Spillovers in Global Production Networks - Online Appendix

Erik Frohm[‡] and Vanessa Gunnella[*]

‡ Sveriges riksbank, SE-103 37 Stockholm, Sweden. E-mail: erik.frohm@riksbank.se
*European Central Bank, Sonnemannstr. 20-60314, Frankfurt am Main, Germany. E-mail: vanessa.gunnella@ecb.europa.eu. The views expressed are those of the authors and do not necessarily reflect those of the European Central Bank (ECB) or Sveriges riksbank. A previous version of this paper was circulated as Sectoral interlinkages in global value chains: spillovers and network effects. We wish to thank Marta Banbura, Chris Boehm, Chiara Osbat, Stephanie Schmitt-Grohe, Yongcheol Shin, Georg Strasser and Mate Toth for useful comments and suggestions, as well as participants at the 2017 CEPR/World Bank Third Conference on Global Value Chains, Trade and Development in Singapore, the 2017 Annual Congress of the European Economic Association in Portugal, the 2017 European Trade Study Group in Florence, the 2018 4th HenU/INFER Workshop on Applied Macroeconomics, as well as seminar participants at the ECB and Sveriges riksbank for useful feedback.

1 Additional results

Table 1: **Correlation between upstream and downstream weights**

year	simple weights corr.	year	dist corrected weights corr.
1995	0.32	1995	0.32
1996	0.32	1996	0.32
1997	0.32	1997	0.32
1998	0.32	1998	0.32
1999	0.32	1999	0.32
2000	0.31	2000	0.31
2001	0.32	2001	0.32
2002	0.32	2002	0.32
2003	0.32	2003	0.32
2004	0.32	2004	0.32
2005	0.32	2005	0.32
2006	0.31	2006	0.31
2007	0.31	2007	0.31
2008	0.31	2008	0.31
2009	0.32	2009	0.32

Notes: For each year, correlation between upstream (equation (4)) and downstream (equation (3)) weights have been computed. Simple weights refers to the case in which $d^{up}_{ij,t}$ and $d^{down}_{ij,t}$ are equal to one for any ij.

Table 2: **Regression results - Full sample (1997-2009)**

	Baseline	**Unobs.factors + Controls**	**Unobs.factors + Controls + Global factors**	**Government (demand) shock**	**TFP (supply) shock**
Lag	0.027***	-0.033***	-0.032***	-0.033***	0.038*
	(0.012)	(0.012)	(0.012)	(0.012)	(0.021)
Upstream	0.705***	0.185***	0.198***	0.307	0.001
	(0.050)	(0.069)	(0.069)	(1.671)	(0.007)
Downstream	0.407***	0.125**	0.123**	1.330**	0.004
	(0.051)	(0.058)	(0.058)	(0.626)	(0.022)
Own				0.060	-0.036*
				(0.054)	(0.024)
Employment		0.455***	0.453***	0.456***	0.457***
		(0.015)	(0.015)	(0.015)	(0.033)
Country VA		0.152***	0.129***	0.224***	0.099**
		(0.027)	(0.026)	(0.015)	(0.043)
Agriculture			-0.056*		
			(0.032)		
Oil			-0.030*		
			(0.017)		
Metal p			0.011		
			(0.023)		
Interest rates			-0.078		
			(0.226)		
Year effects	n	y	n	y	y
Obs.	17511	17511	17511	17511	4950

Notes: $***p < 0.01$, $**p < 0.05$, $*p < 0.1$
The table reports estimated coefficients from regression (1) where the dependent variable y_{it} is the log difference of value added. The average of the dependent variables is considered as common factor in the error term. Standard errors are reported in brackets. Employment is the log differences of employment in a country-sector. Country VA is the log differences of value added in a specific country. Agriculture, oil, metal and real interest rate are the cyclical components of the respective commodity prices and real interest rates and have been taken from Fernández et al. (2017).

Table 3: **Regression results - 1997-2007 sample - standardized coefficients**

	Baseline	**Unobs.factors + Controls**	**Unobs.factors + Controls + Global factors**	**Government (demand) shock**	**TFP (supply) shock**
Lag	0.121***	-0.068***	-0.067***	-0.067***	0.029
	(0.015)	(0.015)	(0.015)	(0.015)	(0.029)
Upstream	0.201***	0.062***	0.065***	0.087***	0.002
	(0.016)	(0.019)	(0.019)	(0.016)	(0.015)
Downstream	0.067***	0.037***	0.036**	0.013	0.002
	(0.014)	(0.014)	(0.014)	(0.013)	(0.015)
Own				-0.002	-0.01
				(0.009)	(0.023)
Employment		0.176***	0.175	0.177***	0.182***
		(0.008)	(0.008)	(0.008)	(0.015)
Capital stocks		0.146***	0.145***	0.149***	0.092***
		(0.009)	(0.008)	(0.009)	(0.017)
Country VA		0.104***	0.090***	0.188***	0.051*
		(0.026)	(0.026)	(0.015)	(0.031)
Agriculture prices			-0.027*		
			(0.015)		
Oil prices			-0.029*		
			(0.015)		
Metal prices			0.022		
			(0.025)		
Interest rates			-0.010		
			(0.017)		
Year effects	n	y	n	y	y
Obs.	14817	14817	14817	14817	4950

Notes: $***p < 0.01$, $**p < 0.05$, $*p < 0.1$
See notes to Table 2. To make it possible to compare coefficients, variables are standardized and the coefficient reported measure the effect of a one standard deviation change of the independent variables. Standard errors are reported in brackets. Employment and capital stocks are expressed in log differences in a country-sector. Country VA is log differences of value added in a specific country. Agriculture, oil, metal and real interest rate are the cyclical components of the respective commodity prices and real interest rates and have been taken from Fernández et al. (2017).

Table 4: **Regression results - 1997-2007 sample - non-standardized coefficients**

	Baseline	**Unobs.factors + Controls**	**Unobs.factors + Controls + Global factors**	**Government (demand) shock**	**TFP (supply) shock**
Lag	0.119***	-0.062***	-0.062***	-0.062***	0.025
	(0.015)	(0.013)	(0.013)	(0.013)	(0.024)
Upstream	0.662***	0.251***	0.262***	17.318***	0.001
	(0.052)	(0.075)	(0.075)	(3.190)	(0.007)
Downstream	0.246***	0.165***	0.161**	1.282	0.003
	(0.052)	(0.064)	(0.064)	(1.250)	(0.022)
Own				-0.027	-0.011
				(0.108)	(0.025)
Employment		0.375***	0.371***	0.376***	0.400***
		(0.018)	(0.018)	(0.018)	(0.034)
Capital stocks		0.454***	0.448***	0.461***	0.230***
		(0.026)	(0.026)	(0.026)	(0.042)
Country VA		0.118***	0.102***	0.213***	0.075*
		(0.029)	(0.029)	(0.017)	(0.045)
Agriculture			-0.066*		
			(0.038)		
Oil			-0.034*		
			(0.018)		
Metal			0.027		
			(0.031)		
Interest rates			-0.209		
			(0.367)		
Year effects	n	y	n	y	y
Obs.	14817	14817	14817	14817	4950

Notes: $***p < 0.01$, $**p < 0.05$, $*p < 0.1$
See notes to Table 2. Standard errors are reported in brackets. Employment and capital stocks are expressed in log differences in a country-sector. Country VA is log differences of value added in a specific country. Agriculture, oil, metal and real interest rate are the cyclical components of the respective commodity prices and real interest rates and have been taken from Fernández et al. (2017).

Table 5: **Change in value added of important hub sectors - 1997-2007 sample**
1% change to value added growth

	Upstream	Downstream
Origin of the change	Germany: Renting of machinery and equipment and other business activities	China: Electronics and optical equipment
number of sectors affected	305	154
sum of impact across affected sectors	1.39	0.53
of which is locally:	0.69	0.22
of which is in the euro area:	0.42	0.08
of which is cross-country:	0.28	0.23

Notes: The impact of sector j reported in the columns on each other sector i is computed as $\rho^* w^*_{ij,t}$ and the overall impact as $\rho^* \sum_{j \neq i} 1(w^*_{ij,t} \geq r^*) w^*_{ij,t}$ with local (same country) and cross-country effects calculated by considering the affected sectors. * stands for "up" and "down".

2 Computational Details

For each $t = 1995, ..., 2009$

- NC - total number of countries

- NI - total number of sectors

- $n = NC \times NI$ total number of country-sectors

- Y - $(NC * NI \times 1)$ vector of country-sector real value added (*e.g.* element y_i is the real value of German car industry). Nominal gross value added deflated with value added price index.

- Z - $n \times n$ global input-output matrix. Element z_{ij} is the amount of intermediate goods produced in sector i used in sector j's production. Reading the matrix along a column yields the intermediate goods produced in all sectors used in a particular sector. A particular row provides information on the intermediate goods from a particular sector to all global value chains in the world.

- GO - $n \times n$ diagonal matrix with sectors gross output on the diagonal

- $A = ZGO^{-1}$ $n \times n$ technical coefficient matrix

- $L = (I - A)^{-1}$ $n \times n$ Leontief matrix

- v - $n \times n$ diagonal matrix with value added vector on the diagonal. Value added vector contains sectors share of direct domestic value added in total output. This is equal to one minus the intermediate input share from all countries (including domestically produced intermediates).

- $VA = v\ L\ GO$ value added contribution matrix. Reading the matrix along the column, yields the value added produced in all sectors used in a particular sector. Each row provides information on the value added from a particular sector to all global value chains in the world.

$$
\begin{aligned}
VA &= vLGO \\
&= \begin{bmatrix} v_1 & 0 & \cdots & 0 \\ 0 & v_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \\ 0 & 0 & \cdots & v_n \end{bmatrix} \begin{bmatrix} L_{11} & L_{12} & \cdots & L_{1n} \\ L_{21} & L_{22} & \cdots & L_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ L_{n1} & L_{n2} & \cdots & L_{nn} \end{bmatrix} \begin{bmatrix} go_1 & 0 & \cdots & 0 \\ 0 & go_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \\ 0 & 0 & \cdots & go_n \end{bmatrix} \\
&= \begin{bmatrix} v_1 L_{11} go_1 & 0 & \cdots & 0 \\ 0 & v_2 L_{22} go_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \\ 0 & 0 & \cdots & v_n L_{nn} go_n \end{bmatrix}
\end{aligned}
$$

- $VA\_w = VA\ GO^{-1}$ weighted (by total output) value added contribution matrix

- $VA\_outdegree = \sum_{j=1,j\neq i}^{n} VA\_w_{ij}$ (row-sums of VA_w)

- $VA\_indegree = \sum_{i=1,i\neq j}^{n} VA\_w_{ij}$ (column-sums of VA_w)

- $VA\_totdegree = VA\_outdegree + VA\_indegree$

- Adj - nxn matrix with $Adj_{ij} = 1$ if $Z_{ij} \neq 0$ and $Adj_{ij} = 0$ if $Z_{ij} = 0$. Transaction below 100,000$ have been considered as 0.

- $Distance\_up$ - $n \times n$ matrix with distances from upstream sectors. Its element d_{ij} is the distance of sector i from the upstream sector j. Distance is computed from Adj, with the Dijkstra algorithm which finds the shortest path (number of edges) between two sectors (nodes).

- $Distance\_down$ - $n \times n$ matrix with distances from downstream sectors. Its element d_{ij} is the distance of sector i from the downstream sector j. It is the transposed of $Distance\_up$.

- W^u - upstream value added weight matrix. Each element w_{ij} is obtained as $w_{ij} = VA_{i\to j} / \sum_{i=1,i\neq j}^{n} VA_{i\to j}$ (value added contribution to j from i divided by total value added contribution from all sectors i - column sums)

- W^d - downstream value added weight matrix. Each element w_{ij} is obtained as $w_{ij} = VA_{i \to j} / \sum_{j=1, j \neq i}^{n} VA_{i \to j}$ (value added contribution from i to j divided by total value added contribution from i to all sectors j - row sums)