDI have been a successful story. From 1995 to 2010, for instance, China received an average of around 4% net FDI to GDP (WB, 2011). FDI in China is export-oriented and also directed in part to investment in infrastructure. The increased integration of China into the world economy has contributed to its rapid growth. Also, China's growth has benefited significantly from the worldwide fragmentation of production, where parts of the production chain have been moved to low-cost countries (Den Butter and Hayat, 2008). Bilateral FDI and portfolio flows between BRICS increasing lately, but they are very low compared to FDI and capital flows between each country and advanced economies. For instance, in terms of regional sources of FDI, Virgin Islands, British, is the largest source of FDI flows to China, flowed by Japan, Singapore and the U.S. (IMF, 2011).

Existing empirical results on the effects of FDI in China on FDI in other countries are mixed and have focused on the Asian countries and the Latin America and the Caribbean. For instance, the FDI to China has encouraged both horizontal and vertical FDI to other countries (Resmini and Siedschlag, 2013) and the emergence of China as a leading FDI destination has encouraged FDI flows to other Asian countries (Eichengreen and Tong, 2006). On the other hand, Mercereau (2005) finds, on average, FDI in China has had a negative effect on FDI in other Asian countries. The rising labour cost in the home country was a cause of the change in the FDI landscape (Tham, 2007), and the Chinese emergence of more attractive destinations for FDI (Hussain and Radelet, 2000).

As China's trade with the rest of the world has deepened, so the composition and geographical pattern of its trade has shifted. China's trade with the BRIS countries is also growing, and China is now among the most important export destinations for these economies. Table 1 shows the Chinese foreign trade with the BRIS countries from 2000 to 2009. According to the table, imports from and exports to the BRIS countries increased between 2000 and 2008, but following the financial crises for instance from 2008 to 2009 there is an overall decline in trade for all countries. In 2009, the BRIS countries combined accounted for 7.2 % of China's imports and 5.7% of China's exports. From the point of view of its source of imports among the BRIS, Russia was the main supplier of China until 2008. Russia's export growth was not as fast as Brazil's between 2000 and 2008. Brazil became China's biggest import market when its exports increased from US$ 1.6 billion in 2000 to US$ 29.6 billion, which accounts for 2.6% of China's total imports. China's imports from India and SA have also increased from US$ 1.3 billion and US$ 1 billion in 2000 to US$ 13.7 billion and US$ 8.7 billion in 2009, respectively. In terms of total exports, in 2000, Russia was the top export market for China's goods (US$ 2.2 billion), followed by India (US$ 1.5 billion), Brazil (US$ 1.2 billion) and SA (US$ 1 billion). However, in 2009, India overtook Russia, and became the leading export destination. Its exports to India increased to US$ 29.7 billion, accounting for 2.5% of China's total exports. China's exports to Russia, Brazil and SA have also increased, but its export growth to these countries was not as fast as India's.

As a consequence, China has provided an opportunity and a market for primary commodity exporters from developing countries. This has helped raise economic growth in a number of developing countries in recent years (Jenkins, 2008). Thus, the emergence of China as a large trading nation and destination of international investment is likely to have positive spillover effects on its trading partners. The question arises as to what extent this affects BRIS economies. This paper attempts to answer this question by identifying supply and demand shocks from China and investigating their transmission to BRIS countries.

Table 1: China's foreign trade with the BRIS countries, 2000-2009 (billion US dollar)

	Imports from				Exports to			
	Brazil	Russia	India	SA	Brazil	Russia	India	SA
2000	1,62	5,77	1,35	1,04	1,22	2,23	1,56	1,01
2001	2,35	7,96	1,70	1,17	1,36	2,71	1,90	1,05
2002	3,00	8,41	2,27	1,27	1,47	3,52	2,67	1,31
2003	5,84	9,73	4,25	1,84	2,14	6,03	3,34	2,03
2004	8,68	12,13	7,68	2,96	3,67	9,10	5,93	2,95
2005	9,98	15,89	9,78	3,44	4,83	13,21	8,94	3,83
2006	12,91	17,54	10,47	4,10	7,38	15,83	14,59	5,77
2007	18,34	19,63	14,66	6,61	11,38	28,48	24,04	7,43
2008	29,63	23,78	20,34	9,21	18,78	33,01	31,52	8,60
2009	28,31	21,10	13,72	8,68	14,13	17,52	29,68	7,37

[1]Source: Direction of Trade Statistics, IMF, 2012.

3 Methodology

This section includes two main steps. It firstly introduces the dynamic factor model used to extract common factors from a large panel of macroeconomic variables and financial variables. Secondly, it adopts a sign restriction procedure to identify structural shocks from China.[3]

3.1 The factor model

Factor analysis has increased in popularity in empirical macroeconomics because of its ability to accommodate large number of variables without facing the degrees-of-freedom problem.[4] Classical factor models were initiated by Sargent and Sims (1977) and Geweke (1977). These models have been applied by Singleton (1980), Chamberlain and Rothschild (1983), and Stock and Watson (1998), among others. The main idea of factor models is that all the information included in a large dataset can be captured by few key common factors. These factors represent the hidden forces underlying the co-movement of observable series. This co-movement in macroeconomics is due to a handful of common factors, such as productivity, monetary policy, trade linkages, financial linkages and oil price shocks. In this paper, the unobserved factors assist in the identification of supply and demand shocks. Various methods have been proposed to construct these common

[3]More details can be found in Forni and Lippi (2001), and Stock and Watson (2002a, 2002b).

[4]It has been used by Forni, Hallin, Lippi and Reichlin (2005), Kabundi (2009), Kabundi and Nadal De Simone (2011), Doz, Giannone and Reichlin (2011), Crucini, Kose and Otrok (2011), and Çakır and Kabundi (2013b).

factors, the simplest being the principal component analysis introduced by Stock and Watson (2002a).

Suppose there are N number of different observable economic variables, each one consisting of T observations. It is assumed that, for each observation in time t, all the N individuals partially depend on a small number, r, of non-observable, or latent common factors. Assume that Y_t is represented as the sum of the two latent components, a common component, $X_t = (x_{1t}, x_{2t}, ..., x_{Nt})'$, and the idiosyncratic component, $\Xi_t = (\varepsilon_{1t}, \varepsilon_{2t}, ..., \varepsilon_{Nt})'$. Thus, the dynamic factor model of Stock and Watson (1998, 2002a) can be represented as

$$Y_t = X_t + \Xi_t = \Lambda F_t + \Xi_t \tag{1}$$

where X is the vector of common components and $\Lambda = \left(\lambda_1^{'}, \lambda_2^{'}, ..., \lambda_N^{'}\right)'$ is the $N \times r$ matrix of factor loadings with $r \ll N$. $F_t = (f_{1t}, f_{2t}, ..., f_{rt})'$ is a vector of r common factors. The common component of each series is driven by a small number of shocks common to all variables. However, the effects of the common shocks are different for each variable because of the different factor loadings. The idiosyncratic component is the part of the series driven by idiosyncratic shocks that are specific to each variable or measurement errors, and they are orthogonal to common factors. Unlike the vector autoregressive (VAR) process, the factor model can accommodate a large number of variables. All the N series depend on r factors, meaning that there is a r-dimensional matrix representing the N series. Mathematically, we have

$$X_t = VV^{'}Y_t \tag{2}$$

where $V^{'}$ is the $N \times r$ matrix of eigenvectors corresponding to the largest r eigenvalues. The common factors, F_t, are estimated in a consistent manner using standard principal component analysis to Y_t,

$$F_t = V^{'}Y_t \tag{3}$$

where V is an estimate of the matrix of factor loadings, Λ in equation (1). Hence, the idiosyncratic component is

$$\Xi_t = Y_t - X_t \tag{4}$$

Lastly, as in Forni, Hallin, Lippi and Reichlin (2005), we estimate the dynamics of common factors by a VAR(1) as follows

$$F_t = \Psi F_{t-1} + \mu_t \tag{5}$$

where Ψ is a $r \times r$ matrix and μ_t a $r \times t$ vector of residuals. We allow the mild serial correlation of the idiosyncratic errors as in Chamberlain (1983) and Chamberlain and Rothschild (1983), but the weak correlation vanishes with the law of large numbers, allowing a better approximation of common factors.

3.2 Identification of structural shocks

The identification of structural shocks is based on the reduced-form VAR model in equation (5). The study follows the identification of supply and demand shocks based on sign restrictions imposed on short-run impulse response functions of variables of interest proposed by Faust (1998).[5]

In the first step, the reduced-form VAR residuals, μ_t, are orthogonalised using the Cholesky decomposition. The vector of orthogonalised residuals is $\upsilon_t = A^{-1}\mu_t$ and $E\left(\nu_t \nu_t^{'}\right) = 1$. Thus,

$$cov(\mu_t) = AE\left(\nu_t \nu_t^{'}\right) A^{'} = AA^{'} \tag{6}$$

with A being the $r \times r$ lower triangular Cholesky matrix.

In the second step, we identify the main driving forces behind China's GDP. This is achieved by extracting the shocks which maximize the changes in China's GDP of the k-step ahead of the forecast error variance out of the orthogonalized residuals.[6] The vector of the estimated main driving forces $\omega_t = (\omega_{1t}, \omega_{2t}, ..., \omega_{rt})^{'}$ is linearly correlated to the identified shocks through the $r \times r$ matrix Q. In so doing, we assure that the shocks observed are indeed from China. Hence, we have

$$\upsilon_t = Q\omega_t \tag{7}$$

The objective of the procedure is to choose Q so that the first shock explains as much as possible the forecast error variance of China's GDP over a certain horizon k, and the second shock explains as much as possible the remaining forecast error variances.

In the third step, orthogonal shocks are identified by rotation. We rotate υ_t and impose sign restrictions, as specified in Table 2, to identify Chinese supply and demand shocks given by $n_t = R\omega_t$. The vector of orthogonal two shocks, $\omega_t = (\omega_{1t}, \omega_{2t})$, is multiplied by any 2×2-dimensional orthogonal rotation matrix, R, of the form

$$R = \begin{pmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{pmatrix}$$

[5] These restrictions have gained popularity in empirical macroeconomics (see Uhlig, 2005; Peersman, 2005; Ruffer, Sanchez and Shen, 2007, and Kabundi and Nadal De Simone, 2011).

[6] In this case k is 20 quarters or five years.

with θ being the rotation angle, $\theta \in (0, \pi)$, which varies on a grid to produce all possible rotations. In this study, the angle of rotation is applied on the first two principal component shocks. To account for uncertainty in the factor estimation, we use the bootstrapping technique proposed by Kilian (1998) in constructing confidence bands.

The identification strategy is based on the aggregate demand and aggregate supply paradigm, which is the core of many macroeconomic textbooks. We have adopted this procedure to avoid the unrealistic identification strategies that are commonly used in the VAR framework setting to zero short-term restrictions and the long-run restrictions of Blanchard and Quah (1989).

Table 2: Sign Restrictions

Shocks	Output	Prices	Interest Rates
Positive Supply Shock	+	-	-
Positive Demand Shock	+	+	+

The sign restrictions used here are in line with a typical aggregate demand and aggregate supply diagram. In addition, they are consistent with the many theoretical models such as IS-LM model and the new Keynesian model used in the dynamic stochastic general equilibrium (DSGE) model of Smets and Wouters (2003). The positive demand shock shifts the aggregate demand curve upwards, while the positive supply shock shifts the aggregate supply curve downwards. Hence, the positive demand shock affects both domestic output and prices positively, whereas the positive supply shock has a positive effect on domestic output, but domestic prices react negatively. Thus, the central bank is likely to react to the supply shock by decreasing the nominal interest rates to account for price reduction and increasing them in the case of a positive demand to curb upward pressure on inflation.[7] Other variables are left unrestricted. If these shocks are correctly identified, the restricted variables - the output, prices, and short-term interest rates - should portray a pattern consistent with the restrictions imposed. Only then we can trust their transmissions to unrestricted variables domestically and their spillover to BRIS countries.

4 Data and Estimation

The dataset comprises a total of 161 ($N = 161$) quarterly variables, ranging from 1995Q2 to 2009Q4 which implies that $T = 59$. The reason for the choice of this timespan is the

[7]See Peersman, 2005; Fratzscher, Saborowski and Straub, 2010; Straub and Peersman, 2006, and Canova and Paustian, 2011 for more details on sign restrictions.

availability of data. Specifically, the dataset contains 32 variables for Brazil, 28 for China, 30 for India, 34 for Russia and 37 variables for SA. The dataset covers the real variables such as GDP, industrial production, consumption expenditure, investment, exports, imports; nominal variables, for instance, the consumer price index (CPI); and financial variables like interest rates, exchange rates, monetary aggregates, portfolio flows and direct investment flows. The series were obtained from International Financial Statistics (IFS) of the IMF, the Organization for Economic Cooperation and Development (OECD) and the GVAR Toolbox1.0 databases.[8] In order to be consistent, all variables are measured in U.S. dollars. They are included in the same dataset as in Eickmeier (2007), and Kabundi and Nadal De Simone (2011). We then use the IC_{p1} information criteria developed by Bai and Ng (2002) to determine the number of factors, which gives three common factors, $r = 3$. As pointed by Stock and Watson (2002b), increasing the number of factor does not alter the results, but it does lead to a degrees-of-freedom issue, given the small sample size.

Where appropriate, all series are seasonally adjusted using the $X12$ filter. They are transformed into logarithms, except those in percentages and those containing negative values. As required in the factor model, the series are transformed to induce stationarity using two unit root tests, namely the Augmented Dickey-Fuller (hereafter ADF) and Kwiatkowski, Phillips, Schmidt and Shin (1992, hereafter the KPSS). The KPSS test differs from the ADF tests in that the data series in the former are assumed to be trend-stationary and use the different null hypothesis of stationarity as opposed to nonstationarity. The variables and their transformations are provided in Table 4. The supply and demand shocks explains more than 90% of the error variance of Chinese GDP common component.

5 Empirical Results

This section presents empirical results in the form of the impulse response functions and the variance share of the common components. The impulse response analysis shows the direction, magnitude and time path of domestic variables from supply and demand shocks emanating from China. Figures 2-6 show the profiles of these variables for each of the BRICS countries, where the dotted lines indicate the 90% confidence intervals. They are calculated over 20 quarters. The variance share of the common component is useful, as it measures the importance of channels through which shocks are transmitted.

[8] The GVAR series are from http://www-cfap.jbs.cam.ac.uk/research/gvartoolbox/download.html

5.1 China's shocks

The impulse response functions of the China's supply and demand shocks and their impact on China's variables are depicted in Figure 2. The results show that the responses of output, interest rates and inflation to supply and demand shocks are consistent with the restrictions imposed in Section 3.2. The supply shocks increase output and lower interest rates. However, the response of inflation is positive, but insignificant.

In contrast to supply shocks, positive demand shocks induce an immediate increase in output, interest rates and inflation. It is more likely that supply shock in China is driven by an increase in productivity, which in turn leads to an improvement of quality of goods produced and a decline in cost of production. This is evident in that in the past three decades the country has experienced higher productivity (He, Chong and Shi, 2009; Gong and Li, 2010) with lower cost of production. High productivity combined with low cost of production pushes exports up and increases imports of raw materials. This is in line with the empirical work of Liu, Wang and Wei (2001), who find that growth of exports causes the growth of imports. While the supply shock is productivity-driven, the demand shock is driven by massive domestic investment (Eickmeier and Kühnlenz, 2013), which boosts output and drives export prices as well as commodity prices up (Cargill and Parker, 2004 and Diao, Zhang, and Chen, 2012).

Positive supply shocks have permanent and long-lasting effects on output, exports, imports, inward FDI flows and share prices. They record 1%, 0.5%, 0.8%, 1% and 0.7% increases in that order and stay high and significant. Industrial production responds strongly to supply shocks, increasing by 0.8%, and stays significant until the eighth quarter. However, the effects on outward FDI flows and short-term interest rates are insignificant. In general, by increasing productivity in China, supply shocks lead to an increase exports to BRIS. All goods that are produced are not consumed locally, and hence there is a substantial portion that is exported. Then exports to BRIS increases, distorting domestic production through outsourcing or simply they closing down, which means a decrease in wages in the BRIS. Autor, Dorn and Hanson (2013) show how the emergence of China has affected the labour market in the U.S. and in Brazil negatively, especially for the industries which are producing similar products. Recipient countries experience an exodus of labour from tradable industry to non-tradable industries. Due to outsourcing, FDI flows out of BRIS to support new industries in China. In addition, economic expansion in China due to higher productivity and low production cost attracts FDI from both advanced economies and emerging market economies in China.

Positive demand shocks, on the other hand, have positive but short-lived effects on output, exports, imports, and inward FDI flows. The immediate response of these variables to demand shocks is less than 0.5%, and the effect dies out after few quarters. The

effect of demand shocks on outward FDI flows, short-term interest rates and consumer prices is positive and significant, and stays high over the long term. Demand shocks encourage more import of raw materials. As import of raw materials increases, the outward FDI rises to support imports. Thus an increase demand for raw materials and agricultural products leads to an increase imports from China. As imports from China rise, exports of BRIS to China also in turn triggers exports, but this effect on export caused by a demand shock is less than the impact induced by a supply shock.

In general, supply shocks seem more important and persistent than demand shocks. These findings are consistent with the work of Kojima, Nakamura and Ohyama (2005), who point out that the increase in the China's GDP growth rate since 1998 indicates the existence of positive supply shocks. Supply shocks attract more inflows of foreign investments into the country, while demand shocks encourage outflows of foreign investments. Supply shocks have permanent positive effects on inward FDI flows, while demand shocks, on the other hand, have a positive and long-lasting impact on outward FDI flows. In addition, the effects of supply shocks on exports and imports are positive, and stay high and significant over the entire period. As expected by theory, both exports and imports react to a positive demand shock. The effects are positive and short-lived on both variables. These findings are in line with the nature of China's economy, which exhibits a significant current account surplus. The findings are further shown to be consistent with the data and the literature, as the average share of international trade (exports and imports) amounts to a significant proportion of China's GDP (WB, 2011).

5.2 Transmission of China's shocks to BRIS

Figures 3-6 present the impact of China's supply and demand shocks on the BRIS variables. Better performance of the Chinese economy leads to a higher demand for raw materials from emerging markets, namely (in the case of the present study), Brazil, Russia and SA. Thus, China's supply shocks have a permanent and long-lasting effect on both the exports and imports of all BRIS countries. Secondly, since supply shocks induce downward pressure on global inflation through low cost of production, Chinese products are cheap and of better quality. These products are now very attractive in both advanced economies and emerging market economies. Hence, by increasing Chinese exports, supply shocks boost imports in BRIS countries. China's supply shocks have a permanent and long-lasting effect on both the exports and imports of all BRIS countries. This finding is in line with Freund and Ozden (2006) who carry out an exercise and find that China is displacing Central American exports mostly in sectors associated with relatively high-wage producing countries. For instance, supply shock in Brazil lead to an impact on tradable sector which lead to a decrease in employment in that sector.

Ultimately, the permanent increase in exports feeds into a rise in output from recipient countries. Real outputs in all countries rise and stay high for the entire period, except for India. The impacts vary across countries, with the highest response recorded in Brazil and Russia. They both record a 1% rise immediately after the shock and increase to 1.5% and 1.7% by the fourth and fifth quarters respectively. The supply shocks are transmitted to SA's output much less forcefully than to Brazil and Russia. On impact, SA output increases to 0.2% and reaches a maximum of 0.4% in quarter four. In the case of India, positive supply shocks are positively transmitted to its output, but the effect is significant only for short horizons. Unlike other BRIS countries that exports raw materials, India trade with China is more of a North-North type rather than North-South.

Positive supply shocks have positive and short-lived effects on SA's FDI inflows and India's FDI inflows and FDI outflows. The shocks, however, are negatively transmitted to SA's and Russia's FDI outflows and Brazil's FDI inflows. On the other hand, China's supply shocks have a positive, significant and long-lasting impact on Russia's FDI inflows. Recent movements in FDI flows between China and BRIS support existing trade linkages. These results are consistent with the study by Liu, Wang, and Wei (2001), who find evidence of a relationship between inward FDI flows and better economic performance in China and by Kueh, Puah and Apoi (2008), who find positive relationship between trade openness and Malaysia's outward FDI in the short and long-run besides other macroeconomic determinants like income and real effective exchange rate.

As discussed in Section 5.1 and consistent with Eickmeier and Kühnlenz (2013), supply shocks in China put downward pressure on global inflation. BRIS monetary authorities react to a decrease in inflation by decreasing short-term interest rates. SA is the most affected, with a recorded drop of 3% immediately after the shock, reaching 4% in the third quarter, while the maximum decline for other BRIS countries varies between 0.1% and 1%.

In general, positive demand shocks from China are transmitted in a similar fashion across all BRIS countries. They affect both the exports and imports of BRIS countries in the short run, and the impacts die out gradually. These effects are then translated into a positive and short-lived rise in output. Brazil's, Russia's, and SA's outputs increase by 0.05%, 0.03%, and 0.002% respectively. The effect on India's GDP is permanent, although weak. It reaches a maximum of 0.002% in quarter four. Both FDI inflows and outflows drop, except for FDI inflows in Russia, which show a short-term increase. In contrast to supply shocks, Eickmeier and Kühnlenz (2013) find evidence that China's demand shocks contribute largely to global inflation. Figures 3-6 depict the reaction of BRIS to the upward trend in inflation by increasing short-term interest rates.

It is evident from the above analysis that both Chinese supply and demand shocks affect all BRIS countries. The findings are consistent with Cesa-Bianchi, Pesaran, Rebucci and Xu (2012) and Eickmeier and Kühnlenz (2013). But the analysis is silent on channels through which the shocks are transmitted. Table 3 presents the variance shares of common components, which measure the degree of variation of each variable attributable to Chinese factors. Variance shares of common components are 48%, 26%, 63%, and 58% for imports of Brazil, Russia, India, and SA, respectively, while we have 39%, 66%, 48%, and 55% for exports of the same countries in the same order. But financial variables exhibit low variance shares of common components. Therefore, these results point to the relevance of trade as the main channel of transmission of shocks rather than financial linkages. These findings are consistent with Çakır and Kabundi (2013a), who find strong trade linkages among BRICS. Finally, high variance shares for short-term interest rates, namely 41% for SA, 44% for Brazil, 54% for Russia, and 67% for India, can be explained by synchronization in reaction of monetary authorities to common shocks, such as global inflation.

Table 3: Variance Shares of the Common Components of BRIS

Variables	Brazil	Russia	India	South Africa
GDP	0.16	0.26	0.00	0.48
Consumer prices	0.27	0.30	0.02	0.09
FDI inflows	0.12	0.07	0.18	0.02
FDI outflows	0.04	0.01	0.00	0.20
Exports	0.39	0.66	0.48	0.55
Imports	0.48	0.26	0.63	0.58
Industrial production	0.48	0.03	0.20	0.53
Real effective exchange rate	0.25	0.14	0.03	0.24
Short-term interest rates	0.44	0.54	0.67	0.41

Overall, the shocks affect BRIS countries differently based on their trade relationship with China. Hence, it can be argued that since China's supply and demand shocks do not have similar effects on the BRIS countries, they require different policy responses. Differences in response depend on products that are traded. China mainly exports manufactured goods to these countries and imports natural resources (Rangasamy and Swanepoel, 2011 and Jenkins, 2012). For instance, commodities especially metal products dominate SA exports to China (Rangasamy and Swanepoel, 2011) while SA's imports from China mainly consist of consist of machinery and electrical equipment, textiles, clothing and footwear (Çakır and Kabundi, 2013a). Brazil's exports to China are

commonly concentrated in a small number of primary products while its imports from China consist mainly of manufactured goods (Jenkins, 2012). Given that oil is an indispensable commodity for the expansion of the Chinese economy and it makes up a large proportion of Russian export to China, one would expect that the trade between China and Russia would affect the latter more than SA. This is why different countries have different reaction to shocks. But they import similar products from China. In addition, the reaction of BRIS depends largely on the structure of their industry (Jenkins, 2012; Vadra, 2012; He, 2013, and Besada, Tok and Winters, 2013). Specifically, the most affected industry is textile and manufacturing. Even though the rise of China has been generally positive for BRIS, as an alternative to trade with advanced economies (AEs), China has benefited a great deal from trade.

This trade imbalance is a result of the structure of the Chinese economy, which is mostly closed to external competition. BRIS countries should find ways of penetrating the Chinese market. If they succeed, they will benefit enormously due to the size of the market which is related to the size of the population. In addition, the rise of the middle class in China creates immense opportunities for many countries. However, the challenge is that any country aspiring to penetrate the Chinese market should be at least as competitive as China. Or they should identify niche markets where they have a competitive advantage. One way of achieving this is through the support of government or the adoption of industrial policies that enhance competitiveness of some industries with a flexible labour market. For example, South-East Asian countries such as Bangladesh and Vietnam have embarked in reforms which have made them more competitive than China, especially in the textile industry. Similarly, India has followed a similar approach in the pharmaceutical industry and thus it has emerged as one of the fast growing pharmaceutical industries in the world with growing trade surpluses (Pradhan, 2006).

6 Conclusions

Since China's emergence as a major player into the global economy, there has been increasing interest among policymakers and academics in examining its impact on the other countries, especially developing ones. This paper investigates the impact of China's shocks on the BRIS countries. In particular, two types of shocks, namely positive supply and demand shocks, are used to assess the time profile of the effects of these shocks. It uses a large-dimensional dynamic factor model with quarterly data from 1995Q2 to 2009Q2.

The findings show that China's shocks do have different impacts on each of the BRIS

countries. For instance, supply shocks are more forcefully transmitted to BRIS than the demand shocks. They have a permanent, positive and significant effect on real output in all countries, except for India. In the case of India, the effect is positive and significant only for short horizons. In addition, the main channels of transmission of all shocks are exports and imports between China and Brazil, but mainly imports; exports and imports between China and Russia, but more exports; more exports but less imports between China and India and roughly equal exports and imports between China and SA. This shows that, across China and BRIS countries, transmission channels are mainly trade rather than financial. Financial linkages are almost non-existent. This seems to suggest that China is a dominant powerhouse when it comes to trade, but financial integration with BRIS is still in its infancy. China's significant demand of raw materials seems to track positive supply shocks, which explains why it seems to affect positively Brazil, Russia and South Africa. It is then possible to refer to the increased volume of trade and investment between China and BRIS countries as evidence of increased international economic integration. As the BRIS are not trading the same product with China, they have different reaction to China's shocks.

Even though the BRIS have benefited from trading with China, the gain is minute in comparison to China. In order to correct this imbalance, the BRIS countries should embark on policy reforms which would increase their competitiveness and thus enable them to penetrate the opaque Chinese market of manufactured goods and services. This can be done via government support and/or reform of labour and product markets.

Figure 2: Impulse-Response Functions of Chinese Variables

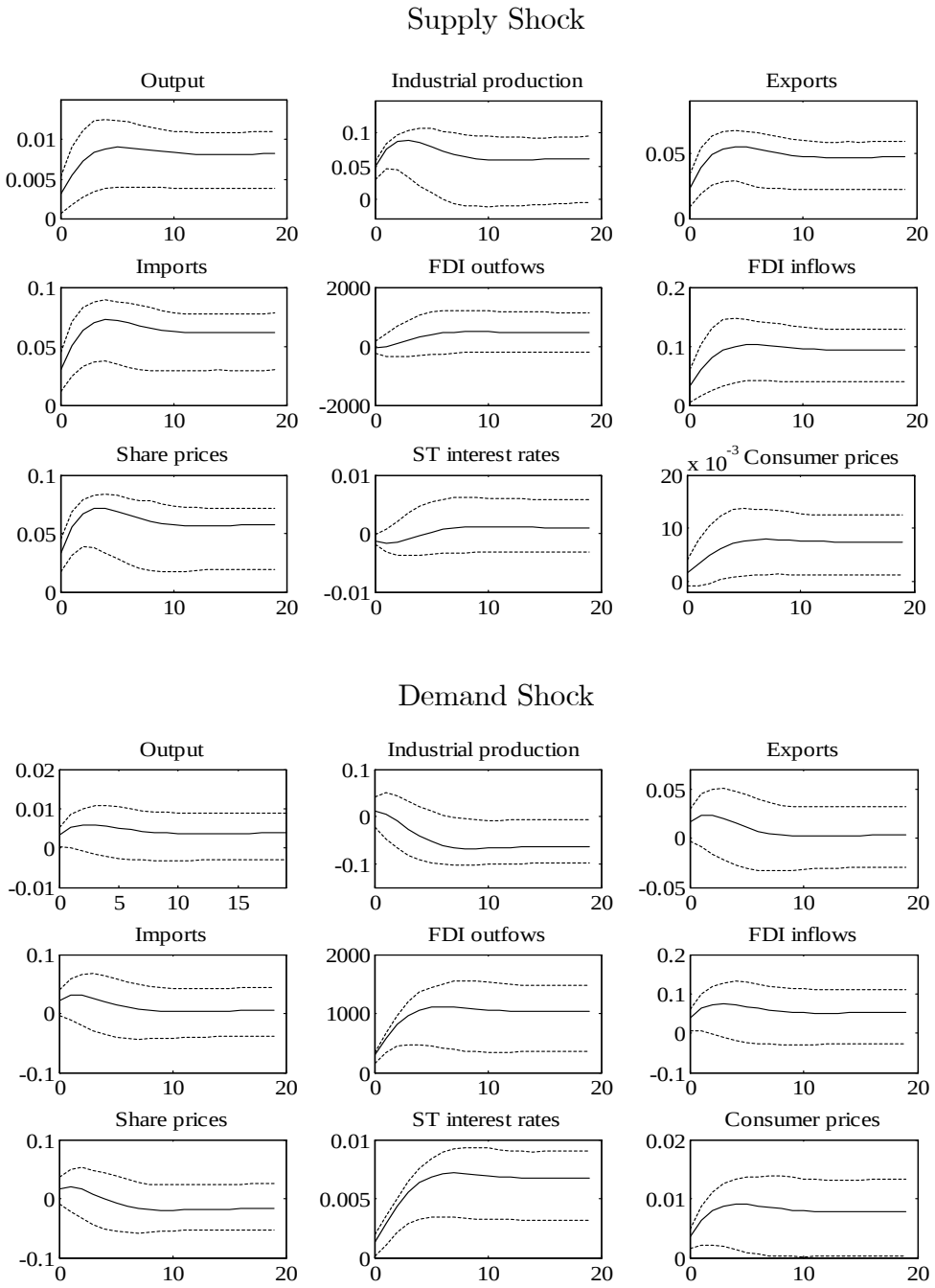


Figure 3: Impulse-Response Functions of Brazilian Variables

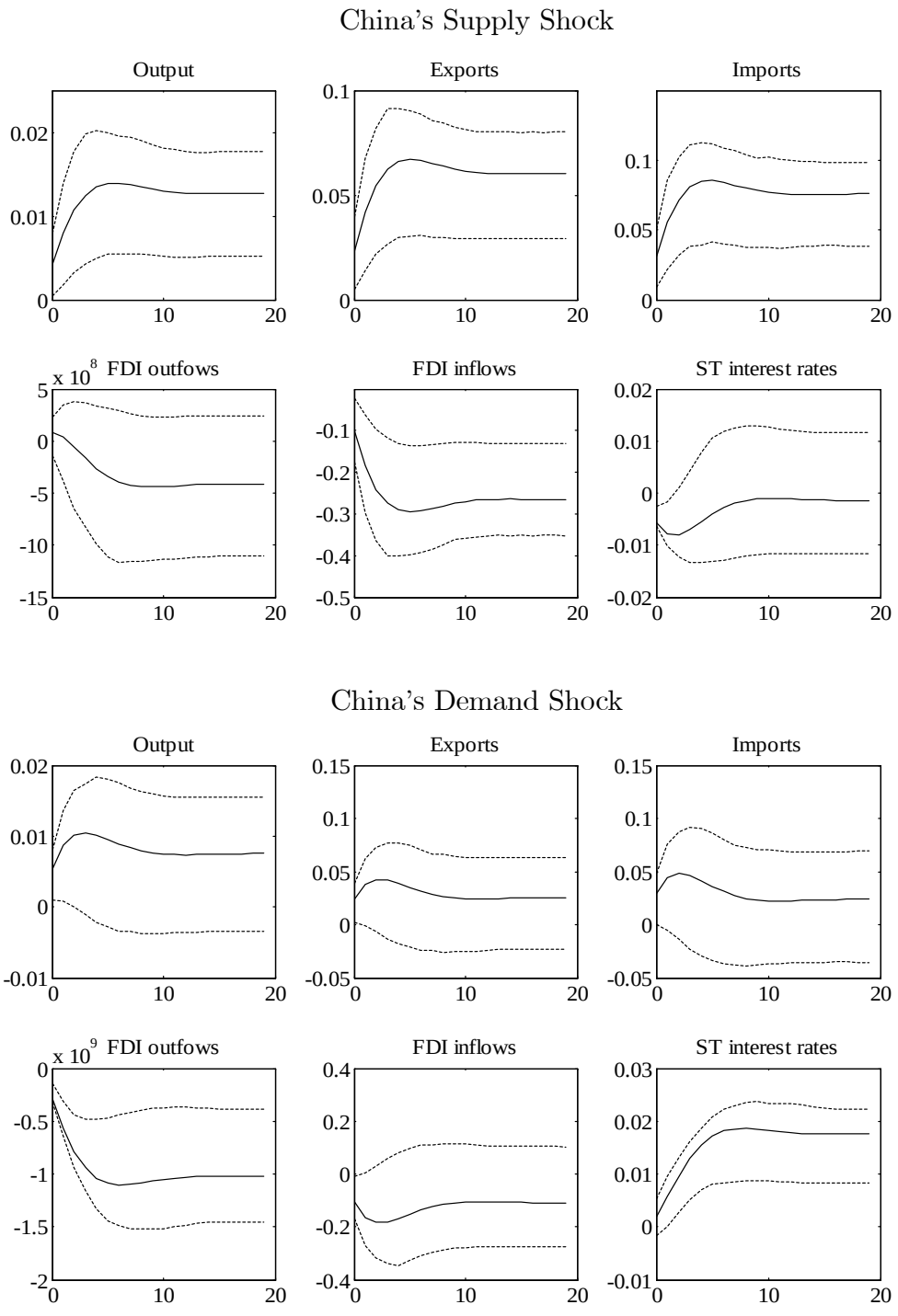


Figure 4: Impulse-Response Functions of Russian Variables

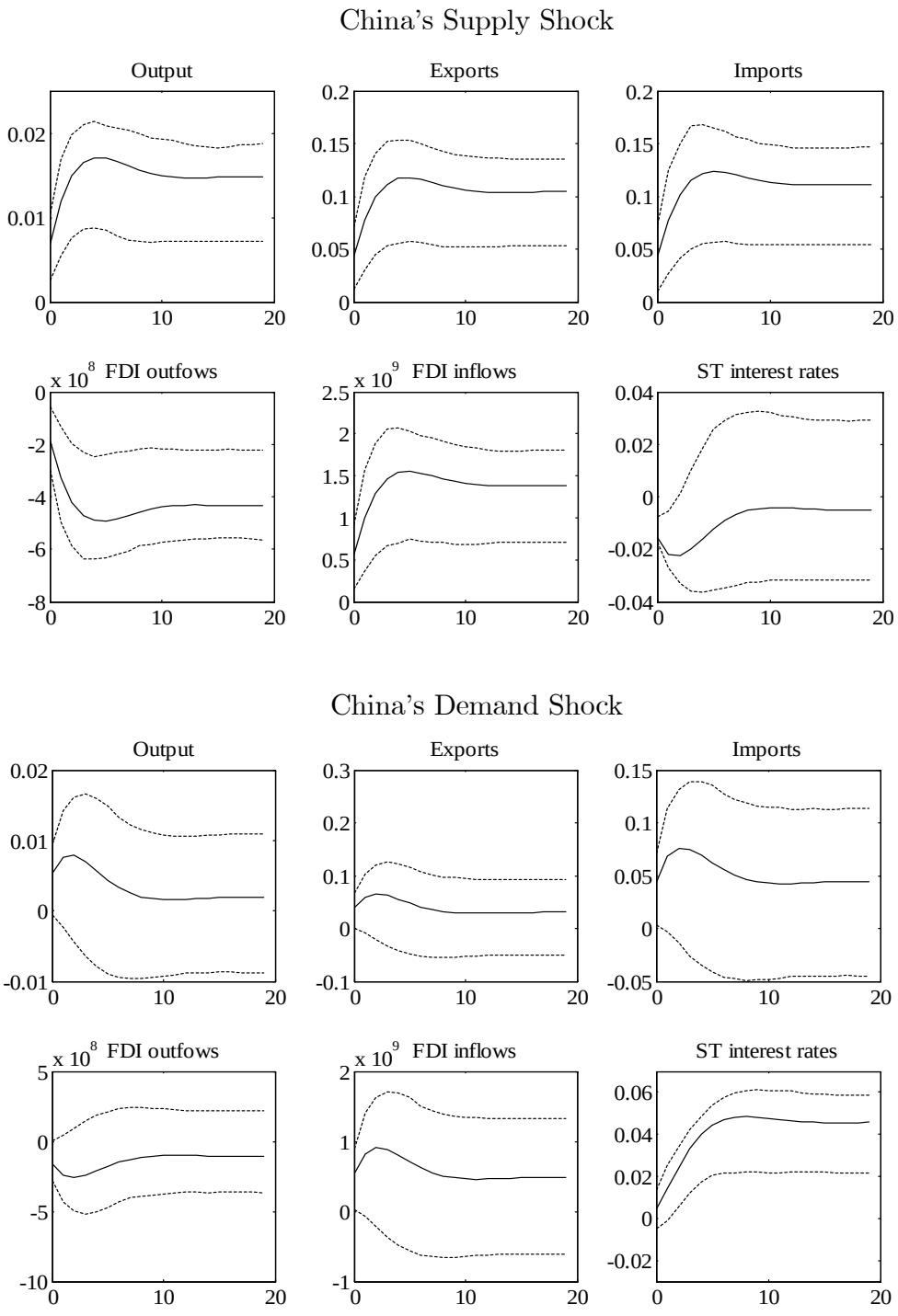


Figure 5: Impulse-Response Functions of Indian Variables

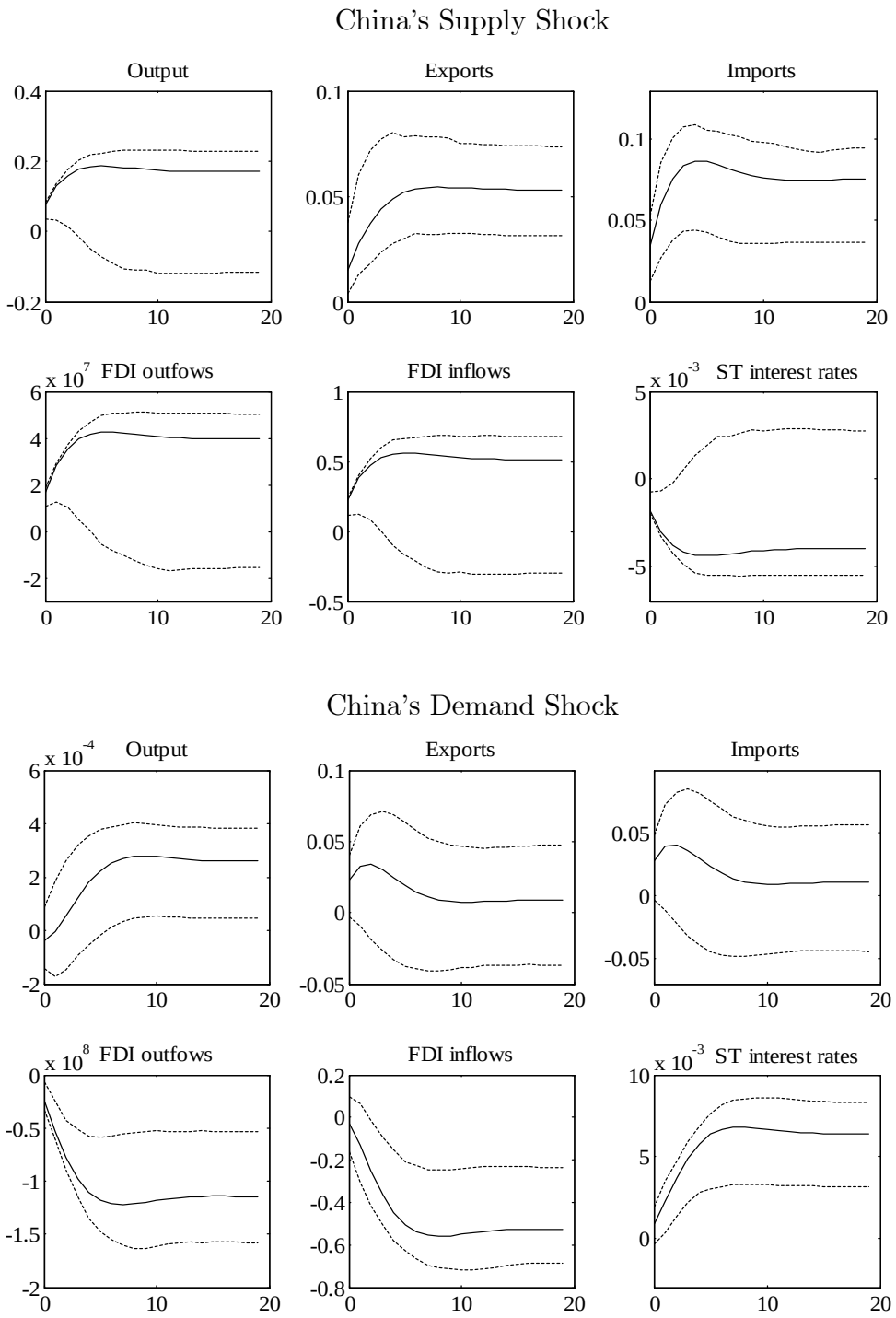


Figure 6: Impulse-Response Functions of SA Variables

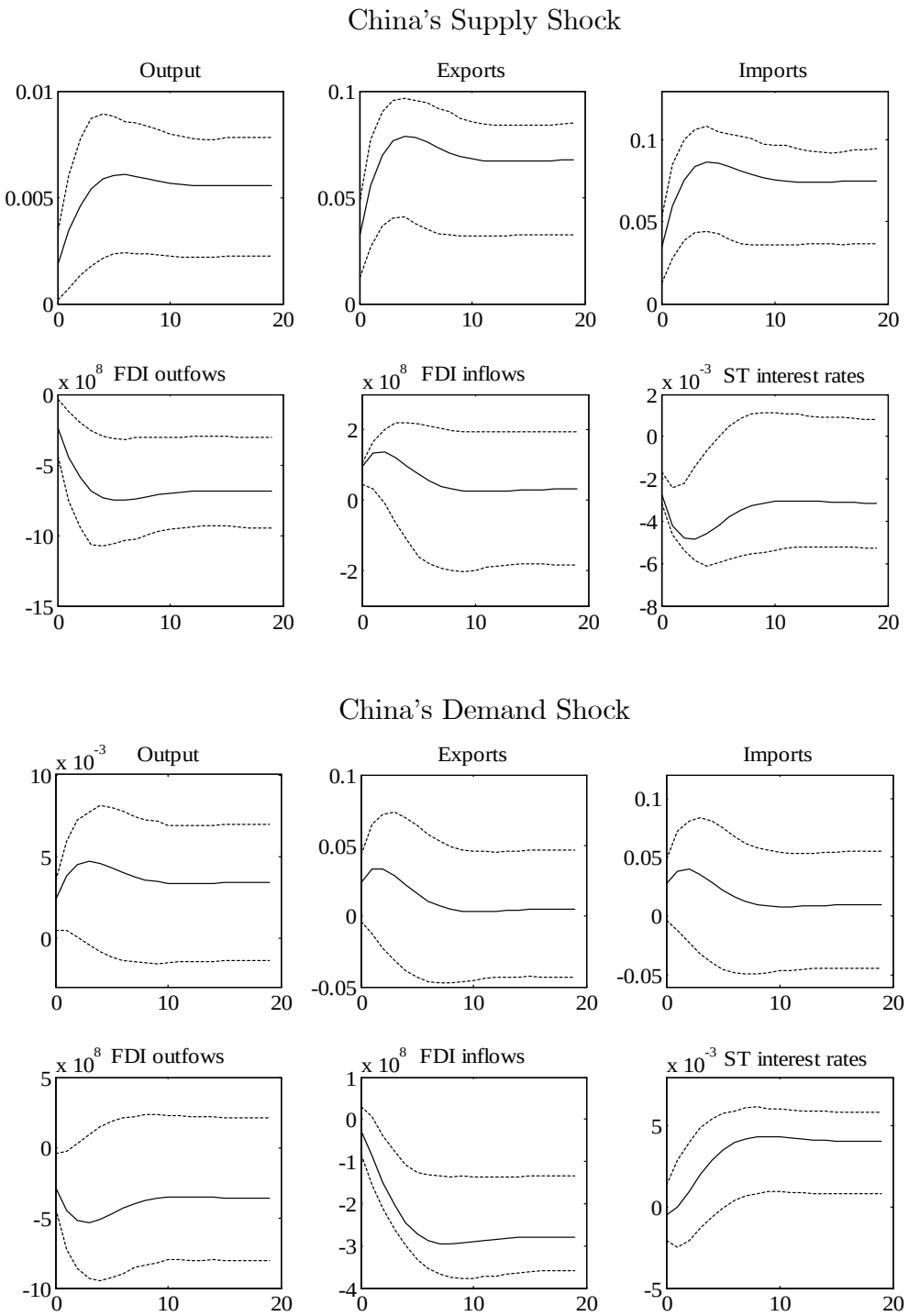


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Table 4: Macroeconomic Series

No	Country	Variable	Log	Stationarity	Treatment
1	Brazil	Monetary aggregate (M1) sa	l	1	5
2	Brazil	Monetary aggregate (M2) sa	l	1	5
3	Brazil	Monetary aggregate (M3)	l	1	5
4	Brazil	National currency per US dollar sa	l	1	5
5	Brazil	NEER from ins (index)	l	1	5
6	Brazil	REER based on rel. cpi (index) sa	l	1	5
7	Brazil	Gold in million ounces	l	1	5
8	Brazil	Savings deposits	nl	1	2
9	Brazil	Time deposits	nl	1	2
10	Brazil	Share prices (index)	l	1	5
11	Brazil	PPI / WPI (index) sa	l	1	5
12	Brazil	National CPI (index) sa	l	1	5
13	Brazil	Industrial production (index) sa	l	1	5
14	Brazil	Production of crude petroleum	l	1	5
15	Brazil	Production in total mining	l	1	5
16	Brazil	Production in total manufacturing sa	l	1	5
17	Brazil	Production of total construction sa	l	1	5
18	Brazil	Exports, f.o.b. (flow) sa	l	1	5
19	Brazil	Imports, c.i.f. (flow) sa	l	1	5
20	Brazil	Current transfers: credit (flow)	l	1	5
21	Brazil	Current transfers: debit (flow) sa	nl	1	2
22	Brazil	Direct investment abroad	nl	0	1
23	Brazil	Direct invest. in rep. economy	l	0	4
24	Brazil	Portfolio investment assets (flow)	nl	1	2
25	Brazil	Portfolio investment liabilities (flow)	nl	0	1
26	Brazil	Reserve assets (flow)	nl	0	1
27	Brazil	Government consumption expend. sa	l	1	5
28	Brazil	Gross fixed capital formation sa	l	1	5
29	Brazil	Household cons. expenditure	l	1	5
30	Brazil	GDP vol. (index) sa	l	1	5
31	Brazil	Short-term interest rates	nl	1	2
32	Brazil	Total reserves minus gold	l	1	5
33	China	Bonds (stock)	l	1	5
34	China	Capital accounts (stock)	l	1	5
35	China	Consumer prices: all items (index) sa	l	1	5
36	China	Consumer prices: food (index) sa	l	1	5
37	China	Demand deposits (stock) sa	l	1	5
38	China	Direct invest. in rep. economy	l	1	5
39	China	Direct investment abroad	nl	1	2
40	China	Exports, f.o.b. (flow) sa	l	1	5
41	China	Foreign assets (stock)	l	1	5
42	China	Foreign liabilities (stock)	l	1	5
43	China	GDP vol. (index, 2005=100)	l	1	5
44	China	Gold ac.to national valuation (stock)	l	1	5
45	China	Imports, c.i.f. (flow) sa	l	1	5
46	China	Industrial production (index)	l	1	5
47	China	Monetary aggregate (M1) sa	l	1	5
48	China	Monetary aggregate (M2)	l	1	5
49	China	Money (stock) sa	l	0	4
50	China	National currency per US dollar	l	1	5
51	China	NEER from ins (index) sa	l	1	5
52	China	Production of cement sa	l	1	5
53	China	REER based on rel. cpi (index) sa	l	1	5
54	China	Reserve money (stock) sa	l	1	5
55	China	Restricted deposits	l	0	4
56	China	Savings deposits (stock)	l	1	5
57	China	Share prices (index)	l	1	5
58	China	Short-term interest rates	nl	1	5
59	China	Time deposits (stock) sa	l	1	5
60	China	Total reserves minus gold (stock) sa	l	1	5

No	Country	Variable	Log	Stationarity	Treatment
61	India	Consumer prices: all items (index) sa	l	1	5
62	India	Demand deposits (stock) sa	l	1	5
63	India	Dir. invest. in rep. economy	l	0	4
64	India	Direct investment abroad	nl	1	2
65	India	Equity price (index)	l	1	5
66	India	Foreign assets (stock) sa	l	1	5
67	India	Foreign liabilities (stock) sa	l	1	5
68	India	GDP vol. (index, 2005=100)	l	1	5
69	India	Exports: f.o.b. total sa	l	1	5
70	India	Imports: c.i.f. total sa	l	1	5
71	India	Government deposits (stock)	l	1	5
72	India	Industrial production (index) sa	l	1	5
73	India	Lending rate (percent per annum)	nl	1	2
74	India	Monetary aggregate (M1) sa	l	1	5
75	India	Monetary aggregate (M3) sa	l	1	5
76	India	Money (stock) sa	l	1	5
77	India	National currency per US dollar, sa	l	1	5
78	India	Portfolio investment liabilities (flow)	nl	0	1
79	India	PPI / WPI (index, 2005=100) sa	l	0	4
80	India	Production in total manufacturing sa	l	1	5
81	India	Production in total mining (index) sa	l	1	5
82	India	Production of electricity (index) sa	l	1	5
83	India	REER based on rel. CPI (index) sa	l	1	5
84	India	Reserve assets (flow)	nl	0	1
85	India	Reserve money (stock) sa	l	1	5
86	India	Reserve position in the fund (US dollars)	l	1	5
87	India	Share prices (index)	l	1	5
88	India	Short-term interest rates	nl	1	5
89	India	Time deposits (stock) sa	l	1	5
90	India	Total reserves minus gold (US dollars) sa	l	1	5
91	Russia	Capital account: credit (flow)	l	0	4
92	Russia	Capital account: debit (flow)	nl	0	1
93	Russia	Consumer price index (index) sa	l	1	5
94	Russia	Consumer prices: food (index) sa	l	1	5
95	Russia	Consumer prices: services (index)	l	1	5
96	Russia	Current transfers: credit (flow) sa	l	1	5
97	Russia	Current transfers: debit (flow) sa	nl	1	2
98	Russia	Deposit rate (percent per annum) sa	l	1	5
99	Russia	Direct invest. in rep. economy	nl	1	2
100	Russia	Direct investment abroad	nl	1	2
101	Russia	Employment (index, 2005=100)	l	1	5
102	Russia	Exports, f.o.b. (flow) sa	l	1	5
103	Russia	GDP vol. (index, 2005=100) sa	l	1	5
104	Russia	Gold in million ounces (stock)	l	1	5
105	Russia	Government consumption expenditure (flow)	l	1	5
106	Russia	Gross fixed capital formation (flow)	l	1	5
107	Russia	Household cons. expenditure (flow) sa	l	1	5
108	Russia	Imports, c.i.f. (flow)	l	1	5
109	Russia	Industrial production (index) sa	l	1	5
110	Russia	Lending rate (percent per annum)	l	1	5
111	Russia	National currency per US dollar	l	1	5
112	Russia	NEER from ins (index)	l	1	5
113	Russia	Portfolio investment assets (flow)	nl	0	1
114	Russia	Portfolio investment liabilities (flow)	nl	0	1
115	Russia	Private final consumption expenditure sa	l	1	5
116	Russia	Production of coal (units, tonnes mln) sa	l	0	5
117	Russia	Production of crude petroleum (index) sa	l	1	4
118	Russia	Production of gas (units, mş bln) sa	l	0	5
119	Russia	REER based on rel. CPI (index) sa	l	1	5
120	Russia	Refinancing rate	l	1	5

No	Country	Variable	Log	Stationarity	Treatment
121	Russia	Reserve assets (flow)	nl	0	1
122	Russia	Reserve position in the fund (US dollars)	l	1	5
123	Russia	Short-term interest rates	l	1	5
124	Russia	Total reserves minus gold (stock) sa	l	1	5
125	South Africa	Capital account: debit (flow)	nl	0	1
126	South Africa	Consumer price index (index) sa	l	1	5
127	South Africa	Consumption of fixed capital sa	l	1	5
128	South Africa	Current transfers: credit (flow)	l	1	5
129	South Africa	Current transfers: debit (flow)	nl	1	2
130	South Africa	Deposit rate (percent per annum)	nl	1	2
131	South Africa	Direct invest. in rep. economy	nl	0	1
132	South Africa	Direct investment abroad	nl	0	1
133	South Africa	Discount rate (percent per annum)	nl	0	1
134	South Africa	GDP deflator (index, 2005=100) sa	l	1	5
135	South Africa	GDP vol. (index, 2005=100) sa	l	1	5
136	South Africa	Gold production (index) sa	l	1	5
137	South Africa	Exports: f.o.b. total sa	l	1	5
138	South Africa	Imports: c.i.f. total sa	l	1	5
139	South Africa	Government bond yield sa	nl	1	2
140	South Africa	Government consumption expend. sa	l	1	5
141	South Africa	Gross fixed capital formation sa	l	1	5
142	South Africa	Household cons. expenditure sa	l	1	5
143	South Africa	Lending rate (percent per annum)	nl	1	2
144	South Africa	Manufacturing production (index) sa	l	1	5
145	South Africa	Mining production (index) sa	l	1	5
146	South Africa	Monetary aggregate (M1) sa	l	1	5
147	South Africa	Monetary aggregate (M2) sa	l	1	5
148	South Africa	Monetary aggregate (M3) sa	l	1	5
149	South Africa	Money market rate (percent)	nl	1	2
150	South Africa	National currency per US dollar	l	1	5
151	South Africa	NEER from ins (index)	l	1	5
152	South Africa	Portfolio investment assets (flow)	nl	0	1
153	South Africa	Portfolio investment liabilities (flow)	nl	0	1
154	South Africa	PPI / WPI (index, 2005=100) sa	l	0	4
155	South Africa	Private final con. expend. (index) sa	l	1	5
156	South Africa	REER based on rel. cpi (index)	l	1	5
157	South Africa	Reserve assets (flow)	nl	0	1
158	South Africa	Reserve position in the fund (US dollars) sa	l	1	5
159	South Africa	Share prices: all shares (index) sa	l	1	5
160	South Africa	Short-term interest rates (percent)	nl	1	2
161	South Africa	Total reserves minus gold (stock)	l	1	5

[2]Notes: The transformation codes (treatment) are as follows: 1 - no transformation (level); 2 - first difference; 4 - logarithm (log-level); 5 - first difference of logarithm (log-first difference). sa denotes seasonally adjusted series; l stands for logarithm; nl indicates the level of the data; 0 denotes integrated of order zero; 1 represents the first difference of the series. The data are available over the 1995Q2-2009Q4 period.