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Global Credit Shocks and Real Economies*

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Abstract

We estimate the marginal effects of identified components of global liquidity on 43 real economies. To this end, we employ global public and private credit components of Herwartz, Ochsner, and Rohloff (2021) in factor-augmented vector-autoregressions to trace credit shocks through the real economy (output, inflation and unemployment). Specifically, two components of global credit boost the business cycle and lower unemployment in the short-run, namely government credit demand and business credit supply, whereas household credit supply is found to deteriorate output. We find substantial heterogeneity with respect to prevalence and amplitude of global sectoral credit effects on real aggregates within the time and cross-sectional (country) dimension.

Keywords: Credit shocks, credit composition, real economy, structural VAR, FAVAR
JEL Classification: C22, E32, E44, E51

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1 Introduction

The collapse of the US subprime mortgage market in 2007 led to the worst world-wide economic downturn since the Great Depression of 1929/1930. In order to stabilise the banking markets and absorb financial shocks to the real economy, some European governments borrowed almost until bankruptcy, in some cases (e.g. Italy, Portugal and, most important, Greece) accompanied by the adoption of severe austerity measures and the suffering of further economic slowdown. When this article is written, governments all over the world issue the largest amounts of credit since WWII to fight the consequences of the COVID-19 pandemic. Recently, cross-country financing conditions have moved into the focus of academics and politicians alike. Borio (2014) has argued that credit volumes and house prices co-move across the globe. Rey (2013) and Miranda-Agrippino and Rey (2020) show that there is a global co-movement in risky asset prices that is negatively correlated with global risk aversion. Eickmeier et al. (2014) view at global liquidity as a triad of three global factors, which can be interpreted as credit supply, credit demand and monetary policy. In this venue, a supply (demand) factor is best understood as a time series summarizing structural global credit supply (demand) shocks, i.e. shocks that increase credit volumes and reduce (increase) lending rates.

Since the global financial crisis, significant advances have been made in the understanding of the interplay of credit and (real) economic activity (i.e. output, inflation and unemployment). While country specific studies have documented the role of domestic credit markets in shaping the business cycle, proponents of the global liquidity debate have only rarely attempted to clarify the role of global liquidity for macroeconomic performance at the country level. It has become evident from dynamic stochastic general equilibrium (DSGE) models and empirical research that exogenous changes in *aggregate* credit demand and supply impact differently on the real economy (e.g. consider Gerali et al. (2010), Peersman (2011), Barnett and Thomas (2013)). However, the aggregate perspective conceals an important sectoral dimension in the understanding of the linkages between credit and the real economy.[1] In the spirit of Eickmeier et al. (2014), Herwartz, Ochsner, and Rohloff (2021) (henceforth, HOR (2021)) conceptualize global liquidity as a set of global credit supply, credit demand and monetary policy factors, and introduce a sectoral disaggregation into business, household and government *credit components*. HOR (2021) convincingly highlight that the components of global credit (business vs. household vs. government credit supply/demand) reveal important information about the state of the financial cycle.

The purpose of this study is to unravel the impacts of global credit conditions on macroeconomic performance at the level of 43 single economies from 1996 until 2020 by means of

[1]To give two examples, Bezemer et al. (2016) and Büyükkarabacak and Valev (2010) find a positive relation between business credit and economic growth. Regarding the growth effects of government credit, the literature yet lacks a consensus. Panizza and Presbitero (2013) summarize that theoretical models yield ambiguous results and that the respective empirical evidence is inconclusive.

a cross section of structural vector-autoregressive models (SVARs). This work is among the first to employ a data-rich environment to single out the real economy impact of global private and public credit shocks that are orthogonal to domestic financial conditions. Since the credit factors of HOR (2021) are correlated with the structural innovations by construction, they can be used as instrumental variables for identifying credit shocks and their effects within country specific proxy SVARs (Mertens and Ravn 2013, Stock and Watson 2018). To summarize the rich informational content of the cross section of proxy SVARs we rely on ANOVA regressions and mean group estimation as suggested by Pesaran et al. (1999).

We find that private (business and household) sector credit supply shocks are the most important global credit shocks for explaining disturbances in real economic aggregates, both with respect to prevalence as well as with regard to real economic impact. Government credit shocks are important in times of economic stress when they lift pressure from the financial system (government credit supply) and help to stabilize the real economy (government credit demand). Business credit supply and demand shocks have similar effects, whereas household sector credit supply shocks mostly imply adverse real economic responses.

In the next Section we briefly review the related literature. Our data as well as the econometric specification and our empirical results are discussed in Sections 3 and 4, respectively. Section 5 concludes. Appendix A contains additional results, Appendix B discusses robustness of our findings and Appendix C documents the data.

2 Review of related literature

In this section, we review briefly the related literature on the effects of credit shocks on (mostly country-specific) real economies. If available our focus is on evidence from structural models (DSGE and SVAR). We first consider effects of credit supply shocks and turn, subsequently to those of credit demand shocks, and supplement our reviews with sectoral evidence.

Peersman (2011) traces output expansions and inflation reductions in the Euro-zone back to expansionary shocks of banking credit supply ('credit multiplier shocks', his wording). At single country levels, Busch et al. (2010), Jacobs and Rayner (2012) and Gulan et al. (2014) find that credit supply shocks contribute considerably to shaping real activity in Germany, Australia, and Finland, respectively. Mumtaz et al. (2018) compare DSGE and empirical VAR results for the US and find that both models imply increasing inflation and output slowdowns in response to adverse credit supply shocks. Hristov et al. (2012) and Barnett and Thomas (2013) argue that adverse credit supply shocks were key determinants of output fluctuations during the financial crisis. Meeks (2012) and Nason and Tallman (2013) point out that credit supply shocks are only moderately important in normal times but more so during periods of economic crisis in the US. Bassett et al. (2014) and Colombo and Paccagnini (2020) document similar results. Examining loan data, Amiti and Weinstein (2013) present firm-level evidence for the high relevance of bank loan supply on investment spending. An extensive review that focuses on the link between credit supply and firm performance is given in Guler et al. (2019). Cesa-Bianchi et al. (2015) and Cesa-Bianchi et al. (2018) point out that (expansionary) global liquidity shocks boost domestic consumption and house prices.

Bekaert et al. (2016), Bezemer and Zhang (2019), and Mian et al. (2017) point out that mortgage credit expansions foster growth in the short-run at the expense of negative longer-term growth outlooks and threats to financial stability. For example, an increase in household credit is associated with higher risk of banking crisis (Büyükkarabacak and Valev 2010). Moreover, Mian and Sufi (2010) and Dynan (2012) find for the US that highly leveraged households consume less with adverse effects for economic growth. Samarina and Bezemer (2016) relate the household credit growth observed in many economies during the past two decades with a lack of investment opportunities in the non-household sectors. Walentin (2014) documents expansionary reactions of consumption and GDP to a contractionary mortgage spread shock (a mortgage credit supply shock, in our framework). Finally, Eberhardt and Presbitero (2015) find a negative relationship between growth and public debt, but no marginal effects common to their global panel. It seems that the expected effect of government credit on economic growth is ambiguous and depends on several (domestic) factors. To summarize, the importance of credit supply shocks is undisputed, but its extent is yet unclear.

Only few studies have rigorously investigated the real economic responses to credit demand shocks. Peersman (2011) and Eickmeier and Ng (2011) present evidence that positive credit demand shocks reduce output in the short run. Barnett and Thomas (2013) render credit demand shocks as largely unimportant for output variation in the UK. On the contrary, De Nicolò and Lucchetta (2011), Fadejeva et al. (2017) and Furlanetto et al. (2017) argue that credit demand shocks are at least of similar importance as credit supply shocks for the US. The risk shock in the DSGE model of Christiano et al. (2014) is best understood as a credit demand shock that deteriorates output. Cesa-Bianchi and Sokol (2017) document that adverse US financial shocks reduce inflation and output. To summarize, there is yet no consensus regarding the effects or the importance of credit demand shocks for the real economic activity.

3 Methodology

In this section, we first describe the global credit factors of HOR (2021) and subsequently introduce the data panels comprising a large set of real and financial variables from 43 economies across the globe. Subsequently, we sketch the identified factor augmented VAR approach adopted for structural analysis in our data-rich environment. Finally, we highlight mean group (MG) estimation as a suitable means to summarize country specific estimates within a large cross section.

3.1 The sectoral approach of HOR (2021)

HOR (2021) identify structural dynamic (i.e. vector-autoregressive of order four) and orthogonal global credit factors. In the spirit of Eickmeier et al. (2014), both supply and demand shocks are conceptualized as originating from a wide range of sources, including, for instance, financial innovation, regulation, balance-sheet innovations, risk-appetite or animal spirits.[2] On the one hand and following Eickmeier et al. (2014), HOR (2021) estimate a model incorporating two aggregate credit components. On the other hand, HOR (2021) augment this approach by unravelling - in total - six credit components (government vs. business vs. household credit demand/supply). By construction, the identified credit factors are neither contaminated with domestic shocks, nor with global co-movements in output, inflation, monetary policy and share prices. Figure 1 shows their estimation results.

Aggregate credit supply and demand (upper panels of Figure 1) depict credit volumes supplied to and demanded by non-financial businesses, governments and households. HOR (2021) find that more credit is supplied in times of low (perceived) financial market risk, whereas the overall non-financial sector borrowing capacity, approximated by aggregate credit demand is high in times of economic stability. Although both aggregate credit supply and demand reveal non-trivial information about global credit flows, their characteristics cannot straightforwardly traced back to the rationales of specific agents on credit markets. Therefore, HOR (2021) decompose aggregate credit into flows directed at the public and private sectors. These sectoral components yield important insights with regard to the diverse roles of credit (components) in shaping the financial cycle. Global credit supplied to and demanded by governments (Figure 1, second row) shows changes in global lenders' credit supply to governments and its demand counterpart. HOR (2021) argue that credit supplied to the government is best understood to show the intensity of safe-haven lending. Government credit demand has an analogous demand-side interpretation reflecting the demand for government liquidity. Put differently, lenders tend to supply credit to governments when they prefer the certainty of credit services over the potential of high yields, and governments tend to demand credit according to political considerations along the voting cycle. Global lenders tend to supply credit to non-financial businesses (Figure 1, third row) in boom-episodes to maximize profits. Businesses tend to borrow pro-cyclically to finance investments and consumption expenditure. During downswings of business and financial cycles, i.e. in times of de-leveraging and low risk-taking capacity, global lenders supply less and businesses demand less credit. Finally, global credit household supply (Figure 1, fourth row) increases, like its business sector counterpart, in financial cycle upswings, but exhibits stronger correlations with leverage (positive correlation) and risk (negative correlation), indicating that household credit supply is closer connected to financial system stress.

[2] Mian and Sufi (2018) characterize credit supply shocks as resembling lender's increased willingness to issue credit, whereas credit demand shocks originate in exogenous changes of borrower's preferences for holding credit.

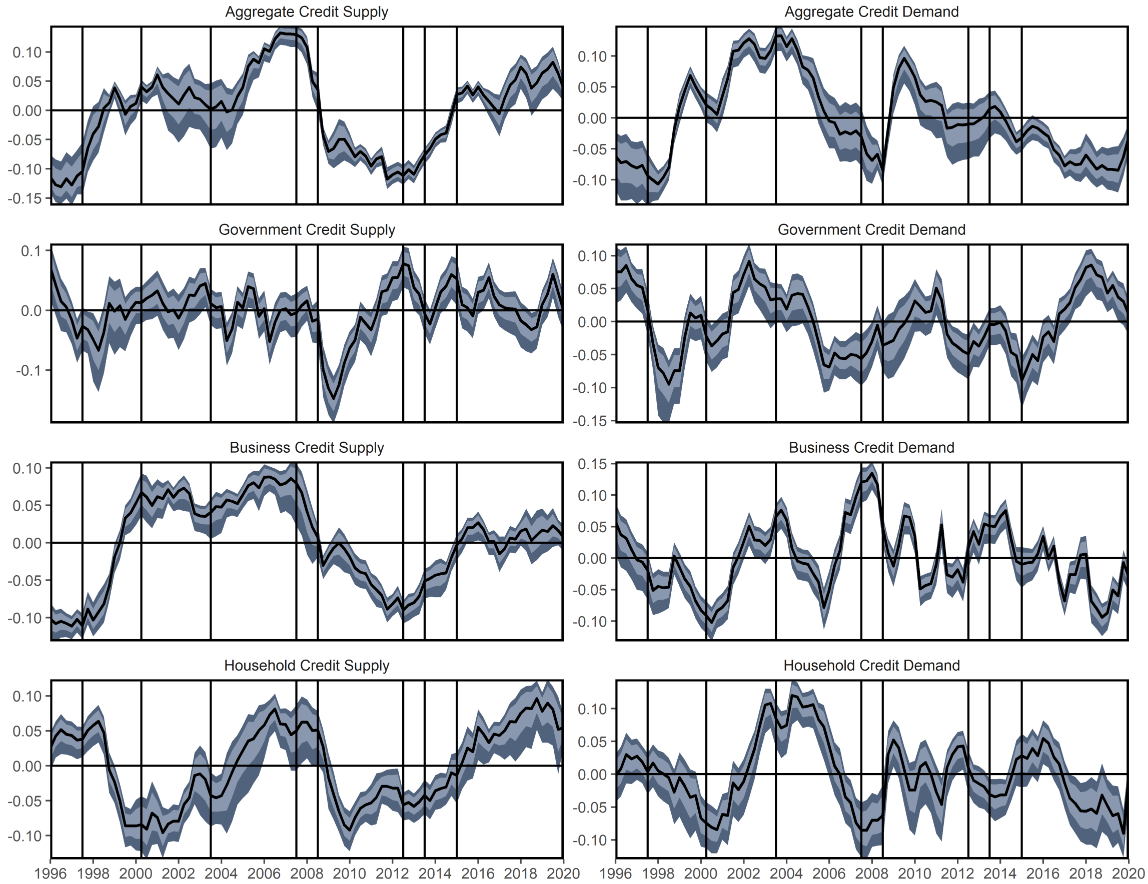

Figure 1: Global credit cycles: Supply (demand) components are shown in the left (right) hand side panel. From top to bottom: Aggregate credit, government sector credit, business and household credit. Black lines indicate the posterior medians. Shaded areas indicate 16 and 84 (inner) as well as 2.5 and 97.5 (outer) posterior percentiles. The sample covers important events in international finance (indicated with horizontal lines), i.e. (i) the Asian crisis (1997Q3), (ii) the burst of dotcom bubble (2000Q2), (iii) the beginning of the US mortgage credit expansion in 2003Q3 (Justiniano et al. 2017), (iv) the financial turmoil of 2007Q3, (v) the bankruptcy of Lehman Brothers (2008Q3), (vi) Mario Draghi's 'whatever it takes' statement during the European banking and sovereign debt crisis (2012Q2), (vii) the Fed's 'taper tantrum' (2013Q2), and (viii) the beginning of the ECB's government sector purchase program (2015Q1).

3.2 A factor augmented VAR approach

We take data from HOR (2021) and sample those countries with a sufficient number of real economy time series and control variables, such as domestic interest rates or house prices. The sample covers 43 economies and the time period 1996Q1 until 2020Q1. Tables A4 and A5 summarize the variables, countries, data sources and transformations. The empirical models employed in this work generally align with factor augmented VARs (FAVARs) in the vein of Bernanke (2005). For tracing the impact of the distinct global credit shocks on domestic macroeconomic indicators, we treat the credit factors of HOR (2021) as proxy variables within complementary model specifications (see Table 1).

A first model specification ($\mathcal{S}_1$) focuses on the effects of aggregate global credit factors on macroeconomic performance at the level of a specific economy. In these country specific models, the first elements (y_{1t} and y_{2t}) in the vector valued process (y_t) are identified aggregate global credit components (credit supply and demand, respectively) as displayed in the top panels of Figure 1. The third component (y_{3t}) is a latent factor extracted from a set of country specific variables that relate to credit markets (yields, interest rates, asset prices). The remaining elements of y_t allow for an explicit view at the marginal effects of global credit (shocks) on core macroeconomic aggregates as GDP, the CPI and the unemployment rate (variables y_{4t} to y_{6t}). A second set of model specifications ($\mathcal{S}_2$) collects in its upper positions y_t six (orthogonal) factors characterizing global credit components as shown in the second, third and fourth row of Figure 1. Similar to specification $\mathcal{S}_1$ the models in $\mathcal{S}_2$ comprise a factor summarizing information from country specific credit markets (y_{7t}). Finally, the variants in $\mathcal{S}_2$ differ with respect to their focus on country specific real economic variables in y_{8t}, i.e. gross domestic product ($\mathcal{S}_{2a}$), consumer prices ($\mathcal{S}_{2b}$) and unemployment ($\mathcal{S}_{2b}$).

For the ease of notation, the following model outline suppresses the fact that the structural VARs considered and the majority of variables in this study are country specific. Let y_t denote a $K \times 1$ dimensional vector of time series ($K = 6$ in $\mathcal{S}_1$ and $K = 8$ in $\mathcal{S}_2$). In reduced form and its structural counterpart the VAR model of order p reads as

$$
\begin{aligned}
y_t &= \nu_t + A_1 y_{t-1} + \ldots + A_p y_{t-p} + u_t \qquad (1) \\
\text{and} &= \nu_t + A_1 y_{t-1} + \ldots + A_p y_{t-p} + B\varepsilon_t, \; t = 1, \ldots, T, \qquad (2)
\end{aligned}
$$

respectively, where $A_j, j = 1, 2, \ldots, p$, are $K \times K$ coefficient matrices and ν_t is a $K \times 1$ dimensional vector of deterministic terms (intercepts and linear trends). Reduced form residuals u_t in (1) are serially uncorrelated with mean zero and non-diagonal covariance matrix Σ_u. By assumption and without loss of generality, structural shocks ε_t in (2) have unit covariance, $\varepsilon_t \sim (0, I_K)$, such that $\Sigma_u = BB'$. By assumption, the process is causal, i.e. $\det A(z) = \det\left(I_K - \sum_{j=1}^{p} A_j z^j\right) \neq 0$ for $|z| \leq 1$. Hence, y_t has a Wold moving average (MA) representation,

$$
\begin{aligned}
y_t &= \mu_t + \sum_{i=0}^{\infty} \Phi_i u_{t-i} \\
&= \mu_t + \sum_{i=0}^{\infty} \Phi_i B \varepsilon_{t-i} = \mu_t + \sum_{i=0}^{\infty} \Theta_i \varepsilon_{t-i}, \qquad (3)
\end{aligned}
$$

where $\mu_t = A(1)^{-1}\nu_t$, $\Phi_0 = I_K$ and $\Phi_i = \sum_{j=1}^{i} A_j \Phi_{i-j}$ with $A_j = 0$ for $j > p$. It is well known that the matrix B cannot be identified without further assumptions. For identification we restrict B as the lower-triangular Choleski factor of Σ_u.

Systems	Description	Variable
$\mathcal{S}_1$	y_1 aggregate credit components demand	global
	y_2 aggregate credit supply	global
	y_3 other shocks control series	country-specific
	y_4 year-on-year changes of gross domestic product	country-specific
	y_5 year-on-year changes of consumer price index	country-specific
	y_6 year-on-year changes of unemployment rate	country-specific
$\mathcal{S}_{2a}$	y_{1-6} global credit components (business, household, government; demand before supply)	global
	y_7 other shocks control series	country-specific
	y_8 year-on-year changes of gross domestic product	country-specific
$\mathcal{S}_{2b}$	y_{1-6} global credit components (business, household, government; demand before supply)	global
	y_7 other shocks control series	country-specific
	y_8 year-on-year changes of consumer price index	country-specific
$\mathcal{S}_{2c}$	y_{1-6} global credit components (business, household, government; demand before supply)	global
	y_7 other shocks control series	country-specific
	y_8 year-on-year changes of unemployment rate	country-specific

Table 1: SVAR specifications. All models include an intercept. A linear trend is included if this is optimal according to the BIC criterion. Computations have been performed in R. For the 'other shocks control series' (y_7) we determine the principle component of the money-market rate, overnight rate, corporate lending rates, mortgage lending rates, long-term government bond yields and their respective spreads over the (shadow) policy rate as well as standardized and quadratically detrended gross capital formation, industrial production, as well as private and government consumption, logarithms of house and share prices, business, household and government credit volumes (aggregate credit volume in case of S_1), M0, M3, as well as bank, real estate and tech equity return indices. We include all countries where at least two of the real economic and four of the financial series are available. We further experimented with separate control variables for the real and financial sectors. As these turned out to be highly correlated (linear correlations in excess of 0.9) for many countries, we joined financial and real variables to avoid multicolinearity and reduce computational burdens. We sign-identify the principle component to be positively correlated with domestic GDP.

3.3 Identification

The imposed recursive causal structure implies that none of the domestic shocks can affect the global factor contemporaneously. Accordingly, the variations in the reduced-form residuals of the global credit factors are attributable to stochastic variations (i.e. shocks) of global credit demand or supply conditions. By construction of the factors in HOR (2021), these shocks are most likely to align with the standard assumptions made for proxy SVAR identification and local projection instrumental variable approaches (Mertens and Ravn 2013, Stock and Watson 2018), namely (i) global credit factors are relevant, i.e., highly correlated with the structural credit shocks of interest, and (ii) global credit factors are exogenous, i.e., not contemporaneously correlated with other (possibly irrelevant) structural shocks.[3] From the graphical displays in Figure 1 it seems evident that the factors exhibit serial correlation, which could originate from either time aggregation of theoretical credit shocks of interest or from serially correlated noise. The structural innovations and the serially correlated components are not separately identified, since the latter's dynamic representations are unknown. To account for serial correlation we select a suitable lag order by means of the BIC. Moreover, as a possible consequence of serially correlated signals attenuation biases in impulse response estimates can be eliminated by considering relative impulse responses. We adapt IRFs in the spirit of Plagborg-Møller and Wolf (2020), Noh (2018) and Stock and Watson (2018) who have shown that normalizing relative impulse responses to one standard deviation of the instrumental variables (i.e. global credit shocks) is equivalent to proxy-SVARs in case that the VAR is invertible. If the VAR is (partially) non-invertible relative impulse responses allow to recover the contemporaneous relations consistently. Since we are also interested in other descriptive quantities, such as historical decompositions, we enrich the information set of our small-scale country specific SVARs with a principle component extracted from a set of domestic variables.

3.4 Mean group estimation

From SVAR estimation we obtain a set of $J = 43$ country specific model evaluations. For the structuring of this rich set of estimation outcomes we use common ANOVA regressions on the one hand. To benefit further from the cross-sectional dimension of sample information, we apply mean group (MG) estimation (Pesaran et al. 1999) on the other hand to sets of country specific impulse response estimates. For purposes of MG estimation and inference we use an index j to characterize country specific estimates. For instance, the parameters of the structural MA representation read as, $\Theta_i^{(j)}$, $i = 0, 1, 2, \ldots$ and $j = 1, 2, \ldots, J$. Hence, with $\theta_i^{(j)}$ denoting any single element of $\Theta_i^{(j)}$ the element-wise MG estimator and its variance

[3] Assumptions (i) and (ii) likely apply, respectively, by virtue of the sign restrictions applied in HOR (2021) and the consideration of domestic influences in the process of factor construction.

are, respectively,

$$\bar{\theta}_i = 1/J \sum_{j=1}^{J} \theta_i^{(j)} \text{ and } \mathrm{Var}[\bar{\theta}_i] = \mathrm{Var}[\theta_i]/J, \tag{4}$$

where the sample variance $\mathrm{Var}[\theta_i]$ can be estimated in the usual way from the cross section of parameter estimates. MG estimation allows us to uncover common dynamic relationships which might be hidden otherwise by idiosyncrasies at the individual country level. We prefer MG estimation over a pooled panel structural vector-autoregression, since we expect substantial heterogeneity in short-run slope and structural model parameters. For instance, countries with a large and internationally integrated financial sector are likely more sensitive to global credit shocks and those may transmit differently to the real economy in comparison with effects that one might expect for less open economies. Moreover, MG estimates obtain from unbiased country specific estimates (for an MG approach to model international credit supply see Cesa-Bianchi et al. (2018)). Hence, relying on MG estimation avoids heterogeneity biases. Rebucci (2010) shows that if slope heterogeneity is present and the sample length is sufficient, the MG approach is $\sqrt{J}$-consistent for the cross sectionally averaged effects, while a pooled fixed effects estimator is efficient in the unlikely case of slope homogeneity. An eyeball inspection of the country specific impulse responses reveals slope heterogeneity, pointing to the benefits of MG estimation. Instead of using the MG variance in (4) for inferential purposes, our inferential analysis takes account of factor uncertainty more explicit in the sense that we implement the MG estimates for a *set of 100 randomly selected alternative factor estimates* determined in HOR (2021) and employed for the assessment of factor uncertainty in Figure 1. Graphical displays of structural IRFs are then aligned with empirical quantiles of MG estimates rather than confidence bounds that could be determined by means of the variance estimator in (4) *conditional on one specific realization* of credit (component) factors.

4 Structural analysis of global credit shocks

In this section, we discuss estimation results. We approximate country-specific macroeconomic performance in terms of gross domestic product, the consumer price index and the unemployment rate by assessing the relative importance of global credit shocks at the sectoral level (i.e., business vs. household vs. government credit) by means of historical decompositions, analysis of variance and impulse responses. Figure 2 depicts historical decompositions and Table 2 shows analysis of variance results. Subsequently, we examine MG response profiles invoked by a shock of one standard deviation in aggregate and sectoral global credit supply and demand components (see Figure 3). We employ MG estimation and inference not only for respective impulse response estimates $\theta_i^{(j,business)}$, $\theta_i^{(j,household)}$ and $\theta_i^{(j,government)}$ but also for differences $\theta_i^{(j,business)} - \theta_i^{(j,household)}$ and $\theta_i^{(j,business)} - \theta_i^{(j,government)}$. Finally, to demonstrate robustness, Appendix B, shows results obtained from alternative specifications of the SVARs.

4.1 Historical decompositions

To assess the importance of shocks to distinct components of global credit, we provide historical decompositions from the SVAR specifications $\mathcal{S}_2$ for 12 selected economies. Figure 2 depicts *cumulated* median effects of shocks on GDP ($\mathcal{S}_{2a}$). In Appendix A, we present full results on historical decompositions for GDP ($\mathcal{S}_{2a}$), CPI ($\mathcal{S}_{2b}$) and the unemployment rate ($\mathcal{S}_{2c}$) for all 43 countries. Summarizing the available estimation results compactly, Table 2 documents ANOVA results.[4]

	GDP	CPI	UNEMP
Government Credit Demand	0.094**	-0.143***	0.204***
	(0.047)	(0.045)	(0.049)
Business Credit Demand	-0.061	0.175***	-0.175***
	(0.046)	(0.046)	(0.046)
Business Credit Supply	0.434***	0.713***	-0.116**
	(0.049)	(0.049)	(0.046)
Household Credit Demand	-0.904***	-0.739***	-0.986***
	(0.042)	(0.042)	(0.041)
Household Credit Supply	-0.261***	0.012	-0.243***
	(0.044)	(0.045)	(0.044)
Constant	2.346***	2.159***	2.342***
	(0.032)	(0.032)	(0.032)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 2: Dummy effect estimates on cumulated effects remapped to $[-1;+1]$. Effects obtained from the specifications $\mathcal{S}_2$ (i.e. $\mathcal{S}_{2a}$ to $\mathcal{S}_{2c}$) for the year-on-year changes of the logarithms of gross domestic product (GDP; left-hand column), year-on-year changes in the logarithms of the consumer price index (CPI; mid column) and year-on-year changes in the levels of the unemployment rate (UNEMP; right-hand column). All estimates are multiplied by 10, and document marginal differences with respect to the benchmark 'Government credit supply'. Heteroskedasticity robust standard errors in parentheses. In Appendix B, we document robustness results.

[4] We regress the cumulated effect sizes of global credit shocks on macroeconomic performance indicators (GDP, CPI, unemployment) for all 43 countries on dummy variables indicating the type of the global credit shock and an intercept term.

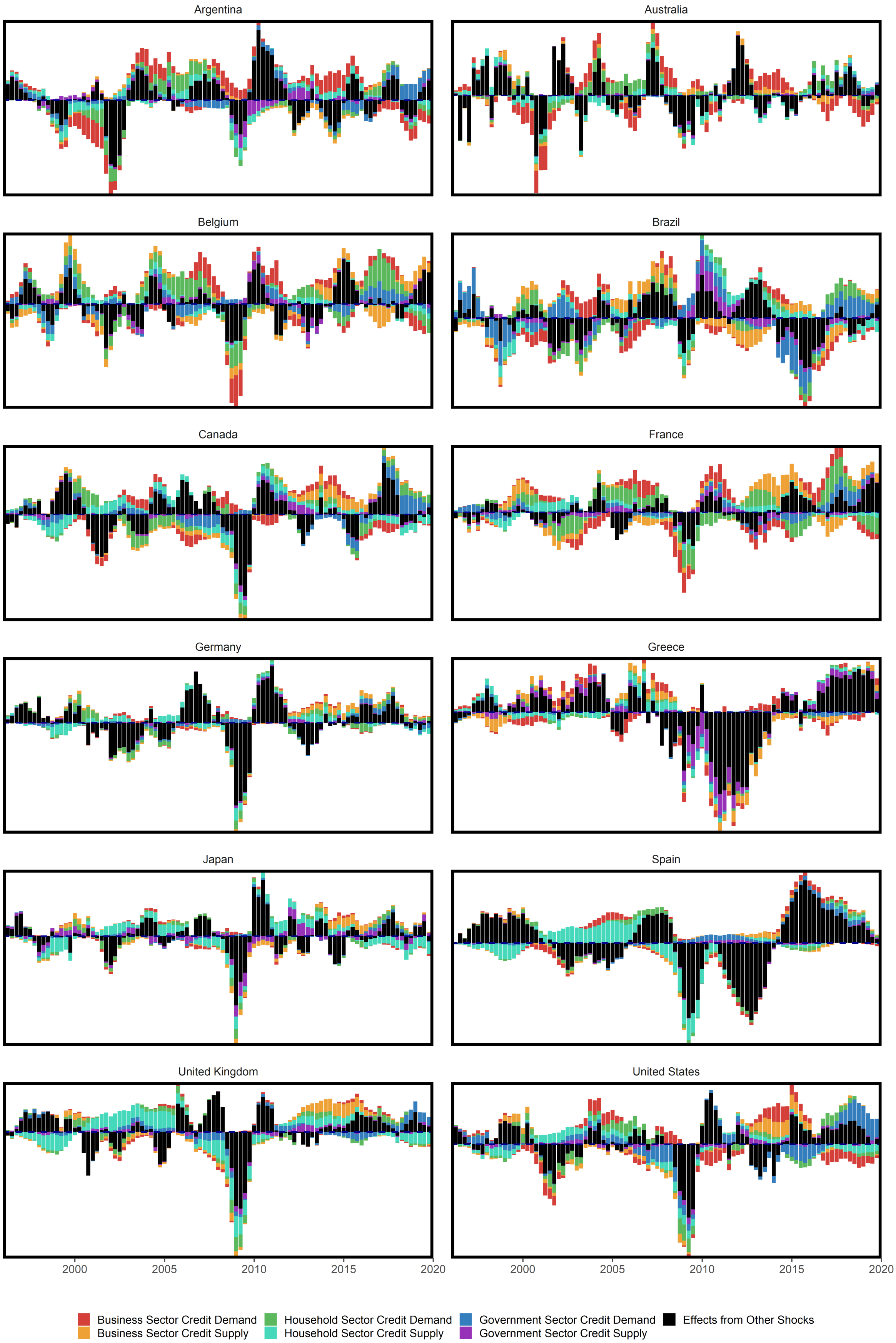

Figure 2: Cumulated median effects of credit shocks on GDP from $\mathcal{S}_2$ for 12 selected countries. 'Effects from other shocks' refers to the sum of cumulated effects of shocks from the control series and GDP.

Generally, we find that global credit component shocks contribute substantially to fluctuations in output, inflation and unemployment across the globe. The results documented in Figure 2 and Table 2, allow for three main conclusions regarding the prevalence of the sectoral components, the importance of demand-supply type shocks and the realized real economic effects. First (sectoral dimension), the prevalence of effects from different shocks is varying in the time- and cross-sectional dimension. For instance, household credit supply shocks are more abundant in the UK and Spain before the financial crisis than afterwards. Moreover, effects from government credit supply shocks (i.e. risk shocks) exhibit higher prevalence and magnitudes in countries with relatively volatile business cycles (e.g. Argentina, France and Greece) than in countries featuring somewhat smoother business cycles (e.g. Germany). Moreover, considering the contributions of business credit demand shocks to output growth, we observe that these are relatively more abundant in Argentina, Austria, and France, whereas they are hardly found for Japan or the UK. Second (demand-supply dimension), the importance of demand and supply shocks varies within and across countries. From eyeball inspection, it is impossible to distinguish if effects from demand or supply shocks are more relevant for shaping business cycles, as heterogeneity across both time and countries is substantial. For example, consider UK and Spain which are largely supply-side dominated and Argentina as well as France which are largely demand-side determined. Third (real economy benefits), compared with government credit supply, household credit demand shocks invoke economic slowdowns and business credit supply shocks benefit the real economy to the largest extent(s) (see Table 2).

4.2 Impulse response analysis

Subsequently, we elaborate on the MG responses of GDP, CPI and unemployment to global credit supply and demand shocks.

4.2.1 Credit supply

Output Figure 3 depicts the medians of the real economy responses to expansionary credit supply shocks. Gross domestic product increases by 0.5% on impact in response to an orthogonal shock of one standard deviation in global aggregate credit supply (first column of Figure 3). Put differently, aggregate credit supply shocks have - on average - substantial and positive effects on the real economy that turn slightly negative after about 10 quarters and fades out after about 25 quarters. This finding is roughly in line with previous studies such as Peersman (2011), Jacobs and Rayner (2012) and Barnett and Thomas (2013). Compared with effects of aggregate credit supply shocks, output responses to business (+0.75% on impact) and government credit supply shocks (+0.2% on impact) are of similar magnitude and sign (second, third and fourth columns of Figure 3), while the GDP response to household credit supply shocks is negative (-0.6% after 10 quarters). These responses vanish after 15, 10 and 30 quarters, respectively. The differences between responses of business and household as well as between business and government credit impulse responses (fifth and sixth columns of Figure 3) point unambiguously to distinct effects on output implied by sectoral credit supply shocks.

The effects of business and household credit supply shocks (Figure 3, third and fourth columns) are likely to resemble shocks of credit supplied to businesses and households in order to yield profit to the lender (HOR (2021)). The household, business and to a lesser extent, aggregate credit supply findings can straightforwardly be rationalized with reference to income effects: If more credit is supplied, e.g. as a relaxation of liquidity constraints, eventually more consumption and house building (households), as well as more investment (businesses) become feasible. The respective transmission channels have been described abundantly in the theoretical literature (see Bernanke and Blinder (1988) for the bank lending channel; Bernanke and Gertler (1989) for the balance sheet / loan allocation channel and Bernanke et al. (1996) for the financial accelerator).[5]

In summary, we find that global shocks related to businesses and, to a smaller extent, government credit supply, cause a surge in output measured as the average over a large cross section of economies, although amplitudes and speeds of adjustment vary across sectors. Interestingly, the opposite holds for household credit supply shocks which impact adversely on output. Government credit supply shocks might mainly resemble flight to quality aspects of liquidity. Put differently, investors primarily supply the government with credit to adjust their risk-return profiles and not to make profits. In case a government credit shock only induces a higher valuation of government securities without a substantial increase of the liquidity flows at the governments' direct disposal, the increase is unlikely to transmit into the real economy. Therefore, it is unsurprising that the output effects of government credit supply shocks are small. In fact, the small output response to a government credit supply shock lends strong support to the interpretation of government credit supply in HOR (2021) who argue that this factor is mostly financial.

Inflation and unemployment exhibit opposite short-term reactions in response to shocks in aggregate credit supply (Figure 3, first column, second and third row). The CPI median impact response is -0.2% and it fade out in the limit. We note a marked instantaneous reduction in unemployment responding to global aggregate credit supply shocks followed by a hump-shaped bounce-back, and subsequent fade-out: The on-impact decrease (-0.05%) is followed by a medium-term increase (+0.15% after 10 quarters). Interestingly, aggregate credit supply shocks seem to have the typical Philips-curve trade-off in the short-term (i.e. different signs of inflation and unemployment responses).

The reactions of inflation and unemployment to orthogonal innovations in government credit supply (Figure 3, second column, second and third row) are slightly smaller than the respective responses to aggregate credit supply shocks. Only the response of the unemployment

[5] Note that monetary policy and credit supply effects are not clearly distinguished in some instances.

rate is significantly different from zero in the short term (-0.09%). Put differently, credit supply shocks that originate from global lending to the government exert very small inflationary pressure (+0.1% on impact, not significantly different from zero) and reduce unemployment slightly.

Responses to a business credit supply shock (third column, second and third row of Figure 3) show a reduction in unemployment and an increase in inflation (-0.5% and +0.3% for CPI and unemployment on impact and after 6 quarters, respectively), whereas responses of unemployment and inflation to household credit supply shocks are expansionary (+0.1% and +0.3% after 6 quarters and on impact, respectively). The effects are significantly different from zero at conventional levels. Put differently, expansionary global private sector supply shocks foster the real economy in the short term. Finally, the differences of the inflation and unemployment responses between business and government as well as business and household credit shocks (fourth column of Figure 3), underline that inflation and unemployment show (credit) sector specific transmission patterns.

To summarize, we find that credit supply shocks reduce inflationary pressures in the short term, whereas the responses differ with regard to unemployment. Theoretical considerations in Buera et al. (2015) and empirical evidence provided by Chodorow-Reich (2014), Duygan-Bump et al. (2015), Chen et al. (2017) and Siemer (2019) motivate the conjecture that credit (supply) shocks translate into changes in (un)employment via financial frictions, such as lending standards (e.g. collateral constraints), external finance exposure as well as lending costs. Moreover, García (2020) shows for the US financial crisis period that a reduction in credit supplied to the household sector (in his case to US housing) reduces employment in downstream sectors, such as construction. In a similar vein Mian and Sufi (2014) attribute reductions in US employment during the Great Recession to reduced (housing) net worth. These channels are promising candidates for rationalizing the unemployment responses to global aggregate and private (business and household) credit supply shocks. Whether similar mechanisms are active for public credit supply shocks is an issue that we leave to future empirical research. For instance, theoretical work by Abo-Zaid and Kamara (2020) suggests that credit constraints and the government spending multiplier are closely related.

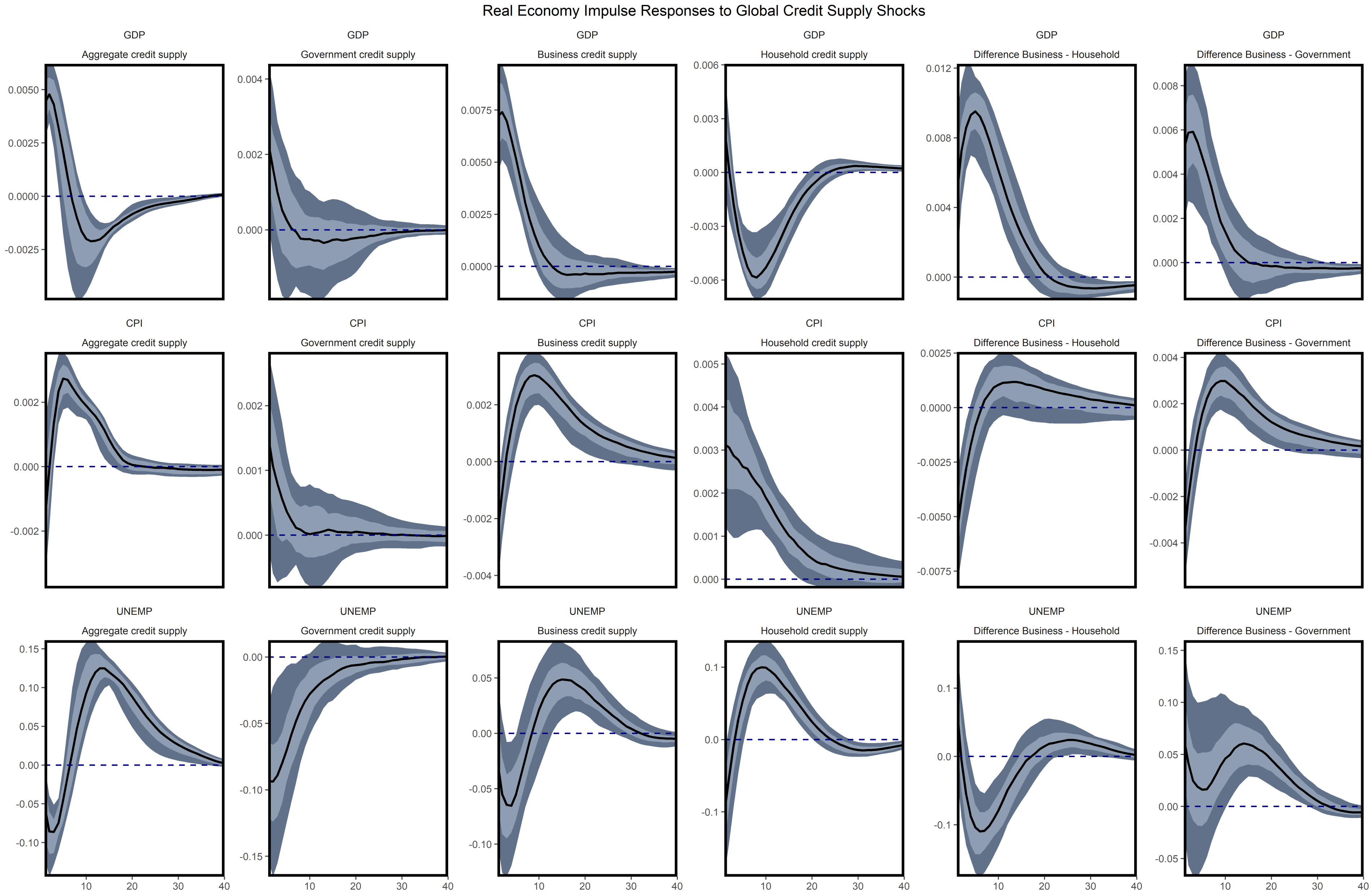

Figure 3: Structural impulse responses from $\mathcal{S}_1$ and $\mathcal{S}_2$ of real gross domestic product (GDP), consumer price index (CPI) and unemployment (UNEMP) to global credit supply shocks over a horizon of 40 quarters. Solid lines indicate the medians of a set of $M = 100$ MG estimates. Shaded areas indicate 16 and 84 (inner) as well as 2.5 and 97.5 (outer) percentiles. The rightmost column shows the respective quantiles for the difference computed from MG responses to public and private credit components. All variables except the unemployment rate are in logarithms.

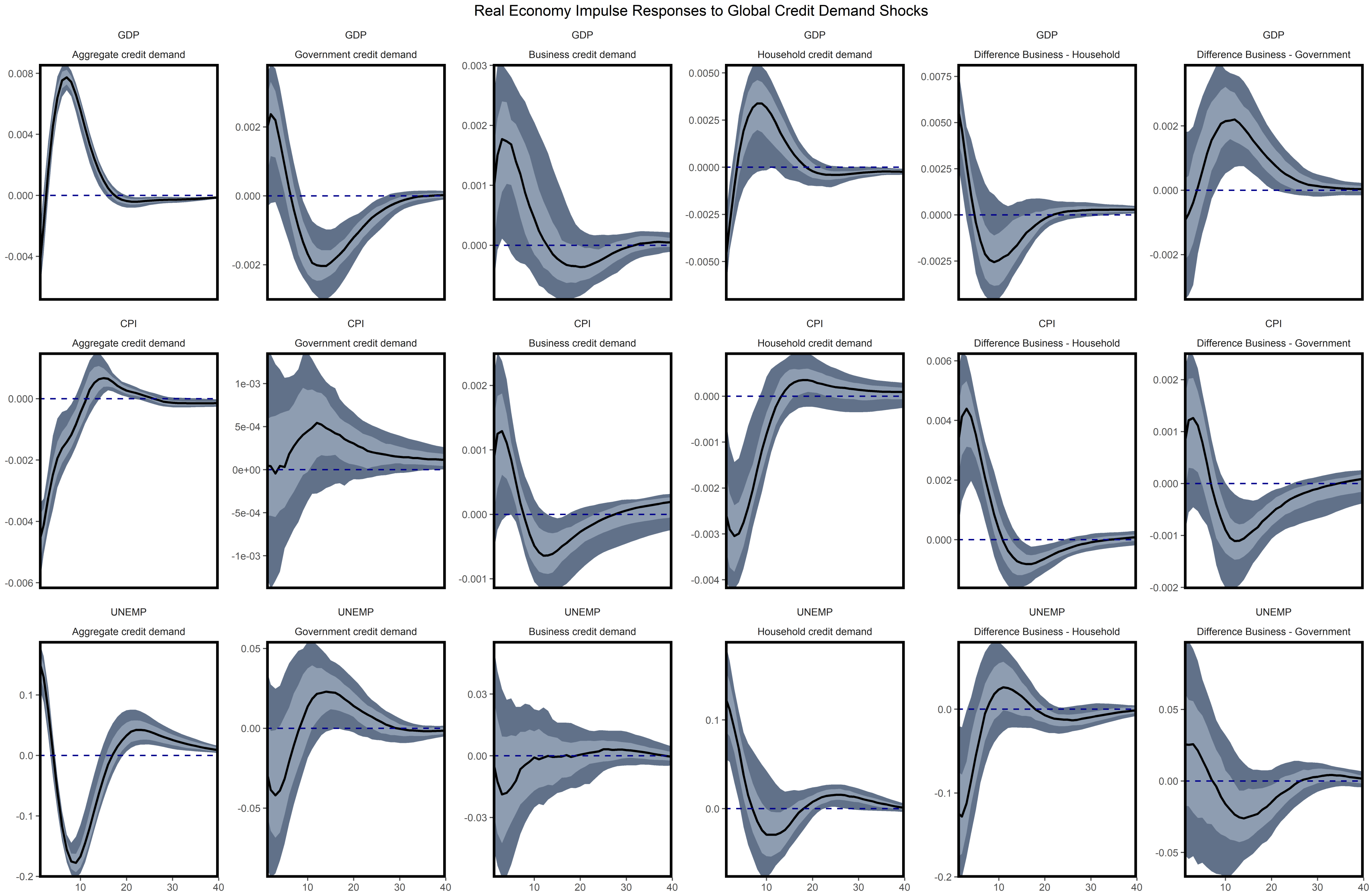

Figure 4: Structural impulse responses from $\mathcal{S}_1$ and $\mathcal{S}_2$ of real gross domestic product (GDP), consumer price index (CPI) and unemployment (UNEMP) to global credit demand shocks over a horizon of 40 quarters. For further notes see Figure 3.

4.2.2 Credit demand

The subsequent analysis of the real economy responses to credit demand shocks proceeds analogously to the discussion of responses to credit supply shocks.

Output increases (by +0.5%) in response to aggregate credit demand shocks (first column of Figure 4) on impact, but suffers from a deterioration (by -0.25%) after 12 quarters. This is in line with related research (e.g., Peersman 2011), who finds an on-impact increase and a subsequent downswing in response to aggregate credit demand shocks. The GDP response to an expansionary government credit demand shock (second column of Figure 4) indicates a sizeable short-term increase of GDP (+0.2%) on impact. After 10 quarters, the response turns slightly negative, which may indicate crowding-out effects. This pattern is in line with the response to the aggregate credit demand shock. Thus, the median MG estimate suggests that expansionary fiscal policies might lead to short-term expansions and medium-term contractions of the business cycle. Recall that government credit demand approximates a global co-movement in expansionary fiscal policy shocks. Naturally, this finding is of importance in the general debate on the real effects of government spending. Whereas Panizza and Presbitero (2013) and Eberhardt and Presbitero (2015) stress cross-sectional (i.e. country-level) heterogeneity for the (supposedly, negative) relationship between public debt and the business cycle, we conclude that (global) government credit demand shocks in fact significantly expand GDP in the short-term, while lowering it in the medium term. Furthermore, the finding is consistent with a positive government spending multiplier. More specific, the documented effects are of core importance in the light of ongoing COVID-19 related expansions of government credit and spending.

Shape and magnitude of the GDP response to a business credit demand shock are very similar with regard to shape and amplitude to the responses provoked by aggregate and government credit demand. On the contrary, GDP decreases (-0.35%) on impact in response to household credit demand shocks and subsequently increases (+0.25%) in the medium term. This might resemble the effects of demand for housing or financial cycle downswing deleveraging. Recall that business credit demand resembles financial-cycle upswing borrowing (HOR (2021)). Apparently, this immediately translates into business-cycle upswings. In principle, the transmission channels for credit demand shocks are similar to those of credit supply shocks, with the exception that the borrowers' perspective needs to be adapted. For instance, the credit demand shocks might transmit through the loan allocation channel in times of crisis: Given constant lending standards, an expansionary credit demand shock will lead to a re-allocation of bank loans to the most solvent agents. This affects the real economy as insolvent agents (i.e. borrowers who cannot borrow more) need to cut spending for consumption and real estate (households) as well as labour and capital inputs (businesses). Similar arguments can be put forth for the case of the external finance premium. These considerations might explain the detected average contraction of GDP after 15 quarters due to household credit demand shocks. Unsurprisingly, the median difference between business and household (fifth column of Figure 4) is large and significant at conventional levels, whereas this is not the case for the difference between the responses to global business and government credit demand shocks.

Inflation and unemployment react similarly to aggregate, government and business credit demand shocks. More precisely, inflation expands (by about +0.2%, +0.1% and +0.1%, respectively), whereas the unemployment rate decreases (by about -0.1%, -0.04%, and -0.01%, respectively) in response to aggregate, government and business credit demand shocks in the short term (see Figure 4, first to third columns, lower two panels). Interestingly, unemployment exhibits a tendency to increase above the zero line (significantly so for aggregate and government credit responses) after 10 quarters (+0.01% for both). Finally, the responses of inflation and unemployment to global household sector demand shocks are opposite to inflation and unemployment responses to global business and government credit demand shocks (Figure 4, lower two panels of fourth columns). To summarize, we observe substantial similarities between the effects of aggregate and government credit demand, whereas the real economy exhibits different responses to private sector demand shocks. The differences between business and government credit demand shocks (Figure 4, fifth column, lower panels) support this conjecture, especially with regard to the responses of unemployment.

5 Conclusion

Numerous financial aggregates, such as credit volumes, equity and house prices and interest rates co-move and transmit financial shocks across the globe (Borio et al. 2011, Eickmeier et al. 2014, Miranda-Agrippino and Rey 2020). Referring to the availability of global funding, 'global liquidity', co-determines financial conditions in open economies. However, there is little evidence how global liquidity shocks translate into the real economy at the country level. In this article, we embraced the global credit composition components from **?** and brought them into an information rich, structural environment to assess their linkages with macroeconomic performance (output, inflation, and unemployment) in 43 economies. By means of mean group inference (Pesaran et al. 1999) on proxy-identified structural vector autoregressions (Stock and Watson 2018), we argue that global credit composition shocks imply substantial and diverse economic costs and benefits.

Business credit supply shocks are clearly the most important credit shocks. They are highly prevalent, as can be inferred from the historical decompositions. Moreover, expansionary shocks have beneficial real output effects in the medium term although they also increase inflationary pressures. On the contrary, household sector credit supply shocks are clearly least beneficial from a real economy perspective. We note that household sector credit supply shocks might lead the way to excessive credit allocations, e.g. prior to the financial crises in many countries. From the perspective of policy conduct, it seems desirable to enable lenders to supply with sufficient liquidity, given economy-wide risk and leverage constraints. Monitoring household credit supply should be a top priority for governments and central banks.

Expansionary government credit supply shocks have relatively small benefits for the real economy compared with other credit shocks. Nevertheless they are important for shaping the real economy in times of economic crisis, as can be seen from the historical decompositions. We emphasize that government credit demand shocks can boost the business cycle in the short run, but crowding out effects obtain in the medium term. Government supply shocks are, as suggested by Herwartz, Ochsner, and Rohloff (2021), mostly irrelevant for the real economy. Therefore, constraints on government spending that prevent excessive debt allocations and careful monitoring of safe-haven investing are of utmost importance.

Furthermore, we document substantial heterogeneity with respect to prevalence and amplitude of global sectoral credit effects on real aggregates. Promising avenues of future research include the investigation of differences in the effects of global credit shocks across groups of advanced and emerging economies.

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Appendix

A Appendix on historical decompositions

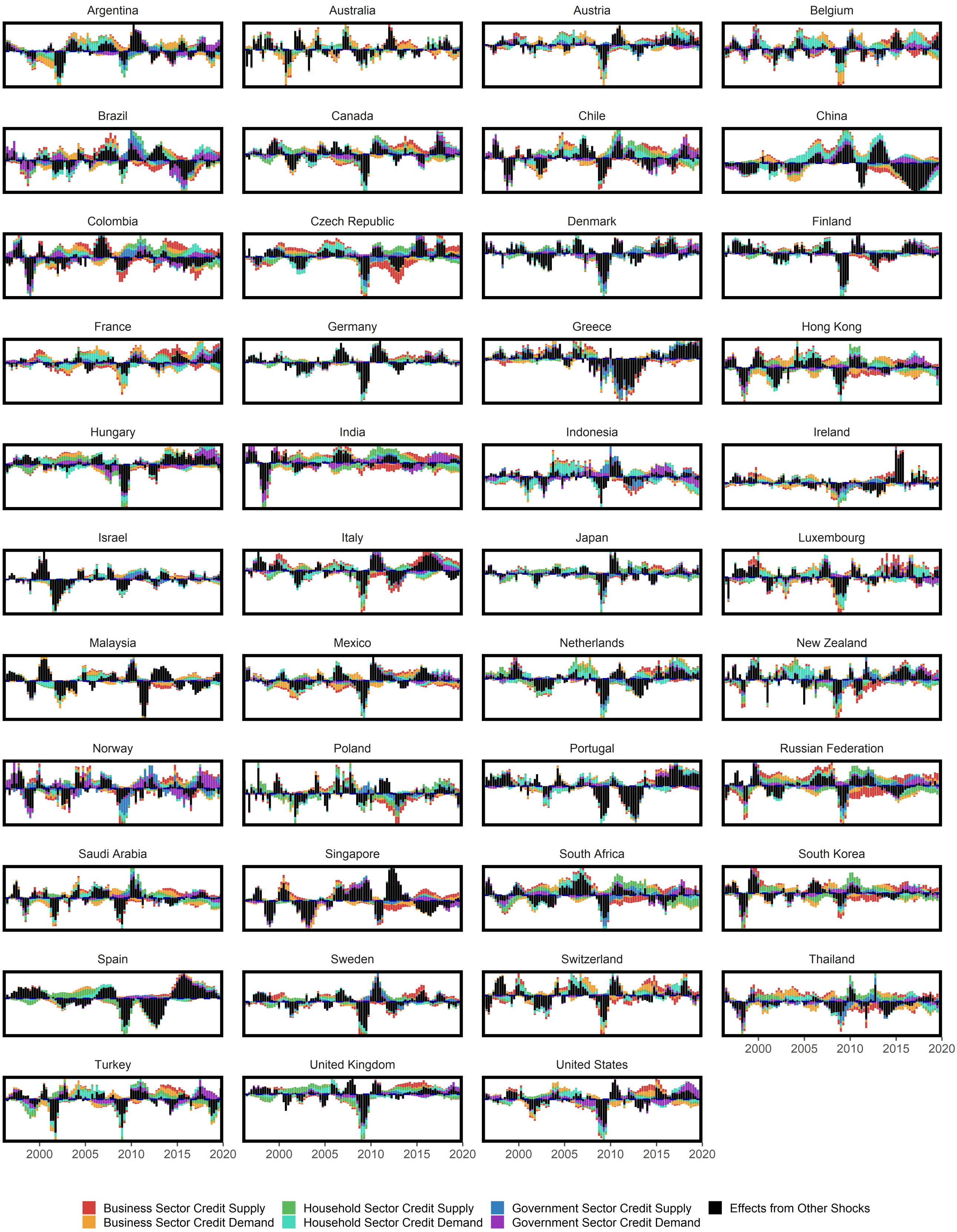

Figure A1: Cumulated median effects of shocks on year-on-year changes of the logarithm of gross domestic product from $\mathcal{S}_{2a}$ for all sampled countries.

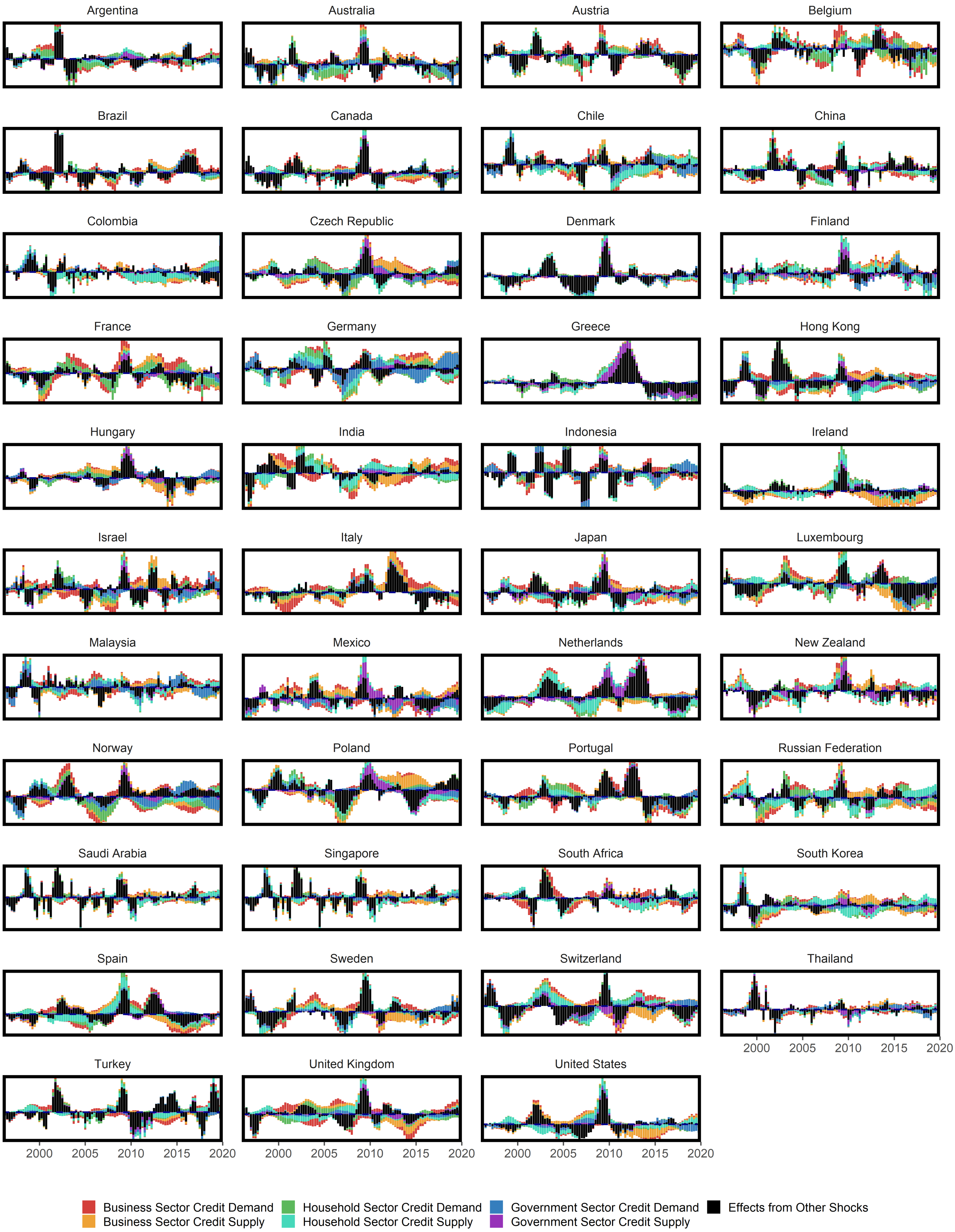

Figure A2: Cumulated median effects of shocks on year-on-year changes of the logarithm of the consumer price index from $\mathcal{S}_{2b}$ for all sampled countries.

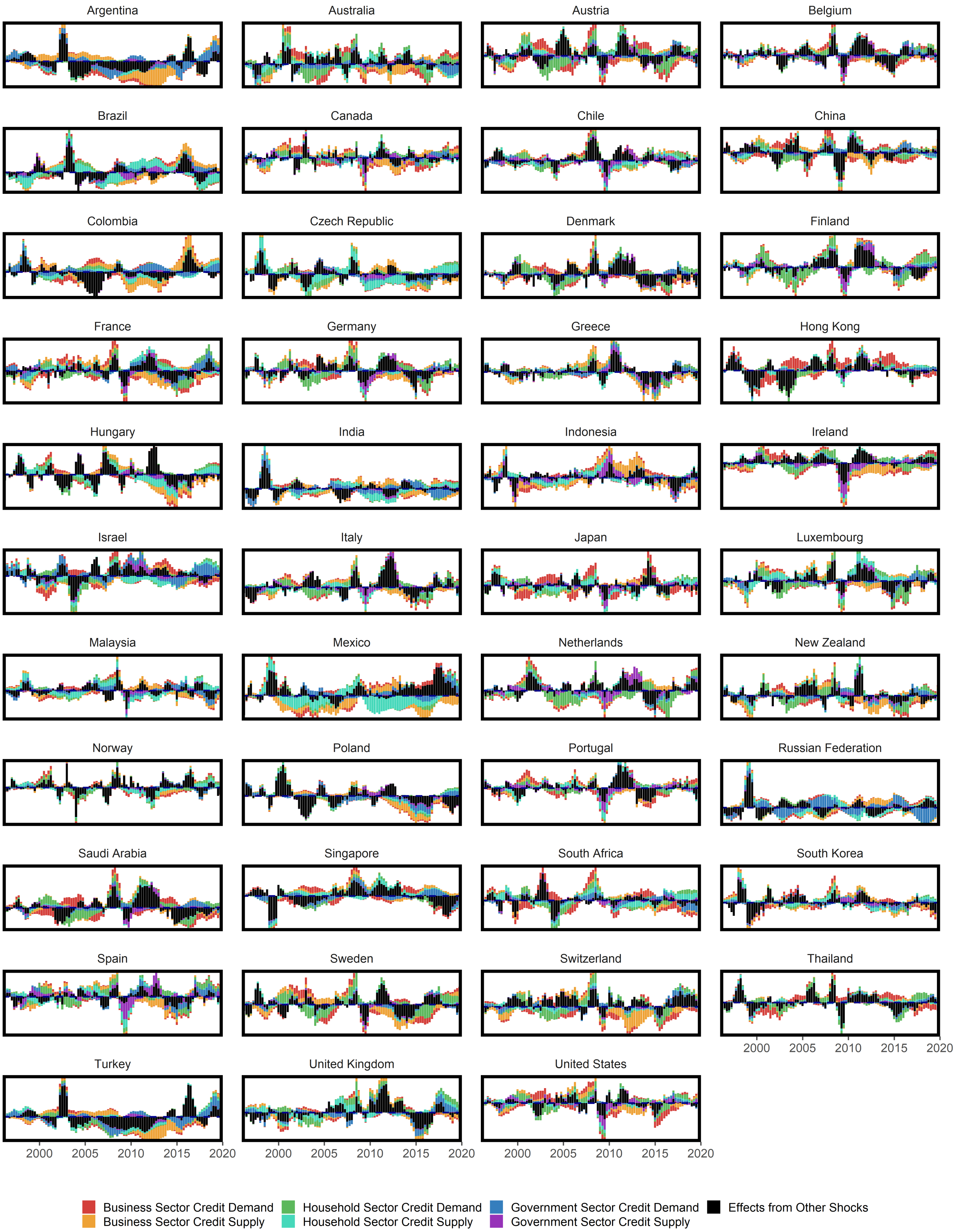

Figure A3: Cumulated median effects of shocks on the year-on-year changes of the unemployment rate from $\mathcal{S}_{2c}$ for all sampled countries.

B Appendix on robustness

In this appendix, we document results for the analysis of variance, historical decompositions and impulse responses obtained from models where the global credit components have been reordered. In Appendix B.1 we present results for models in which supply components are ordered before demand components and in Appendix B.2, we present results for models in which government components are ordered before private sector components. As can be seen from Appendix B.1, the results for the historical decompositions and impulse responses hardly change when supply components are ordered before demand components. The magnitude of the coefficients in the analysis of variance slightly change, but most of the signs are preserved. As can be seen from Appendix B.2, the same holds if we order government credit before the private credit factors, although we note minor deviations for the impulse responses of CPI and unemployment to business and government demand shocks. As these are hardly significantly different from zero in both the baseline and the government-before-private specification, this is acceptable. Therefore, we conclude that our results are robust against alternative recursive orderings.

B.1 Supply components ordered before demand components

Table A1: Analysis of Variance

	Dependent variable:		
	Cumulated Effects		
	GDP	CPI	UNEMP
Government Credit Demand	0.481^{***}	0.099^{**}	0.403^{***}
	(0.049)	(0.045)	(0.050)
Business Credit Demand	-0.062	0.115^{**}	-0.271^{***}
	(0.046)	(0.045)	(0.046)
Business Credit Supply	0.070	0.526^{***}	-0.347^{***}
	(0.046)	(0.047)	(0.045)
Household Credit Supply	-0.011	0.177^{***}	-0.141^{***}
	(0.045)	(0.047)	(0.045)
Household Credit Demand	-0.732^{***}	-0.633^{***}	-0.848^{***}
	(0.042)	(0.042)	(0.043)
Constant	2.271^{***}	2.153^{***}	2.377^{***}
	(0.032)	(0.032)	(0.033)
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table A2: Dummy effect estimates on cumulated effects remapped to $[-1;+1]$ from $\mathcal{S}_{2a-c}$ with supply components ordered before demand components on the year-on-year changes of the logarithms of gross domestic product (GDP; left-hand column), year-on-year changes in the logarithms of the consumer price index (CPI; mid column) and year-on-year changes in the levels of the unemployment rate (UNEMP; right-hand column). For further notes see Figure 2.

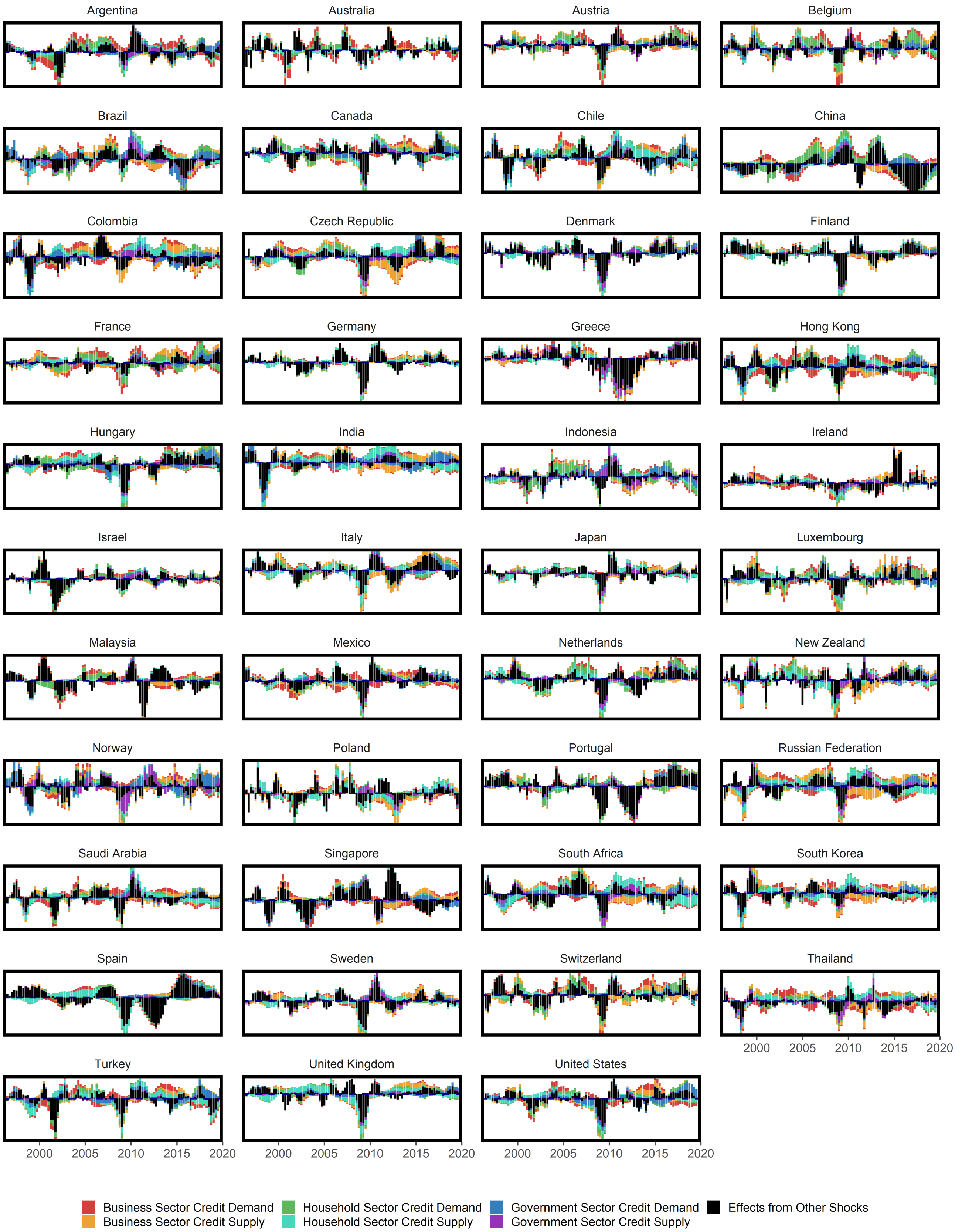

Figure A4: Cumulated median effects of shocks on year-on-year changes of the logarithm of gross domestic product from $\mathcal{S}_{2a}$ with supply components ordered before demand components for all sampled countries.

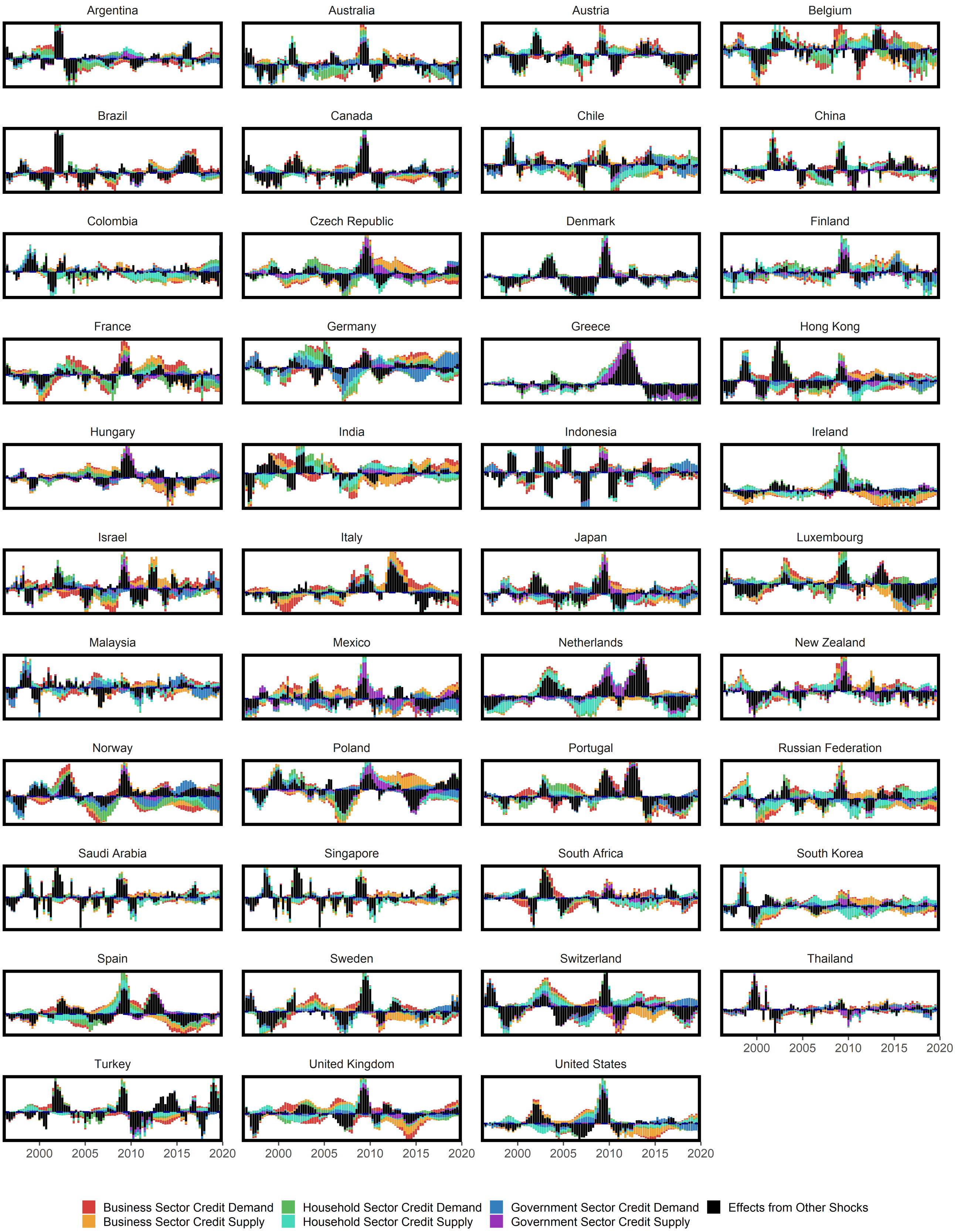

Figure A5: Cumulated median effects of shocks on year-on-year changes of the logarithm of the consumer price index from $\mathcal{S}_{2b}$ with supply components ordered before demand components for all sampled countries.

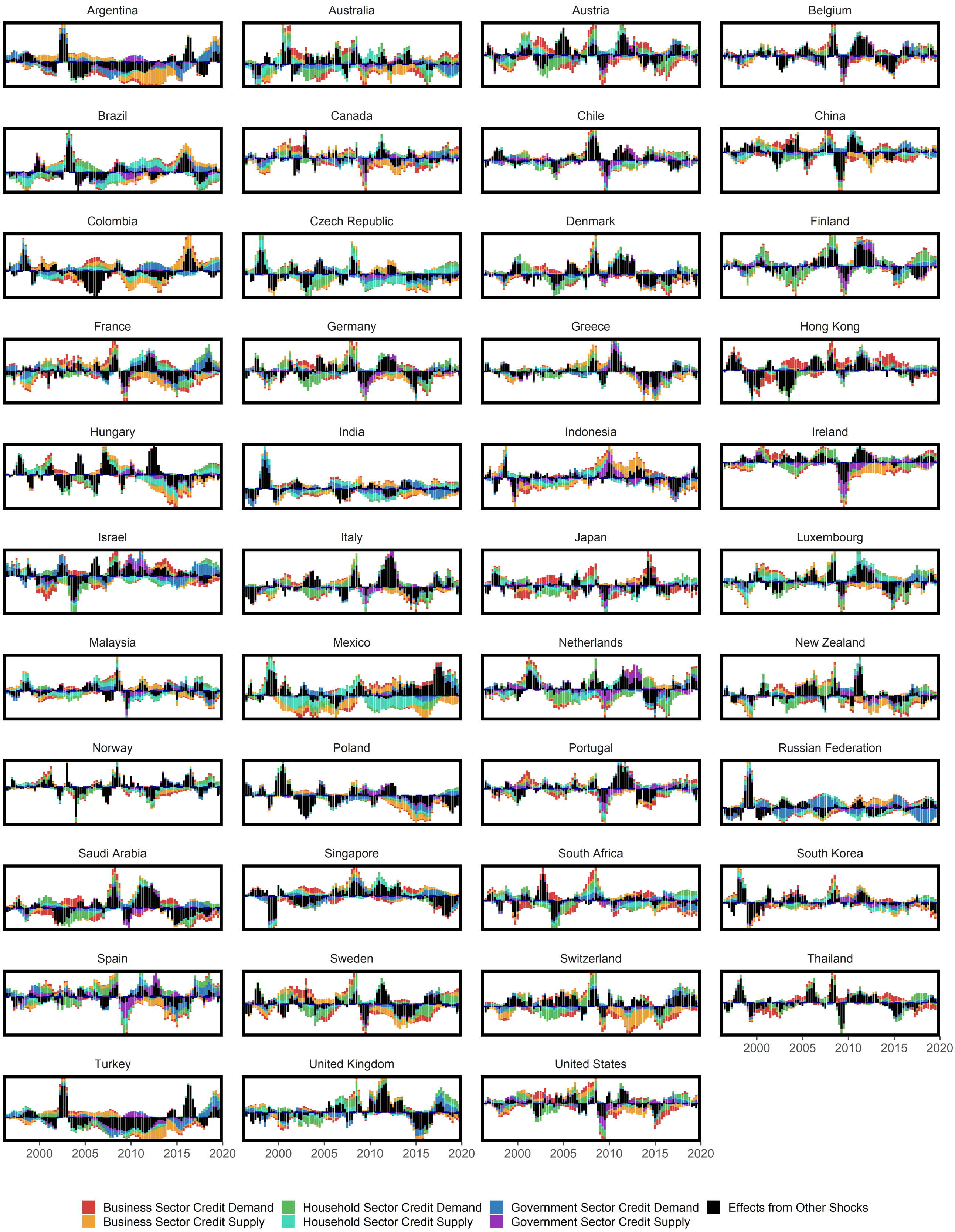

Figure A6: Cumulated median effects of shocks on the year-on-year changes of the unemployment rate from $\mathcal{S}_{2c}$ with supply components ordered before demand components for all sampled countries.

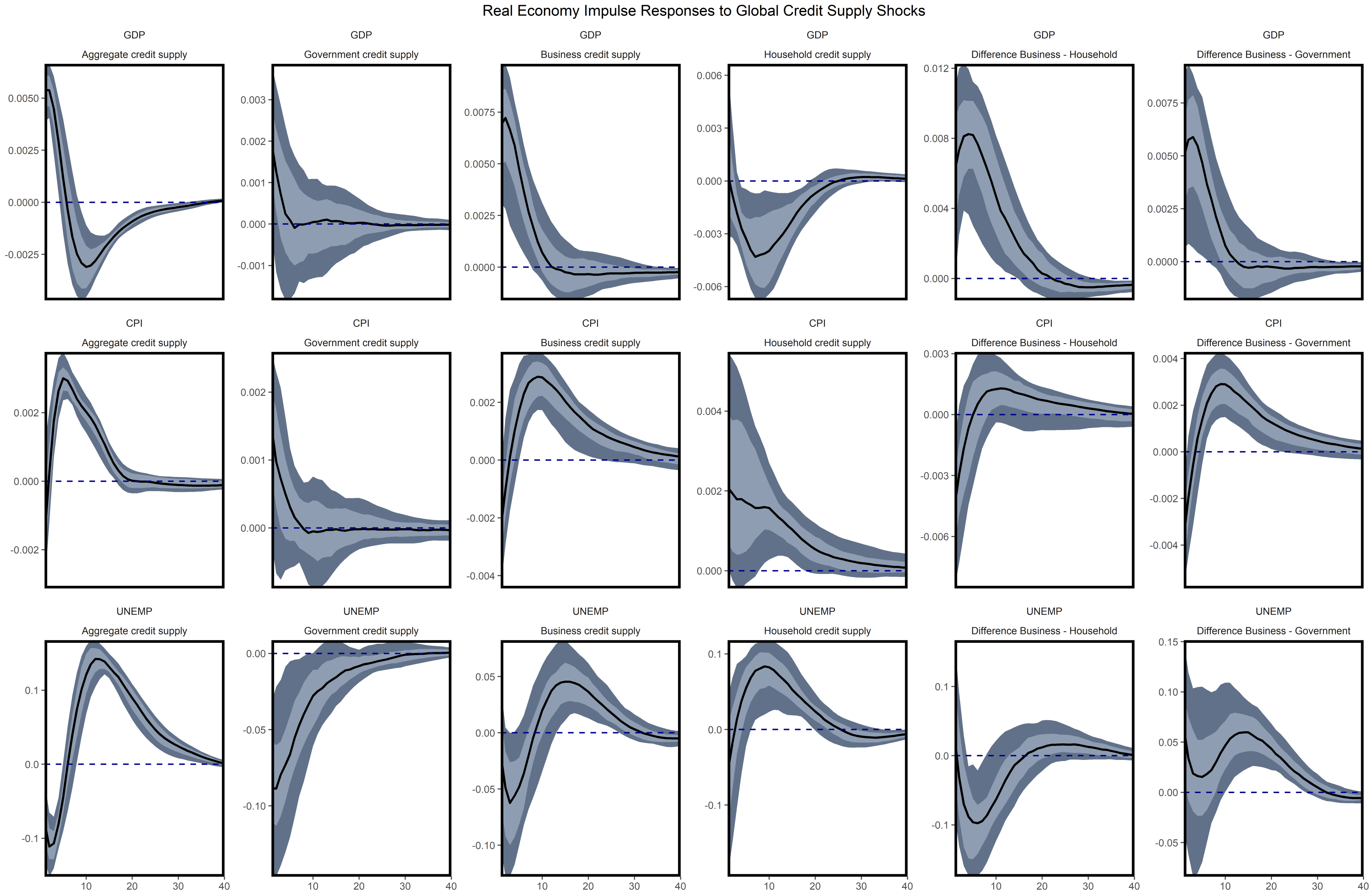

Figure A7: Structural impulse responses from $\mathcal{S}_1$ and $\mathcal{S}_2$ of real gross domestic product (GDP), consumer price index (CPI) and unemployment (UNEMP) to global credit supply shocks over a horizon of 40 quarters when supply components are ordered before demand components. For further notes see Figure 3.

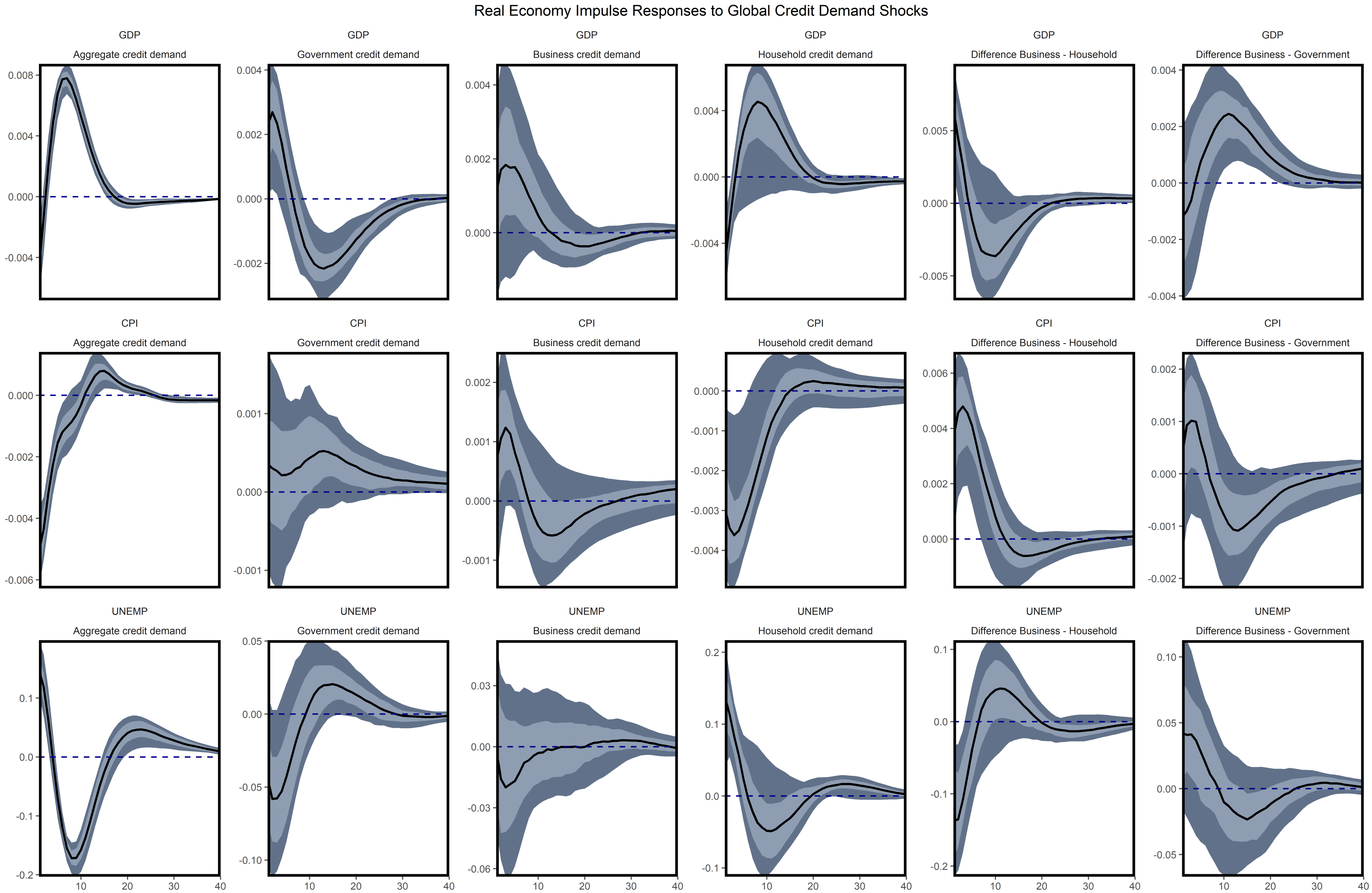

Figure A8: Structural impulse responses from $\mathcal{S}_1$ and $\mathcal{S}_2$ of real gross domestic product (GDP), consumer price index (CPI) and unemployment (UNEMP) to global credit demand shocks over a horizon of 40 quarters when supply components are ordered before demand components. For further notes see Figure 3.

B.2 Government components ordered before private sector components

Table A3: Analysis of Variance

	Dependent variable:		
	Cumulated Effects		
	GDP	CPI	UNEMP
Government Credit Demand	0.031	-0.092**	0.070
	(0.046)	(0.044)	(0.048)
Business Credit Demand	-0.090**	0.253***	-0.220***
	(0.045)	(0.046)	(0.045)
Business Credit Supply	0.473***	0.789***	-0.200***
	(0.048)	(0.049)	(0.045)
Household Credit Supply	-0.032	0.060	-0.087*
	(0.044)	(0.045)	(0.045)
Household Credit Demand	-0.719***	-0.496***	-0.838***
	(0.042)	(0.042)	(0.042)
Constant	2.243***	2.018***	2.325***
	(0.032)	(0.031)	(0.032)

Note: *p<0.1; **p<0.05; ***p<0.01

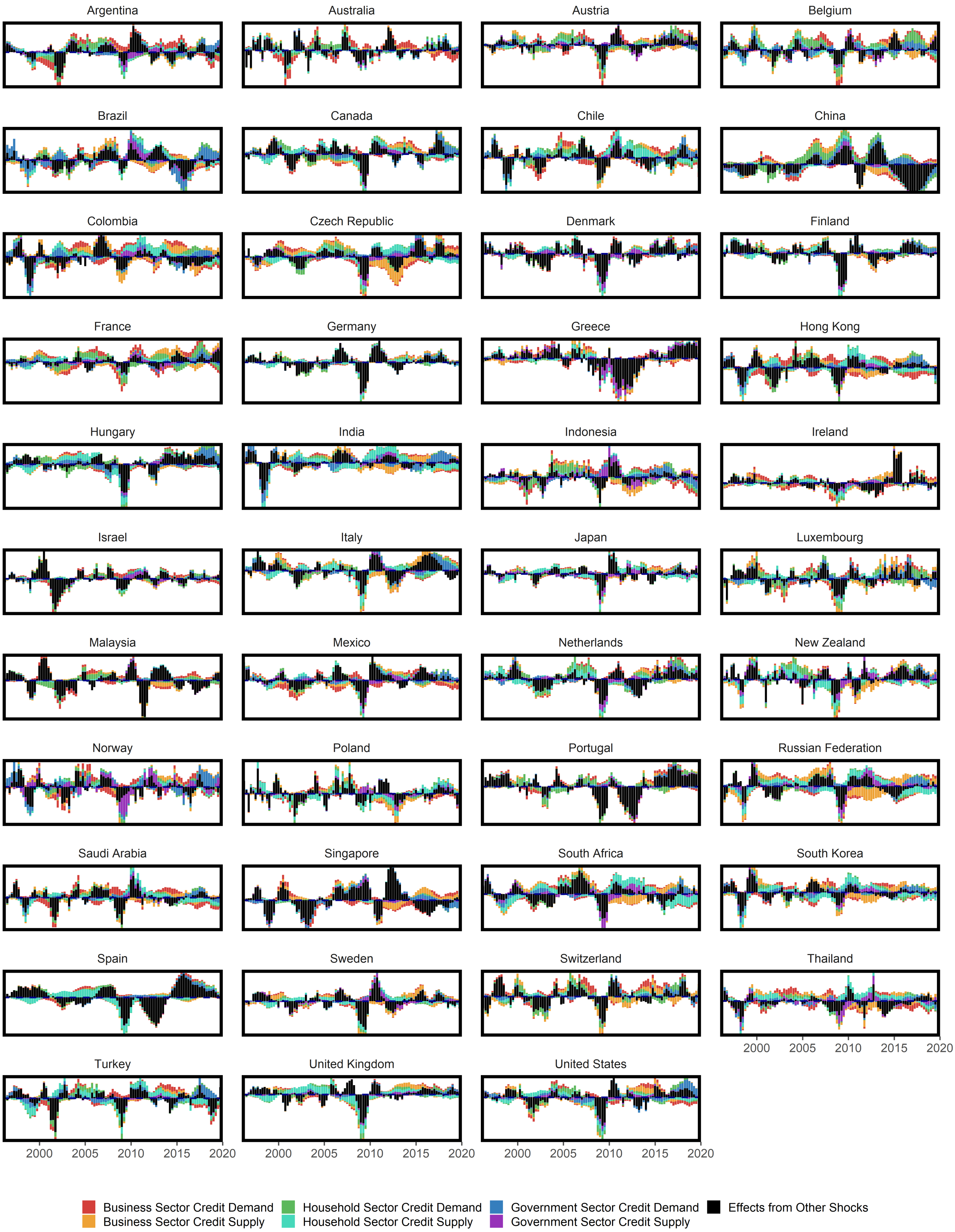

Figure A9: Cumulated median effects of shocks on year-on-year changes of the logarithm of gross domestic product from $\mathcal{S}_{2a}$ with government components ordered before private sector components for all sampled countries.

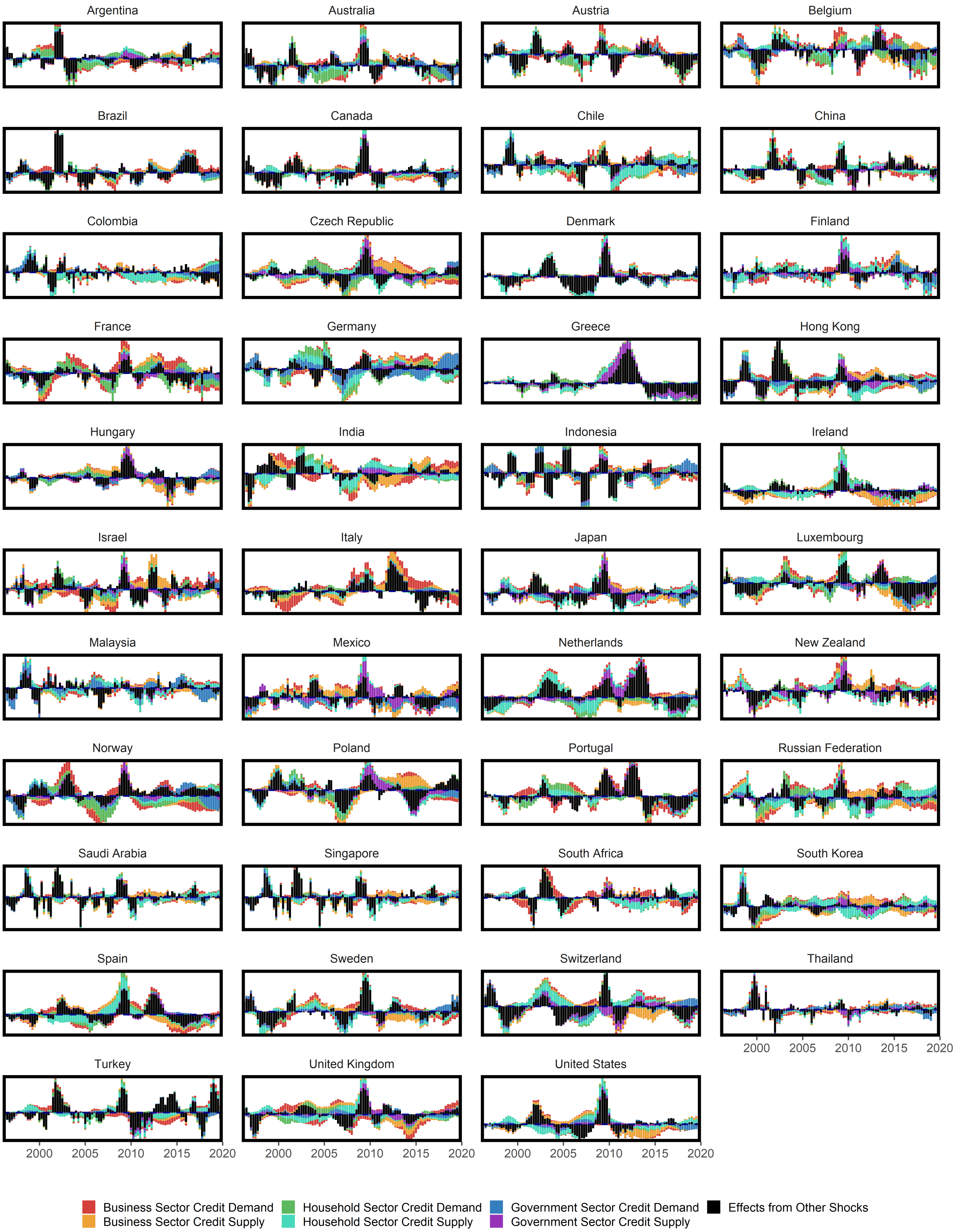

Figure A10: Cumulated median effects of shocks on year-on-year changes of the logarithm of the consumer price index from $\mathcal{S}_{2b}$ with government components ordered before private sector components for all sampled countries.

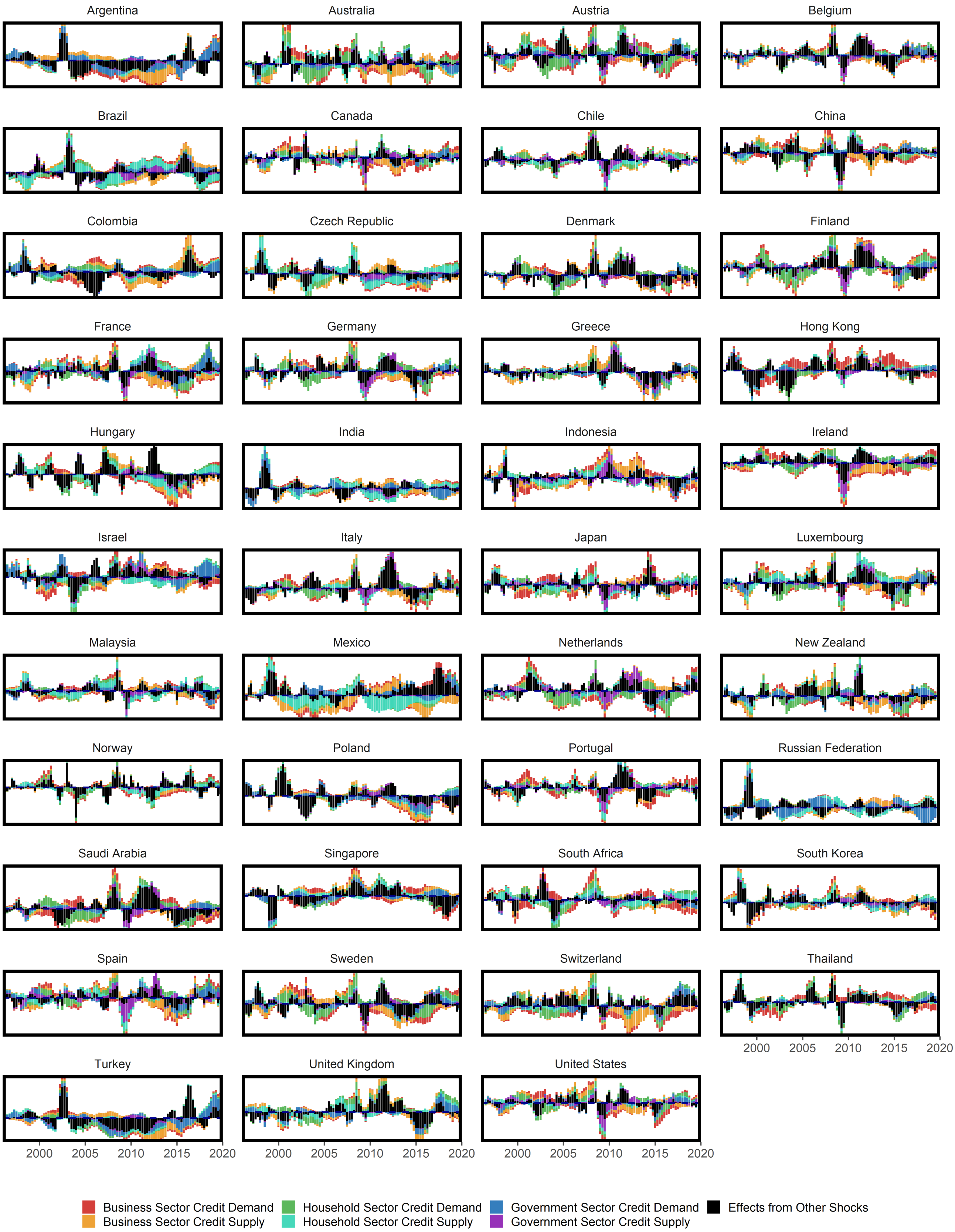

Figure A11: Cumulated median effects of shocks on the year-on-year changes of the unemployment rate from $\mathcal{S}_{2c}$ with government components ordered before private sector components for all sampled countries.

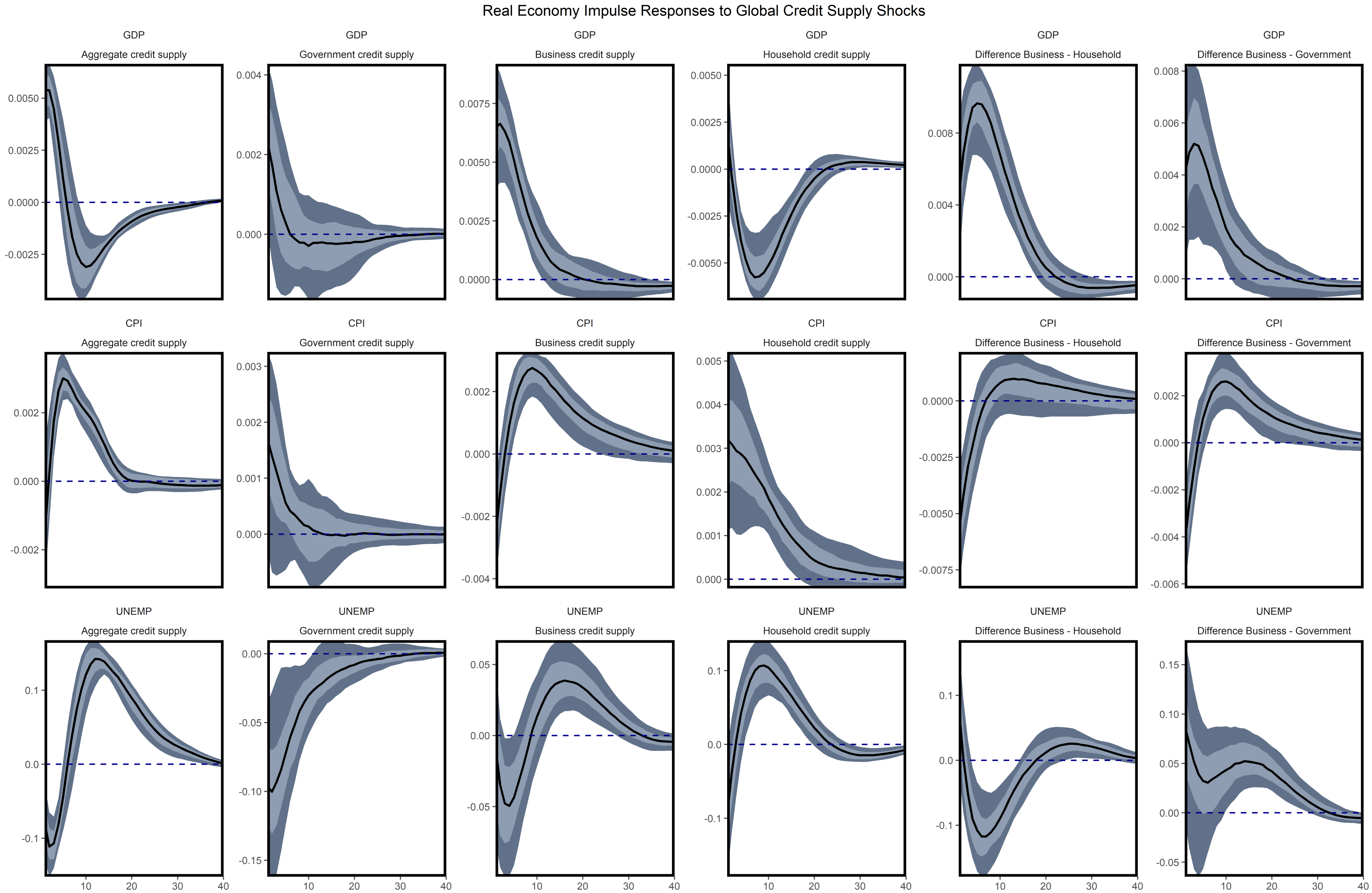

Figure A12: Structural impulse responses from $\mathcal{S}_1$ and $\mathcal{S}_2$ of real gross domestic product (GDP), consumer price index (CPI) and unemployment (UNEMP) to global credit supply shocks over a horizon of 40 quarters when government components ordered before private sector components. For further notes see Figure 3.

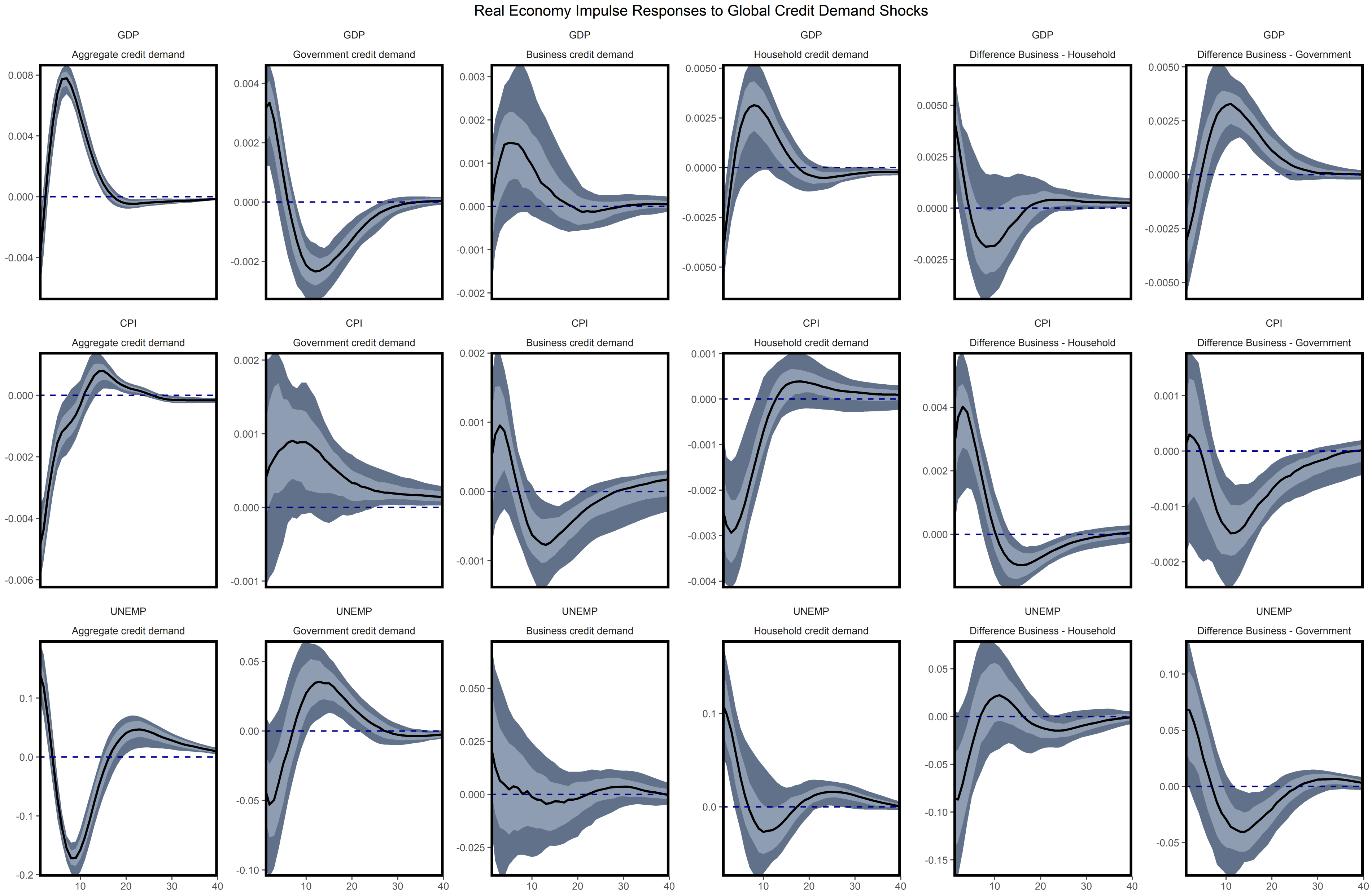

Figure A13: Structural impulse responses from $\mathcal{S}_1$ and $\mathcal{S}_2$ of real gross domestic product (GDP), consumer price index (CPI) and unemployment (UNEMP) to global credit demand shocks over a horizon of 40 quarters when government components ordered before private sector components. For further notes see Figure 3.

C Appendix on variables and cross sectional entities

Variable Group	Name of data	Source
Consumption (CONS)	Private consumption expenditure, constant prices, seasonally adjusted Government consumption expenditure, constant prices, seasonally adjusted	IMF IFS, Datastream IMF IFS, Datastream
Government credit (CG)	Credit to general government from all sectors, breaks adjusted, at market value, US-Dollar	BIS credit statistics
Household credit (CH)	Credit to households from all sectors, breaks adjusted, at market value, US-Dollar	BIS credit statistics
House prices (HP)	OECD real house price index, seasonally adjusted	Datastream
Inflation (I)	Consumer price index, not seasonally adjusted Producer price index, not seasonally adjusted	Datastream and country-specific sources (see dataset)
Interest rates (IR)	Long-term government bond yield (mostly ten year maturity) Money market rate (mostly prime lending rates) Overnight rate (mostly deposit & interbank lending rates) Business lending rate Mortgage lending rate Shadow policy rate	Global financial data, Datastream Datastream Datastream, Eickmeier et al. (2014) Global financial data, Eickmeier et al. (2014) Global financial data, Eickmeier et al. (2014) Krippner (2020)
Investment (INV)	Gross capital formation, constant prices, seasonally adjusted	IMF IFS, Datastream
Money (M)	M0 current prices, not seasonally adjusted M3 current prices, not seasonally adjusted	Datastream, Global financial data
Non-financial corp. credit (NFC)	Credit to non-financial corporations from all sectors, breaks adjusted, at market value, US-Dollar	BIS credit statistics
Output (O)	GDP, expenditure approach, constant prices, seasonally adjusted Industrial Production	IMF IFS, Datastream and country-specific sources (see dataset) OECD and country-specific sources (see dataset)
Unemployment (UNEMP)	Unemployment rate	Datastream, OECD and country-specific sources (see dataset)
Share Prices (SP)	Nominal share price index, not seasonally adjusted	Datastream, Global Financial Data

Table A4: Variables and data sources.

Argentina	Austria	Australia	Belgium	Brazil	Canada
Colombia	China	Chile	Czech Republic	Denmark	Finland
France	Germany	Greece	Hong Kong	Hungary	India
Indonesia	Ireland	Israel	Italy	Japan	Luxembourg
Malaysia	Mexico	Netherlands	New Zealand	Norway	Poland
Portugal	Russian Federation	Singapore	South Africa	South Korea	Spain
Sweden	Saudi Arabia	Switzerland	Thailand	Turkey	United Kingdom
United States					

Table A5: Included economies.