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Title of Paper

The Rise of China and its Implications for the Global Economy - Evidence from a GVAR model

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Abstract

This paper studies the role of country laws that protect employment in cross-border merger decisions and merger premiums. I find that cross-border mergers are more common in countries with stricter labor regulation. Cross-border deals typically involve targets from countries with more restrictive labor laws than those of their acquirers. Targets receive higher premiums if their acquirers are from countries with more flexible labor laws. The effects of labor laws are more pronounced in innovation-intensive sectors. The results are consistent with the hypothesis that stricter labor laws, by helping countries to generate comparative advantage in innovation, facilitate value-maximizing cross-border mergers.

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The Rise of China and its Implications for the Global Economy - Evidence from a GVAR model*

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Abstract

This paper studies empirically the role of China in the world economy. We examine both the way the Chinese economy reacts to exchange rate shocks and the repercussions for the world economy of an output shock emanating from China. Based on a global VAR (GVAR) model and a new data set that excels in country coverage and covers the most recent time period including the global financial crisis, our results are threefold: First, we show that a +1% shock to Chinese output translates to a permanent increase of 1.1% in Chinese real GDP and a 0.1% to 0.5% rise in output for most large economies. Secondly, to benchmark the shock to Chinese output, we examine the response to a +1% shock to US GDP. The results show that the US economy remains dominant in the world economy, as output rises in other advanced economies by 0.6% to 1%. By contrast, China seems to be little affected by the US shock. Finally, we are the first to assess the impact of a real appreciation of the renminbi versus the USD in a global model. Our results indicate that real appreciation of the renminbi decreases the level of Chinese GDP slightly and the long-run effect is also negative for many countries exporting e.g. raw materials to China.

Keywords: China, macroeconomic shocks, GVAR, great recession

JEL Classification: C32, F44, E32, O54

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1. Introduction – The rise of China and its role in the global economy

China's economic growth since the 1980s has been enormous. The Chinese growth miracle has been fueled by a buoyant investments coupled with strong growth in exports. Even during the global financial crisis, with the global economy sliding into recession and global trade collapsing, the Chinese economy was able to post healthy growth rates. Many other emerging markets have also grown rapidly in recent years, which has shifted the balance of power in the global economy towards middle-income countries and away from high-income OECD countries. This change in the composition of global output and trade makes the analysis of the larger emerging markets, and especially China, even more important than before. Our contribution concerns the role of China in the global economy, both concerning its output and exchange rate.

The rise of the Chinese economy is accompanied by a steady increase in its trade integration with the world economy. Figure 1 depicts the share of trade (goods imports and exports) with China in total foreign trade for a number of countries over the period from 1995 to 2011. The graph illustrates a surge in China's trade integration with Asia, especially with Japan, whose share in China trade bounded from 10% in 1995 to 25% in 2011. Trade integration with other large economies such as the US, India, Brazil and Russia rose to around 10% in 2011, while that of the euro area increased to about 5%.

There are several studies that examine the impact of macroeconomic shocks on China, but there are only a few that embed the Chinese economy into a global context. On one hand, trade and consequently the relocation of production based on comparative advantage, fosters economic growth across the globe. On the other hand, the recent global financial crisis produced evidence of the danger of stress spilling over via the trade channel. It is thus natural to study the impact of macroeconomic shocks by means of a global model that includes the interdependencies among the economies. There are three recent studies that look at the impact of an increase in Chinese real output on the world economy, using a global vector autoregressive (GVAR) model. Cesa-Bianchi et al. (2012) demonstrated the growing importance of China for the region of Latin America.

In particular, they show that the impact of a positive shock to Chinese output has increased almost threefold compared to the same shock in the context of the 1990s' trade flows in accounting for the integration of China with the world economy. In the same vein, Cesa-Bianchi et al. (2012) demonstrate that the response of the Latin American region to a shock emanating from the US has halved as a consequence of the rise of China in the world economy.[1] Using the same empirical framework, Dreger and Zhang (2011) trace the impact of a +1% change in Chinese GDP on inflation and real economic performance in the industrialized countries. Their results show that the impact on output is substantial for the Asian region, while the effects on the US economy and the euro area are less pronounced. In contrast to this result, Chen et al. (2012) report that a China shock is only marginally important for other Asian economies, including Japan. Shocks emanating from the US are more important for the smaller Asian economies.

Other approaches to the question can produce slightly differing results. For example, He and Wei (2012) find that overall the Asian countries are less dependent on global cycle than other large economies. Intra-Asian trade integration has increased similarity of business cycles. Artis and Okubo (2012) take a long-term view with data extending from 1870 to 2006, and they find no evidence of Asian business cycle correlation, although it must be noted that their sample of Asian countries is smaller than those of He and Wei (2012).

In this paper we study the impact of a shock emanating from the Chinese economy on the real economies of both industrialized and emerging markets. For that purpose we extended the country coverage of the data set used e.g. in Cesa-Bianchi et al. (2012) as well as Dreger and Zhang (2011), to include 43 advanced and emerging economies. Secondly we look at potential threats to the Chinese growth miracle by examining a revaluation of the renminbi as well as a hike in oil prices. The paper is structured as follows. The next section briefly introduces the empirical framework. Section 3 presents the data and model specification along with a range of empirical tests, to ensure the model's statistical verity. In Section 4 we introduce three macroeconomic shocks and examine their spatial and dynamic propagation. Section 5 concludes.

[1] Interestingly, Fidrmuc et al. (2013) report that OECD countries that trade more with China have seen their business cycle correlation with other OECD countries decrease.

2 Empirical Approach – The GVAR Model

The global vector autoregressive (GVAR) model is a compact representation of the world economy, highlighting its economic and financial interdependencies. The GVAR model has been successfully employed in the study of propagation of macroeconomic shocks (see e.g. Dees et al., 2007, Pesaran et al., 2004, Pesaran et al. 2007) and financial stress (Chudik and Fratzscher, 2011 and Sgherri and Galesi, 2009).

The model comprises *two layers*[2] that account for cross-sectional linkages among the economies. First, there are N country-specific submodels that link each economy to the world by allowing for foreign and global factors. Since macroeconomic time series predominantly share common stochastic trends, these country models are typically specified in vector error correction form. For a particular country i, and $z_t = (y_t, x_t)$ comprising the data, the following system of equations is estimated:

$$\begin{aligned} \Delta y_t &= c_0 + c_1 t + \Pi_y z_{t-1} + \sum_{i=1}^{p-1} \Gamma_{yy,i} \Delta\, y_{t-i} + \sum_{i=1}^{q-1} \Gamma_{yx,i} \Delta\, x_{t-i} + \sum_{i=1}^{lex-1} \Psi_i \Delta\, d_{t-i} + \Lambda_x \Delta \mathrm{x}_t + \Lambda_d \Delta \mathrm{d}_t + e_{yt} \\ \Delta x_t &= c_{x0} + c_{x1} t + \sum_{i=1}^{p-1} \Gamma_{xy,i} \Delta\, y_{t-i} + \sum_{i=1}^{q-1} \Gamma_{xx,i} \Delta\, x_{t-i} + e_{xt} \end{aligned} \quad (1)$$

with $u_t = (e_{yt}, e_{xt})$ and $u_t \sim N(0, \Sigma_u)$. We distinguish between four variable types: First, $\mathrm{y_t}$ denotes the set of domestic (endogenous) variables, which is enlarged by controlling for external factors $\mathrm{x_t}$. This set of (weakly exogenous) 'foreign' variables is constructed as a cross-country weighted average of its domestic counterparts $x_t^i = \sum_{j \neq i} w_{ij} y_t^j$, with $w_{ij} \geq 0$; $w_{ii} = 0$; $\sum_{j=1}^{N} w_{ij} = 1$. The weights $w_{ij} \in W_b$ represent economic ties between countries and are typically based on bilateral trade flows, which are captured in an N x N matrix W_b. Thirdly, $\mathrm{d_t}$ denotes global (exogenous) variables that are not determined within the country systems. In the empirical application we control for the global business cycle by including the price of oil as an exogenous variable for all other countries except the US. Note that both weakly exogenous and exogenous variables

[2] For an excellent textbook exposition of the GVAR see Garrat et al. (2006).

enter the conditional model for Δy_t, both *contemporaneously* and in lagged form p, lex >1. Finally, each country model contains a trend and/or an intercept term.

The system of equations comprises information about both the long-run, $\Pi = \begin{pmatrix} \Pi_y \\ \Pi_x \end{pmatrix} = \begin{pmatrix} \Pi_{yy} & \Pi_{yx} \\ \Pi_{xy} & \Pi_{xx} \end{pmatrix}$, and short-run, $\Gamma = \begin{pmatrix} \Gamma_{yy} & \Gamma_{yx} \\ \Gamma_{xy} & \Gamma_{xx} \end{pmatrix}$. Note that $\Pi_x = 0$, which means that information from the conditional model for Δy_t is redundant for Δx_t. Furthermore, this assumption implies that the vector of foreign variables is not cointegrated (Assenmacher-Wesche and Pesaran, 2008). The way common stochastic trends are accounted for in the GVAR resembles a cointegration system approach akin to Johansen (1995). Should the domestic variables be cointegrated, the 'long-run' matrix Π is rank deficient, which in turn prevents straightforward economic interpretation of the coefficients describing the long-run equilibrium.

In the *second layer* of the GVAR framework, the single-country models are 'stacked' to yield a coherent global macro-model that is able to capture the dynamics and spatial propagation of macroeconomic shocks to the system:

$$\mathrm{G}y_t = c_0 + c_1 t + \sum_{k=1}^{P} \mathrm{H}_k \, y_{t-k} + \sum_{k=1}^{L} \Upsilon_k \, d_{t-k} + u_t \qquad (2)$$

with H and ϒ containing the stacked coefficient matrices from the single countries and $P = \max(p_i, q_i)$, $L = \max(lex_i)$. Note that we have linked the models by making use of the fact that $z_t^i = \begin{pmatrix} y_t^i \\ x_t^i \end{pmatrix} = W_{global}^i \begin{pmatrix} y_t^1 \\ \vdots \\ y_t^N \end{pmatrix} = W_{global}^i y_t$, where W_{global}^i is a $K_i \; x \; K$ matrix with K_i being the sum of endogenous and weakly exogenous variables in country model i and $K = \sum_{i=1}^{N} K_i$ is the total number of endogenous and weakly exogenous variables in the system. G contains the stacked weighted coefficients, i.e. $G^i = (I, -\Lambda_x) z^i W_{global}^i$. As is evident from above the matrix, W_{global}^i is a crucial element of the GVAR framework in the sense that it links the single country models and thus governs the propagation of a shock. Note that the weigths in W_{global}^i need not match those used to construct the foreign variables. Since the square matrix G is non-singular, equation (2) can be left-multiplied by G^{-1} to yield the GVAR model:

$$y_t = \tilde{c}_0 + \tilde{c}_0 t + \sum_{k=1}^{r} \widetilde{H}_k \, y_{t-k} + \sum_{k=0}^{p} \widetilde{\Upsilon}_k \Delta \, d_{t-k} + \tilde{u}_t \qquad (3)$$

3 Data and Model Specification

3.1 Data

We extended the data used in Cesa-Bianchi et al. (2012) and Dreger and Zhang (2011) to cover N=43 economies[3], comprising 42 single countries and the euro area (EA)[4] as a regional aggregate. Table 1 lists the countries in our data sample.

Table 1: Country coverage

1) Focus countries (8)	US, EA, UK, CN, RU, BR, IN, JP
2.) CESEE (10):	CZ, HU, PL, SK, SI, BG, RO, HR, AL, RS
4.) CIS (5):	UA, BY, KG, MN, GE
5.) Asia (6):	KR, PH, SG, TH, ID, MY
6.) Latin America (4):	AR, CL, MX, PE
8.) ROW (10):	CA, AU, NZ, CH, NO, SE, DK, IS, EG, TR

Source: Authors' calculations.

Thus our data set spans a very heterogeneous set of countries including advanced economies, catching-up economies and many of the most important oil producers and consumers. The inclusion of European emerging economies limits the time span of the analysis to the period subsequent to the transition to market-based economies, although also availability of the Chinese GDP data places limits on the estimation period. We thus have quarterly data from 1995Q1 to 2011Q4, which gives us 68 observations per variable. To the best of our knowledge this data set excels in terms of both country coverage and inclusion of the most recent data available on a global scale.

3 In an earlier version of the paper (Feldkircher and Korhonen, 2012) we included 52 individual economies, including some very small economies and countries where GDP indicators are not available at quarterly frequency. Removing them from the sample decreases the volatility of the overall model.

4 Note that the country composition on which data for the euro area are based changes over time. That is, while historical time series are based on data for the 10 original member states, the most recent data are based on 17 countries. Nevertheless we report separate results for Slovenia and Slovakia since we are also interested in emerging Europe. Our results are qualitatively unchanged if we use instead of the rolling country composition for the data on the euro area a consistent set of 14 euro area states throughout the sample period, as these three economies are of roughly the same magnitude.

We include the following five *domestic variables*[5]: Real GDP (y), inflation (Dp), the real exchange rate vis-à-vis the USD (i.e. nominal exchange rate deflated by national price levels, rer), short-term interest rates (stir) and long-term interest rates (ltir). Among the variables, only real GDP, inflation and the real exchange rate are available for all 43 countries. In particular, long-term interest rates are often not available for emerging economies. The set of domestic variables is complemented by oil prices.

Economic ties among countries are captured by bilateral flows of exports and imports of goods, which are available on an annual basis. These trade flows are captured in row-standardized link matrices denoted by $W_{b,t} \in \{W_{b,1995}, \cdots, W_{b,2011}\}$.

All variables are tested for a unit root via an augmented Dickey-Fuller test. We follow Pesaran et al. (2004) in allowing for a trend and intercept term in the ADF regression in levels for all variables except interest rates and inflation. These are modeled with an intercept term only. The results are presented in Table B.4 in the appendix. For most variables the ADF test could not reject the null-hypothesis of a unit root. One notable exception is the long-term interest rate in the euro area. This also skews the results for foreign long-term interests for emerging economies in Europe due to the regions' strong trade integration with the euro area. Table B.5 contains the results of the ADF test on first differences of the data. Note that we specified the ADF test here without a trend term for all variables. The test results show that almost all of the variables are stationary after first differencing. Together with the results on the levels, this implies roughly that all variables are integrated of order 1, which lends support to the cointegration framework employed here.

[5] See appendix, Table A.1 for details.

3.1 Model Specification and Specification Tests

Based on trade weights, *foreign variables* are constructed to account for global and regional factors. Economic activity seems to be generally assumed to be the channel via which spillovers take place. However, spillovers could in principle take place via any of the domestic variables. For degrees of freedom considerations, we aim at keeping the number of variables per country small. We thus allow for spillovers via real GDP (y*) and interest rates (stir*, ltir*) only. Our choice of spillover variables is supported by the fact that co-movements of these variables are strong, with cross-sectional correlations ranging from 0.5 (short-term interest rates) to 0.9 (real GDP), while cross-country correlation of inflation is rather low (0.2). Following Cesa-Bianchi et al. (2012) foreign variables x_t are constructed using *time varying* trade weights. This allows us to empirically keep track with the rise of the Chinese economy in the global economy. The weights for stacking the single models are based on trade flows in 2011.

As outlined in Pesaran et al. (2000) we test for specification of the deterministic terms (trend and intercept) in equation (1). For the majority of the countries (21 of 43) the likelihood ratio test lent empirical support to including an unrestricted intercept and a trend term restricted to lie in the cointegration space (Case IV)[6]. Note that this is the specification one would expect during 'normal' times since most macroeconomic variables are trending (see e.g. Cesa-Bianchi et al., 2001, Dees et al. 2007). For the remaining countries the test revealed a zero intercept, zero trend model (Case I, 5 times), a restricted intercept, zero trend model (Case II, 12 times) and an unrestricted intercept, zero trend model (Case III, 5 times).

The number of the long-run relationships is tested by means of the trace statistic test (Juselius, 2006). The trace statistic is preferred to the maximum eigenvalue statistic since it has better small sample properties (Cesa-Bianchi et al., 2012). In order to achieve a parsimonious model and ensure stability of the global model, we examine the long-run properties for each country model in more detail. More specifically, we assess the dynamics of a global shock[7] to the country specific long-run equilibria by means of persistence-profiles (see Pesaran et al., 2003). Following Cesa-Bianchi et al. (2012) the

[6] See Juselius (2006) for a textbook discussion on trends and intercepts in VECMs.
[7] Full results are available from the authors upon request.

cointegration rank has then been reduced as long as the economy is restored to an equilibrium within 10-15 quarters. Note that we have set the lag length for domestic, foreign and global variables to one in equation (1). Finally, the modeling of the global variable (oil prices) is discussed in more detail in appendix C where we carry out an oil price shock. Table B.1 in the appendix summarizes the specification for each country model.

Our final model passed several specification tests. First, it is globally stable in that all its roots lie either on or inside the unit circle. Secondly, we tested whether the foreign variables can be considered as weakly exogenous. The results provided in Table B.2 show that weak exogeneity is by and large met in all the country models. Finally we carried out an F test for residual serial correlation (Pesaran et al., 2004). Although our hands are tied in the sense that increasing the number of lags in the GVAR would require longer time series, we feel that testing for autocorrelation in a time series model is necessary. Of the 186 equations in the model, 140 pass the F test for first order serial autocorrelation, which gives us further confidence in the statistical properties of the model.

4 Macroeconomic Shocks

We are interested in propagation of three different macroeconomic shocks in the global economy and their impact on the real economy[8]:

1. A +1% shock to Chinese GDP
2. A +1% shock to US GDP
3. A +3% real appreciation of the Chinese exchange against the USD

Besides assessing the dynamics of a shock locally, the GVAR framework allows us to trace out the spatial shock propagation. For this purpose we follow the bulk of the literature in employing the Generalized Impulse Response Function (GIRF) put forward in Pesaran and Shin (1998):

[8] As a further robustness check, we also assess the impact of an oil price shock in our GVAR. These results are reported in Appendix C.

$$\mathrm{GIRF}(y_t, u_t, n) = \frac{F_n G^{-1} \sum_u s_j}{\sqrt{s'_j \sum_u s_j}}$$

with s_j denoting a binary shock indicator vector, n the shock horizon, Σ_u the corresponding variance covariance matrix of the GVAR and $F = G^{-1}H$. As noted in Pesaran and Shin (1998) the generalized impulse responses are not sensitive to the ordering of the variables in the country models – in contrast to the standard VAR analysis. However, this comes at the cost of having non-orthogonalized impulse responses. That is, shocks cannot be isolated since the variables in the system are typically correlated. Lastly, note that the dynamic analysis in a GVAR is carried out on the *levels* of the variables, which implies that the effects of a given shock are typically permanent. In what follows we present the results for the largest advanced economies and the BRICs separately, and the CEE, SEE, CIS, Latin American and Asian countries listed in Table 1 as regional aggregates.

4.1 Shock to China's output

We first assess the impact of a positive +1% shock to real Chinese output to the global economy that is depicted in Figure 2. In what follows we discuss the median of the bootstrapped impulse responses (solid red line) along with 90% confidence bands (dotted blue lines). Confidence bands are based on a bootstrap employing 1000 draws. [9]

The initial shock translates into a 1% permanent increase of GDP in the Chinese economy. The long-run boost to Chinese real output goes in parallel with a decrease in inflation and an increase in the short-term interest rate. This particular behavior of the Chinese economy with regard to the shock transmission is in line with findings of Chen et al. (2012).

[FIGURE 2 TO BE INSERTED HERE]

[9] For details on the bootstrap, see the GVAR toolbox manual available at http://www-cfap.jbs.cam.ac.uk/research/gvartoolbox/download.html. As suggested there, we have opted to shrink the off diagonal elements of the GVAR variance covariance matrix modestly to its diagonal elements in order to ensure invertibility. The shrinkage parameter was set to 0.9.

Among the remaining BRIC countries, Brazil shows a very pronounced response of more than 0.5% increase in GDP, while Russia's reactions to the Chinese GDP increase is contained. Our estimate for the effect on the US economy (0%) is close to that of Cesa-Bianchi et al (2012), but unlike them we get a slightly larger effect for the euro area (0.2%). The middle and bottom panels of Figure 2 display PPP aggregated impulse responses for the countries belonging to the five regions in Table 1.[10] Latin America (with the exception of Brazil, as noted above) is insulated from the positive shock to Chinese output, which is mirrored in a median response close to zero (0.1%) and relatively large confidence bands. In a same vein, the shock does not translate into a significant effect on output in the CESEE region and – more surprisingly – Asian economies. While the effect on Japan is larger (0.2%), the confidence bands still include zero. The small and insignificant effect of Chinese activity on its neighbors is in line with findings of Chen et al. (2012). At first glance this may be surprising, given the extensive trade links between China and the rest of Asia, but our interpretation is that most other Asian countries are, in fact, China's competitors in third markets. Therefore China's higher economic activity comes partly at the expense of other Asian countries, and trade links signify activities within Asian production networks, where production can also be shifted from one country to another.

4.2 Shock to US output

To obtain a benchmark for the China real GDP shock, we conduct a +1% shock to US real output. The initial shock translates to a 1.1% increase in US real GDP in the long-run. In contrast to the Chinese economy, both short and long-term interest rates decrease, while inflation declines. One particular feature of the US country model is that it includes oil prices as an endogenous variable. The strong US economy spurs the demand for oil, which is mirrored in a marked 6% increase in oil prices in the long-run.

[FIGURE 3 TO BE INSERTED HERE]

The dominance of the US economy can also be seen in the response of other countries'

[10] Results for the single countries are available from the authors upon request.

real output to the growing US economy. The results are shown in Figure 3. Naturally, the effects are larger for the major trading partners of the US: Mexico (1.2%), UK (1.1%) and Canada (0.9%). The euro area sees its real output rising by about 0.7% in the long-run. With the exception of Japan (0.8%), the large Asian countries such as India and China do not benefit from the shock. This finding is in line with Chen et al. 2012 and Cesa-Bianchi et al. (2011). Russia (0.5%) reacts more strongly to the positive US output shock, which can be partially attributed to the rise in the oil price that goes in parallel with the US expansion. Admittedly, estimation uncertainty for the Russian country model is large, which is mirrored in comparably wide confidence bands. Real output in the CESEE region increases by about 0.7%. While the confidence bands include zero, most of the interval lies in the positive area thus suggesting that the US expansion is growth enhancing for CESEE economies. In general, these results show that - despite China's rapid emergence as an economic powerhouse at the global level - the US still exerts the largest influence on other countries' economic fortunes. This is true despite the relatively closed nature of the US economy, although the US economy is of course approximately three times the size of China's. It is worth noting again that our simulations are performed with the 2011 trade weights, which already take into account China's strong position in global trade.

4.3 Shock to China's real exchange rate

We finally model effects from a revaluation of the Chinese renminbi. The nominal exchange rate of the renminbi has appreciated over the sample period by about 20% versus the USD and by about 40% versus the euro. In the same period, the average annual growth rate of real output was close to 10%. There has been an intense debate on whether the Chinese growth miracle was partially fueled by the undervalued renminbi and how large the potential undervaluation of the renminbi might be. While most of the empirical contributions suggest that the renminbi has been undervalued in recent years (Feng and Wu, 2008), others seem conclude the reverse (Cheung et al., 2007). Korhonen and Ritola (2011) provide a meta-analysis of studies on the renminbi's misalignment vis-à-vis its equilibrium value. They find that the renminbi may have been undervalued, especially against the dollar, but the degree of this undervaluation has decreased in recent years. In a recent contribution, Zhang and Sato (2012) show that the effect of a revaluation of the renminbi on China's trade balance is very limited. The trade balance in China seems to be largely determined by world demand.

On top of that, the literature on the direct impact of a renminbi revaluation on real output is scarce. Cheung et al. (2012) show that Chinese exports are well-behaved in the sense that they rise with foreign GDP and fall when the renminbi appreciates. However, imports often behave counterintuitively - responding positively to a depreciation of the renminbi and negatively to an increase in Chinese GDP. García Herrero and Koivu (2008) arrive at the same conclusion as to the link between imports and exchange rate, which they attribute to the special role of processing trade in China.

In the context of a GVAR model, the interpretation of currency shocks is notoriously difficult. Since there is no foreign counterpart of the real exchange rate variable that soaks up cross-country correlation in the system, cross-country residual correlations of the marginal models for real exchange rates are typically non-negligible[11]. Given these caveats we try to assess the impact of a Chinese revaluation with two different shocks.

Given that the nominal exchange rate (vs USD) has been broadly stable over the last few years (Zhang and Sato, 2012), we induce a small shock to the renminbi-USD currency pair. The response of the Chinese economy to a 3% appreciation of the renminbi (deflated by national price levels) is as follows: After less than 10 quarters the Chinese GDP level has permanently declined by some 0.2%, at the median. However, the bootstrapped confidence interval indicates that a positive response cannot be ruled out empirically.

[FIGURE 4 TO BE INSERTED HERE]

The decline in Chinese output does not leave the other countries unaffected. The US, the euro area and Japan display declines in real output of close to 0.8%. While the confidence bands are large, the interval does not contain positive values indicating that the renminbi revaluation significantly lowers output in the aforementioned countries. By contrast, sizeable estimation uncertainty for the CESEE and Russian country models

[11] The mean of the average pair-wise cross-country correlations of the residuals from the marginal model for the real exchange rate is 0.2, standard deviation 0.13.

is mirrored in even larger bootstrapped confidence intervals that contain negative and positive responses to the shock to the renminbi-USD currency pair. Still, also for these economies, the median response is clearly negative as well (-0.6% and -0.7% respectively). Taken at face value, these results would suggest that exchange rate appreciation in China would be welfare-reducing for almost everyone in the global economy. However, there are several reasons why this result may not perfectly mirror reality. The problems mentioned above (e.g. Cheung et al., 2012, as well as García Herrero and Koivu, 2008) regarding exchange rate, production networks, imports and GDP in China are almost certainly affecting our empirical results. Moreover, it should be noted that the impulse responses are done with 2011 trade weights, i.e. China's trade shares don't change as a response to exchange rate appreciation. As it is realistic to assume some trade adjustment as a response to exchange rate appreciation, Figure 6 in Appendix D shows the output response to 3% real renminbi appreciation using the 2006 trade matrix to stack the country models (W_{global}^{i}). We can see that the output response in China and India is in practice zero, while Brazil's output increases by 0.4%. For other major economies, such as the US, the euro area and Japan, the effect is also insignificant with the median response hovering around 0. Therefore, our results show that stronger renminbi does not necessarily lead to higher global welfare, as argued by some.

5 Conclusions

We assessed the role of China in the global economy with the help of a GVAR model. Our GVAR model has larger country coverage and is estimated on a more recent data sample than other models attempting to tackle similar issues, which gives our results added credibility and allows us to track China's importance for more countries

We find that developments in the Chinese economy have very clear and often large effects on other countries and the whole global economy. For example, Brazil, which has increased its exports to China tremendously during the past decade, is perhaps the largest outside beneficiary of higher Chinese GDP. Also the euro area and Japan benefit from more economic activity in China. Usually those countries or country groups trading more with China will benefit from higher Chinese GDP, but China's smaller neighbors in Asia are a partial exception to the rule. As they are often China's competitors in third markets, higher output in China does not necessarily imply greatly increased demand for smaller Asian countries' products. However, we need to remember that the US economy, roughly three times the size of the Chinese economy, still exerts the strongest influence on other countries. The rise of China in the global economy can be perhaps best seen by examining the impact of a currency shock. In particular, a real appreciation of the renminbi versus the USD has welfare reducing consequences for almost all countries. In line with our expectations, countries that do trade more with China, such as e.g. Russia, are more strongly affected by the currency appreciation.

Our results emphasize the pre-eminent role the large and open Chinese economy has assumed in recent years. China's economic fortunes have large effects on other countries, developed and developing alike. As China's growth continues, these effects - mostly positive - will only become more pronounced and closer in magnitude to the current impact of the US economy.

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Appendix A – Data Description

Table A.1: Data Description

Variable	*Description*	*Source*	*Min.*	*Mean*	*Max*	*Coverage*
y	Real GDP, average of 2005=100. Seasonally adjusted, in logarithms.	IMF, IFS database. Data for China is from BOFIT, Finland	3.465	4.509	5.092	100%
Dp	First differences of Consumer price inflation, seasonally adjusted, in logarithms.	IMF, IFS database and OECD.	-0.2578	0.0206	1.194	100%
rer	Nominal Exchange Rate vis-a-vis the USD, deflated by national price levels.	IMF, IFS database, Thomson data stream, Eurostat.	-5.373	-2.039	5.459	97.7%
stir	3 months money market rate. For some countries, overnight deposit rates / treasury bill rate.	IMF, IFS database	0	0.105	4.332	93.1%
ltir	Government bond yield.	IMF, IFS database, OECD.	0.006	0.061	0.777	39.5%
poil	Price of oil, seasonally adjusted, in logarithms.	IMF, IFS database.	-	-	-	-
Trade flows	Exports and Imports of Goods and services, annual data.	IMF, DOTS database.	-	-	-	-

Note: Data span is from 1995Q1-2011Q4, 68 quarterly observations. Data on bilateral trade flows is annual. Coverage refers to the availability of a particular variable in all the country models of the GVAR, in %.

Appendix B – Model Specification

Table B.1: Specification of country models

Country	*Domestic Variables*	*Foreign Variables*	*Coint. Rank*	*Trend / Intercept*	*p=q=lex*
AL	y, Dp, rer, stir	y*, stir*, ltir*	2	II	1
AR	y, Dp, rer, stir	y*, stir*, ltir*	2	IV	1
AU	y, Dp, rer, stir, ltir	y*, stir*, ltir*	2	IV	1
BG	y, Dp, rer, stir, ltir	y*, stir*, ltir*	2	II	1
BR	y, Dp, rer, stir	y*, stir*, ltir*, poil*	1	IV	1
BY	y, Dp, rer, stir	y*, stir*, ltir*	3	IV	1
CA	y, Dp, rer, stir, ltir	y*, stir*, ltir*, poil*	1	I	1
CH	y, Dp, rer, stir, ltir	y*, stir*, ltir*	2	IV	1
CL	y, Dp, rer	y*, stir*, ltir*	2	II	1
CN	y, Dp, rer, stir	y*, stir*, ltir*, poil*	1	IV	1
CZ	y, Dp, rer, stir	y*, stir*	2	II	1
DK	y, Dp, rer, stir, ltir	y*, stir*, ltir*	3	IV	1
EA	y, Dp, rer, stir, ltir	y*, stir*, ltir*, poil*	1	IV	1
EG	y, Dp, rer	y*, stir*, ltir*	1	III	1
GE	y, Dp, rer, stir	y*, stir*, ltir*	3	II	1
HR	y, Dp, rer, stir	y*, stir*, ltir*	1	IV	1
HU	y, Dp, rer, stir	y*, stir*, ltir*	1	IV	1
ID	y, Dp, rer, stir	y*, stir*, ltir*	1	II	1
IN	y, Dp, rer, stir	y*, stir*, ltir*, poil*	1	III	1
IS	y, Dp, rer, stir, ltir	y*, stir*, ltir*	3	IV	1
JP	y, Dp, rer, stir, ltir	y*, stir*, ltir*, poil*	1	III	1
KG	y, Dp, rer, stir	y*, stir*, ltir*	2	IV	1
KR	y, Dp, rer, stir, ltir	y*, stir*, ltir*	1	III	1
MN	y, Dp, rer, stir	y*, stir*, ltir*	2	IV	1
MX	y, Dp, rer, stir, ltir	y*, stir*, ltir*, poil*	2	I	1
MY	y, Dp, rer, stir, ltir	y*, stir*, ltir*	1	I	1
NO	y, Dp, rer, stir, ltir	y*, stir*, ltir*, poil*	2	II	1
NZ	y, Dp, rer, stir, ltir	y*, stir*, ltir*	2	I	1
PE	y, Dp, rer, stir	y*, stir*, ltir*	1	IV	1
PH	y, Dp, rer, stir	y*, stir*, ltir*	1	IV	1
PL	y, Dp, rer, stir	y*, stir*, ltir*	2	IV	1
RO	y, Dp, rer, stir	y*, stir*, ltir*	2	II	1
RS	y, Dp, rer	y*, stir*, ltir*	1	II	1
RU	y, Dp, rer, stir	y*, stir*, ltir*, poil*	2	II	1
SE	y, Dp, rer, stir, ltir	y*, stir*, ltir*	1	IV	1
SG	y, Dp, rer, stir	y*, stir*, ltir*	1	I	1
SI	y, Dp, rer, stir	y*, stir*, ltir*	2	IV	1

SK	y, Dp, rer, stir	y*, stir*, ltir*	2	II	1
TH	y, Dp, rer, stir, ltir	y*, stir*, ltir*	1	II	1
TR	y, Dp, rer, stir	y*, stir*, ltir*	1	IV	1
UA	y, Dp, rer, stir	y*, stir*, ltir*	1	III	1
UK	y, Dp, rer, stir, ltir	y*, stir*, ltir*	1	IV	1
US	y, Dp, stir, ltir, poil	y*, ltir*	1	IV	1

Source: Authors' calculations.

Table B.2: Test of weak exogeneity assumption.

Country	*DoF*	*F-crit. (0.95)*	*y**	*stir**	*ltir**	*poil**
EA	F(1,55)	4.0162	2.94926	0.18813	1.46679	1.72465
-	-	-	(0.092)	(0.666)	(0.231)	(0.195)
US	F(1,56)	4.01297	1.70561	-	4.10818	-
-	-	-	(0.197)	-	(0.047)	-
UK	F(1,55)	4.0162	2.83435	0.02573	0.07873	4.17425
-	-	-	(0.098)	(0.873)	(0.780)	(0.046)
JP	F(1,55)	4.0162	0.16248	0.04202	0.21482	0.00880
-	-	-	(0.688)	(0.838)	(0.645)	(0.926)
CN	F(1,56)	4.01297	0.07448	0.32639	0.54727	0.15175
-	-	-	(0.786)	(0.570)	(0.463)	(0.698)
CZ	F(2,54)	3.16825	2.37644	2.41869	-	0.83910
-	-	-	(0.103)	(0.099)	-	(0.438)
HU	F(1,56)	4.01297	3.44578	0.42909	0.04516	2.64991
-	-	-	(0.069)	(0.515)	(0.832)	(0.109)
PL	F(2,55)	3.16499	0.60166	6.83476	0.01708	2.39824
-	-	-	(0.551)	(0.002)	(0.983)	(0.100)
SI	F(2,55)	3.16499	2.87265	6.20824	2.27362	2.36095
-	-	-	(0.065)	(0.004)	(0.113)	(0.104)
SK	F(2,55)	3.16499	1.49629	0.73557	2.29175	1.59905
-	-	-	(0.233)	(0.484)	(0.111)	(0.211)
BG	F(2,54)	3.16825	0.61836	3.00009	0.10934	0.05542
-	-	-	(0.543)	(0.058)	(0.897)	(0.946)
RO	F(2,55)	3.16499	2.09709	3.37924	0.49033	1.34521
-	-	-	(0.133)	(0.041)	(0.615)	(0.269)
HR	F(1,56)	4.01297	0.00744	6.87355	3.21328	4.55950
-	-	-	(0.932)	(0.011)	(0.078)	(0.037)
AL	F(2,55)	3.16499	0.59177	4.86635	0.23998	0.55057
-	-	-	(0.557)	(0.011)	(0.787)	(0.580)
RS	F(1,57)	4.00987	0.82439	0.08134	4.37312	0.04882
-	-	-	(0.368)	(0.777)	(0.041)	(0.826)
RU	F(2,55)	3.16499	3.58600	0.07804	1.86600	0.38814
-	-	-	(0.034)	(0.925)	(0.164)	(0.680)
UA	F(1,56)	4.01297	6.03515	0.14345	1.33532	0.01226
-	-	-	(0.017)	(0.706)	(0.253)	(0.912)
BY	F(3,54)	2.77576	1.27146	0.66653	2.33911	1.06640
-	-	-	(0.293)	(0.576)	(0.084)	(0.371)
GE	F(3,54)	2.77576	2.98647	2.43918	3.64449	1.83386
-	-	-	(0.039)	(0.074)	(0.018)	(0.152)
MN	F(2,55)	3.16499	0.54704	2.24070	0.46748	0.60095
-	-	-	(0.582)	(0.116)	(0.629)	(0.552)
KG	F(2,55)	3.16499	0.26259	3.01343	0.75982	0.58752
-	-	-	(0.770)	(0.057)	(0.473)	(0.559)
AR	F(2,55)	3.16499	0.17261	1.71080	0.62588	0.33918
-	-	-	(0.842)	(0.190)	(0.539)	(0.714)

BR	F(1,56)	4.01297	0.51835	0.20742	0.00713	0.17003
-	-	-	(0.475)	(0.651)	(0.933)	(0.682)
CL	F(2,56)	3.16186	3.56312	0.31418	5.44348	0.86196
-	-	-	(0.035)	(0.732)	(0.007)	(0.428)
MX	F(2,54)	3.16825	1.02335	0.70906	1.04955	1.01351
-	-	-	(0.366)	(0.497)	(0.357)	(0.370)
PE	F(1,56)	4.01297	0.05134	0.19510	0.08151	0.00801
-	-	-	(0.822)	(0.660)	(0.776)	(0.929)
KR	F(1,55)	4.0162	2.36372	0.58132	0.15496	3.94879
-	-	-	(0.130)	(0.449)	(0.695)	(0.052)
PH	F(1,56)	4.01297	1.43332	0.92836	0.12350	0.56095
-	-	-	(0.236)	(0.339)	(0.727)	(0.457)
SG	F(1,56)	4.01297	1.22995	5.71021	1.90530	0.29036
-	-	-	(0.272)	(0.020)	(0.173)	(0.592)
TH	F(1,55)	4.0162	6.06491	2.04846	0.34994	0.49119
-	-	-	(0.017)	(0.158)	(0.557)	(0.486)
IN	F(1,56)	4.01297	0.33341	1.29977	0.38665	0.91173
-	-	-	(0.566)	(0.259)	(0.537)	(0.344)
ID	F(1,56)	4.01297	0.12334	0.51979	0.94090	0.89143
-	-	-	(0.727)	(0.474)	(0.336)	(0.349)
MY	F(1,55)	4.0162	0.52879	0.77489	1.06798	0.07751
-	-	-	(0.470)	(0.383)	(0.306)	(0.782)
AU	F(2,54)	3.16825	1.67163	0.10084	0.10518	0.34001
-	-	-	(0.198)	(0.904)	(0.900)	(0.713)
NZ	F(2,54)	3.16825	0.62114	0.06707	0.50173	0.85623
-	-	-	(0.541)	(0.935)	(0.608)	(0.430)
TR	F(1,56)	4.01297	2.01108	0.97169	0.50482	0.01527
-	-	-	(0.162)	(0.329)	(0.480)	(0.902)
EG	F(1,57)	4.00987	7.57924	0.97264	0.57421	11.70021
-	-	-	(0.008)	(0.328)	(0.452)	(0.001)
CA	F(1,55)	4.0162	0.61196	0.41345	3.26175	4.50712
-	-	-	(0.437)	(0.523)	(0.076)	(0.038)
CH	F(2,54)	3.16825	5.47052	1.00293	0.62687	7.38793
-	-	-	(0.007)	(0.374)	(0.538)	(0.001)
NO	F(2,54)	3.16825	0.35921	0.26840	0.40664	0.04883
-	-	-	(0.700)	(0.766)	(0.668)	(0.952)
SE	F(1,55)	4.0162	0.43018	0.42735	0.55754	0.01862
-	-	-	(0.515)	(0.516)	(0.458)	(0.892)
DK	F(3,53)	2.77911	1.65424	0.39542	0.13489	3.85298
-	-	-	(0.188)	(0.757)	(0.939)	(0.014)
IS	F(3,53)	2.77911	0.29190	1.03270	1.51692	1.48802
-	-	-	(0.831)	(0.386)	(0.221)	(0.228)

Note: Weak exogeneity test. P-values at 5% significance level in parentheses.

Source: Authors’ calculations.

Table B.3: Serial autocorrelation test.

Country	*DoF*	*F-crit. (0.95)*	*y*	*Dp*	*rer*	*stir*	*ltir*	*poil*
EA	F(1,60)	4.00119	8.70950	4.94424	6.65535	0.00376	5.83779	-
-	-	-	(0.005)	(0.030)	(0.012)	(0.951)	(0.019)	-
US	F(1,62)	3.99589	21.59719	0.00232	-	21.13607	4.15988	2.22026
-	-	-	(0.000)	(0.962)	-	(0.000)	(0.046)	-0.141
UK	F(1,60)	4.00119	18.84266	0.54779	5.34945	0.01280	8.34955	-
-	-	-	(0.000)	(0.462)	(0.024)	(0.910)	(0.005)	-
JP	F(1,60)	4.00119	1.15286	15.86328	1.72886	5.44413	0.68492	-
-	-	-	(0.287)	(0.000)	(0.194)	(0.023)	(0.411)	-
CN	F(1,60)	4.00119	0.06787	5.74816	3.45315	2.03055	-	-
-	-	-	(0.795)	(0.020)	(0.068)	(0.159)	-	-
CZ	F(1,60)	4.00119	0.23660	0.05425	8.36618	1.02406	-	-
-	-	-	(0.628)	(0.817)	(0.005)	(0.316)	-	-
HU	F(1,60)	4.00119	14.30156	2.39682	4.21649	6.08281	-	-
-	-	-	(0.000)	(0.127)	(0.044)	(0.017)	-	-
PL	F(1,59)	4.00398	0.25130	0.06794	0.98958	1.88359	-	-
-	-	-	(0.618)	(0.795)	(0.324)	(0.175)	-	-
SI	F(1,59)	4.00398	2.42382	1.28021	2.69111	0.59577	-	-
-	-	-	(0.125)	(0.262)	(0.106)	(0.443)	-	-
SK	F(1,60)	4.00119	3.71503	0.14117	2.14855	4.56431	-	-
-	-	-	(0.059)	(0.708)	(0.148)	(0.037)	-	-
BG	F(1,60)	4.00119	0.00319	0.69953	32.21880	8.48039	6.29815	-
-	-	-	(0.955)	(0.406)	(0.000)	(0.005)	(0.015)	-
RO	F(1,60)	4.00119	0.61289	0.32498	0.59148	0.00515	-	-
-	-	-	(0.437)	(0.571)	(0.445)	(0.943)	-	-
HR	F(1,60)	4.00119	0.12815	0.56321	0.44769	0.04330	-	-
-	-	-	(0.722)	(0.456)	(0.506)	(0.836)	-	-
AL	F(1,60)	4.00119	0.04028	1.38206	6.21011	0.01924	-	-
-	-	-	(0.842)	(0.244)	(0.015)	(0.890)	-	-
RS	F(1,61)	3.99849	0.55144	5.73884	0.03764	-	-	-
-	-	-	(0.461)	(0.020)	(0.847)	-	-	-
RU	F(1,60)	4.00119	0.71217	0.01454	7.52570	0.21688	-	-
-	-	-	(0.402)	(0.904)	(0.008)	(0.643)	-	-
UA	F(1,60)	4.00119	2.88483	1.48063	0.16723	0.26260	-	-
-	-	-	(0.095)	(0.228)	(0.684)	(0.610)	-	-
BY	F(1,58)	4.00687	0.74157	0.01656	0.46712	0.05988	-	-
-	-	-	(0.393)	(0.898)	(0.497)	(0.808)	-	-
GE	F(1,59)	4.00398	0.78531	0.48003	0.10426	0.58397	-	-
-	-	-	(0.379)	(0.491)	(0.748)	(0.448)	-	-
MN	F(1,59)	4.00398	1.32289	2.58785	3.82227	1.35176	-	-
-	-	-	(0.255)	(0.113)	(0.055)	(0.250)	-	-
KG	F(1,59)	4.00398	3.62041	0.11039	1.29669	0.01023	-	-
-	-	-	(0.062)	(0.741)	(0.259)	(0.920)	-	-
AR	F(1,59)	4.00398	2.34570	0.55970	6.94739	0.19640	-	-

-	-	-	(0.131)	(0.457)	(0.011)	(0.659)	-	-
BR	F(1,60)	4.00119	0.75553	0.56293	0.71806	4.32611	-	-
-	-	-	(0.388)	(0.456)	(0.400)	(0.042)	-	-
CL	F(1,60)	4.00119	0.38666	2.90246	1.60360	-	-	-
-	-	-	(0.536)	(0.094)	(0.210)	-	-	-
MX	F(1,60)	4.00119	5.00592	0.02428	0.07408	0.00118	0.25309	-
-	-	-	(0.029)	(0.877)	(0.786)	(0.973)	(0.617)	-
PE	F(1,60)	4.00119	3.22658	6.04304	4.17524	1.56500	-	-
-	-	-	(0.077)	(0.017)	(0.045)	(0.216)	-	-
KR	F(1,60)	4.00119	0.04204	0.00119	2.27280	5.58311	7.34674	-
-	-	-	(0.838)	(0.973)	(0.137)	(0.021)	(0.009)	-
PH	F(1,60)	4.00119	10.99096	10.14647	0.00851	1.07387	-	-
-	-	-	(0.002)	(0.002)	(0.927)	(0.304)	-	-
SG	F(1,61)	3.99849	1.50245	2.17578	0.63215	1.24310	-	-
-	-	-	(0.225)	(0.145)	(0.430)	(0.269)	-	-
TH	F(1,61)	3.99849	0.59881	0.00450	4.32390	8.89843	1.30123	-
-	-	-	(0.442)	(0.947)	(0.042)	(0.004)	(0.258)	-
IN	F(1,60)	4.00119	2.22767	0.07326	1.12549	1.78743	-	-
-	-	-	(0.141)	(0.788)	(0.293)	(0.186)	-	-
ID	F(1,61)	3.99849	3.09324	0.21302	2.61100	0.01975	-	-
-	-	-	(0.084)	(0.646)	(0.111)	(0.889)	-	-
MY	F(1,61)	3.99849	0.04935	2.73504	7.36764	0.16130	0.36040	-
-	-	-	(0.825)	(0.103)	(0.009)	(0.689)	(0.551)	-
AU	F(1,59)	4.00398	0.15027	0.92862	0.09874	1.39298	1.74830	-
-	-	-	(0.700)	(0.339)	(0.754)	(0.243)	(0.191)	-
NZ	F(1,60)	4.00119	0.02355	0.00240	4.06181	8.84955	0.80868	-
-	-	-	(0.879)	(0.961)	(0.048)	(0.004)	(0.372)	-
TR	F(1,60)	4.00119	0.40009	2.64073	0.02366	1.50876	-	-
-	-	-	(0.529)	(0.109)	(0.878)	(0.224)	-	-
EG	F(1,60)	4.00119	0.31445	0.00102	6.81838	-	-	-
-	-	-	(0.577)	(0.975)	(0.011)	-	-	-
CA	F(1,61)	3.99849	1.55209	0.74864	1.79579	6.58669	2.01984	-
-	-	-	(0.218)	(0.390)	(0.185)	(0.013)	(0.160)	-
CH	F(1,59)	4.00398	0.34225	0.61799	0.11193	2.40135	0.01268	-
-	-	-	(0.561)	(0.435)	(0.739)	(0.127)	(0.911)	-
NO	F(1,60)	4.00119	13.47190	0.79683	1.20951	10.52520	2.63521	-
-	-	-	(0.001)	(0.376)	(0.276)	(0.002)	(0.110)	-
SE	F(1,60)	4.00119	1.80074	0.00018	5.43561	0.72691	6.13691	-
-	-	-	(0.185)	(0.989)	(0.023)	(0.397)	(0.016)	-
DK	F(1,58)	4.00687	0.07581	4.42738	0.15164	7.47455	0.80790	-
-	-	-	(0.784)	(0.040)	(0.698)	(0.008)	(0.372)	-
IS	F(1,58)	4.00687	3.29533	0.32626	0.21389	0.02775	1.50737	-
-	-	-	(0.075)	(0.570)	(0.645)	(0.868)	(0.224)	-

Note: Test for first order serial autocorrelation, p-values at 5% significance level in parentheses.
Source: Authors' calculations.

Table B.4 ADF test in levels

	EA	US	UK	JP	CN	CZ	HU	PL	SI	SK	BG	RO	HR	AL	RS	Nr. > CV
y	-0.847	-1.215	0.37	-1.606	-1.918	-2.249	-0.163	-2.168	0.647	-1.653	-1.901	-2.716	-0.022	-2.265	-1.409	0
Dp	-3.078	-2.874	-0.841	-3.119	-3.213	-2.725	-3.121	-2.835	-1.836	-2.029	-2.415	-1.565	-3.015	-3.314	-2.656	6
rer	-2.152	-	-2.093	-1.75	-0.69	-1.993	-1.827	-1.999	-2.049	-2.101	-2.716	-1.897	-1.941	-1.725	-2.425	0
stir	-1.344	-1.462	-1.035	-2.36	-5.082	-1.469	-2.93	-1.339	-2.83	-1.176	-2.011	-0.994	-5.047	-2.002	-	3
ltir	-3.119	-0.301	-1.561	-2.998	-	-	-	-	-	-	-3.466	-	-	-	-	3
*y**	-2.237	-2.713	-1.813	-1.891	-1.834	-1.485	-1.651	-1.149	-1.088	-1.121	-1.191	-1.266	-1.442	-2.485	-1.22	0
*stir**	-1.611	-1.882	-1.605	-1.734	-2.181	-1.698	-2.576	-2.299	-1.955	-3.082	-2.439	-2.429	-2.321	-1.83	-1.524	1
*ltir**	-1.52	-4.487	-2.745	-2.005	-1.942	-3.043	-3.086	-2.985	-3.037	-3.068	-3.078	-3.102	-3.028	-3.308	-3.388	11
	RU	UA	BY	GE	MN	KG	AR	BR	CL	MX	PE	KR	PH	SG	TH	Nr. > CV
y	-1.958	-1.293	-1.655	-1.992	-1.284	-2.554	-1.334	-1.004	-1.898	-1.715	-0.602	-2.054	-1.637	-1.586	-1.703	0
Dp	-2.468	-3.608	-1.196	-4.3	-3.076	-2.841	-2.116	-2.926	-2.794	-3.754	-2.764	-3.126	-3.238	-2.109	-2.779	7
rer	-2.429	-2.62	-2.324	-2.002	-1.444	-2.008	-1.516	-1.152	-1.339	-2.379	-0.959	-2.587	-1.383	-1.012	-2.104	0
stir	-3.519	-2.186	-1.95	-4.626	-4.227	-2.173	-3.084	-2.65	-	-2.205	-1.354	-1.386	-1.124	-1.474	-1.788	4
ltir	-	-	-	-	-	-	-	-	-	-4.028	-	-1.354	-	-	-1.571	1
*y**	-1.682	-1.663	-1.668	-1.804	-1.999	-1.401	-1.184	-2.014	-1.043	-1.693	-2.808	-1.586	-2.502	-2.127	-1.978	0
*stir**	-1.98	-3.108	-3.307	-2.718	-3.605	-3.323	-2.268	-2.13	-1.766	-1.257	-1.471	-1.919	-1.332	-2.028	-1.536	4
*ltir**	-2.925	-3.322	-2.912	-4.792	-1.339	-2.344	-2.663	-2.505	-2.677	-0.53	-2.418	-2.017	-1.503	-1.977	-1.681	4
	IN	ID	MY	AU	NZ	TR	EG	CA	CH	NO	SE	DK	IS	-	-	Nr. > CV
y	-1.634	-1.836	-2.212	-0.079	1.001	-1.66	-1.534	-0.947	-2.045	-1.389	-1.444	-1.246	-0.877	-	-	0
Dp	-2.141	-2.402	-3.099	-2.705	-3.198	-1.068	-1.369	-3.346	-3.065	-4.371	-2.769	-3.496	-1.676	-	-	6
rer	-1.461	-2.769	-2.059	-1.771	-2.107	-2.074	-1.346	-1.982	-2.462	-2.095	-2.092	-2.235	-2.422	-	-	0
stir	-4.429	-2.687	-2.164	-2.919	-1.355	-1.027	-	-1.785	-2.489	-2.118	-2.743	-1.716	-2.531	-	-	2
ltir	-	-	-1.209	-3.123	-1.234	-	-	-1.401	-0.883	-0.755	-2.266	-1.557	-1.789	-	-	1
*y**	-2.465	-1.904	-1.828	-1.517	-2.479	-2.111	-2.538	-1.766	-1.191	-0.959	-1.046	-1.126	-1.005	-	-	0
*stir**	-2.171	-1.877	-1.542	-1.624	-2.023	-2.692	-1.744	-1.421	-1.457	-1.563	-1.389	-1.793	-1.846	-	-	0
*ltir**	-2.294	-2.308	-1.812	-1.946	-2.462	-2.971	-2.671	-0.811	-2.998	-2.575	-2.446	-2.644	-2.423	-	-	2
*poil***	-	-2.389	-2.389	-2.389	-2.389	-2.389	-2.389	-	-2.389	-	-2.389	-2.389	-2.389	-	-	0

	EA	US	UK	JP	CN	CZ	HU	PL	SI	SK	BG	RO	HR	AL	RS	Nr. > CV
y	-0.847	-1.215	0.37	-1.606	-1.918	-2.249	-0.163	-2.168	0.647	-1.653	-1.901	-2.716	-0.022	-2.265	-1.409	0

Dp	-3.078	-2.874	-0.841	-3.119	-3.213	-2.725	-3.121	-2.835	-1.836	-2.029	-2.415	-1.565	-3.015	-3.314	-2.656	6
rer	-2.152	-	-2.093	-1.75	-0.69	-1.993	-1.827	-1.999	-2.049	-2.101	-2.716	-1.897	-1.941	-1.725	-2.425	0
stir.a	-1.344	-1.462	-1.035	-2.36	-5.082	-1.469	-2.93	-1.339	-2.83	-1.176	-2.011	-0.994	-5.047	-2.002	-	3
ltir.a	-3.119	-0.301	-1.561	-2.998	-	-	-	-	-	-	-3.466	-	-	-	-	3
y*	-2.237	-2.713	-1.813	-1.891	-1.834	-1.485	-1.651	-1.149	-1.088	-1.121	-1.191	-1.266	-1.442	-2.485	-1.22	0
stir.a*	-1.611	-1.882	-1.605	-1.734	-2.181	-1.698	-2.576	-2.299	-1.955	-3.082	-2.439	-2.429	-2.321	-1.83	-1.524	1
ltir.a*	-1.52	-4.487	-2.745	-2.005	-1.942	-3.043	-3.086	-2.985	-3.037	-3.068	-3.078	-3.102	-3.028	-3.308	-3.388	11
	RU	UA	BY	GE	MN	KG	AR	BR	CL	MX	PE	KR	PH	SG	TH	Nr. > CV
y	-1.958	-1.293	-1.655	-1.992	-1.284	-2.554	-1.334	-1.004	-1.898	-1.715	-0.602	-2.054	-1.637	-1.586	-1.703	0
Dp	-2.468	-3.608	-1.196	-4.3	-3.076	-2.841	-2.116	-2.926	-2.794	-3.754	-2.764	-3.126	-3.238	-2.109	-2.779	7
rer	-2.429	-2.62	-2.324	-2.002	-1.444	-2.008	-1.516	-1.152	-1.339	-2.379	-0.959	-2.587	-1.383	-1.012	-2.104	0
stir.a	-3.519	-2.186	-1.95	-4.626	-4.227	-2.173	-3.084	-2.65	-	-2.205	-1.354	-1.386	-1.124	-1.474	-1.788	4
ltir.a	-	-	-	-	-	-	-	-	-	-4.028	-	-1.354	-	-	-1.571	1
y*	-1.682	-1.663	-1.668	-1.804	-1.999	-1.401	-1.184	-2.014	-1.043	-1.693	-2.808	-1.586	-2.502	-2.127	-1.978	0
stir.a*	-1.98	-3.108	-3.307	-2.718	-3.605	-3.323	-2.268	-2.13	-1.766	-1.257	-1.471	-1.919	-1.332	-2.028	-1.536	4
ltir.a*	-2.925	-3.322	-2.912	-4.792	-1.339	-2.344	-2.663	-2.505	-2.677	-0.53	-2.418	-2.017	-1.503	-1.977	-1.681	4
	IN	ID	MY	AU	NZ	TR	EG	CA	CH	NO	SE	DK	IS	-	-	Nr. > CV
y	-1.634	-1.836	-2.212	-0.079	1.001	-1.66	-1.534	-0.947	-2.045	-1.389	-1.444	-1.246	-0.877	-	-	0
Dp	-2.141	-2.402	-3.099	-2.705	-3.198	-1.068	-1.369	-3.346	-3.065	-4.371	-2.769	-3.496	-1.676	-	-	6
rer	-1.461	-2.769	-2.059	-1.771	-2.107	-2.074	-1.346	-1.982	-2.462	-2.095	-2.092	-2.235	-2.422	-	-	0
stir.a	-4.429	-2.687	-2.164	-2.919	-1.355	-1.027	-	-1.785	-2.489	-2.118	-2.743	-1.716	-2.531	-	-	2
ltir.a	-	-	-1.209	-3.123	-1.234	-	-	-1.401	-0.883	-0.755	-2.266	-1.557	-1.789	-	-	1
y*	-2.465	-1.904	-1.828	-1.517	-2.479	-2.111	-2.538	-1.766	-1.191	-0.959	-1.046	-1.126	-1.005	-	-	0
stir.a*	-2.171	-1.877	-1.542	-1.624	-2.023	-2.692	-1.744	-1.421	-1.457	-1.563	-1.389	-1.793	-1.846	-	-	0
ltir.a*	-2.294	-2.308	-1.812	-1.946	-2.462	-2.971	-2.671	-0.811	-2.998	-2.575	-2.446	-2.644	-2.423	-	-	2
poil**	-	-2.389	-2.389	-2.389	-2.389	-2.389	-2.389	-	-2.389	-	-2.389	-2.389	-2.389	-	-	0

Note: ADF tests on variables in levels. T-statistics reported. The regressions for all variables except interest rates and inflation together with its foreign counterparts contain a constant and a trend term. ADF tests for interest rates and inflation are based on a constant in the ADF regression only. The 5% critical value of the ADF statistic including trend and intercept is -3.47, the one without trend is -2.91.
Source: Authors' calculations.

Table B.5 ADF test in first differences

	EA	US	UK	JP	CN	CZ	HU	PL	SI	SK	BG	RO	HR	AL	RS	Nr. > CV
y	-2.395	-2.237	-1.800	-4.060	-2.434	-2.152	-2.116	-4.113	-2.000	-3.515	-3.173	-2.423	-2.242	-4.047	-4.526	6
Dp	-5.774	-6.152	-7.209	-6.435	-4.304	-6.663	-4.751	-5.115	-6.047	-6.829	-5.32	-4.911	-5.659	-4.167	-4.542	15
rer	-2.876	-	-3.138	-2.704	-2.186	-3.504	-3.096	-3.919	-2.919	-2.403	-4.272	-3.636	-2.763	-3.599	-4.415	9
stir	-3.476	-3.419	-3.856	-3.719	-2.822	-2.846	-4.045	-4.458	-4.130	-3.455	-4.871	-4.258	-4.309	-4.367	-	12
ltir	-3.017	-3.708	-3.248	-4.100	-	-	-	-	-	-	-3.341	-	-	-	-	5
*y**	-3.739	-4.054	-3.080	-4.443	-3.408	-3.226	-3.366	-2.702	-2.783	-3.203	-3.438	-3.133	-3.146	-3.485	-3.415	13
*stir**	-4.466	-4.625	-4.071	-4.633	-3.755	-4.323	-4.053	-4.326	-4.094	-4.504	-4.809	-4.814	-4.023	-4.285	-5.144	15
*ltir**	-3.428	-2.569	-3.332	-4.237	-4.735	-3.021	-3.058	-3.159	-3.042	-2.943	-3.154	-2.797	-3.031	-1.858	-7.552	12
	RU	UA	BY	GE	MN	KG	AR	BR	CL	MX	PE	KR	PH	SG	TH	Nr. > CV
y	-2.946	-2.529	-4.110	-3.615	-2.494	-4.339	-2.329	-3.471	-3.442	-3.018	-2.944	-4.032	-4.479	-3.922	-2.28	11
Dp	-5.049	-5.283	-4.485	-5.415	-4.430	-5.478	-4.718	-4.648	-5.191	-5.651	-5.361	-5.887	-5.629	-5.99	-6.518	15
rer	-3.475	-3.404	-3.529	-3.997	-4.922	-3.677	-3.484	-3.083	-3.683	-3.492	-2.848	-3.601	-3.717	-2.804	-3.684	13
stir	-4.846	-3.837	-4.300	-5.520	-4.223	-4.438	-4.631	-4.942	-	-4.154	-5.644	-3.488	-4.869	-3.686	-4.423	14
ltir	-	-	-	-	-	-	-	-	-	-3.201	-	-4.913	-	-	-4.837	3
*y**	-3.343	-3.352	-2.848	-3.550	-2.763	-3.880	-3.803	-3.717	-3.269	-3.197	-3.735	-3.833	-4.493	-4.407	-4.137	13
*stir**	-3.698	-4.856	-4.886	-5.593	-4.837	-5.390	-5.118	-3.763	-3.842	-3.663	-4.03	-3.793	-4.604	-4.6	-4.149	15
*ltir**	-2.832	-2.074	-2.710	-1.520	-5.194	-5.763	-3.163	-3.452	-3.578	-3.858	-3.421	-3.942	-4.633	-4.806	-4.463	11
	IN	ID	MY	AU	NZ	TR	EG	CA	CH	NO	SE	DK	IS			Nr. > CV
y	-2.938	-2.526	-3.790	-2.413	-2.727	-3.751	-3.171	-2.096	-3.037	-3.416	-4.043	-3.766	-2.776	-	-	8
Dp	-7.225	-4.677	-5.873	-5.773	-6.529	-6.224	-5.737	-6.796	-6.558	-7.138	-5.935	-6.191	-4.74	-	-	13
rer	-3.435	-3.788	-3.440	-3.336	-3.106	-3.528	-2.011	-4.182	-3.225	-3.721	-3.126	-3.01	-3.783	-	-	12
stir	-5.552	-4.730	-4.035	-3.877	-4.148	-5.361	-	-3.844	-2.771	-3.538	-3.669	-3.883	-2.797	-	-	10
ltir	-	-	-4.021	-3.430	-5.260	-	-	-2.870	-3.805	-2.926	-3.326	-3.38	-3.172	-	-	8
*y**	-4.652	-4.050	-3.833	-4.424	-4.063	-3.199	-3.754	-2.827	-2.775	-2.899	-2.954	-2.766	-3.205	-	-	9
*stir**	-3.784	-4.269	-4.375	-4.814	-4.434	-5.173	-4.606	-3.745	-4.017	-4.078	-3.932	-4.05	-3.898	-	-	13
*ltir**	-3.855	-5.090	-4.720	-4.810	-3.871	-2.925	-3.525	-3.659	-3.172	-3.222	-3.251	-3.254	-3.513	-	-	13
*poil***	-	-3.286	-3.286	-3.286	-3.286	-3.286	-3.286	-	-3.286	-	-3.286	-3.286	-3.286	-	-	10

Note: ADF tests on variables in first differences. T-statistics reported. The regressions for all variables contain a constant term in the ADF regression only. The 5% critical value of the ADF statistic including trend and intercept is -3.48, that without trend is -2.91.
Source: Authors' calculations.

Appendix C – Shocks to the Price of Oil

To complement our analysis on China's position in the global economy, we also look at the response of the global economy to a +50% hike in oil prices. On the one hand, positive oil price shocks are expected to deter economic activity in oil importing countries by dampening the global economy. On the other hand, oil price hikes are expected to boost real GDP of oil exporting countries, with the potential for spillovers to countries with which they have strong economic ties. Following the literature we opted to model the oil price as an endogenous variable in the US country model. This might be justified since the US is the dominant economy in the GVAR system as well as among the largest oil producers, and is by the far the largest oil importer. For the bootstrap, however, we have treated the oil price as exogenous, since this yielded by far more stable results. Hence, we have modeled the oil price as a function of US variables, foreign US GDP and deterministic components employing the original data. The bootstrapped oil price is then predicted using these coefficient estimates applied to the bootstrapped data that has been generated as described in the GVAR toolbox. [12]

In contrast to Dees et al. (2007) and Cesa-Bianchi et al. (2011), we opted for excluding oil prices as a conditioning variable from the long-run equilibrium. Thus oil prices are assumed to have only a short-run influence on the domestic variables . We relax this assumption for the largest oil exporters (Russia, US, Norway, Canada and Mexico) and importers (euro area, China and India) where oil price is included as an additional foreign variable.

The effect of the +50% increase in oil prices is shown in Figure 5.

[FIGURE 5 TO BE INSERTED HERE]

As expected, the Russian economy sees a permanent and large increase in real GDP. After 10 quarters, real output in Russia rises by 3.4%. As expected, oil importers, such as the US (-0.1%) and the euro area (-0.4%) are negatively affected by increases in oil prices. Although also an oil importer, the effect on China is close to zero, contrasting

[12] The median of the bootstrapped impulse response for Russia are based on an oil price prediction that includes Russian GDP as a control variable on top of the US variables. It turns out that this ensures the median bootstrapped impulse response to match its analytical counterpart. In general, results for Russia are plagued by large estimation uncertainty which is also evident from Figures 2-4.

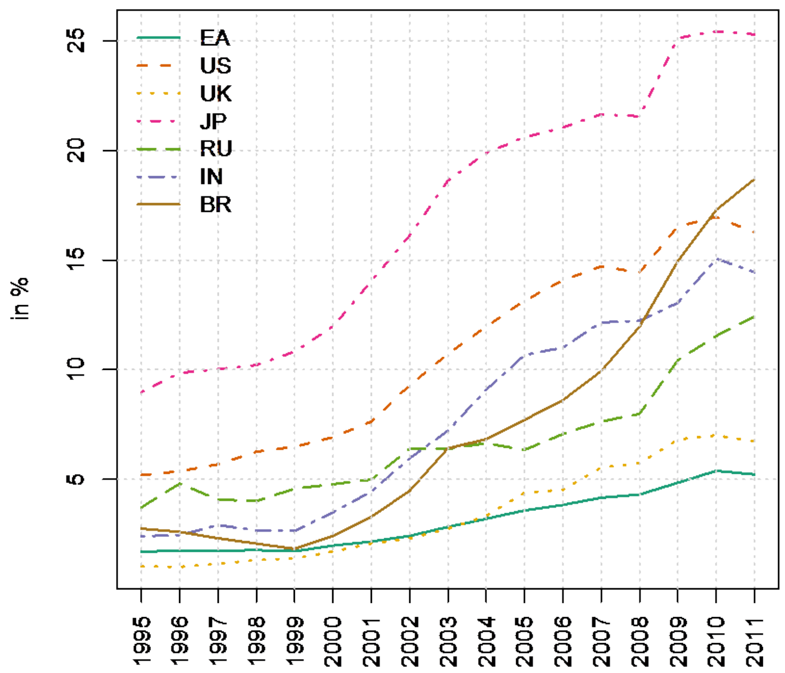
findings in Tang et al. (2010) who find a permanent negative effect on output and investment. The resilience of the Chinese economy to the oil price shock might mirror the fact that oil prices are regulated in China. Furthemore, it is also worth noting that within a GVAR framework Cashin et al. (2013) find that oil supply shocks depress output in the largest economies, i.e. the US and euro area, just as we do. However, in their analysis the impact of higher oil prices on China is actually positive, and statistically significant. They contribute this result to China's dependence on coal rather than oil in its energy production, and China is still self-sufficient in its coal consumption.

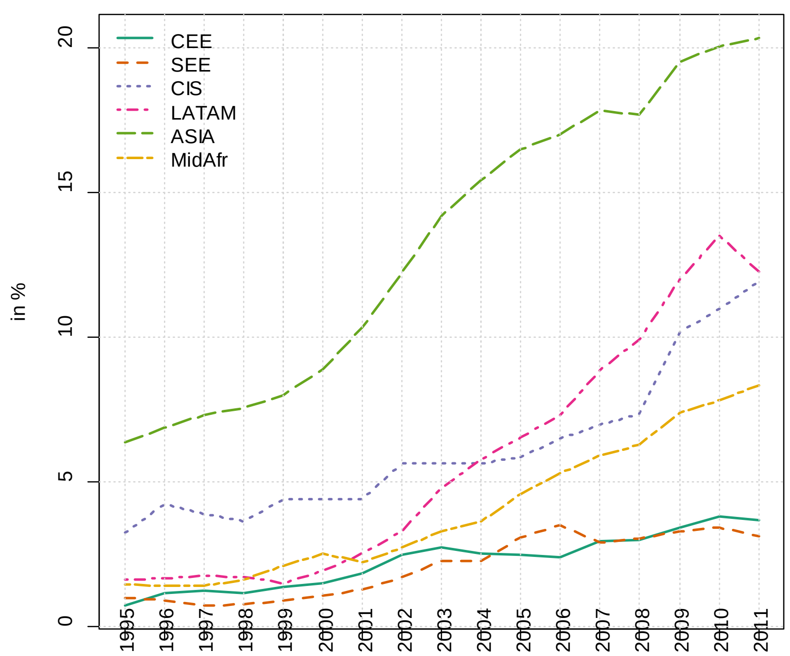
In general, our results are broadly in line with Korhonen and Ledyaeva (2010) who use a trade-linkage approach to capture economic ties between countries. However, the size of the responses tends to be overall smaller than reported in Korhonen and Ledyaeva (2010), which might be explained by the difference in estimation technique as well as data span used. Among the emerging economies, the CIS region shows a negative but insignificant response to the increase in oil prices. Most of the countries in the CIS region are oil importers and thus can be expected to react negatively to the oil price shock. This implies that the negative consequences of the oil price shock cannot be offset by positive growth spillovers emanating from a booming Russian economy.

The Latin American region displays a rather contained response. The countries belonging to the CESEE region are all oil importers. Consequently the oil price hike translates to a permanent drag on real as indicated by the median of the bootstrapped impulse response. This negative effect is reinforced by the drop in output in the euro area, which comprises the countries' largest trading partner. On the other hand, trade ties with Russia slightly mitigate these negative effects. These two offsetting effects are reflected in relatively large confidence bands.

Appendix D – Figures

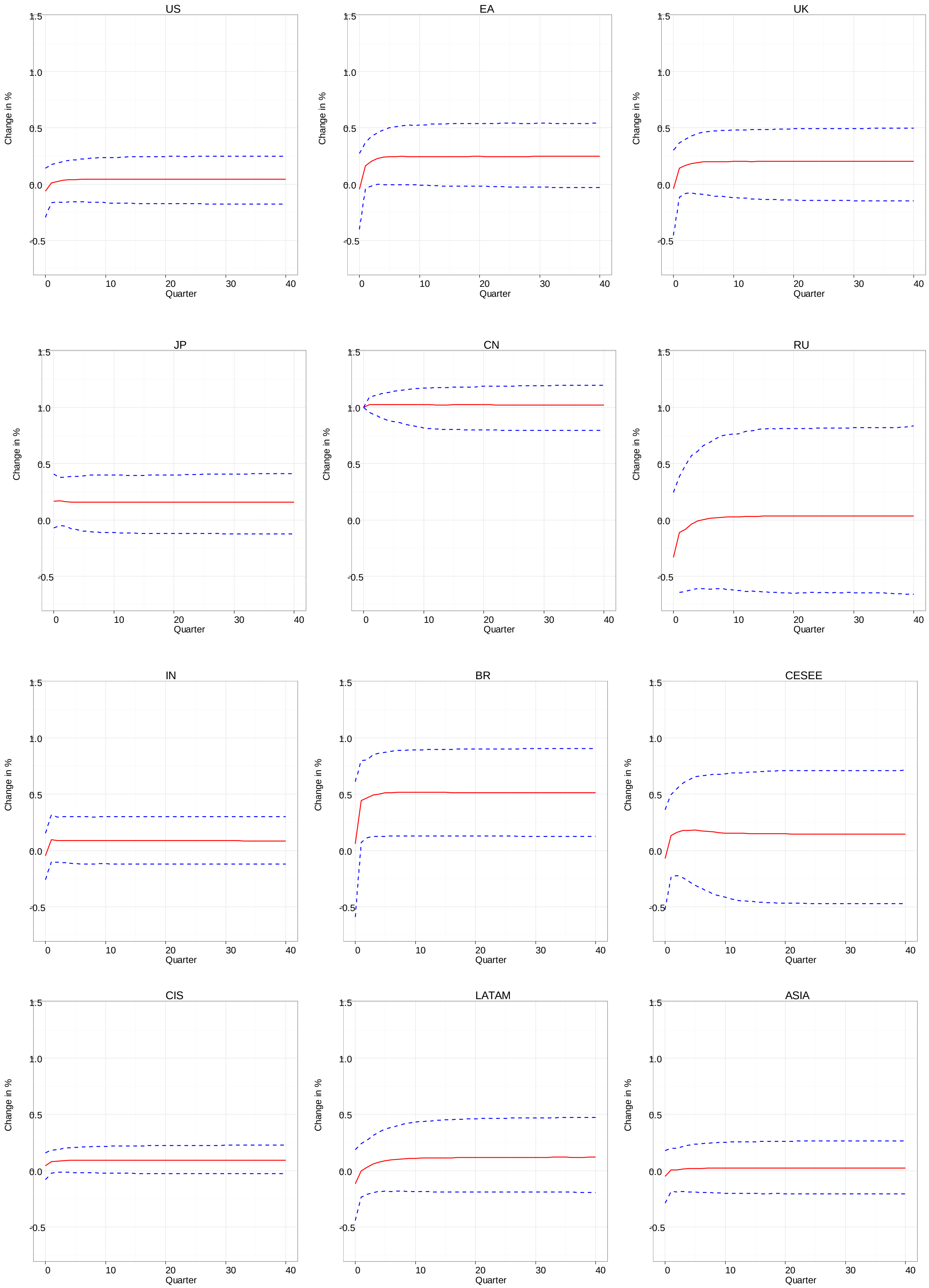
Figure 1: Country shares in China's total trade, %





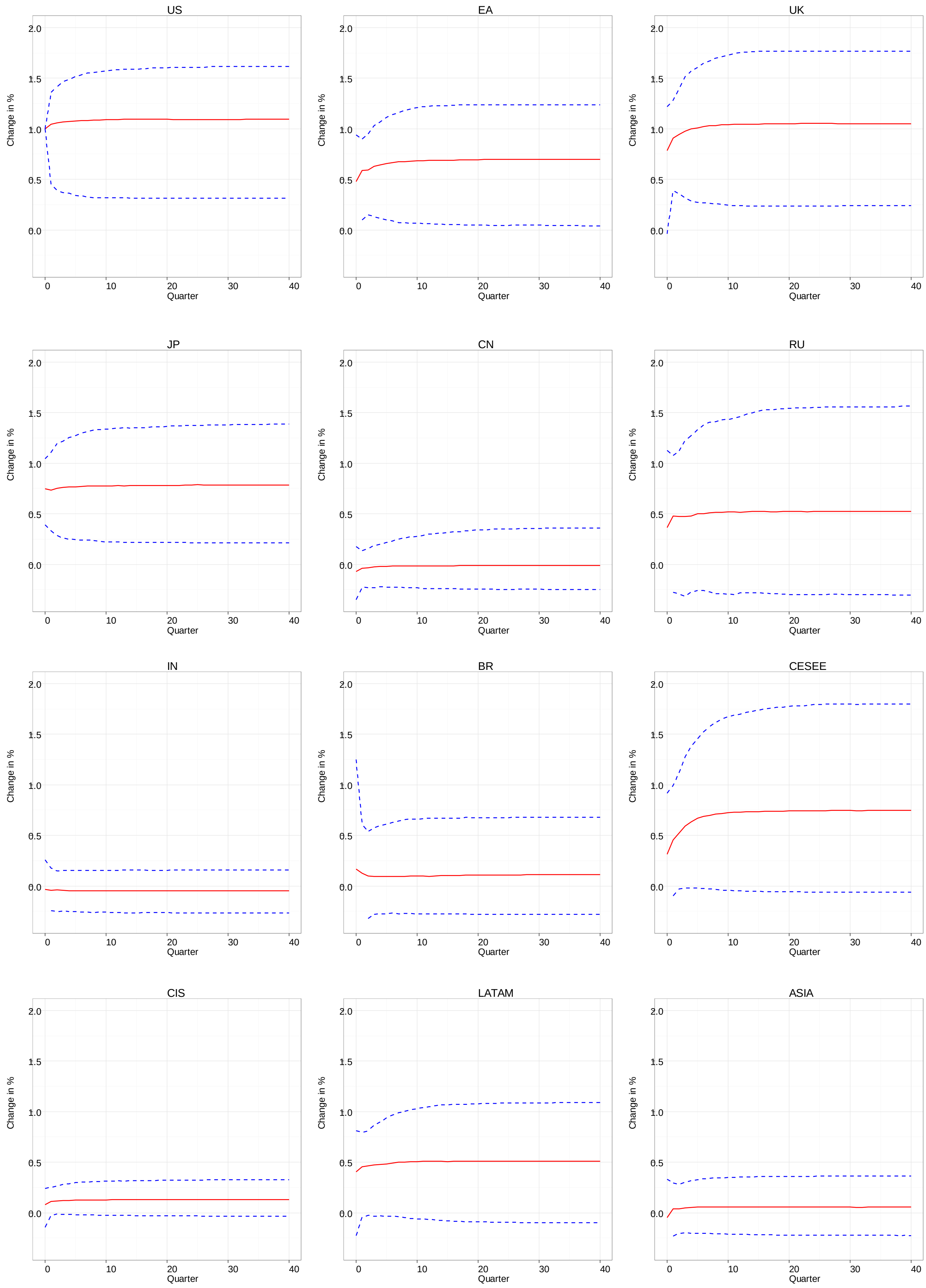
Source: Authors' calculations.

Figure 2: Country-output impact responses to 1% positive shock to Chinese output



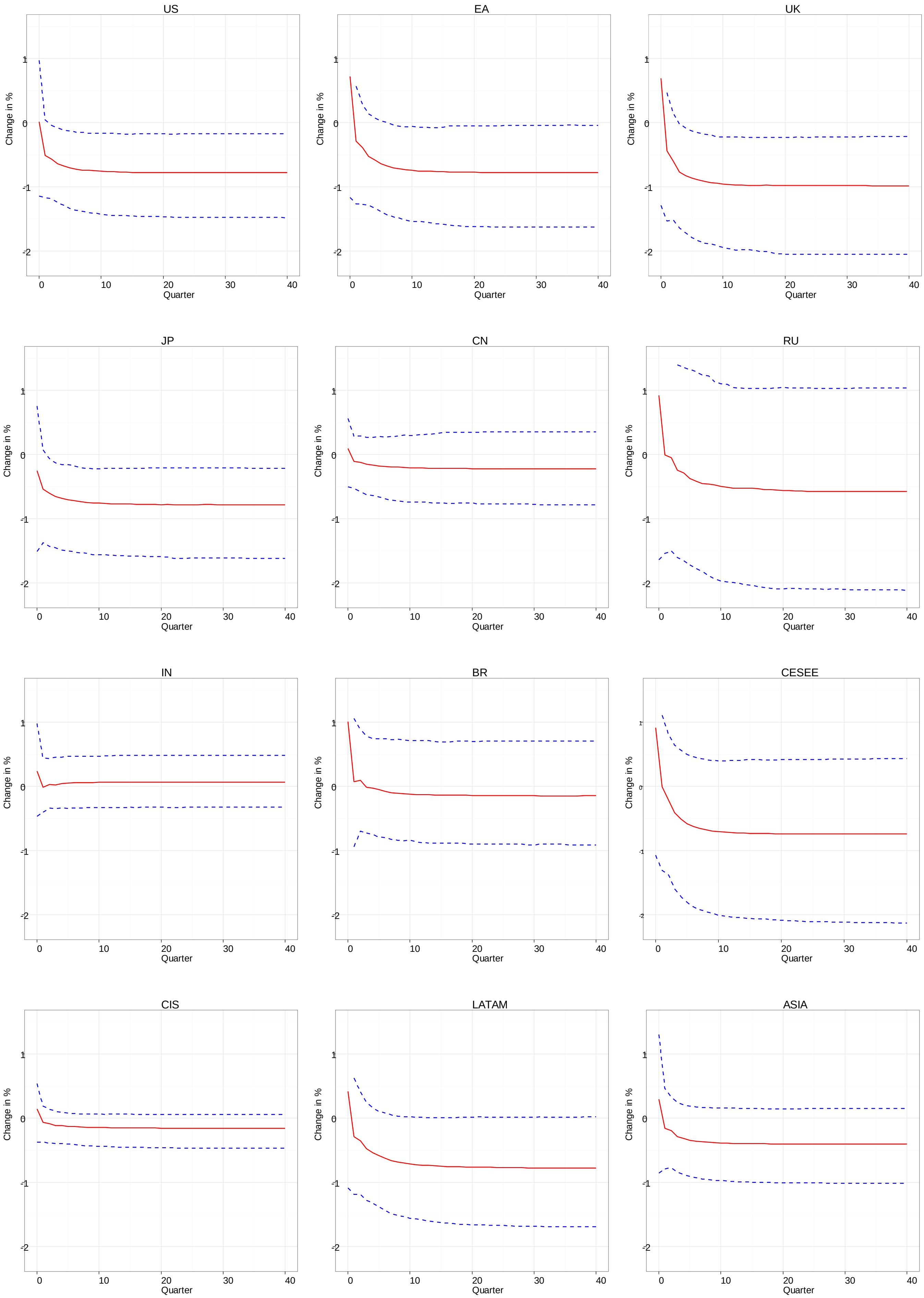
Source: Authors' calculations.

Figure 3: Country-output impact responses to positive 1% shock to US Output



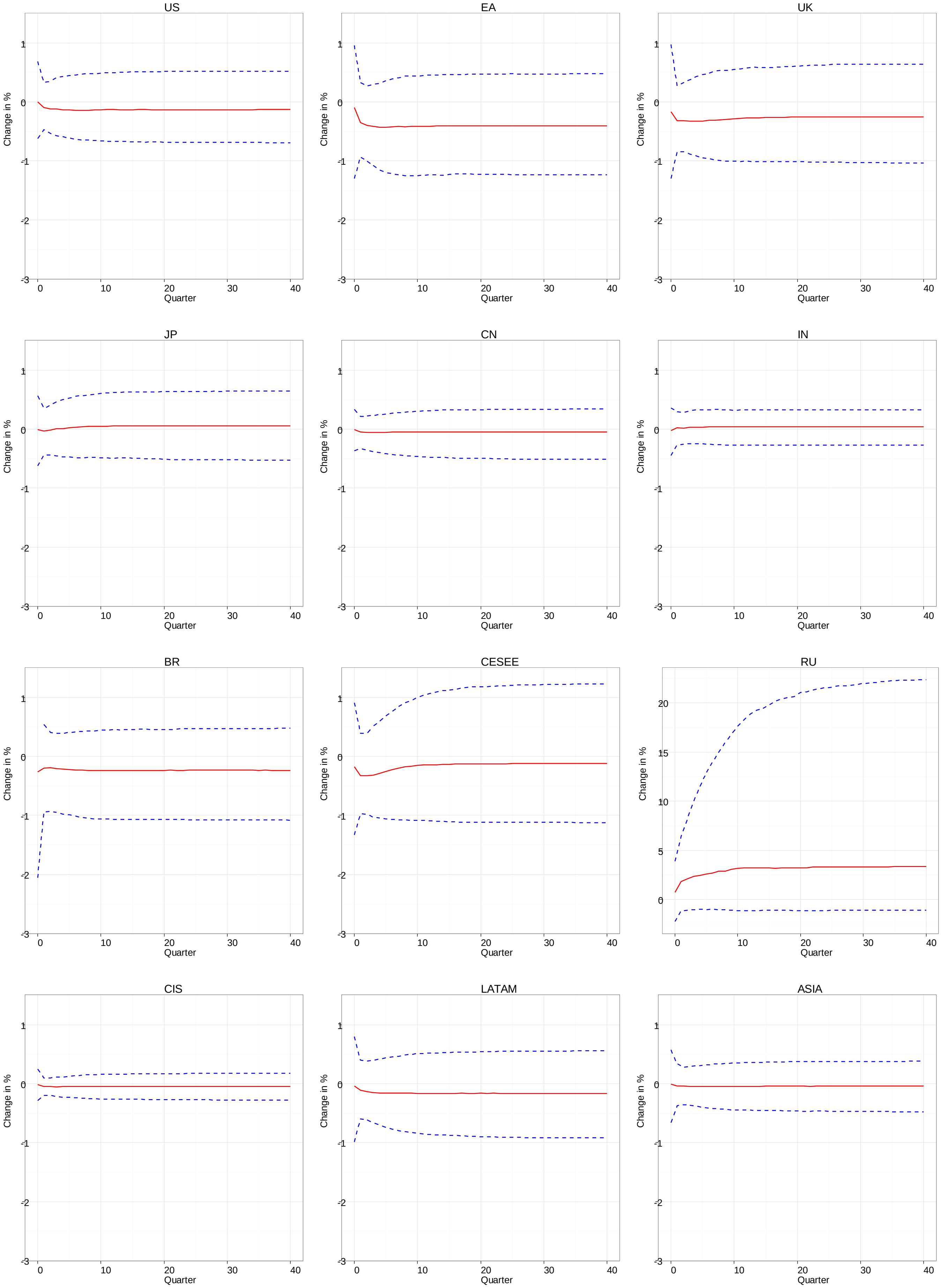
Source: Authors' calculations.

Figure 4: Country-output impact responses to 3% renminbi appreciation vs USD



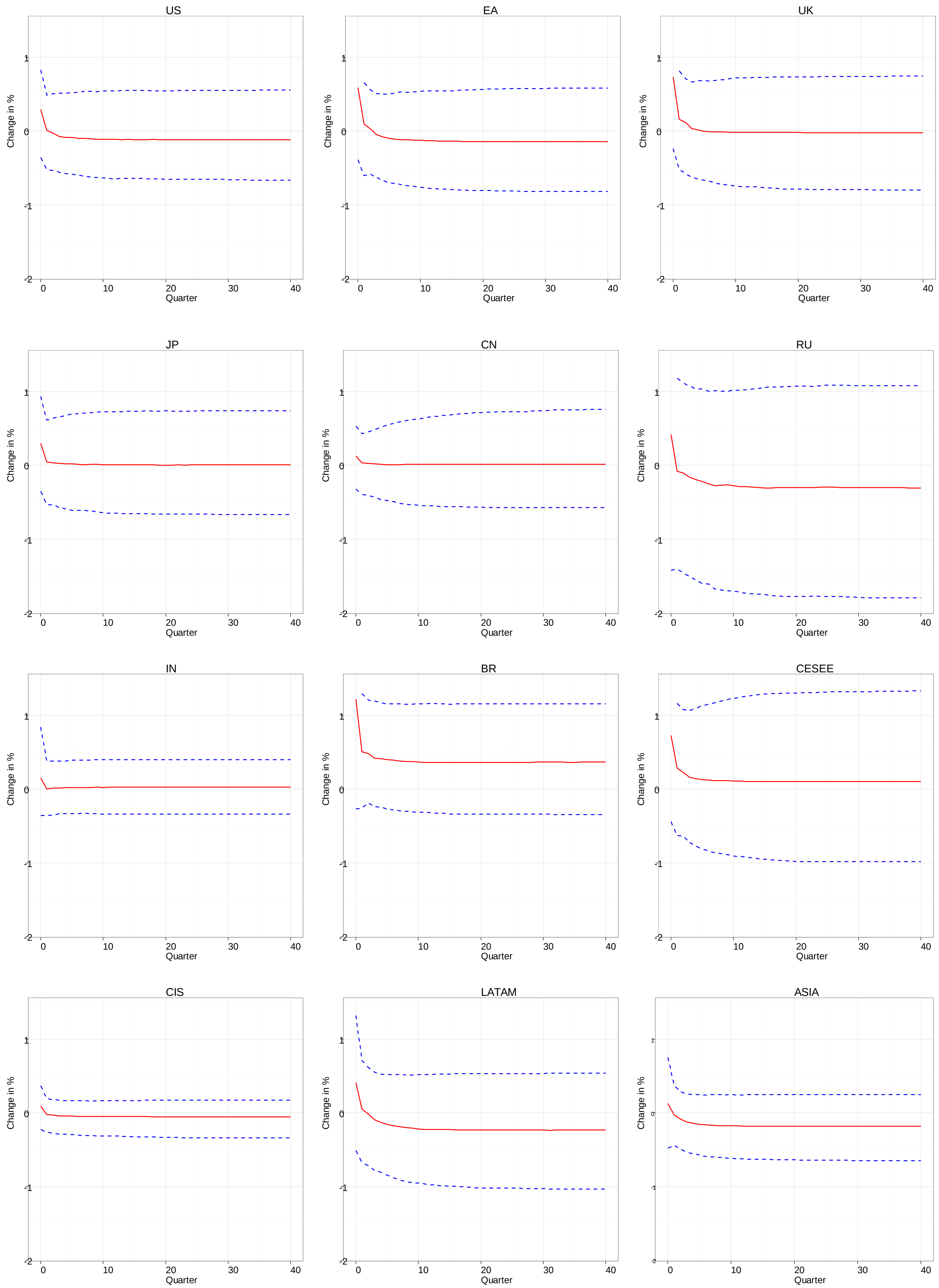
Source: Authors' calculations.

Figure 5: Country-output impact responses to 50% hike in oil price



Source: Authors' calculations.

Figure 6: Country-output impact responses to 3% renminbi appreciation vs USD with 2006 trade weights employed to stack the country models.



Source: Authors' calculations.