

# Online Appendix of “Housing Cycles and Macroeconomic Fluctuations: A Global Perspective”

Ambrogio Cesa-Bianchi

*Research Department, Inter-American Development Bank, 1300 New York Avenue, 20577  
Washington DC, USA*

---

---

## Appendix A. Specification of the GVAR Model

In this appendix, I present the details of the GVAR model specification used in the paper and describe technical details such as integration properties of the series, lag-length selection and cointegration rank, weak exogeneity of foreign variables, and stability of the GVAR. In addition, I provide some of the main estimation results, such as impact elasticities, the pair-wise cross-section correlation of all variables and associated residuals, and the robustness exercises.

The GVAR model uses data for thirty-three countries. The core economies included in the model are China, Japan, the United Kingdom, and the United States; Latin American is composed by Argentina, Brazil, Chile, Peru, and Mexico; the euro area block is made up of the eight largest economies, namely Austria, Belgium, Finland, France, Germany, Italy, Netherlands, and Spain. Other developed and European economies in the model are Australia, Canada, New Zealand, Norway, Sweden and Switzerland. For emerging Asia, we have Indonesia, Korea, Malaysia, the Philippines, Singapore, and Thailand. Finally, the model also considers India, South Africa, South Arabia, and Turkey.

### *Appendix A.1. Unit root tests*

The GVAR model can be specified in terms of either stationary or integrated variables. Following [Dees et al. \(2007\)](#), I assume that the variables included in the country-specific models are integrated of order one (or  $I(1)$ ) and I distinguish between short run and long run relations. To examine the integration properties of both the domestic and foreign variables, given the recognized poor performance of ADF tests in small samples, I consider unit root t-statistics based on weighted symmetric estimation of ADF type regressions introduced by [Fuller and Park \(1995\)](#) (WS henceforth). The lag length employed in the WS unit root tests is selected by the Akaike Information Criterion (AIC) based on standard ADF regressions.

Results of the WS statistics for the level, first differences and second differences of the country-specific domestic and foreign variables are reported in [Tables A.1](#) and [A.2](#). This battery of tests generally support the unit root hypothesis with only a few exceptions, as evidenced in [Cesa-Bianchi et al. \(2012\)](#). For house prices, the

unit root tests generally reject the null hypothesis of unit root for house price log-differences. There are three exceptions though: house price returns in France, Italy, and US are still  $I(1)$  after first differencing. However, the values of the statistics imply that those are borderline cases.

### *Appendix A.2. Selecting lag-length and cointegration rank*

The order of the individual country VARX $^*(p_i, q_i)$  models is selected according to the Akaike information criterion under the constraints imposed by data limitations. Accordingly, the lag order of the foreign variables,  $q_i$ , is set equal to one in all countries; for the same reason, I constraint  $p_i \leq 2$ . Notice that, in preliminary analysis of the GIRFs, Argentina, Belgium, Brazil, Malaysia, Netherlands, New Zealand, Norway, Philippines, and Singapore displayed very ragged responses. Therefore, and consistently with [Cesa-Bianchi et al. \(2012\)](#), I changed the orders of the VARX $^*$  models for these countries from VARX(2,1) to VARX(1,1).

The rank of the cointegrating space for each country was tested using Johansen's trace and maximal eigenvalue statistics, as set out in [Pesaran et al. \(2000\)](#) for models with weakly exogenous  $I(1)$  regressors, in the case where unrestricted constants and restricted trend coefficients are included in the individual country error correction models. [Table A.3](#) reports the trace test statistics and the 95% critical values for all the country-specific VARX $^*$  models, respectively. The critical values are taken from [MacKinnon \(1991\)](#). The trace test is preferred, because it has better small sample properties compared to the maximal eigenvalue test.

To address the issue of possible overstatement of the number of cointegration relationships based on asymptotic critical values, and to assure the stability of the global model, I reduced the number of cointegration relations. Specifically, the following *ad hoc* adjustments in the number of cointegration relations have been made from the results implied by the statistical tests: Argentina from 3 to 1, Australia from 4 to 1, Austria from 5 to 1, Belgium from 3 to 1, Brazil from 2 to 1, Canada from 5 to 1, China from 2 to 1, France from 4 to 1, Germany from 3 to 1, Indonesia from 3 to 1, Italy from 2 to 1, Japan from 3 to 1, Korea from 3 to 1, Malaysia from 2 to 1, Netherlands from 4 to 1, Norway from 4 to 1, New Zealand from 4 to 2, Peru from 3 to 1, Philippines from 2 to 1, South Africa from 2 to 1, Saudi Arabia from 2 to 1, Singapore from 3 to 1, Spain from 3 to 2, Sweden from 4 to 1, Switzerland from 4 to 1, Thailand from 2 to 1, United Kingdom from 2 to 1, and United States from 3 to 2.

Finally, the country-specific models were estimated subject to reduced rank restrictions ([Johansen, 1992](#)). The order of the VARX $^*$  models, as well as the number of cointegration relations, are presented in [Table A.4](#).

### *Appendix A.3. Testing weak exogeneity*

The weak exogeneity of foreign variables is the key assumption for the whole GVAR modeling approach. After having estimated each country VECMX model individually, it is necessary to verify the validity of the hypothesis of weak exogeneity for both the country-specific foreign variables and the oil price in each of these country specific models.

I employ the weak exogeneity test proposed by [Johansen \(1992\)](#) and [Harbo et al. \(1998\)](#), that is a test on the joint significance of the estimated error correction terms

in auxiliary equations for the country-specific foreign variables,  $x_{it}^*$ . In particular, for each  $l^{th}$  element of  $x_{it}$  the following regression is estimated:

$$\Delta x_{it,l}^* = \mu_{il} + \sum_{j=1}^{r_i} \gamma_{ij,l} ECM_{i,t-1}^j + \sum_{k=1}^{s_i} \varphi_{ik,l} \Delta x_{i,t-k} + \sum_{m=1}^{n_i} \vartheta_{im,l} \Delta \tilde{x}_{i,t-m}^* + \epsilon_{it,l}, \quad (\text{A.1})$$

where  $ECM_{i,t-1}^j$ ,  $j = 1, 2, \dots, r_i$  are the estimated error correction terms corresponding to the  $r_i$  cointegrating relations found for the  $i^{th}$  country model, and  $\Delta \tilde{x}_{it}^* = [\Delta x_{it}^*, \Delta(e_{it}^* - p_{it}^*), \Delta p_{it}^*]'$ .<sup>1</sup> The test consists in verifying by means of an  $F$  test the joint hypothesis that  $\gamma_{ij,l} = i$  for each  $j = 1, 2, \dots, r_i$ .

Results in Table A.5 suggest that most of the weak exogeneity assumptions are not rejected by the data: only 14 out of the 264 exogeneity tests reject the weak exogeneity assumption made. Notice that, concerning house prices, the weak exogeneity assumption does not hold for Chile and Korea, but holds for the US.

#### Appendix A.4. Stability of the GVAR

The eigenvalues of the GVAR model are 386 in total. In fact, the GVAR contains 193 endogenous variables with a maximum lag order of 2, which give rise to a companion  $VAR(1)$  model with 386 variables. From the individual country models and the theorem in Pesaran et al. (2004) we do not expect the rank of the cointegrating matrix in the global model to exceed 52 (namely the number of cointegrating relations in all the individual country models). Hence, the global system should have at least 141 eigenvalues (i.e. 193 - 52), that fall on the unit circle. The GVAR satisfies these properties and, indeed, has 141 eigenvalues equal to unity, with the remaining 245 eigenvalues having moduli all less than unity. After the unit roots, the two largest eigenvalues (in *modulus*) are 0.931 and 0.847, implying a reasonable rate of convergence of the model after a shock to its long-run equilibrium. Given the unit eigenvalues of the system, some shocks will have permanent effects on the levels of the endogenous variables.

Moreover, the stability of the system is analyzed through the persistence profiles, i.e. the time profiles of the effects of system or variable specific shocks on the cointegration relations in the GVAR model. If the vector under consideration is a valid cointegrating vector, the persistence profiles should return to equilibrium at acceptable rate (normally less than 40 periods). Figure A.1 displays the persistence profiles of all cointegration relations in the GVAR model.

#### Appendix A.5. Contemporaneous effects of foreign variables on their domestic counterparts

The estimation of the cointegrating VECMX models permits to examine the impact of foreign-specific variables on their domestic counterparts. As explained in the main text, these estimates are generally viewed as impact elasticities, which measure the contemporaneous variation of a domestic variable due to a 1 percent change in its corresponding foreign-specific counterpart.

---

<sup>1</sup>Note that in the case of the United States the term  $\Delta(e_{it}^* - p_{it}^*)$  is implicitly included in  $\Delta x_{it}^*$ .

Table A.6 reports these impact elasticities, for all countries and variables. Statistical significance is computed with the corresponding t-ratios based on the White’s heteroscedasticity-consistent variance estimator. As in earlier exercises by Pesaran et al. (2004) and Dees et al. (2007), there is substantial comovement between the major advanced economies’ real GDP and their specific foreign counterparts. The same result holds -with larger magnitudes- for most of the East Asian countries in the sample. Inflation transmission in the above-mentioned economies is smaller but still positive and significant. Contemporaneous elasticity between real equity prices is remarkably close to unity in the case of the euro area countries and Canada, reflecting their high degree of financial integration.

For the house price series considered in the current GVAR specification, the impact elasticities between foreign and domestic variables are generally positive and significant. The cross-country average of the coefficients is equal to about 0.5, implying that a 1 percent change in foreign real house price leads to an average increase of 0.5 percent in domestic house prices. Nonetheless, these coefficients vary considerably across countries. Countries with very active and volatile housing markets, such as Spain and Sweden, have coefficients ranging above one. In contrast, impact elasticities can be very low (e.g., Germany and Japan) or even negative (e.g., Switzerland), underlying the different historical behavior of the housing sector in such countries relative to other industrialized economies.

Finally, the high and positive coefficients of impact elasticities between foreign and domestic real GDP imply strong comovement of output across countries, a standard result in the international business cycle literature as well as in the GVAR literature.

*Appendix A.6. Pair-wise cross country correlation*

One of the basic assumption underlying the GVAR model is that the cross-dependence of the variable-specific innovations must be sufficiently small, so that

$$\frac{\sum_{j=1}^N \sigma_{ij,ls}}{N} \rightarrow 0 \text{ as } N \rightarrow \infty \forall i, l, s \tag{A.2}$$

where  $\sigma_{ij,ls} = cov(u_{ilt}, u_{jst})$  is the covariance of the variable  $l$  in country  $i$  with the variable  $s$  in country  $j$ . This means that the country-specific shocks are cross-sectionally weakly correlated. I check this requirement by following Dees et al. (2007): I calculate the pair-wise cross-section correlations of all the variables in the GVAR, both in levels and in differences, and of all the corresponding residuals, obtained both from each country-VECM and from country-VECMX model estimation. The main rationale is that foreign variables could be considered as common global factors for each country considered in the GVAR model. Thus, the estimation of each country-specific model by conditioning on the foreign variables can "clean" the common component among countries, in order to obtain simultaneously weakly correlated residuals.

Tables A.7 and A.8 report the pair-wise cross section correlations for the domestic variables and the residuals of the VECMX models (column labeled ResX) and the auxiliary unrestricted VECM models (column labeled Res). Although, these results do not constitute a formal statistical test of the importance of the foreign variables in the GVAR model, they do provide an important indication of their

usefulness in modeling global interdependencies. As illustrated by the differences between the two columns ResX and Res, the results show that once country-specific models are formulated conditional on foreign variables, the degree of correlations across the shocks from different countries is sharply reduced.

*Appendix A.7. Robustness issues*

As discussed in the main text of the paper, to check the validity of the identification strategy, two robustness exercises are considered. Figure A.2 displays the impulse responses to a US housing demand shock identified with the following ordering,  $x_{it} = (x_{it}^1, x_{it}^2, r_t')'$ , as in Iacoviello (2005) and Giuliadori (2005). Figure A.3 displays the impulse responses to a US housing demand shock computed assuming cross-sectional orthogonality of the GVAR residuals.

Table A.1: Unit Root t-Statistics (Weighted Symmetric Estimation of ADF) for Domestic Variables

	Arg.	Austr.	Austria	Bel.	Bra.	Can.	China	Chile	Finl.	France	Germ.	India	Indon.	Italy	Japan	Korea	Mal.
$y$	-2.60	-2.47	-1.48	-2.64	-1.81	-2.12	-1.83	-1.01	-2.56	-2.52	-0.31	-0.86	-1.61	0.55	-0.96	-0.14	-2.09
$\Delta y$	-4.78	-3.48	-7.40	-5.20	-3.85	-3.85	-3.36	-6.76	-3.85	-4.67	-4.87	-7.51	-5.87	-4.61	-3.72	-5.59	-4.94
$\Delta^2 y$	-6.56	-9.88	-9.20	-7.58	-7.98	-10.61	-10.77	-9.03	-9.25	-7.33	-6.90	-10.01	-7.71	-7.92	-13.41	-9.63	-6.91
$\pi$	-3.71	-4.55	-4.09	-4.17	-2.83	-6.58	-2.99	-4.28	-2.65	-5.23	-3.14	-5.22	-5.65	-2.19	-3.97	-3.61	-6.17
$\Delta \pi$	-11.62	-7.11	-6.41	-7.98	-5.91	-8.49	-6.40	-6.52	-6.38	-6.21	-12.41	-8.09	-6.75	-5.69	-7.40	-12.15	-9.00
$\Delta^2 \pi$	-13.95	-9.11	-7.65	-8.21	-8.28	-9.61	-8.20	-8.83	-8.61	-8.46	-9.70	-8.11	-8.11	-10.30	-10.10	-7.71	-11.20
$r^S$	-2.07	-1.84	-1.57	-0.64	-2.55	-1.13	-1.39	-1.89	-1.41	-0.24	-1.72	-2.55	-3.83	0.13	-1.10	-1.51	-1.92
$\Delta r^S$	-15.00	-4.40	-5.23	-4.52	-8.61	-5.05	-5.74	-6.03	-4.39	-5.58	-4.76	-6.24	-6.07	-7.39	-4.03	-8.64	-6.53
$\Delta^2 r^S$	-12.23	-7.57	-10.97	-6.60	-10.60	-8.09	-7.38	-13.15	-7.46	-7.82	-9.59	-8.02	-11.00	-7.42	-9.56	-8.78	-8.00
$hp$	-	-	-	-1.85	-	-1.54	-	-	-2.86	-2.41	-1.45	-	-	-3.67	-	-	-
$\Delta hp$	-	-5.29	-	-2.67	-	-4.45	-	-	-3.96	-2.01	-3.68	-	-	-1.72	-2.55	-	-
$\Delta^2 hp$	-	-7.78	-	-9.12	-	-7.80	-	-	-6.41	-8.92	-7.23	-	-	-13.78	-8.43	-	-
$r^L$	-	-0.38	-0.63	0.02	-	0.19	-	-	-	0.84	-1.13	-	-	0.16	-0.36	-0.82	-
$\Delta r^L$	-	-6.24	-5.80	-5.15	-	-6.15	-	-	-	-6.08	-5.24	-	-	-4.28	-7.27	-7.09	-
$\Delta^2 r^L$	-	-8.87	-12.18	-6.88	-	-8.46	-	-	-	-7.78	-13.86	-	-	-8.47	-7.57	-9.59	-
$(e-p)$	-1.47	-0.19	-0.02	-0.05	-1.03	0.29	-1.21	-0.61	-0.33	-0.23	-0.16	-0.48	-2.29	-0.09	-0.22	-1.00	-1.62
$\Delta(e-p)$	-7.07	-7.48	-6.49	-6.48	-6.66	-7.11	-6.68	-7.03	-4.67	-6.33	-6.44	-6.27	-7.57	-6.85	-4.74	-7.29	-6.76
$\Delta^2(e-p)$	-8.43	-8.56	-9.27	-12.53	-9.48	-7.25	-10.15	-10.30	-13.06	-6.97	-9.48	-11.46	-8.14	-7.20	-10.20	-8.21	-7.29
$q$	-3.58	-3.30	-2.35	-1.68	-	-2.84	-	-1.29	-2.95	-1.90	-2.52	-	-	-3.86	-1.98	-2.44	-2.83
$\Delta q$	-7.09	-7.25	-6.78	-6.19	-	-7.19	-	-5.50	-3.97	-6.30	-6.58	-6.82	-	-4.32	-4.69	-6.36	-7.14
$\Delta^2 q$	-8.44	-8.47	-9.75	-7.59	-	-7.16	-	-9.11	-12.87	-9.36	-12.17	-8.66	-	-9.58	-8.08	-12.22	-12.52

	Mex.	Neth.	Norway	New Zeal.	Peru	Philip.	South Afr.	Saudi A.	Sing.	Spain	Swed.	Switz.	Thail.	Turk.	UK	US
$y$	-3.24	-1.41	-1.32	-1.96	-1.42	-1.88	-1.37	-0.70	-1.62	-2.69	-2.38	-2.04	-1.22	-2.54	-1.66	-1.10
$\Delta y$	-4.09	-3.65	-10.30	-2.84	-7.45	-2.87	-4.53	-3.15	-5.76	-3.05	-4.75	-5.42	-4.84	-7.34	-4.22	-3.98
$\Delta^2 y$	-9.59	-6.17	-9.25	-9.57	-8.76	-9.46	-7.96	-19.64	-8.02	-8.48	-7.45	-7.99	-8.79	-8.60	-7.51	-6.85
$\pi$	-3.76	-3.09	-3.83	-3.83	-3.33	-5.88	-4.60	-4.53	-4.94	-2.79	-3.31	-3.79	-5.46	-2.09	-4.55	-4.11
$\Delta \pi$	-4.82	-12.52	-10.52	-7.46	-8.92	-5.87	-7.70	-10.17	-6.73	-7.21	-11.43	-6.41	-7.93	-7.69	-8.61	-8.50
$\Delta^2 \pi$	-13.82	-8.16	-9.42	-9.31	-9.47	-7.85	-8.42	-9.01	-8.68	-9.17	-7.62	-8.39	-9.48	-9.85	-9.96	-9.46
$r^S$	-1.20	-1.68	-1.58	-1.77	-3.00	-2.37	-2.97	-	-2.01	-0.48	-0.78	-2.27	-2.22	-1.76	-0.89	-2.10
$\Delta r^S$	-9.49	-5.18	-8.41	-5.83	-4.17	-7.44	-5.23	-	-7.46	-6.94	-5.17	-4.00	-5.98	-8.89	-5.13	-4.07
$\Delta^2 r^S$	-10.37	-10.44	-10.64	-8.76	-8.35	-9.13	-8.42	-	-9.56	-7.55	-8.07	-8.57	-6.90	-8.64	-9.66	-10.30
$hp$	-	-1.62	-1.99	-2.11	-	-	-1.02	-	-2.44	-2.58	-1.39	-1.92	-	-	-2.63	-1.77
$\Delta hp$	-	-2.57	-3.84	-3.45	-	-	-2.87	-	-5.27	-3.00	-3.32	-2.55	-	-	-3.31	-1.59
$\Delta^2 hp$	-	-12.35	-7.77	-7.73	-	-	-5.61	-	-9.89	-7.87	-6.88	-13.29	-	-	-6.52	-7.83
$r^L$	-	-1.17	-0.64	-1.04	-	-	-1.43	-	-	-0.70	-0.20	-1.71	-	-	-0.10	-0.45
$\Delta r^L$	-	-4.76	-6.90	-7.20	-	-	-7.83	-	-	-6.81	-6.94	-7.00	-	-	-5.48	-5.45
$\Delta^2 r^L$	-	-13.72	-7.29	-8.49	-	-	-8.04	-	-	-8.98	-7.52	-11.42	-	-	-8.09	-7.25
$(e-p)$	-0.53	-0.15	-0.03	-0.71	0.13	-0.78	-2.17	-0.75	0.40	0.24	-0.70	-0.04	-1.03	0.02	-0.07	-
$\Delta(e-p)$	-4.86	-6.42	-6.78	-6.09	-8.24	-5.45	-4.48	-2.60	-5.89	-5.93	-6.88	-6.57	-7.10	-6.14	-7.73	-
$\Delta^2(e-p)$	-14.47	-9.43	-7.78	-7.52	-8.16	-6.87	-14.89	-8.67	-8.13	-7.27	-7.88	-13.12	-8.48	-9.65	-8.32	-
$q$	-	-1.49	-3.39	-2.61	-	-1.59	-4.01	-	-3.86	-1.78	-7.88	-1.97	-1.54	-	-1.51	-1.51
$\Delta q$	-	-6.01	-7.22	-5.30	-	-5.78	-7.86	-	-7.03	-6.17	-6.42	-6.26	-7.08	-	-6.88	-5.94
$\Delta^2 q$	-	-6.96	-13.29	-6.74	-	-12.22	-10.00	-	-9.20	-10.17	-12.24	-11.53	-9.73	-	-10.33	-7.67

**Note.** The ADF statistics are based on univariate AR(p) models in the level of the endogenous variables with  $p \leq 5$ , and the statistics for the level, first differences, and second differences of the variables are all computed on the basis of the same sample period, namely 1983:1–2009:4. The ADF statistics for all the level variables are based on regressions including a linear trend, except for the interest variables, and an intercept term only in the case of the first and second differences. The 95% critical value of the WS statistics for regressions with trend is -3.24, and for regressions without trend -2.55.

Table A.2: Unit Root t-Statistics (Weighted Symmetric Estimation of ADF) for Foreign Variables

	Arg.	Austr.	Austria	Bel.	Bra.	Can.	China	Chile	Finl.	France	Germm.	India	Indon.	Italy	Japan	Korea	Mal.
$y^*$	-2.19	-1.70	-0.44	-1.02	-3.02	-1.22	-0.95	-2.57	-2.20	-1.23	-2.30	-2.00	-1.59	-1.71	-2.20	-2.49	-1.58
$\Delta y^*$	-6.20	-3.77	-5.53	-4.69	-4.21	-3.48	-5.04	-5.21	-5.12	-4.90	-5.06	-4.06	-5.39	-5.12	-4.90	-3.94	-5.38
$\Delta^2 y^*$	-7.61	-9.32	-6.74	-7.97	-7.39	-6.98	-6.95	-7.02	-7.02	-7.94	-8.23	-7.98	-7.90	-8.10	-7.59	-9.75	-8.22
$\pi^*$	-2.78	-2.51	-2.84	-2.87	-3.51	-2.71	-2.84	-2.76	-3.05	-2.73	-3.55	-3.04	-2.43	-3.14	-3.07	-2.88	-3.52
$\Delta \pi^*$	-5.83	-6.96	-11.15	-10.08	-11.51	-7.83	-8.27	-7.12	-9.26	-6.59	-9.58	-8.75	-6.70	-9.31	-7.05	-6.72	-7.12
$\Delta^2 \pi^*$	-8.20	-8.77	-8.36	-8.06	-14.42	-8.50	-8.01	-10.20	-8.37	-8.10	-8.03	-8.59	-8.33	-8.23	-8.97	-8.70	-8.70
$r^S$	-2.41	-0.78	-0.78	-0.94	-1.68	-0.99	-1.30	-0.84	-0.84	-0.87	-0.67	-1.16	-1.09	-0.93	-0.95	-1.07	-1.16
$\Delta r^S$	-10.09	-5.41	-7.10	-8.65	-14.28	-4.78	-9.92	-5.96	-9.07	-8.88	-9.36	-9.73	-9.38	-9.24	-9.00	-9.57	-5.27
$\Delta^2 r^S$	-10.57	-10.31	-9.82	-9.61	-11.88	-10.49	-10.10	-9.44	-9.75	-9.50	-9.78	-9.83	-9.34	-9.82	-8.94	-9.63	-15.46
$hp^*$	-3.04	-3.07	-3.79	-2.69	-2.83	-1.98	-3.17	-2.08	-3.17	-2.08	-3.18	-3.00	-2.45	-2.96	-2.03	-2.36	-2.70
$\Delta hp^*$	-2.32	-3.70	-2.67	-3.10	-2.74	-1.50	-3.33	-2.29	-3.42	-2.72	-3.06	-3.74	-5.05	-2.96	-3.85	-3.91	-5.17
$\Delta^2 hp^*$	-5.65	-7.91	-9.27	-5.03	-5.64	-7.56	-6.05	-6.20	-5.84	-8.79	-4.91	-8.17	-9.33	-4.90	-6.30	-9.38	-9.52
$r^L$	0.15	0.03	-0.34	-0.03	0.16	-0.17	0.01	0.17	0.07	0.00	0.28	0.23	-0.08	-0.04	0.09	0.10	0.00
$\Delta r^L$	-6.22	-6.04	-5.60	-5.88	-6.23	-5.96	-6.06	-6.15	-6.34	-5.69	-6.05	-6.36	-5.68	-6.01	-6.57	-5.97	-6.01
$\Delta^2 r^L$	-7.70	-7.93	-7.52	-7.59	-7.64	-7.39	-7.67	-7.65	-7.75	-7.54	-7.61	-7.62	-7.68	-7.71	-7.77	-7.97	-7.63
$(e-p)$	-0.18	0.03	-0.03	-0.02	0.05	0.42	0.20	0.28	-0.05	0.09	0.08	0.05	0.31	0.06	-0.29	0.10	0.08
$\Delta(e-p)$	-6.03	-6.69	-6.54	-6.57	-7.20	-7.31	-6.32	-6.25	-6.65	-6.60	-6.65	-6.59	-6.52	-6.50	-6.27	-6.76	-6.34
$\Delta^2(e-p)$	-8.88	-8.18	-9.40	-9.33	-12.60	-7.71	-7.40	-7.25	-7.25	-9.32	-7.16	-7.70	-8.09	-9.24	-7.43	-8.13	-8.07
$q^*$	-1.71	-2.33	-2.28	-1.99	-2.81	-1.62	-2.23	-2.55	-2.31	-2.00	-1.88	-2.30	-2.69	-2.00	-2.20	-2.23	-2.58
$\Delta q^*$	-6.44	-6.67	-6.44	-6.42	-7.23	-6.12	-6.59	-6.84	-6.53	-6.38	-6.41	-6.76	-6.77	-6.48	-6.80	-6.74	-6.84
$\Delta^2 q^*$	-9.50	-11.47	-12.05	-9.25	-12.63	-7.54	-11.41	-12.17	-12.10	-9.31	-9.46	-9.13	-11.34	-9.24	-11.64	-9.14	-11.44

	Mex.	Neth.	Norway	New Zeal.	Peru	Philip.	South Afr.	Saudi A.	Sing.	Spain	Swed.	Switz.	Thail.	Turk.	UK	US
$y^*$	-0.83	-1.37	-1.76	-1.73	-2.18	-1.44	-1.96	-1.20	-1.63	-1.51	-1.85	-0.57	-1.66	-1.61	-1.94	-3.93
$\Delta y^*$	-3.28	-5.41	-4.67	-3.84	-3.97	-3.93	-5.19	-5.09	-4.38	-5.12	-5.01	-5.13	-4.07	-5.11	-4.83	-4.91
$\Delta^2 y^*$	-8.01	-6.80	-7.82	-8.04	-7.62	-7.60	-7.76	-6.61	-6.29	-8.31	-7.23	-6.72	-7.02	-7.77	-8.12	-7.81
$\pi^*$	-3.11	-3.34	-2.65	-4.26	-2.88	-3.23	-2.74	-3.16	-4.57	-3.04	-3.05	-2.78	-3.28	-3.31	-2.86	-2.74
$\Delta \pi^*$	-9.00	-9.36	-6.90	-7.44	-8.31	-6.65	-9.15	-6.97	-7.54	-9.02	-10.00	-10.44	-6.72	-9.47	-10.21	-5.70
$\Delta^2 \pi^*$	-8.36	-8.35	-8.41	-8.64	-8.24	-8.53	-7.95	-8.32	-9.15	-7.72	-7.84	-8.00	-8.75	-8.40	-7.95	-10.20
$r^S$	-1.40	-0.88	-0.86	-1.10	-1.75	-1.19	-1.51	-1.03	-1.20	-1.05	-0.56	-0.72	-0.94	-0.95	-0.59	-0.83
$\Delta r^S$	-9.29	-9.23	-8.29	-4.70	-10.51	-4.98	-5.99	-9.99	-7.02	-9.81	-8.83	-9.43	-9.30	-9.00	-9.12	-11.23
$\Delta^2 r^S$	-9.48	-9.81	-9.18	-13.98	-9.82	-17.22	-9.37	-10.09	-10.08	-9.60	-9.40	-10.09	-9.38	-9.24	-9.67	-10.08
$hp^*$	-1.98	-3.48	-2.06	-2.71	-2.79	-2.26	-3.01	-2.94	-3.35	-3.13	-2.63	-4.13	-2.33	-3.78	-2.60	-2.52
$\Delta hp^*$	-1.57	-3.03	-4.02	-4.75	-2.19	-4.71	-3.16	-3.34	-2.66	-2.15	-2.98	-2.35	-4.12	-2.67	-2.82	-4.15
$\Delta^2 hp^*$	-7.88	-5.26	-6.28	-7.21	-6.62	-9.62	-5.00	-5.83	-10.27	-8.12	-6.41	-9.64	-8.77	-8.21	-9.71	-6.92
$r^L$	-0.18	0.11	0.10	0.16	0.15	-0.09	0.10	0.00	0.10	0.31	0.17	0.11	-0.05	0.17	0.16	0.19
$\Delta r^L$	-5.95	-5.84	-5.94	-6.42	-6.18	-5.75	-5.99	-5.93	-6.26	-5.89	-6.22	-5.91	-5.70	-6.03	-6.26	-5.79
$\Delta^2 r^L$	-7.35	-7.64	-7.74	-7.56	-7.62	-7.56	-7.75	-7.69	-7.66	-7.58	-7.67	-7.60	-7.73	-7.63	-7.72	-8.15
$(e-p)$	0.20	0.04	-0.03	-0.04	0.26	0.09	0.21	0.15	-0.70	0.05	0.05	0.05	0.10	0.05	0.07	0.65
$\Delta(e-p)$	-6.24	-6.67	-6.90	-6.69	-6.44	-6.60	-6.81	-6.55	-6.33	-6.68	-6.72	-6.56	-6.64	-6.67	-6.48	-7.35
$\Delta^2(e-p)$	-7.48	-7.14	-7.48	-7.88	-7.31	-8.26	-7.57	-7.63	-7.66	-7.08	-7.25	-9.42	-8.04	-7.19	-9.28	-7.14
$q^*$	-1.74	-2.04	-2.05	-2.45	-2.11	-2.48	-2.18	-2.21	-2.36	-2.09	-2.00	-2.16	-2.48	-2.13	-2.10	-2.88
$\Delta q^*$	-6.19	-6.51	-6.44	-6.84	-6.46	-6.78	-6.65	-6.57	-6.93	-6.40	-6.50	-6.51	-6.68	-6.48	-6.50	-6.91
$\Delta^2 q^*$	-7.61	-11.97	-9.29	-7.60	-11.33	-11.40	-11.82	-11.41	-11.75	-9.13	-12.24	-9.18	-11.34	-9.24	-9.17	-7.48

**Note.** The ADF statistics are based on univariate AR(p) models in the level of the endogenous variables with  $p \leq 5$ , and the statistics for the level, first differences, and second differences of the variables are all computed on the basis of the same sample period, namely 1983:1–2009:4. The ADF statistics for all the level variables are based on regressions including a linear trend, except for the interest variables, and an intercept term only in the case of the first and second differences. The 95% critical value of the WS statistics for regressions with trend is -3.24, and for regressions without trend -2.55.

Table A.3: Cointegration Rank Statistics (Trace Test)

	# End.	# For.	$r = 0$	$r = 1$	$r = 2$	$r = 3$	$r = 4$	$r = 5$	$r = 6$
ARGENTINA	5	7	289.66	108.28	63.25	24.89	20.72	–	–
AUSTRALIA	7	7	102.74	89.46	72.28	43.33	37.98	26.66	21.64
AUSTRIA	6	7	132.50	62.36	59.18	46.97	41.45	19.13	–
BELGIUM	7	7	83.70	67.42	62.95	40.92	29.58	19.06	17.47
BRAZIL	4	7	238.42	57.42	34.50	24.69	–	–	–
CANADA	7	7	123.83	76.79	58.91	50.21	44.10	32.30	19.62
CHINA	4	7	72.49	52.61	28.71	22.41	–	–	–
CHILE	5	7	106.64	54.06	37.57	20.50	18.19	–	–
FINLAND	6	7	87.92	73.99	46.88	31.80	26.77	19.20	–
FRANCE	7	7	95.18	85.29	80.43	51.85	34.94	30.11	22.93
GERMANY	7	7	90.51	73.21	58.12	52.95	40.00	20.21	14.14
INDIA	5	7	67.24	52.28	42.42	18.87	11.14	–	–
INDONESIA	4	7	66.15	55.29	40.04	20.24	–	–	–
ITALY	7	7	117.26	90.39	53.46	42.67	29.09	24.38	10.57
JAPAN	7	7	96.40	68.97	56.57	43.97	30.38	27.84	16.35
KOREA	6	7	98.00	77.10	51.37	40.12	30.94	17.16	–
MALAYSIA	5	7	71.85	53.43	41.71	22.96	16.04	–	–
MEXICO	4	7	97.94	49.28	40.75	17.70	–	–	–
NETHERL.	7	7	124.09	88.79	72.22	48.42	40.26	25.91	16.56
NORWAY	7	7	134.52	110.05	99.76	86.13	39.92	19.83	18.24
NEW ZEAL.	7	7	152.70	140.66	103.18	88.13	34.72	27.30	20.12
PERU	4	7	91.36	50.92	40.70	26.58	–	–	–
PHILIPPINES	5	7	119.62	64.43	47.86	24.66	12.02	–	–
SOUTH AFR.	7	7	71.41	63.87	48.33	40.48	37.11	23.69	14.38
SAUDI AR.	3	7	68.79	50.87	29.33	–	–	–	–
SINGAPORE	6	7	110.10	82.89	68.77	40.39	26.52	15.92	–
SPAIN	7	7	120.79	100.00	57.71	51.13	31.91	29.40	14.65
SWEDEN	7	7	92.13	83.21	59.88	52.41	35.01	22.86	18.87
SWITZ.	7	7	119.34	95.55	83.40	61.43	36.38	30.73	17.47
THAILAND	5	7	70.79	56.63	29.68	26.78	19.06	–	–
TURKEY	4	7	52.86	48.52	28.89	10.53	–	–	–
U.K.	7	7	123.93	64.57	53.98	38.30	32.20	21.24	18.23
U.S.	7	4	87.96	58.29	43.93	38.97	26.04	19.05	13.81

**Note.** Tests are conducted using the trace statistic at the 5% level of significance. The critical values for models including weakly exogenous variables are obtained from [MacKinnon \(1991\)](#); “# End.” corresponds to the number of domestic variables in each model; “# For.” corresponds to the number of foreign (star) variables; “ $r$ ” is the number of cointegrating relation to be tested.

Table A.4: Lag Specification of the Country-specific VARX\* Models and Number of Cointegrating Relations

	$p_i$	$q_i$	CV		$p_i$	$q_i$	CV
ARGENTINA	<b>1</b>	1	<b>1</b>	MEXICO	1	1	2
AUSTRALIA	2	1	<b>1</b>	NETHERLANDS	<b>1</b>	1	<b>1</b>
AUSTRIA	1	1	<b>1</b>	NORWAY	<b>1</b>	1	<b>1</b>
BELGIUM	<b>1</b>	1	<b>1</b>	NEW ZEALAND	<b>1</b>	1	<b>2</b>
BRAZIL	<b>1</b>	1	<b>1</b>	PERU	2	1	<b>1</b>
CANADA	1	1	<b>1</b>	PHILIPPINES	<b>1</b>	1	<b>1</b>
CHINA	1	1	<b>1</b>	SOUTH AFRICA	2	1	<b>1</b>
CHILE	2	1	2	SAUDI ARABIA	2	1	<b>1</b>
FINLAND	2	1	2	SINGAPORE	<b>1</b>	1	<b>1</b>
FRANCE	2	1	<b>1</b>	SPAIN	2	1	<b>2</b>
GERMANY	2	1	<b>1</b>	SWEDEN	2	1	<b>1</b>
INDIA	2	1	1	SWITZERLAND	2	1	<b>1</b>
INDONESIA	2	1	<b>1</b>	THAILAND	2	1	<b>1</b>
ITALY	2	1	<b>1</b>	TURKEY	2	1	1
JAPAN	2	1	<b>1</b>	UNITED KINGDOM	2	1	<b>1</b>
KOREA	2	1	<b>1</b>	UNITED STATES	2	1	<b>2</b>
MALAYSIA	<b>1</b>	1	<b>1</b>				

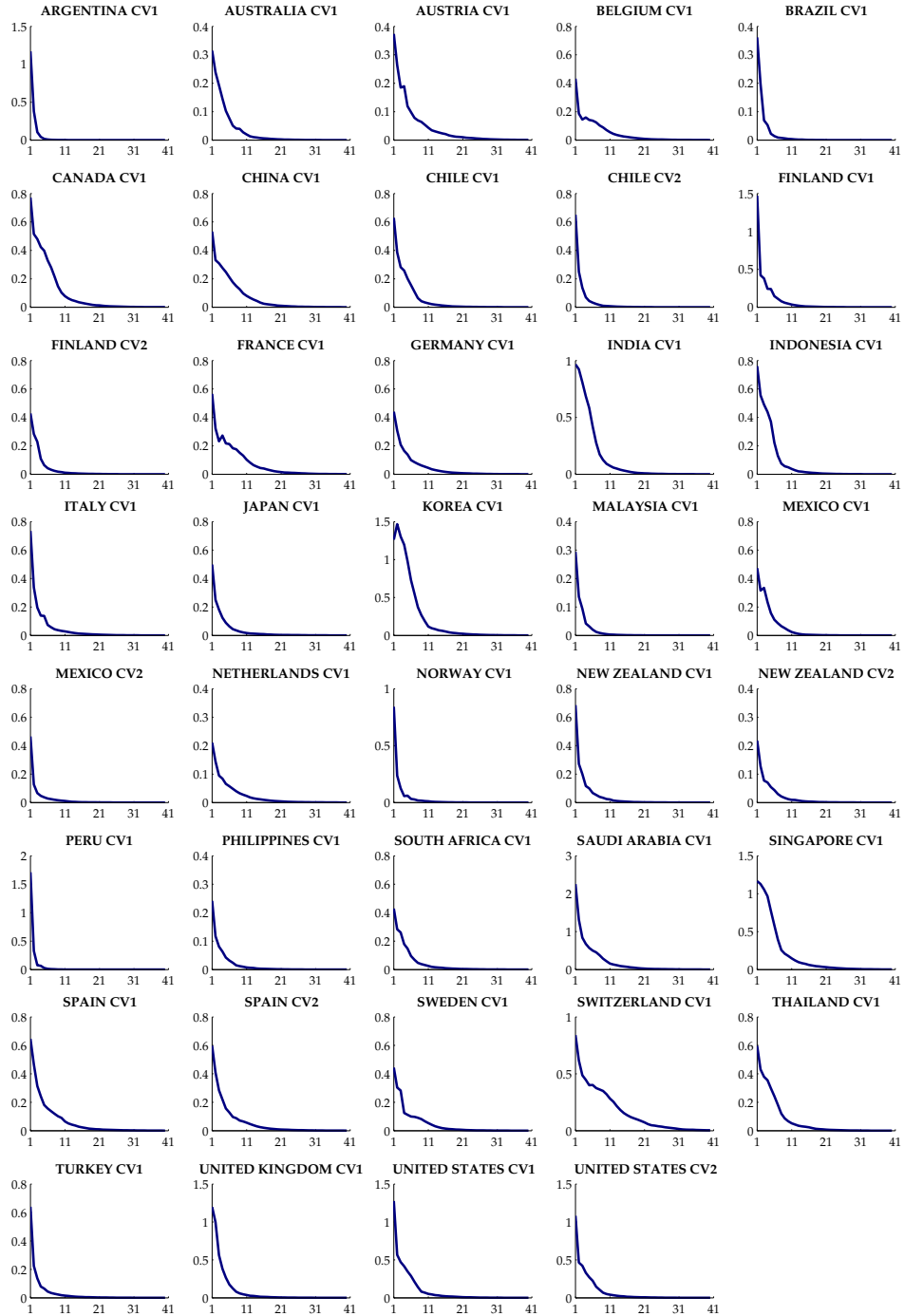
**Note.** The lag orders of the VARX\* models are selected by AIC. Countries that showed very ragged responses in the GIRFs were changed from VARX(2,1) to VARX(1,1), as marked in bold. The number of cointegration relationships are based on trace statistics with MacKinnon's asymptotic critical values. To resolve the issues of potential overestimation of cointegration relationships with asymptotic critical values, the number of cointegration relationships for 29 countries are reduced, as marked in bold, to be consistent to economic theory and to maintain the stability in the global model.

Table A.5: F-Statistics for Testing the Weak Exogeneity of the Country-specific Foreign Variables and Oil Prices

		$y^*$	$\pi^*$	$\rho^{S*}$	$hp^*$	$\rho^{L*}$	$(e^* - p^*)$	$q^*$	$p^o$
ARGENTINA	F(1,82)	0.03	0.30	0.02	0.50	0.34	–	2.47	0.69
AUSTRALIA	F(1,73)	0.25	2.77	0.07	0.02	0.00	–	0.00	0.18
AUSTRIA	F(1,81)	0.35	1.86	0.00	2.54	0.73	–	2.39	1.12
BELGIUM	F(1,80)	0.37	0.03	0.17	5.49 <sup>†</sup>	0.00	–	0.32	0.99
BRAZIL	F(1,83)	0.01	0.17	0.73	0.09	0.01	–	0.07	4.86 <sup>†</sup>
CANADA	F(1,80)	0.40	0.15	0.91	0.17	2.29	–	0.00	0.49
CHINA	F(1,83)	1.37	0.03	0.00	0.09	2.68	–	0.00	2.35
CHILE	F(2,76)	0.80	1.02	0.74	3.18 <sup>†</sup>	0.92	–	1.16	1.62
FINLAND	F(2,74)	0.47	0.67	3.20 <sup>†</sup>	0.27	0.11	–	0.69	0.41
FRANCE	F(1,73)	0.31	0.52	0.03	3.61	1.62	–	1.63	4.37 <sup>†</sup>
GERMANY	F(1,73)	1.28	0.73	0.00	0.00	0.34	–	0.03	0.63
INDIA	F(1,77)	0.41	0.50	0.77	0.02	0.47	–	0.58	0.10
INDONESIA	F(1,79)	1.57	0.02	0.04	0.31	0.04	–	0.12	0.56
ITALY	F(1,73)	2.73	2.56	1.05	0.68	0.27	–	7.24 <sup>†</sup>	0.05
JAPAN	F(1,73)	0.03	0.42	8.26 <sup>†</sup>	0.02	5.84 <sup>†</sup>	–	0.11	4.89 <sup>†</sup>
KOREA	F(1,75)	0.05	1.45	0.29	1.43	1.42	–	0.02	0.19
MALAYSIA	F(1,82)	0.79	0.86	0.19	0.70	0.29	–	1.82	0.69
MEXICO	F(2,82)	0.03	1.73	3.39 <sup>†</sup>	0.87	0.82	–	1.73	0.30
NETH.	F(1,80)	1.41	0.12	0.01	2.21	0.00	–	0.01	0.07
NORWAY	F(1,80)	0.96	0.02	0.90	1.57	0.06	–	0.09	0.56
NEW ZEALAND	F(2,79)	1.49	2.51	1.49	1.07	1.25	–	0.78	0.05
PERU	F(1,79)	0.97	2.01	0.01	1.99	0.05	–	0.84	0.49
PHILIPPINES	F(1,82)	1.29	2.07	0.20	0.97	0.00	–	1.90	2.64
SOUTH AFRICA	F(1,73)	0.22	0.60	0.00	0.03	1.46	–	0.02	0.36
SAUDI ARABIA	F(1,81)	0.78	0.31	2.43	0.17	0.69	–	4.23 <sup>†</sup>	2.77
SINGAPORE	F(1,81)	1.12	0.21	1.47	0.00	0.64	–	0.76	1.40
SPAIN	F(2,72)	0.51	0.51	0.82	2.89	0.83	–	1.29	0.88
SWEDEN	F(1,73)	0.68	1.20	0.00	0.48	1.19	–	6.38 <sup>†</sup>	1.88
SWITZ.	F(1,73)	0.06	0.04	0.03	0.03	0.53	–	1.96	0.35
THAILAND	F(1,77)	0.01	0.29	0.00	0.30	0.08	–	0.60	0.59
TURKEY	F(1,79)	6.43 <sup>†</sup>	2.85	3.31	7.98	5.47 <sup>†</sup>	–	0.78	2.72
U.K.	F(1,73)	1.40	0.22	0.03	2.94	0.59	–	0.11	0.00
U.S.	F(2,80)	0.09	0.04	–	0.02	–	0.18	–	–

**Note.** The F statistics test zero restrictions on the coefficients of the error correction terms in the error-correction regression for the country-specific foreign variables. † denotes statistical significance at the 5% level.

Figure A.1: Persistence Profiles of the GVAR Model



**Note.** Time profiles of the effects of system or variable specific shocks on the cointegration relations in the GVAR model. Note that the value of these profiles is unity on impact, while it should tend to zero as the horizon of the persistence profiles tends to infinity.

Table A.6: Contemporaneous Effect of Foreign Variables on Domestic Counterparts

	$y^*$	$\pi^*$	$\rho^{S*}$	$hp^*$	$\rho^{L*}$	$q^*$
ARGENTINA	0.20 <sup>†</sup>	0.58 <sup>†</sup>	1.38 <sup>†</sup>	–	–	1.21
AUSTRALIA	0.36	0.60	0.29	0.18 <sup>†</sup>	0.94	0.86
AUSTRIA	0.94	0.14 <sup>†</sup>	0.44	–	0.88	1.01
BELGIUM	0.68	0.86	0.25	0.56	0.94	1.04
BRAZIL	0.35 <sup>†</sup>	1.39	0.51 <sup>†</sup>	–	–	–
CANADA	0.54	0.78	0.39	0.91	0.85	0.92
CHINA	0.65	0.53 <sup>†</sup>	0.00 <sup>†</sup>	–	–	–
CHILE	0.70	-0.11 <sup>†</sup>	0.20	–	–	0.51
FINLAND	1.25	0.30	0.20	0.90	–	0.92
FRANCE	0.62	0.52	0.19	0.71	0.93	0.99
GERMANY	1.65	0.54	0.03 <sup>†</sup>	0.05 <sup>†</sup>	0.90	0.96
INDIA	-0.15 <sup>†</sup>	0.69	-0.07 <sup>†</sup>	–	–	0.67
INDONESIA	0.58 <sup>†</sup>	0.87 <sup>†</sup>	0.24 <sup>†</sup>	–	–	–
ITALY	0.73	0.17 <sup>†</sup>	0.16	0.59	1.00	0.91
JAPAN	0.68	-0.08 <sup>†</sup>	0.01 <sup>†</sup>	0.16	0.55	0.69
KOREA	0.00 <sup>†</sup>	0.29 <sup>†</sup>	-0.14 <sup>†</sup>	–	0.56	0.93
MALAYSIA	1.30	0.87	-0.02 <sup>†</sup>	–	–	1.00
MEXICO	0.69	-0.27 <sup>†</sup>	0.11 <sup>†</sup>	–	–	–
NETHERLANDS	0.67	0.36	0.14	0.47 <sup>†</sup>	0.91	1.01
NORWAY	1.07	0.64	0.12 <sup>†</sup>	0.44 <sup>†</sup>	0.76	1.23
NEW ZEALAND	0.54	0.62	0.27 <sup>†</sup>	0.38 <sup>†</sup>	0.69	0.81
PERU	0.28 <sup>†</sup>	2.56 <sup>†</sup>	0.80 <sup>†</sup>	–	–	–
PHILIPPINES	-0.07 <sup>†</sup>	-0.10 <sup>†</sup>	0.60 <sup>†</sup>	–	–	1.18
SOUTH AFRICA	0.16 <sup>†</sup>	0.42	0.07	0.34	0.45 <sup>†</sup>	0.93
SAUDI ARABIA	0.47 <sup>†</sup>	0.16 <sup>†</sup>	–	–	–	–
SINGAPORE	1.22	0.16 <sup>†</sup>	0.04 <sup>†</sup>	0.95	–	1.23
SPAIN	0.17 <sup>†</sup>	0.54	0.15	1.05	1.15	1.09
SWEDEN	1.22	1.00	0.47	1.05	1.15	1.09
SWITZERLAND	0.47	0.23 <sup>†</sup>	0.08 <sup>†</sup>	-0.41 <sup>†</sup>	0.54	0.94
THAILAND	0.68 <sup>†</sup>	0.49 <sup>†</sup>	0.08 <sup>†</sup>	–	–	1.08
TURKEY	2.16	0.31 <sup>†</sup>	2.09	–	–	–
UNITED KINGDOM	0.54	0.52	0.19	0.48 <sup>†</sup>	0.80	0.86
UNITED STATES	0.40	0.12	–	0.08 <sup>†</sup>	–	–

**Note.** Contemporaneous effect of foreign variables on domestic counterparts can be interpreted as impact elasticities between domestic and foreign variables. T-ratios are computed using Newey-West's Adjusted standard errors. Non significant values are denoted with †.

Table A.7: Average Pairwise Cross-section Correlations

	Real GDP			Inflation			Short-term Int. Rate			House Price						
	$x_{it}$	$\Delta x_{it}$	Res	ResX	$x_{it}$	$\Delta x_{it}$	Res	ResX	$x_{it}$	$\Delta x_{it}$	Res	ResX				
ARGENTINA	0.89	0.05	0.02	0.01	0.32	0.05	0.08	0.02	0.46	0.04	0.02	-0.04	-	-	-	
AUSTRALIA	0.97	0.14	0.12	0.02	0.24	0.12	0.09	0.00	0.59	0.15	0.07	0.03	0.59	0.19	0.10	0.03
AUSTRIA	0.97	0.20	0.14	-0.02	0.33	0.16	0.11	0.01	0.66	0.29	0.18	0.10	-	-	-	-
BELGIUM	0.97	0.29	0.18	0.00	0.33	0.18	0.11	0.01	0.69	0.23	0.15	0.09	0.58	0.24	0.10	0.00
BRAZIL	0.95	0.15	0.09	0.01	0.29	0.02	-0.02	-0.04	0.49	0.04	0.02	-0.07	-	-	-	-
CANADA	0.97	0.23	0.09	0.02	0.32	0.18	0.10	0.02	0.70	0.20	0.14	0.07	0.58	0.20	0.16	0.03
CHINA	0.97	0.09	0.06	-0.07	0.17	0.09	0.06	-0.02	0.58	0.09	0.05	0.02	-	-	-	-
CHILE	0.97	0.15	0.09	0.00	0.39	0.04	-0.04	-0.03	0.67	0.05	-0.02	-0.07	-	-	-	-
FINLAND	0.94	0.28	0.15	0.03	0.40	0.14	0.08	0.02	0.70	0.21	0.05	0.02	0.47	0.26	0.06	-0.02
FRANCE	0.97	0.31	0.16	0.01	0.37	0.14	0.10	0.01	0.71	0.21	0.10	0.05	0.59	0.32	0.13	-0.03
GERMANY	0.95	0.26	0.14	-0.08	0.25	0.15	0.12	0.02	0.62	0.27	0.12	0.09	-0.63	-0.06	0.06	-0.01
INDIA	0.97	0.01	0.02	0.01	0.12	0.03	0.05	0.00	0.40	0.14	0.08	0.04	-	-	-	-
INDONESIA	0.96	0.09	0.01	-0.02	-0.02	0.06	0.08	0.02	0.13	0.08	0.08	0.06	-	-	-	-
ITALY	0.95	0.32	0.17	0.01	0.41	0.13	0.07	0.02	0.71	0.22	0.11	0.07	0.53	0.22	0.11	0.00
JAPAN	0.90	0.21	0.08	-0.03	0.33	0.08	0.06	0.01	0.69	0.12	0.01	0.00	-0.55	0.04	0.07	0.00
KOREA	0.96	0.19	0.12	0.02	0.21	0.05	0.05	0.02	0.61	0.08	0.06	0.05	-	-	-	-
MALAYSIA	0.96	0.22	0.15	0.01	0.16	0.13	0.12	-0.02	0.50	0.10	0.05	0.06	-	-	-	-
MEXICO	0.96	0.20	0.12	0.00	0.19	0.01	0.03	0.00	0.47	0.02	-0.02	-0.01	-	-	-	-
NETHERLANDS	0.97	0.25	0.15	-0.02	0.12	0.13	0.10	0.00	0.66	0.28	0.19	0.12	0.53	0.10	0.05	-0.05
NORWAY	0.97	0.13	0.13	0.01	0.23	0.10	0.07	0.01	0.61	0.08	0.05	0.05	0.50	0.07	0.12	0.04
NEW ZEALAND	0.95	0.17	0.10	0.04	0.19	0.08	0.03	0.00	0.52	0.07	0.03	0.00	0.56	0.16	0.12	0.00
PERU	0.86	0.05	0.05	0.01	0.30	-0.03	-0.01	-0.02	0.48	0.04	0.01	0.02	-	-	-	-
PHILIPPINES	0.96	0.09	0.04	0.01	0.25	0.03	0.05	0.02	0.65	0.12	0.09	0.07	-	-	-	-
SOUTH AFRICA	0.94	0.21	0.09	0.04	0.33	0.10	0.08	0.02	0.57	0.14	0.06	0.04	0.42	0.19	0.08	0.02
SAUDI ARABIA	0.96	-0.03	0.03	-0.01	-0.01	0.02	0.07	0.02	-	-	-	-	-	-	-	-
SINGAPORE	0.97	0.23	0.14	-0.02	0.22	0.07	0.04	0.00	0.61	0.06	0.02	0.01	0.30	0.06	0.09	-0.03
SPAIN	0.97	0.26	0.09	0.01	0.38	0.14	0.12	0.02	0.70	0.06	0.03	-0.01	0.59	0.26	0.10	-0.03
SWEDEN	0.96	0.28	0.20	0.01	0.42	0.13	0.12	0.01	0.73	0.20	0.12	0.02	0.59	0.30	0.14	-0.02
SWITZERLAND	0.96	0.24	0.15	0.02	0.39	0.14	0.10	0.05	0.61	0.18	0.05	0.03	-0.22	0.18	0.07	0.01
THAILAND	0.94	0.20	0.10	0.01	0.17	0.08	0.05	-0.02	0.58	0.10	0.06	0.04	-	-	-	-
TURKEY	0.97	0.15	0.12	0.01	0.13	-0.03	0.04	-0.02	0.30	0.04	0.04	-0.01	-	-	-	-
UNITED KINGDOM	0.97	0.30	0.17	0.01	0.38	0.14	0.13	0.02	0.70	0.24	0.14	0.08	0.60	0.30	0.08	-0.01
UNITED STATES	0.97	0.26	0.08	-0.05	0.35	0.22	0.17	0.03	0.61	0.16	0.05	0.05	0.58	0.17	0.05	0.01

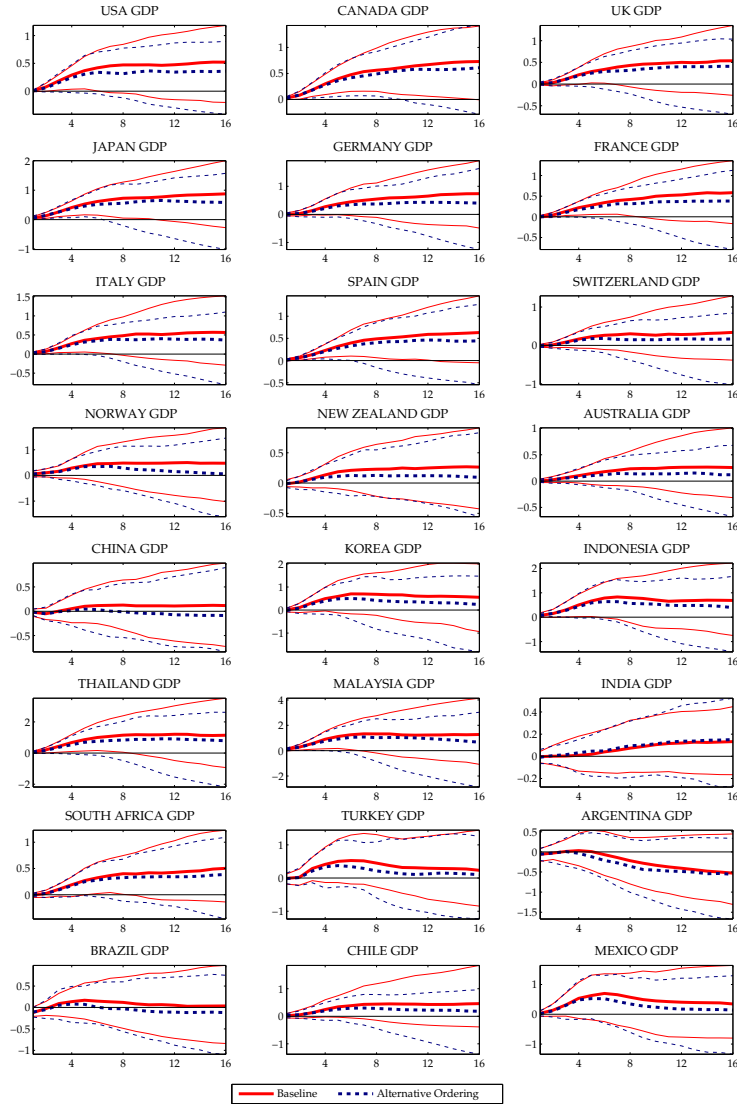
**Note.**  $x_{it}$  corresponds to the variables in log-levels;  $\Delta x_{it}$  corresponds to the variables in log-differences; Res corresponds to the auxiliary unrestricted VECM model's residuals (i.e.: without conditioning endogenous variables on the star variables) while ResX relates to the VECMX model's residuals.

Table A.8: Average Pairwise Cross-section Correlations

	Long-term Int. Rate			Exchange Rate			Equity Price					
	$x_{it}$	$\Delta x_{it}$	Res	ResX	$x_{it}$	$\Delta x_{it}$	Res	ResX	$x_{it}$	$\Delta x_{it}$	Res	ResX
ARGENTINA	-	-	-	-	0.44	0.08	0.07	0.07	0.51	0.22	0.19	-0.03
AUSTRALIA	0.87	0.38	0.32	0.01	0.81	0.37	0.30	0.23	0.77	0.58	0.55	0.01
AUSTRIA	0.90	0.50	0.39	0.00	0.83	0.50	0.44	0.44	0.70	0.46	0.44	-0.02
BELGIUM	0.91	0.53	0.42	-0.01	0.83	0.50	0.45	0.46	0.75	0.58	0.52	-0.02
BRAZIL	-	-	-	-	0.74	0.20	0.15	0.17	-	-	-	-
CANADA	0.91	0.42	0.35	-0.01	0.79	0.34	0.27	0.24	0.71	0.59	0.58	0.04
CHINA	-	-	-	-	0.48	0.05	0.00	0.00	-	-	-	-
CHILE	-	-	-	-	0.76	0.29	0.22	0.21	0.71	0.33	0.33	0.05
FINLAND	-	-	-	-	0.77	0.48	0.43	0.41	0.69	0.44	0.39	-0.03
FRANCE	0.90	0.55	0.40	-0.03	0.83	0.50	0.43	0.43	0.77	0.61	0.55	-0.03
GERMANY	0.87	0.56	0.42	-0.05	0.83	0.50	0.44	0.45	0.74	0.60	0.52	-0.06
INDIA	-	-	-	-	0.37	0.28	0.21	0.18	0.68	0.36	0.32	-0.02
INDONESIA	-	-	-	-	0.23	0.22	0.16	0.11	-	-	-	-
ITALY	0.87	0.34	0.26	-0.07	0.81	0.47	0.41	0.42	0.57	0.52	0.45	-0.06
JAPAN	0.87	0.34	0.26	-0.05	0.71	0.21	0.19	0.17	0.12	0.48	0.36	-0.07
KOREA	0.83	0.16	0.10	-0.03	0.79	0.27	0.22	0.17	0.58	0.39	0.35	-0.03
MALAYSIA	-	-	-	-	0.62	0.28	0.22	0.19	0.55	0.40	0.38	0.01
MEXICO	-	-	-	-	0.68	0.01	-0.04	-0.10	-	-	-	-
NETHERLANDS	0.88	0.57	0.47	-0.02	0.83	0.49	0.45	0.47	0.73	0.64	0.60	-0.03
NORWAY	0.84	0.33	0.24	-0.01	0.83	0.49	0.44	0.44	0.77	0.56	0.54	0.04
NEW ZEALAND	0.74	0.23	0.14	0.01	0.82	0.40	0.32	0.33	0.34	0.44	0.40	0.01
PERU	-	-	-	-	0.76	0.05	0.06	0.09	-	-	-	-
PHILIPPINES	-	-	-	-	0.77	0.16	0.16	0.14	0.62	0.39	0.37	0.00
SOUTH AFRICA	0.75	0.17	0.04	-0.02	0.69	0.35	0.28	0.26	0.74	0.53	0.48	0.05
SAUDI ARABIA	-	-	-	-	0.59	0.03	0.04	0.01	-	-	-	-
SINGAPORE	-	-	-	-	0.80	0.41	0.36	0.34	0.66	0.57	0.55	0.01
SPAIN	0.91	0.36	0.25	-0.06	0.82	0.48	0.43	0.44	0.77	0.59	0.56	0.00
SWEDEN	0.91	0.48	0.36	0.02	0.78	0.47	0.39	0.39	0.75	0.60	0.53	-0.01
SWITZERLAND	0.81	0.40	0.25	0.02	0.82	0.44	0.39	0.42	0.76	0.60	0.59	0.00
THAILAND	-	-	-	-	0.76	0.32	0.28	0.26	0.45	0.39	0.38	0.00
TURKEY	-	-	-	-	0.79	0.23	0.19	0.16	-	-	-	-
UNITED KINGDOM	0.91	0.46	0.36	-0.04	0.79	0.43	0.36	0.36	0.75	0.61	0.55	-0.02
UNITED STATES	0.85	0.44	0.32	-0.02	-	-	-	-	0.75	0.59	0.52	0.01

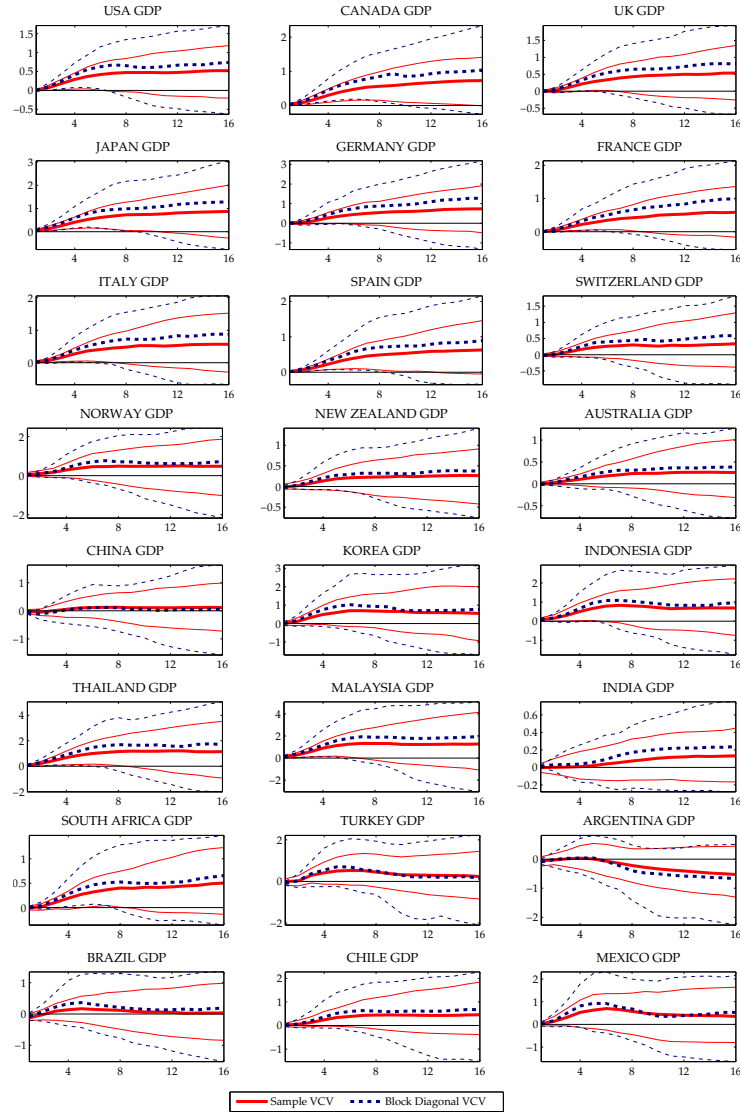
**Note.**  $x_{it}$  corresponds to the variables in log-levels;  $\Delta x_{it}$  corresponds to the variables in log-differences; Res corresponds to the auxiliary unrestricted VECM model's residuals (i.e.: without conditioning endogenous variables on the star variables) while ResX relates to the VECMX model's residuals.

Figure A.2: US House Price Shock - Alternative Orderings of US Variables



**Note.** Cumulative impulse responses to a one standard deviation increase in US house price residuals. The solid line is the baseline (as in the main text). The dashed line has been computed assuming a an alternative ordering for the variables in the US model, namely  $\mathbf{x}_{0t} = (\mathbf{x}_{0t}^1, \mathbf{x}_{0t}^2, r_{0t}')'$ . Bootstrap median estimates with 90% error bands.

Figure A.3: US House Price Shock - Sample VS Block Diagonal Co-  
variance Matrix



**Note.** Cumulative impulse responses to a one standard deviation increase in US house price residuals. The solid line is computed as in the main text. The dashed line has been computed assuming a block diagonal covariance matrix for the reduced form residuals of the GVAR. Bootstrap median estimates with 90% error bands.

## References

- Cesa-Bianchi, A., M. H. Pesaran, A. Rebucci, and T. Xu (2012). China's emergence in the world economy and business cycles in latin america. *Economia* 12(2)(Spring), 1–75.
- Dees, S., F. di Mauro, M. H. Pesaran, and L. V. Smith (2007). Exploring the international linkages of the euro area: a global var analysis. *Journal of Applied Econometrics* 22(1), 1–38.
- Dees, S., S. Holly, M. H. Pesaran, and L. V. Smith (2007). Long run macroeconomic relations in the global economy. *Economics - The Open-Access, Open-Assessment E-Journal* 1(3), 1–20.
- Fuller, W. and H. Park (1995). Alternative estimators and unit root tests for the autoregressive process. *Journal of Time Series Analysis* 16, 415–429.
- Giuliodori, M. (2005, September). Monetary policy shocks and the role of house prices across european countries. *Scottish Journal of Political Economy* 52(4), 519–543.
- Harbo, I., S. Johansen, B. Nielsen, and A. Rahbek (1998, October). Asymptotic inference on cointegrating rank in partial systems. *Journal of Business & Economic Statistics* 16(4), 388–99.
- Iacoviello, M. (2005, June). House prices, borrowing constraints, and monetary policy in the business cycle. *American Economic Review* 95(3), 739–764.
- Johansen, S. (1992, June). Cointegration in partial systems and the efficiency of single-equation analysis. *Journal of Econometrics* 52(3), 389–402.
- MacKinnon, J. G. (1991). Critical values for cointegration tests. In R. F. Engle and C. W. J. Granger (Eds.), *Long-Run Economic Relationships: Readings in Cointegration*, Volume 1 of *Oxford*, Chapter 13. Oxford University Press.
- Pesaran, M. H., T. Schuermann, and S. M. Weiner (2004, April). Modeling regional interdependencies using a global error-correcting macroeconomic model. *Journal of Business & Economic Statistics* 22, 129–162.
- Pesaran, M. H., Y. Shin, and R. J. Smith (2000, August). Structural analysis of vector error correction models with exogenous  $i(1)$  variables. *Journal of Econometrics* 97(2), 293–343.