Global Trade Spillovers: Insights from a Network Model

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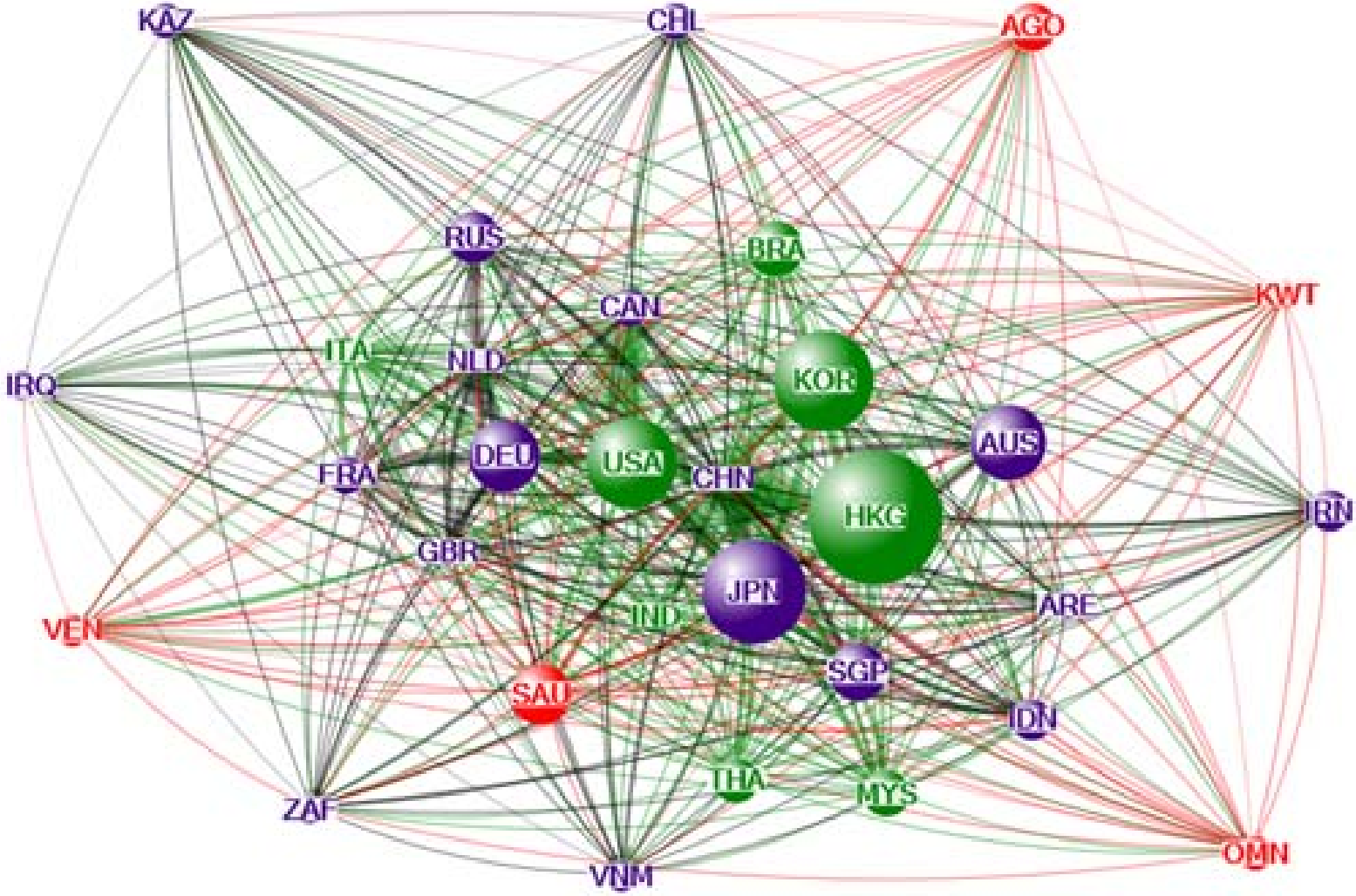
Trade Network



Conclusions

- **Model**
  - import shock in any country
  - quantification of impact
- **Three effects**
  - spillovers
  - spillins
  - spillback
- **Spillover strength**
  - by country/country group
  - by commodity
- **Spillover pass-through**
  - amplifies
  - absorbers
  - blockers

Motivation

MD's Global Policy Agenda (April 17, 2016)

"Spillovers through the trade-channel risk exacerbating the global weakness in activity"

G-RAM (April, 2016):

- Slowdown in emerging economies
- Deleveraging and re-risking
- Migrant flows

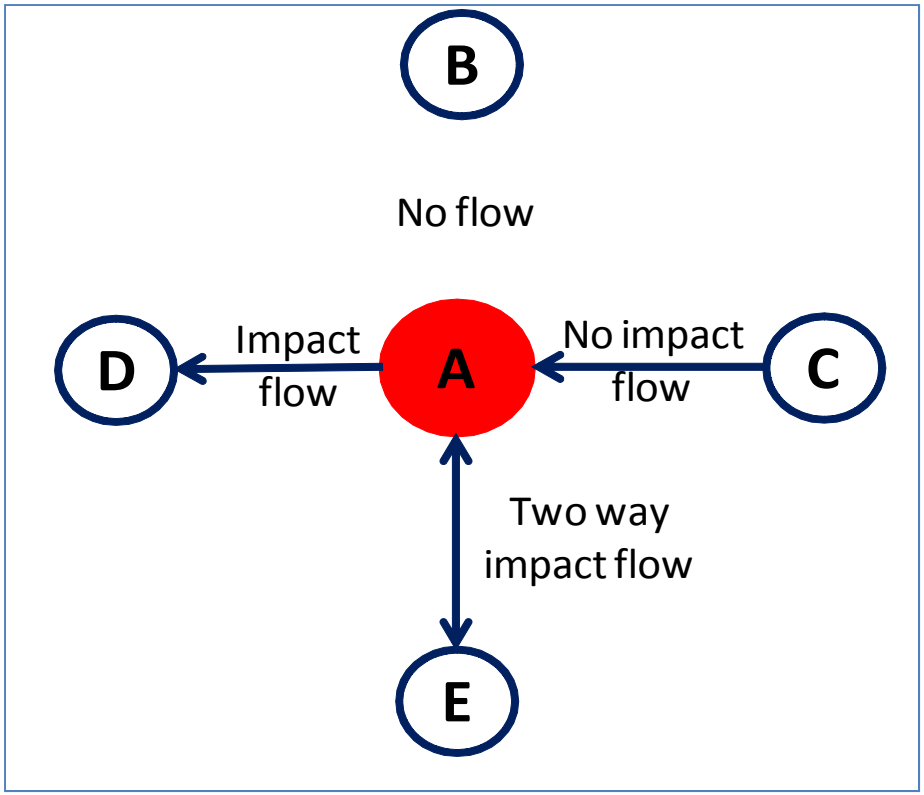
Spillovers from

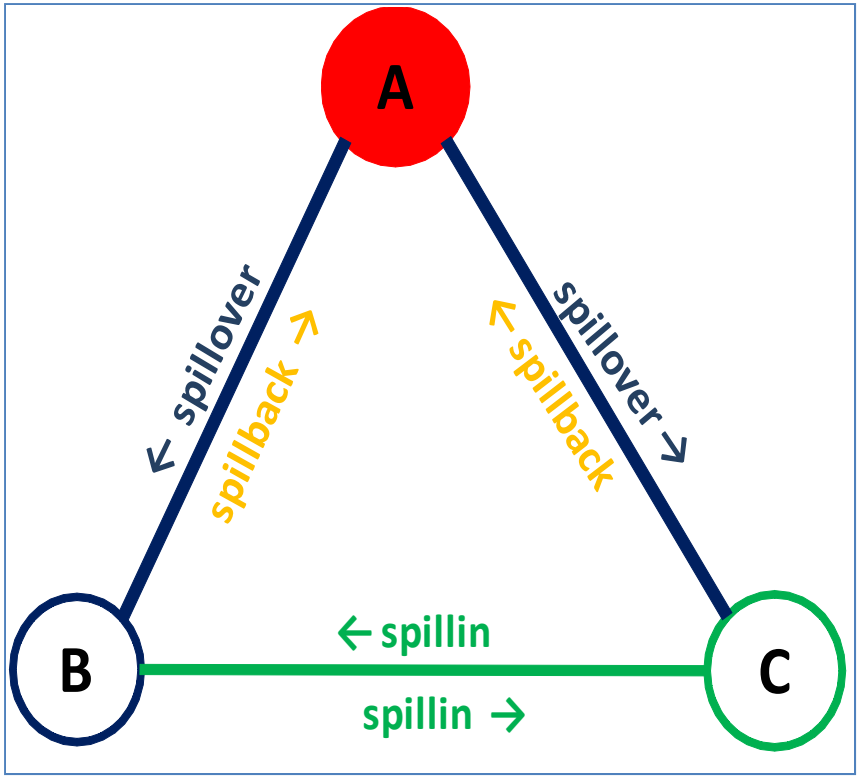
- Monetary policy normalization
- China's imports slowdown
- Low oil/commodity prices
- Geopolitical shocks

Application

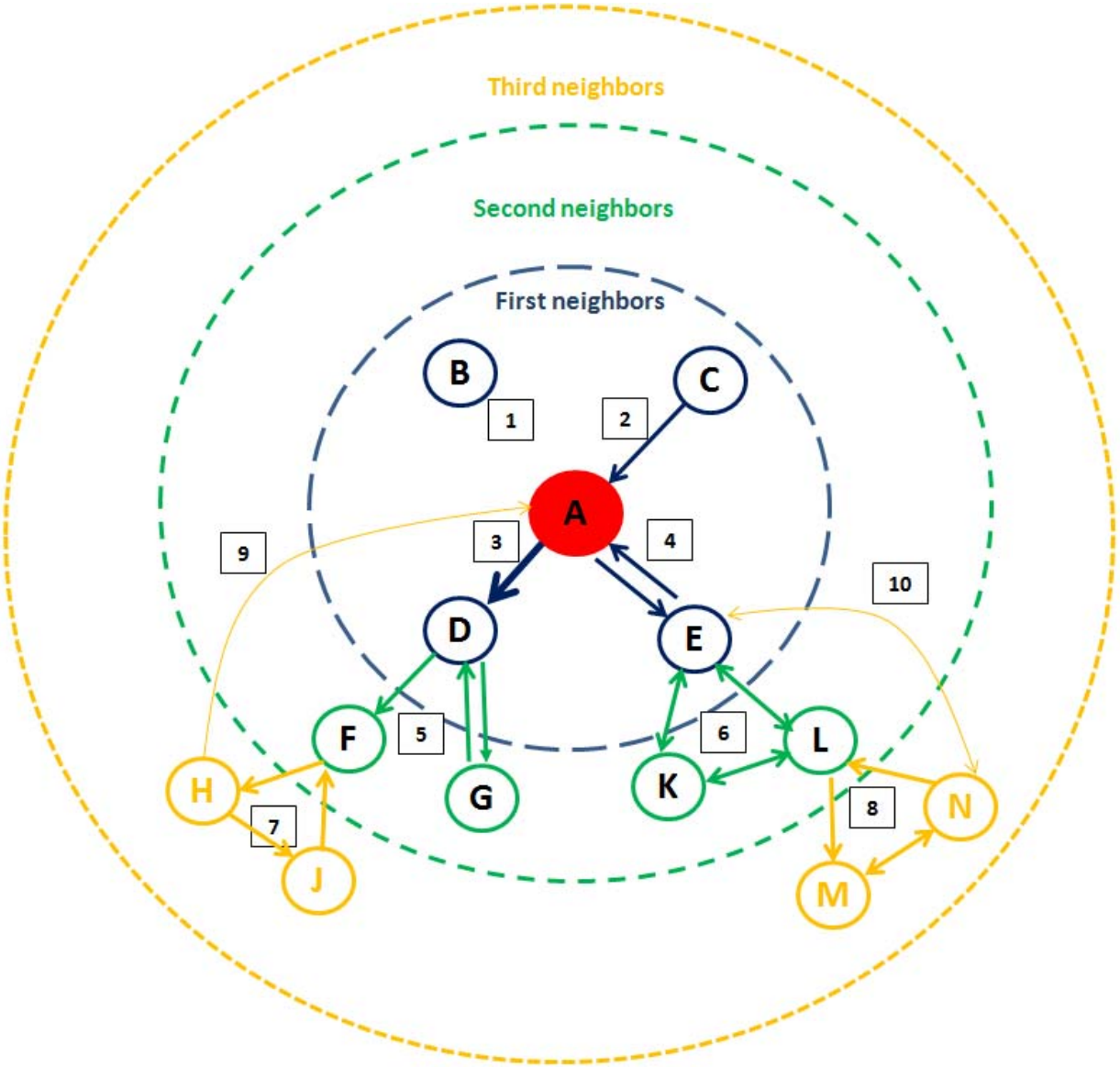
- **Initial shock**: 10 percent below the 2016-17 baseline - loss of 1.2 percent GDP of export revenue in 2016 –2.0 (2017) – 0.2 (2020)
- **Three effects**: spillovers (0.4) –spillins (0.4-1.0)—spillback (0.5-1.1)
- **Spillover strength**: Asia and Pacific; Middle East and Central Asia; sub-Saharan Africa; Europe; Western Hemisphere, including the United States.
- **Spillover pass-through**: amplifies (48), absorbers (96), blockers (24).

Elementary Links in a Trade Network

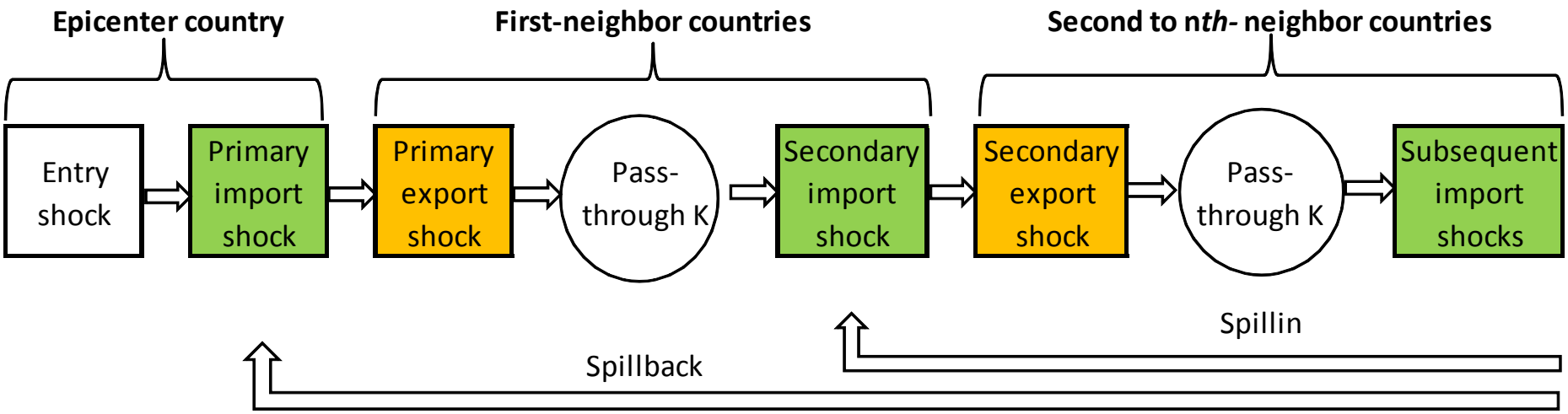




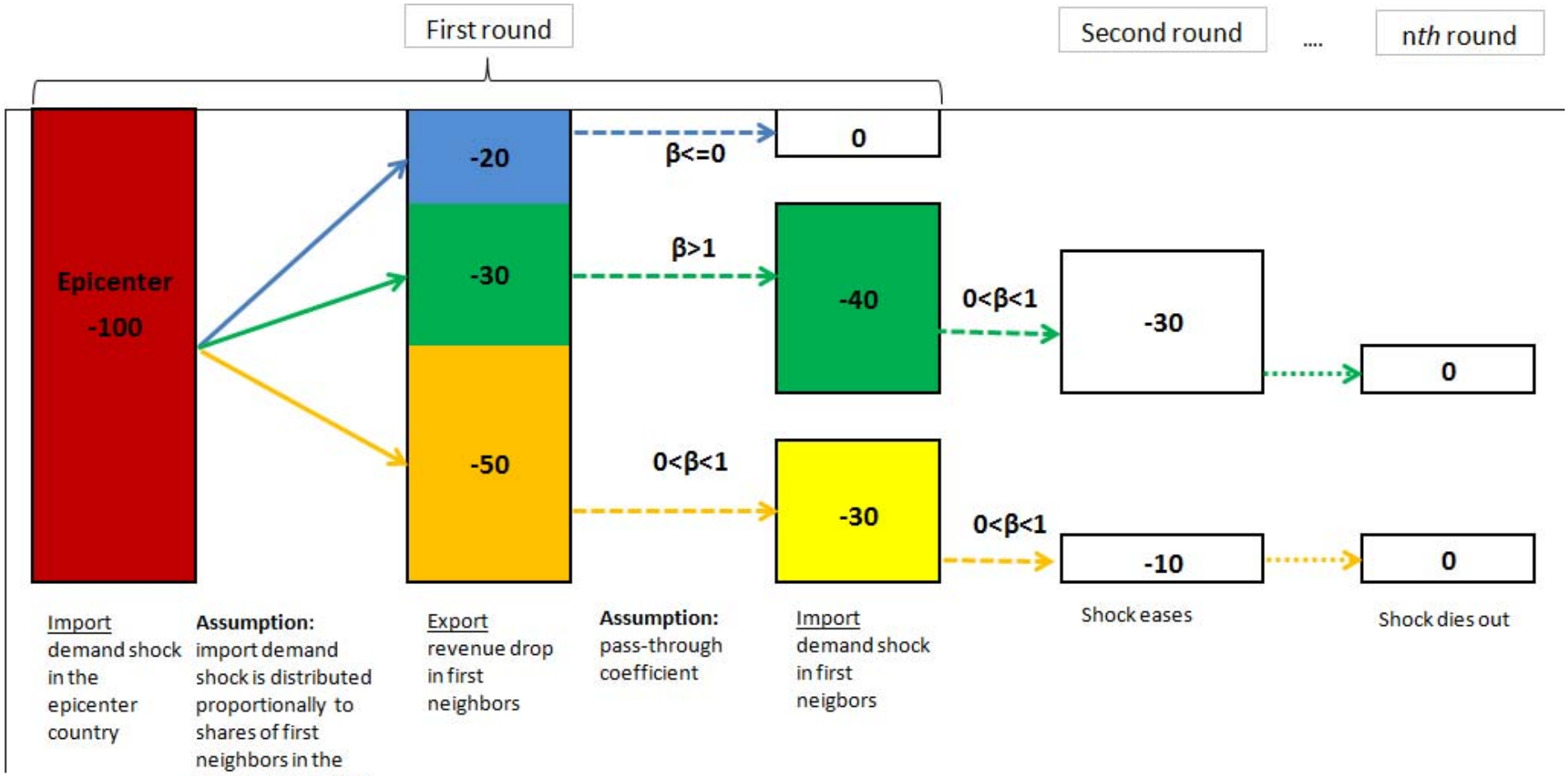
Spillovers on a Network



Spillover Cascade



Numerical Example



Spillover Model

- The initial import shock $(\Delta M_1, \dots, \Delta M_N)$ is distributed among exporters

$$(\Delta M_1, \dots, \Delta M_N) \rightarrow (\Delta X_1, \dots, \Delta X_N)$$

- Export shocks create secondary import shocks $(\Delta \widetilde{M}_1, \dots, \Delta \widetilde{M}_N)$, i.e.,

$$(\Delta X_1, \dots, \Delta X_N) \rightarrow (\Delta \widetilde{M}_1, \dots, \Delta \widetilde{M}_N)$$

- Export reduction is proportional to corresponding shares of export from i to j

$$\Delta w_{ij} = \frac{w_{ij}}{\sum_{k=1}^{N} w_{kj}} \Delta M_j \equiv \frac{w_{ij}}{M_j} \Delta M_j$$

- This leads to the transformation $W \rightarrow \widetilde{W}$ of the import-export matrix by which

$$W = \begin{pmatrix} w_{11} & \cdots & w_{1j} & \cdots & w_{1N} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ w_{N1} & \cdots & w_{Nj} & \cdots & w_{NN} \end{pmatrix}$$

turns into

$$\widetilde{W} = W - \Delta W$$

- Secondary import shocks are generated as follows.

$$ln\left(\frac{M_i - \Delta \widetilde{M}_i}{M_i}\right) = \beta_i ln\left(\frac{X_i - \Delta X_i}{X_i}\right)$$

$$\Delta \widetilde{M}_i = M_i \left(1 - \left(1 - \frac{\Delta X_i}{X_i}\right)^{\beta_i}\right)$$

Bilateral Trade Adjacency Matrices 1995-2020 (import data)

	AFG	ALB	DZA	AGO	ATG	ARG	ARM	AUS	AUT	BEL	BRA	BRN	BGR	CAN	CHL	CHN
AFG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALB	0	0	0	0	0	0	0	1	20	2	2	0	21	6	0	220
DZA	0	7	0	1	0	0	0	78	232	1,864	3,075	0	2	3,268	0	1,945
AGO	0	0	0	0	0	0	0	31	0	492	727	0	0	1,509	0	29,044
ATG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARG	1	1	1,643	208	1	0	11	776	60	275	16,463	0	11	1,800	3,576	5,542
ARM	1	0	0	0	0	0	0	0	1	131	1	0	152	87	0	69
AUS	6	3	4	8	2	174	5	0	86	1,175	694	48	91	1,339	343	91,544
AUT	8	67	233	13	0	152	146	806	0	2,360	1,019	0	863	833	214	3,521
BEL	49	22	1,359	431	57	1,204	92	2,121	4,567	0	4,007	9	660	2,883	575	7,369
BRA	12	54	1,200	1,271	6	19,615	36	451	139	3,594	0	2	219	2,702	4,484	46,026
BRN	0	0	0	0	0	0	0	844	0	0	0	0	0	6	0	79
BGR	5	82	108	1	1	6	22	27	532	860	18	0	0	99	6	783
CAN	39	36	362	80	16	276	14	1,620	410	2,402	2,402	23	72	0	785	19,912
CHL	0	0	3	7	1	1,045	1	801	46	1,388	4,427	0	488	1,425	0	19,090
CHN	329	324	6,015	3,965	246	8,750	120	37,556	2,038	15,559	36,190	1,703	1,116	29,198	13,110	0

Pass-Through Coefficients

Import revenue elasticity

$$ln\left(\frac{M_{i,t+1}}{M_{i,t}}\right) = \alpha_i + \beta_i ln\left(\frac{X_{i,t+1}}{X_{i,t}}\right) + \gamma_i ln\left(\frac{R_{i,t+1}}{R_{i,t}}\right) + \varepsilon_i$$

- Spillover amplifiers if $\beta > 1$
- Spillover absorbing if $0 < \beta \leq 1$
- Spillover blocking if $\beta \leq 0$

M – spending on imports

X – revenue generated by exports

R – revenue generated domestically (Y-M)

Assumptions

- A drop of a country's nominal imports by X percent below the baseline
- The shock is quarterly and affects the country's imports in the same amount
- No policy flexibility for offsetting measures in the short run
- Unchanged pass-through coefficients and trade structure
- The shock is distributed proportionately partners
- No initial and subsequent output gaps

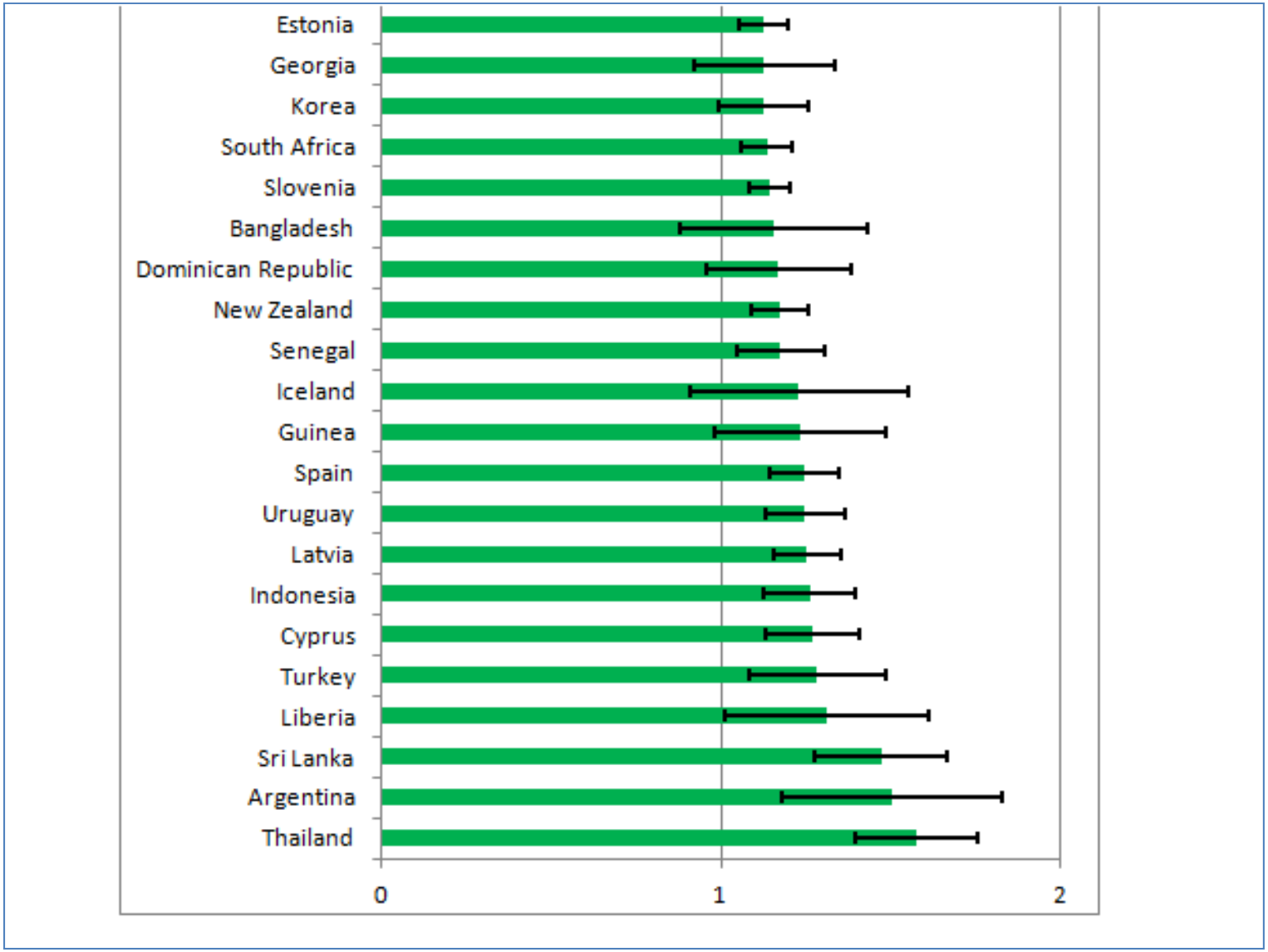
Limitations

- The model is in nominal terms, no price and volume effects
- Only the trade channel, no financial channels
- Partial equilibrium, no general equilibrium effects
- Aggregated trade flows, no value-added and supply chains analysis
- Data: bilateral exports may not equal imports

Shock Pass-through Coefficients

	Amplifiers	Absorbers	Blockers
Number of countries	48	96	24
High probability countries	22	66	24
IMF WEO classification			
Advanced economies	21	14	0
Fuel exporters	1	15	10
World Bank classification			
High-income	23	28	5
Upper-middle-income	8	29	6
Low-middle-income	13	25	5
Low-income	4	14	8
Pass-through coefficients			
Average	1.14	0.71	0
s.e	0.14	0.14	0
Max	1.57	0.99	0
s.e.	0.45	0.44	0
Min	1.00	0.20	0
s.e.	0.04	0.03	0

Amplifiers


Estonia
Georgia
Korea
South Africa
Slovenia
Bangladesh
Dominican Republic
New Zealand
Senegal
Iceland
Guinea
Spain
Uruguay
Latvia
Indonesia
Cyprus
Turkey
Liberia
Sri Lanka
Argentina
Thailand
0
1
2

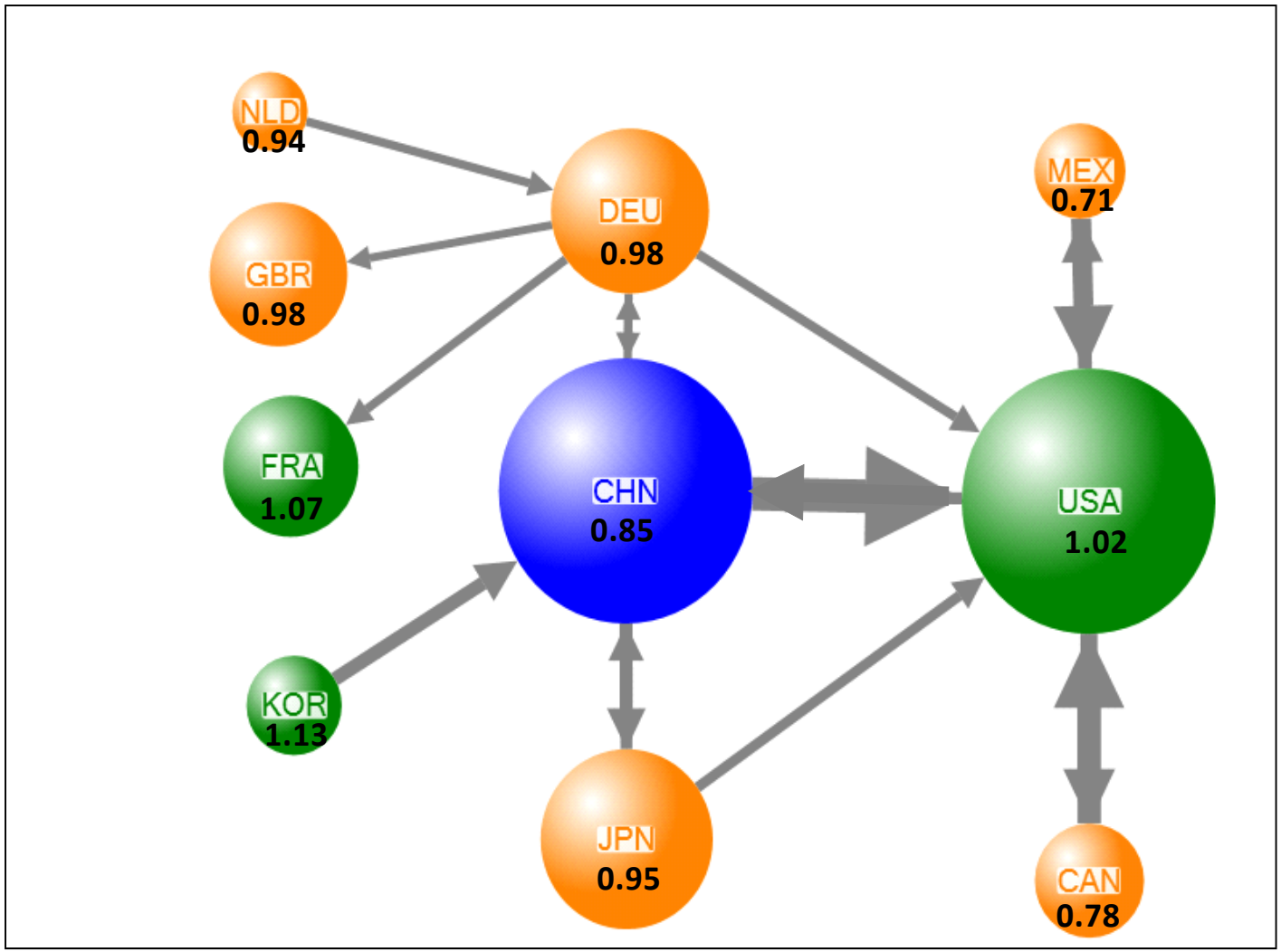
Absorbers

	0<b<1	s.e.	0.95% conf.		HICs	UMICs	LMICs	LICs	Fuel exporters	Advanced economies
Italy	0.99	0.09	0.82	1.16	x					x
Vietnam	0.99	0.16	0.68	1.30			x			
United Kingdom	0.98	0.06	0.87	1.09	x					x
Finland	0.98	0.06	0.86	1.10	x					x
Germany	0.98	0.06	0.85	1.10	x					x
Poland	0.97	0.13	0.71	1.24	x					
Ukraine	0.97	0.06	0.85	1.09			x			
Tunisia	0.97	0.06	0.85	1.09		x				
Czech Republic	0.96	0.06	0.84	1.08	x					x
Sweden	0.96	0.04	0.89	1.03	x					x
Uzbekistan	0.96	0.17	0.62	1.30			x			
Japan	0.95	0.12	0.72	1.17	x					x
Slovak Republic	0.95	0.10	0.75	1.14	x					x
Netherlands	0.94	0.03	0.88	1.00	x					x
Bulgaria	0.94	0.11	0.73	1.15		x				
Portugal	0.93	0.10	0.74	1.12	x					x
Russia	0.93	0.14	0.66	1.19	x				x	
Barbados	0.92	0.14	0.64	1.19	x					
Costa Rica	0.91	0.18	0.55	1.26		x				
Croatia	0.91	0.20	0.52	1.29	x					
Djibouti	0.90	0.44	0.04	1.77			x			
Greece	0.90	0.13	0.64	1.16	x					x

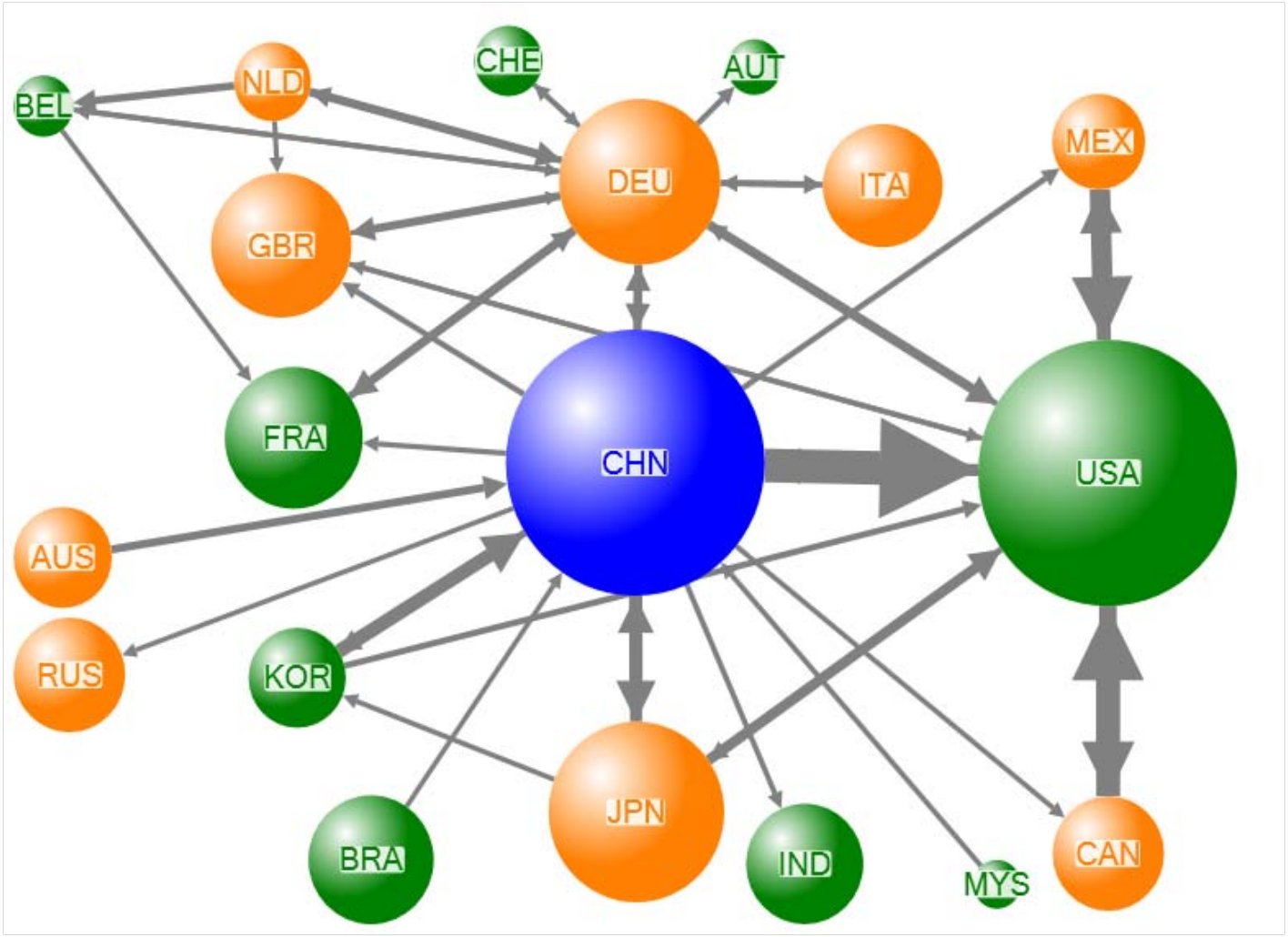
Blockers

	b=<0	HICs	UMICs	LMICs	LICs	Advanced economies	Fuel exporters
Algeria	0.00		x				x
Azerbaijan	0.00		x				x
Central African Republic	0.00				x		
Chad	0.00				x		x
Republic of Congo	0.00			x			
Equatorial Guinea	0.00	x					x
Ethiopia	0.00				x		
Gabon	0.00		x				x
Iraq	0.00		x				x
Malawi	0.00				x		
Mali	0.00				x		
Mauritania	0.00			x			
Oman	0.00	x					x
Qatar	0.00	x					x
Rwanda	0.00				x		
Samoa	0.00			x			
São Tomé and Príncipe	0.00			x			
Sierra Leone	0.00				x		
St. Kitts and Nevis	0.00	x					
St. Vincent and the Grenadines	0.00		x				
Sudan	0.00			x			
Tanzania	0.00				x		
Turkmenistan	0.00		x				x
Venezuela	0.00	x					x

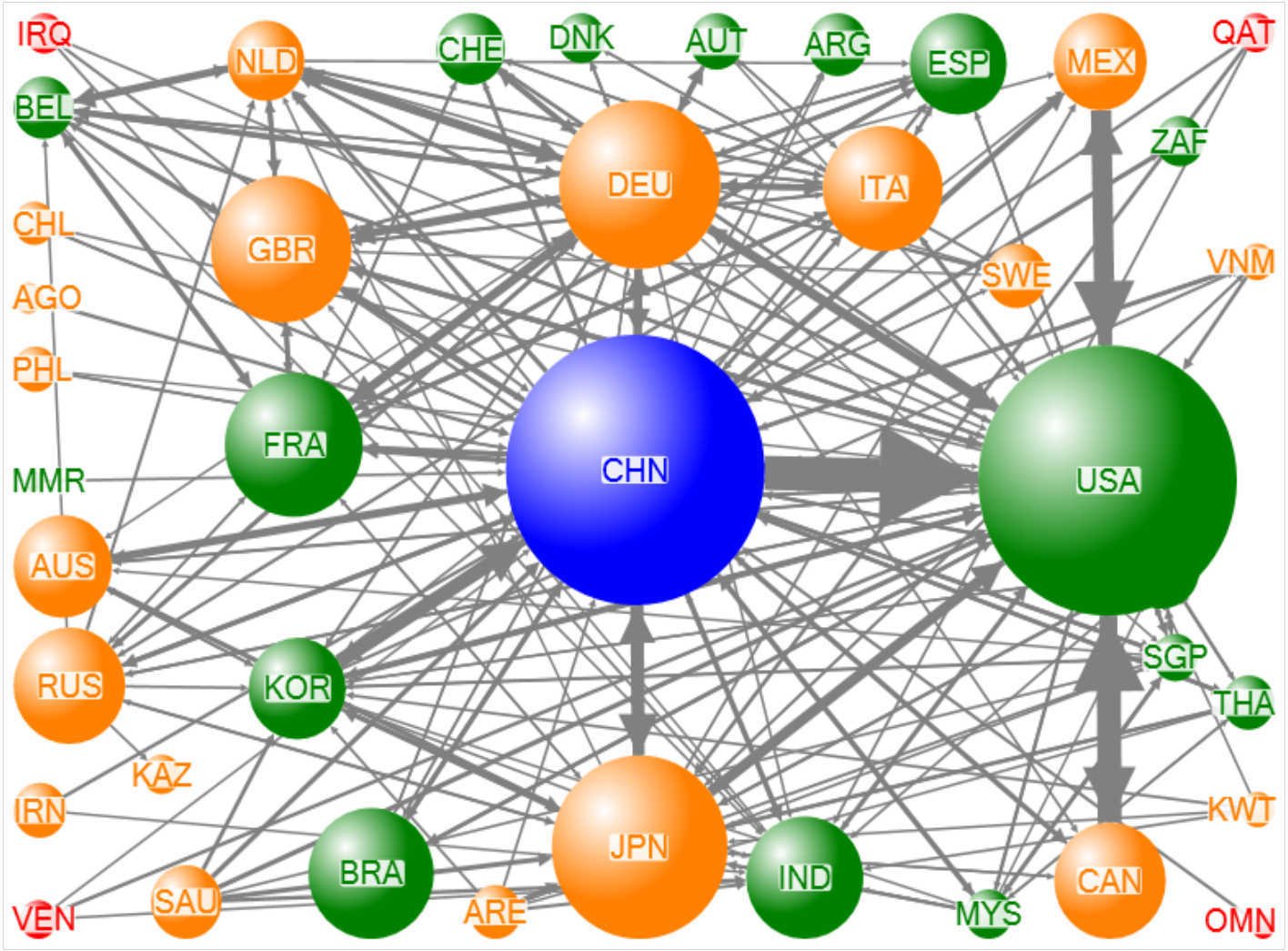
China's Import Network, 2014
US$ 100 billion cut-off



China's Import Network, 2014
US$ 50 billion cut-off

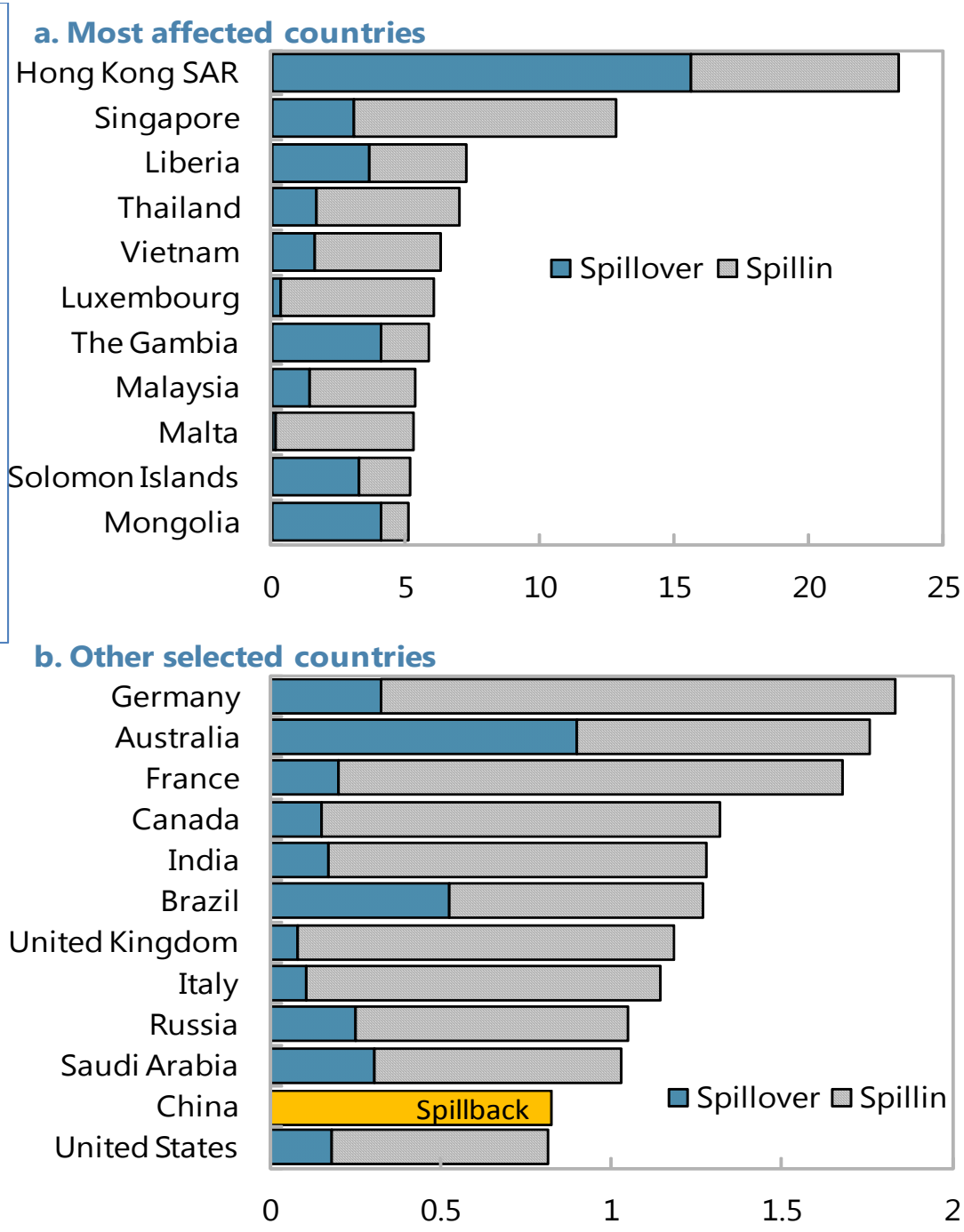


China's Import Network, 2014
US$ 10 billion cut-off



Static 2017 Spillovers and Spillins

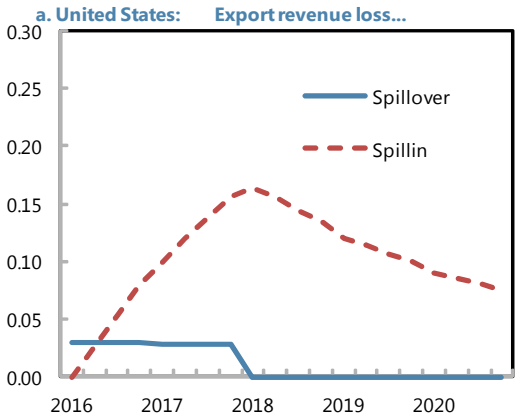
(Percent of GDP)

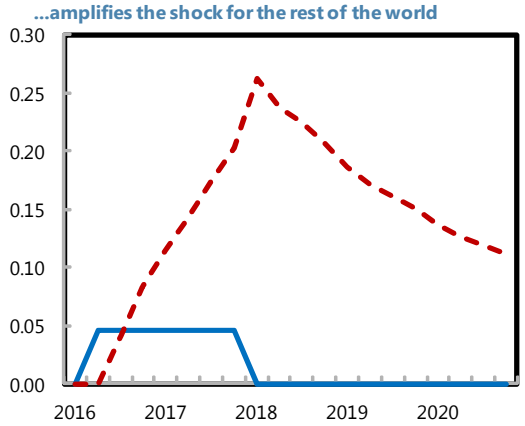


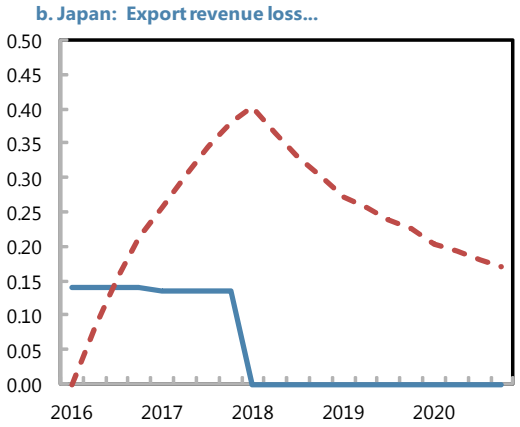
Source: IMF staff estimates.

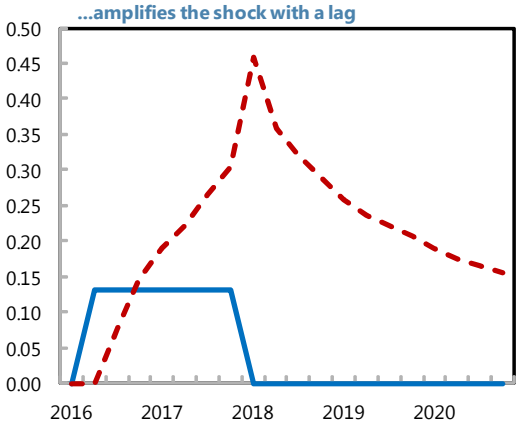
Dynamic 2016-20 Spillovers and Spillins

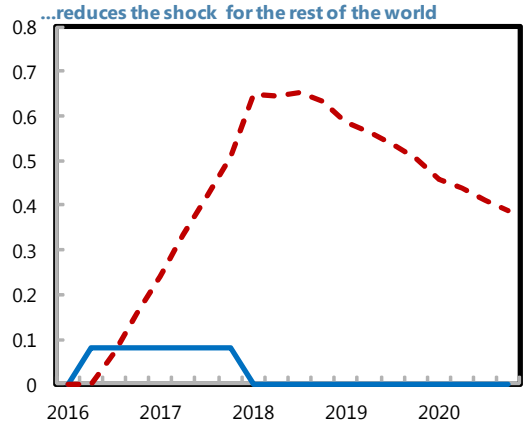
(Percent of GDP)







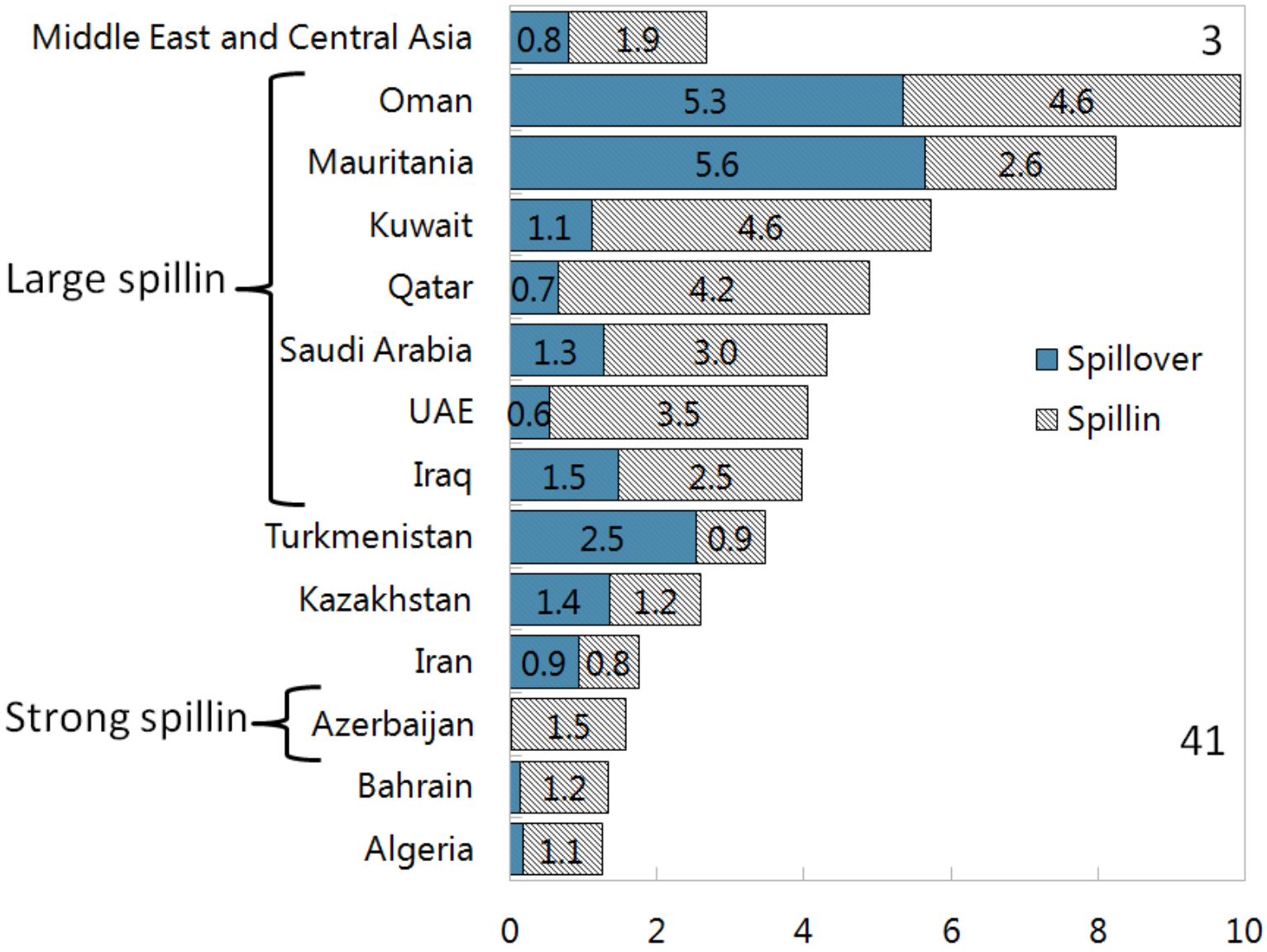




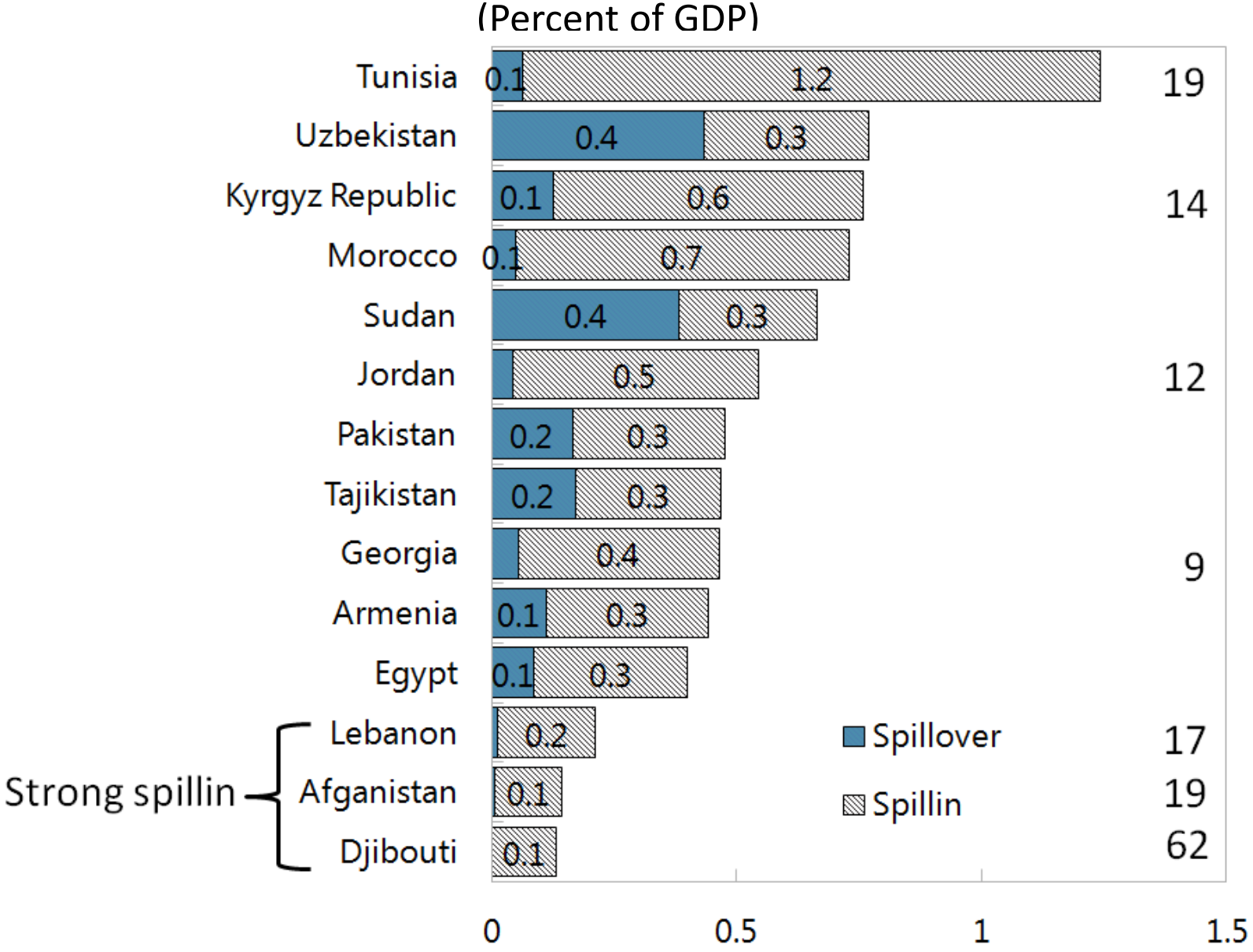
Source: IMF staff estimates.

Maximum Static Impact, 2017

(Percent of GDP)

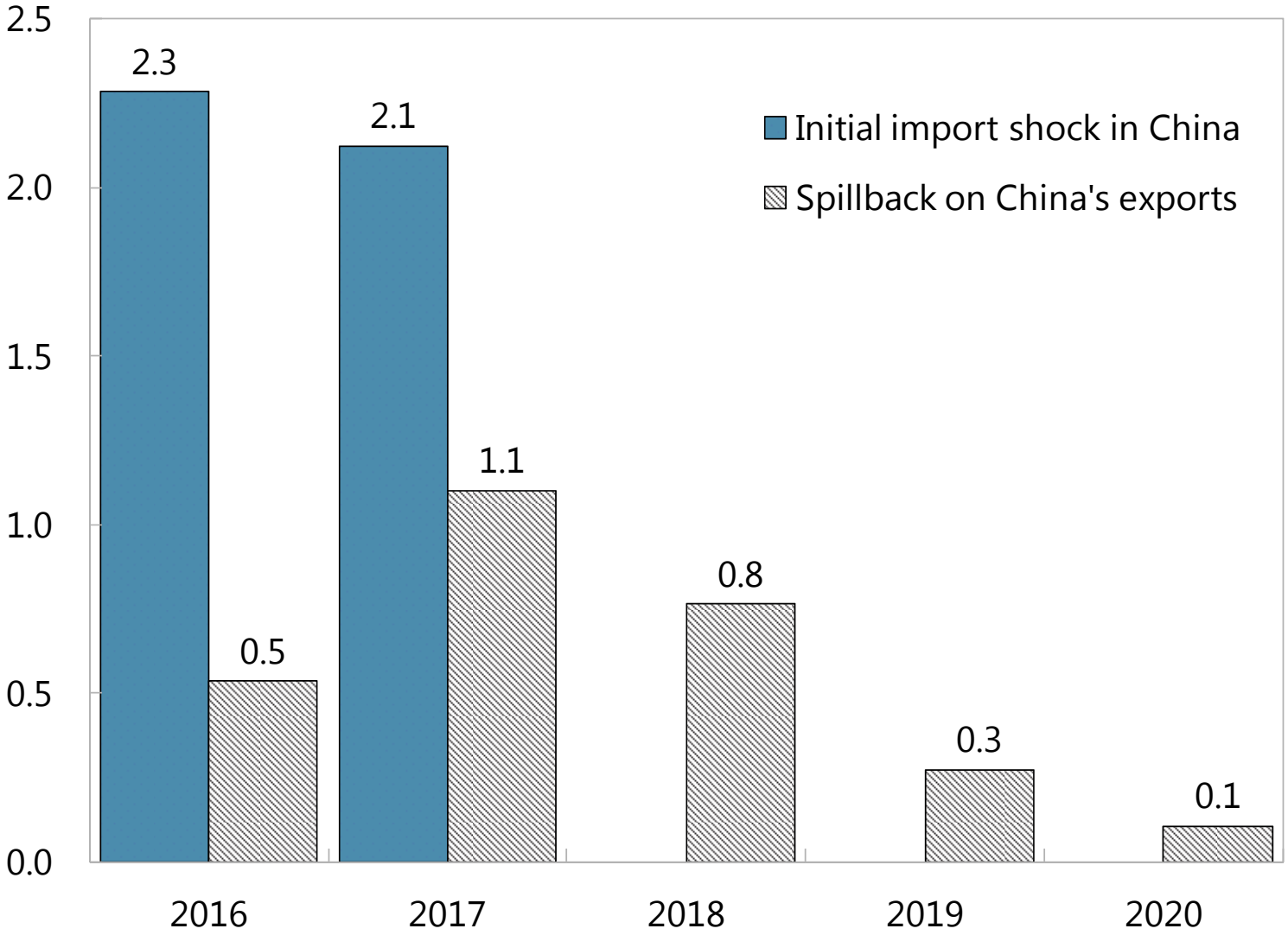


Maximum Static Impact, 2017



Spillback

(Percent of GDP)



Further Research

- Model price and volume effects separately
- Re-estimate pass through coefficients
- Model spillovers at commodity level
- Identify pass-through frictions
- Actions to mitigate negative and amplify positive spillovers