



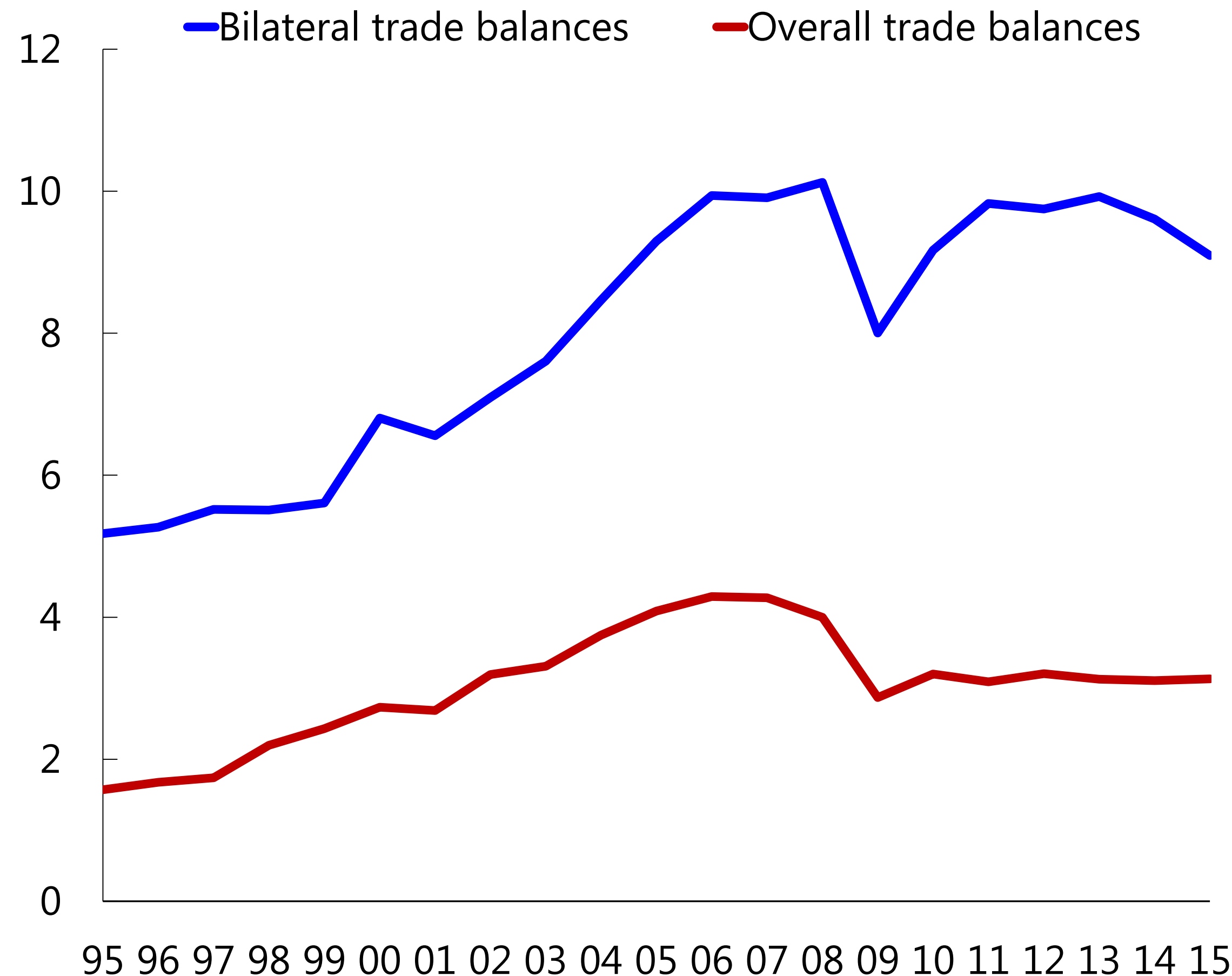
DRIVERS OF BILATERAL TRADE AND SPILLOVERS FROM TARIFFS

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Motivation and Research Questions

Overall and bilateral trade balances

(Percent of global GDP; sum of absolute values)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.

The chapter's questions:

- What drives bilateral trade balances? What are the roles of macroeconomic factors, trade costs and the international division of labor?
- What is the link between aggregate and bilateral trade balances?
- What are the effects of bilateral tariffs on the countries involved and their spillovers on others?

Preview of the Results

- **Overall balances move bilateral ones, but not vice-versa.** A change in bilateral balances tends to be offset by balances with other trading partners.
- **The evolution of bilateral trade balances has largely been driven by macroeconomic factors.** Relative aggregate demand and supply are themselves driven by factors such as demographics, institutions, credit cycles and macroeconomic policies (e.g., fiscal, exchange rate and domestic supply-side policies).
- **Changes in bilateral tariffs played a smaller role in the evolution of bilateral trade balances,** partly reflecting the reciprocal reduction of tariffs.
- **But tariffs themselves can create significant economic costs.** Bilateral tariffs hurt output, employment, and productivity in the economies directly affected as well as countries and sectors up and down the value chains. While some benefit from trade diversion, tariffs generally leave the global economy worse off.

Preview of Policy Conclusions

- **Discussions of external balances rightly focus on macroeconomic determinants of trade- and current account balances.** Unless macroeconomic conditions change, efforts to target a subset of bilateral trade balances will likely result in offsetting changes in trade balances with other partners through trade diversion, leaving the aggregate trade balance little changed.
- **Reducing tariffs and other non-tariff barriers would benefit trade and improve macroeconomic outcomes.** Higher bilateral tariffs on the other hand can come at a significant economic cost not only for the countries involved, but also for countries up and down the value chain.

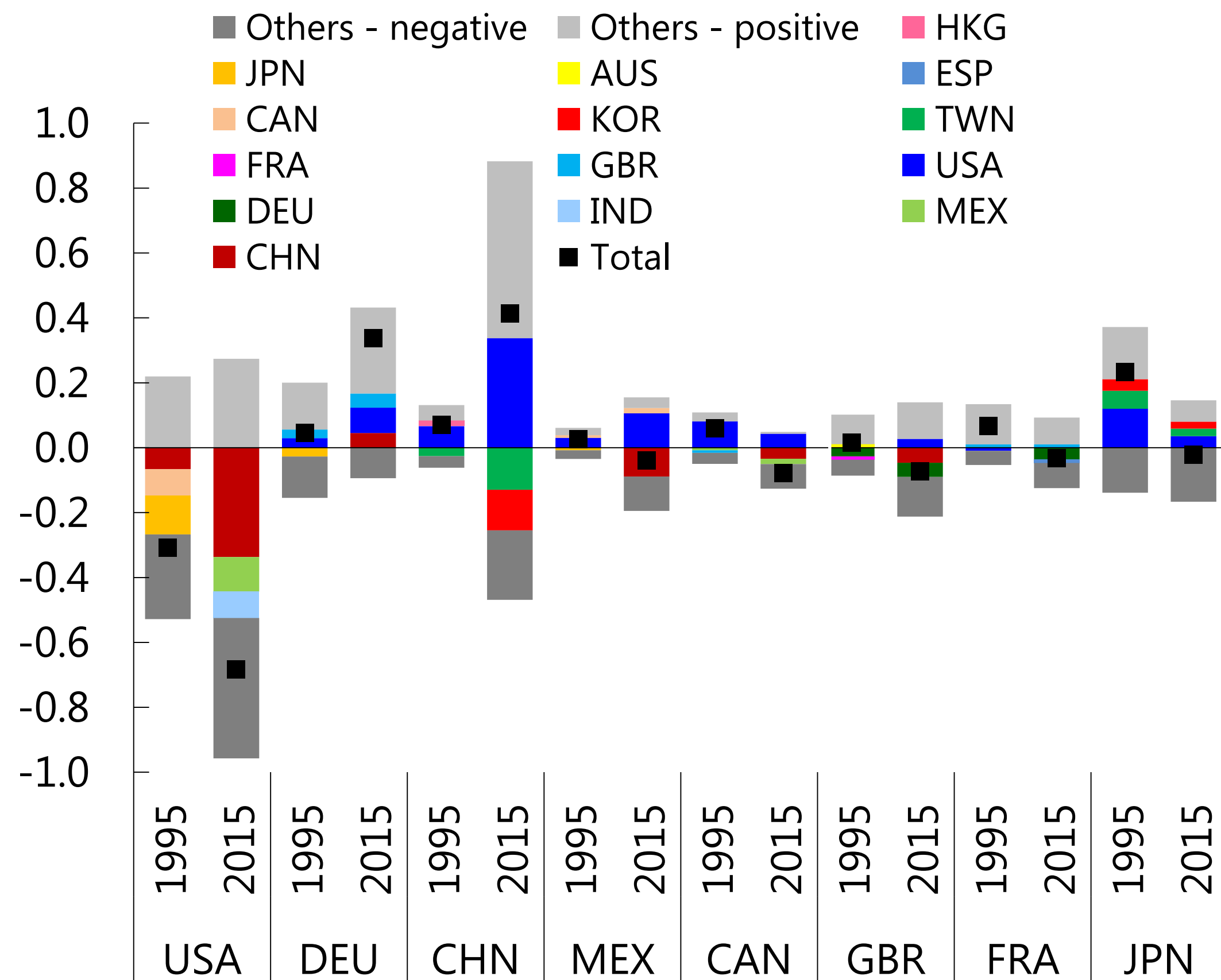
Roadmap

1. **Stylized facts:** Bilateral vs. overall trade balances, trade costs, patterns of specialization & global value chains (GVCs)
2. **Drivers of bilateral trade balances:** Gravity model to explain exports and changes in the trade balances
3. **More detailed look at macroeconomic factors** through the EBA framework to see how they are influenced by fundamentals and policies;
4. **Effect of tariffs on economic outcomes**, e.g., on real value added, employment and productivity, taking into account GVCs and trade diversion

Stylized facts

Bilateral and Aggregate Trade Balances

Bilateral trade balances by major partners
(Percent of global GDP)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.

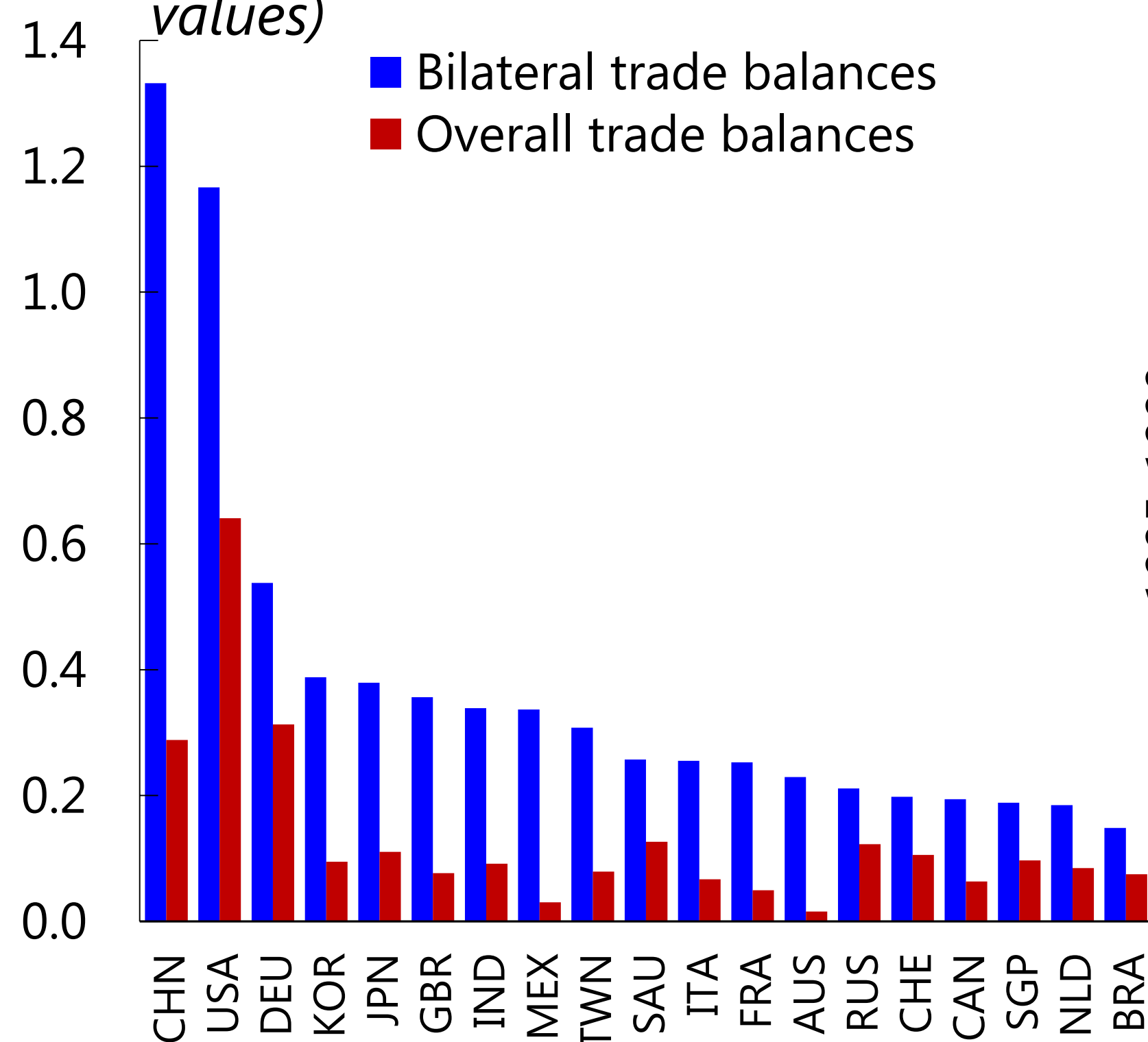
Note: Top three partners shown per year. Data labels in the figure use International Organization for Standardization (ISO) country codes.

- **Aggregate = sum(bilateral)**
- **Go in same direction for some:** large overall balances often accompanied by one-sided bilateral balances
- **But in general + and – bilateral balances:** Sometimes large and offsetting bilateral imbalances with roughly balanced aggregate trade

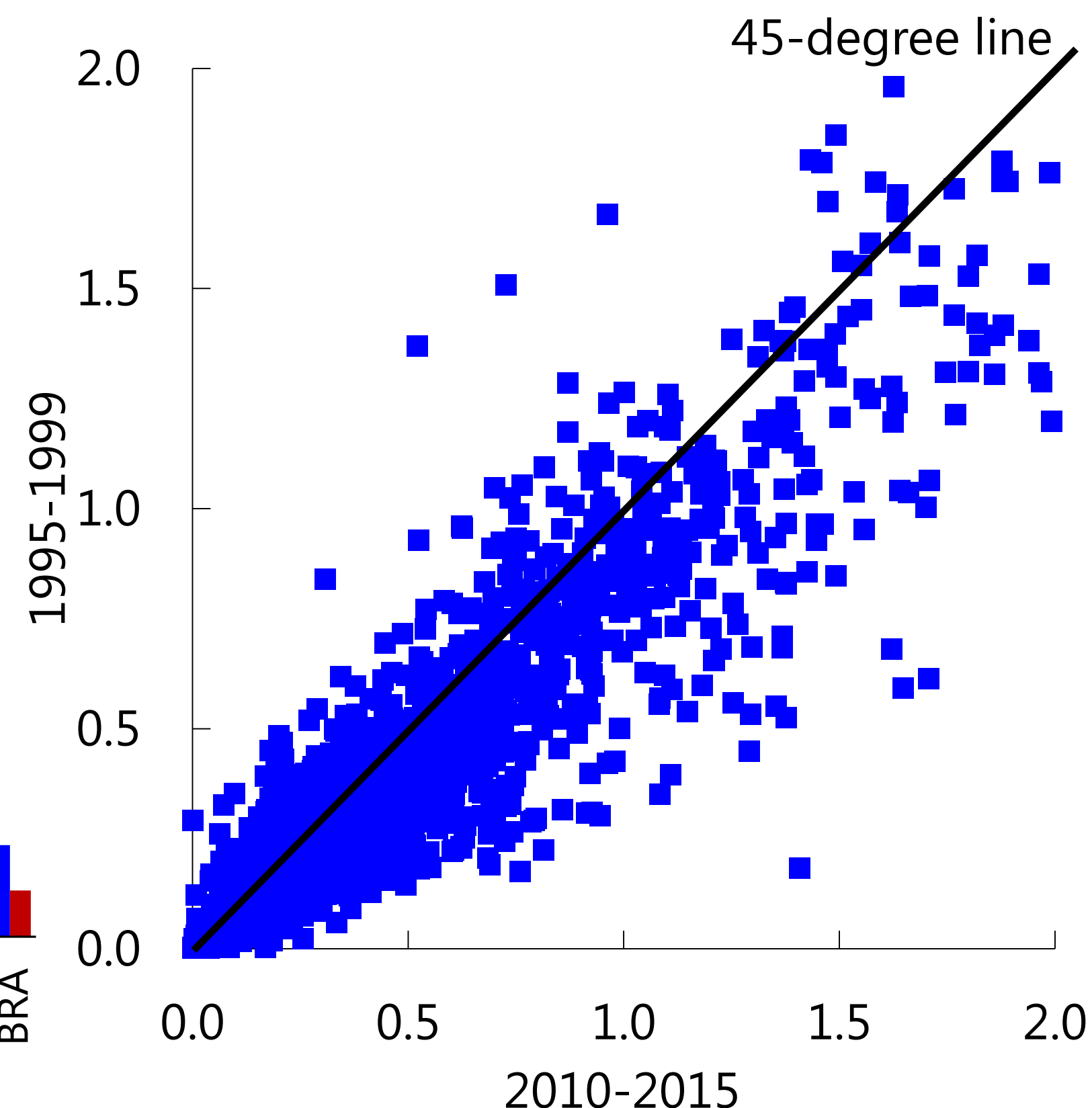
Bilateral Balances, Integration and Trade Costs

**Trade balances: average level
2013-2015**

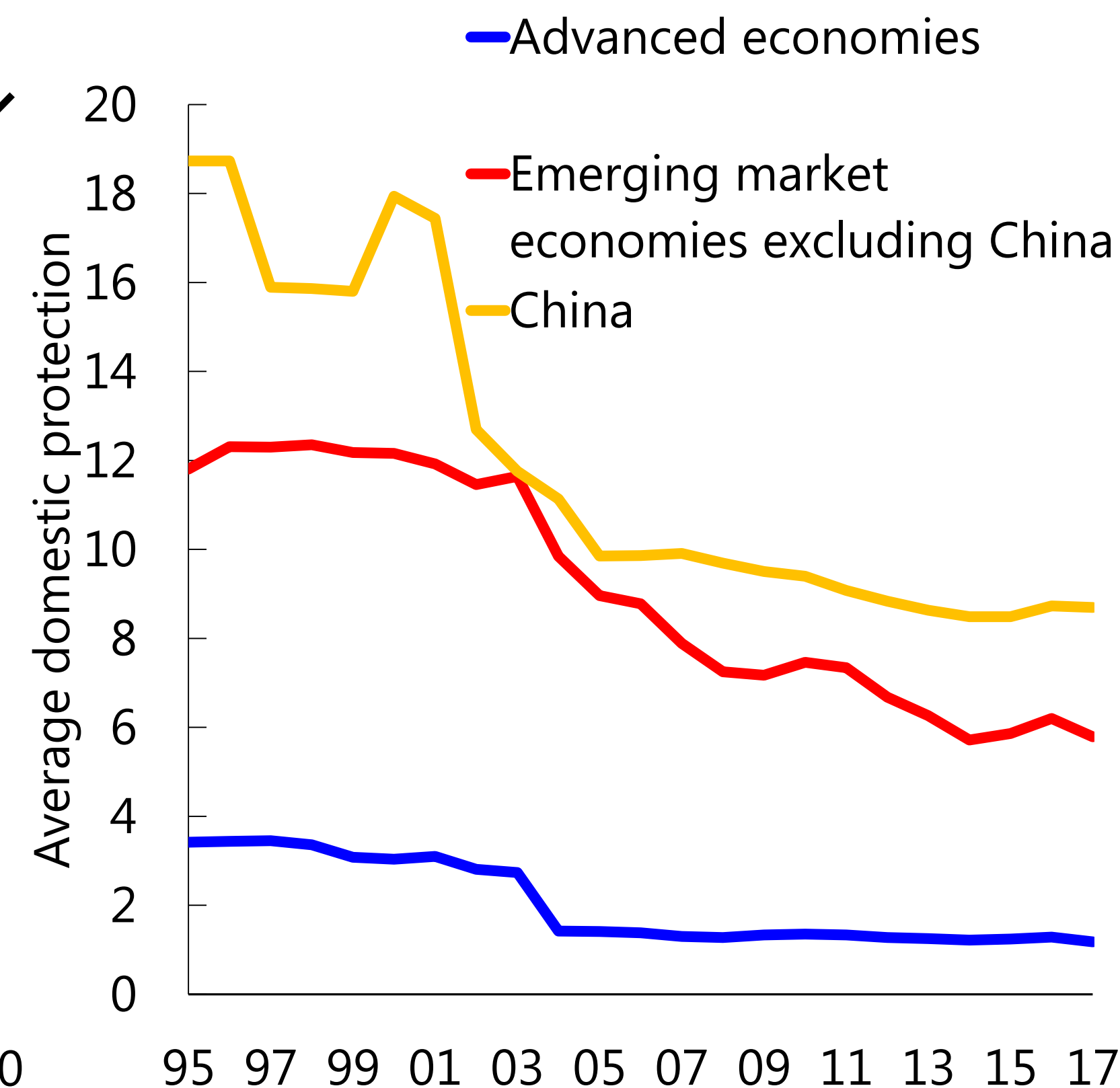
(Percent of global GDP; sum of absolute values)



Bilateral trade intensities 1/



**Average tariff by country groups 2/
(Percent)**



Sources: *World Integrated Trade Solution (WITS)*; Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes.

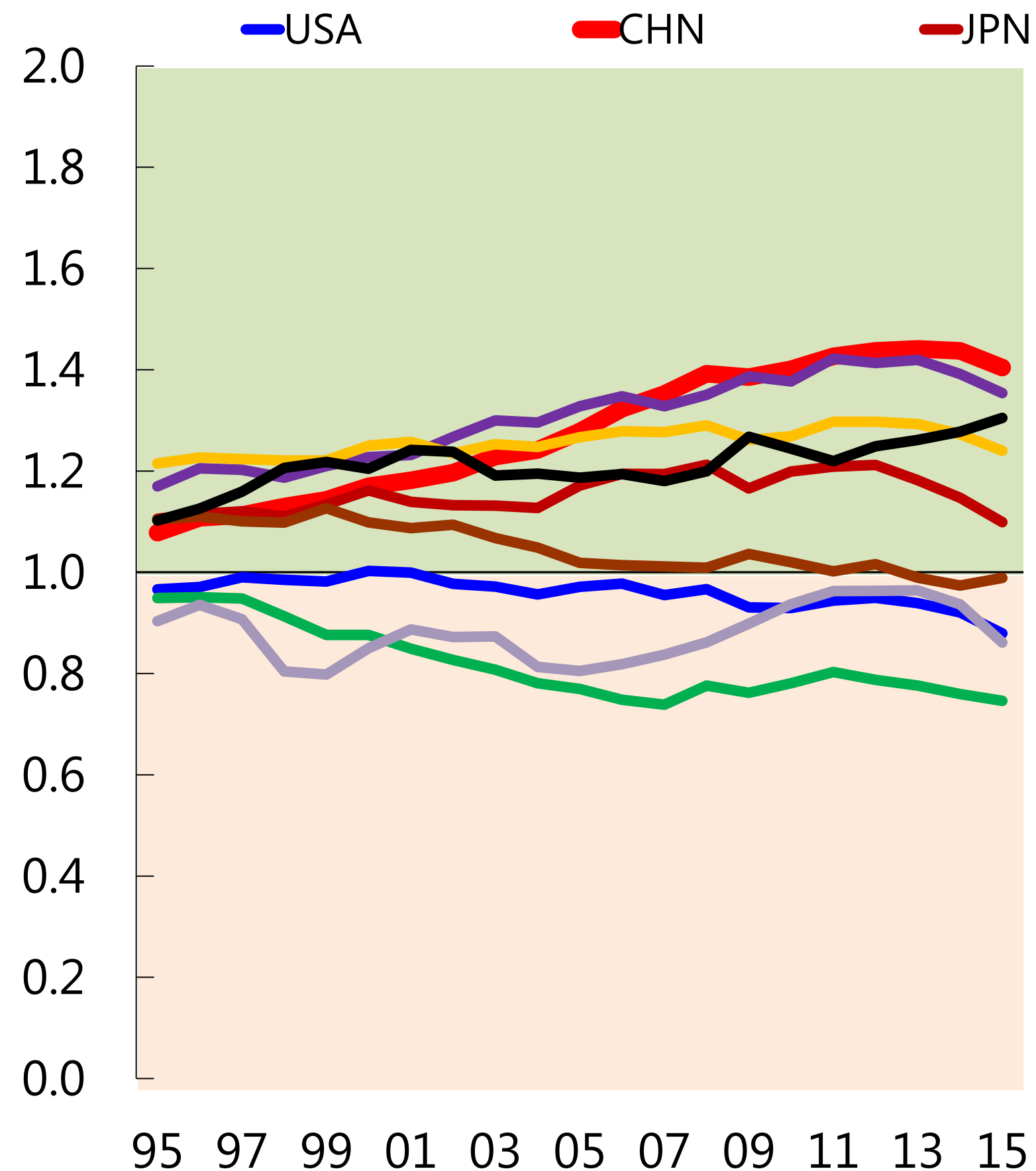
1/ Each dot represents a country pair. For a given pair of countries, the estimated trade intensity provides the impact on exports of the pair-specific bilateral and multilateral trading costs. To improve readability, pairs with intensity greater than 2 have been excluded.

2/ Averages are aggregated from the country-sector level, using constant (2000) value-added shares as weights.

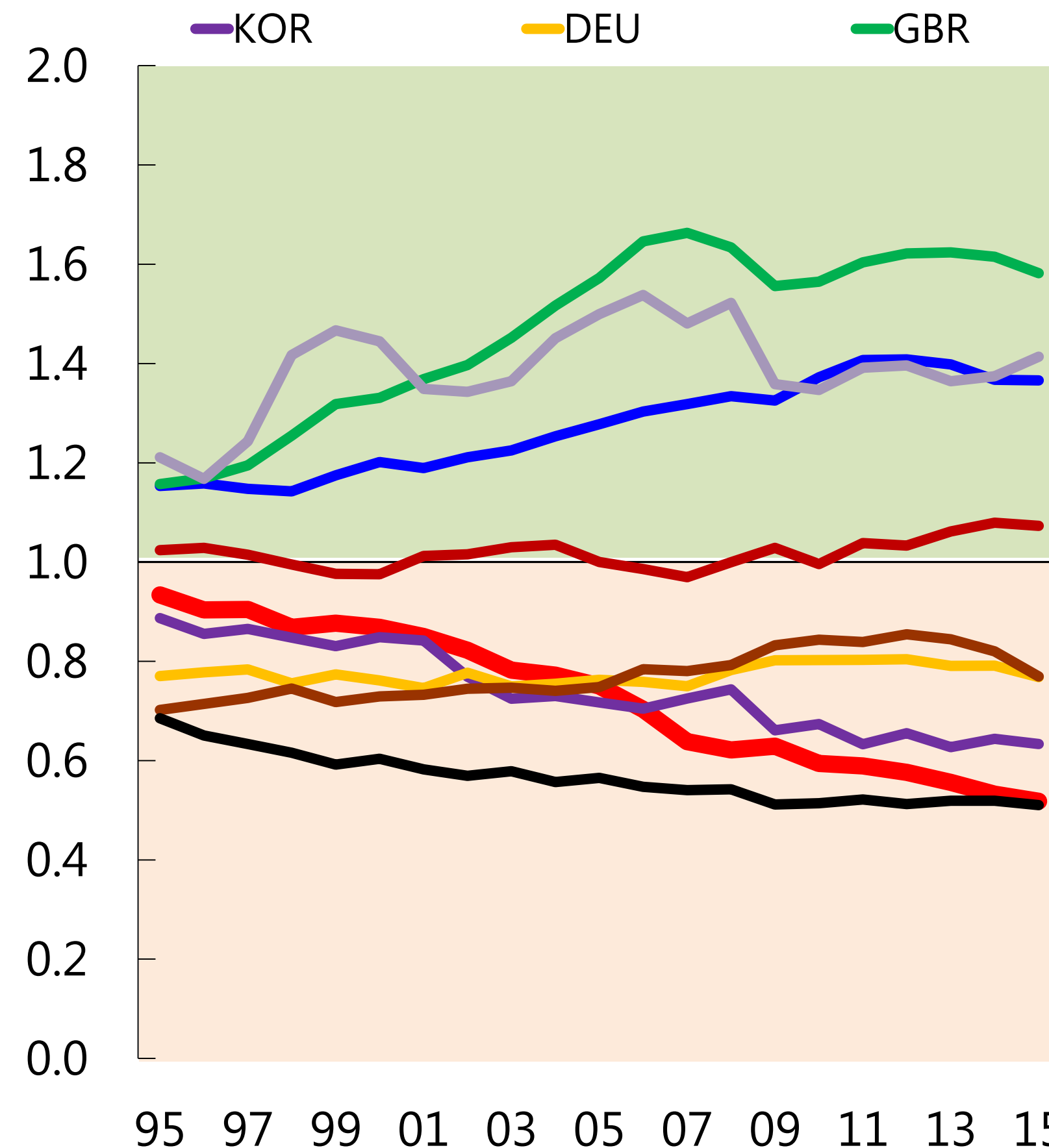
Specialization According to Comparative Advantage

Revealed Comparative Advantage (Gross exports)

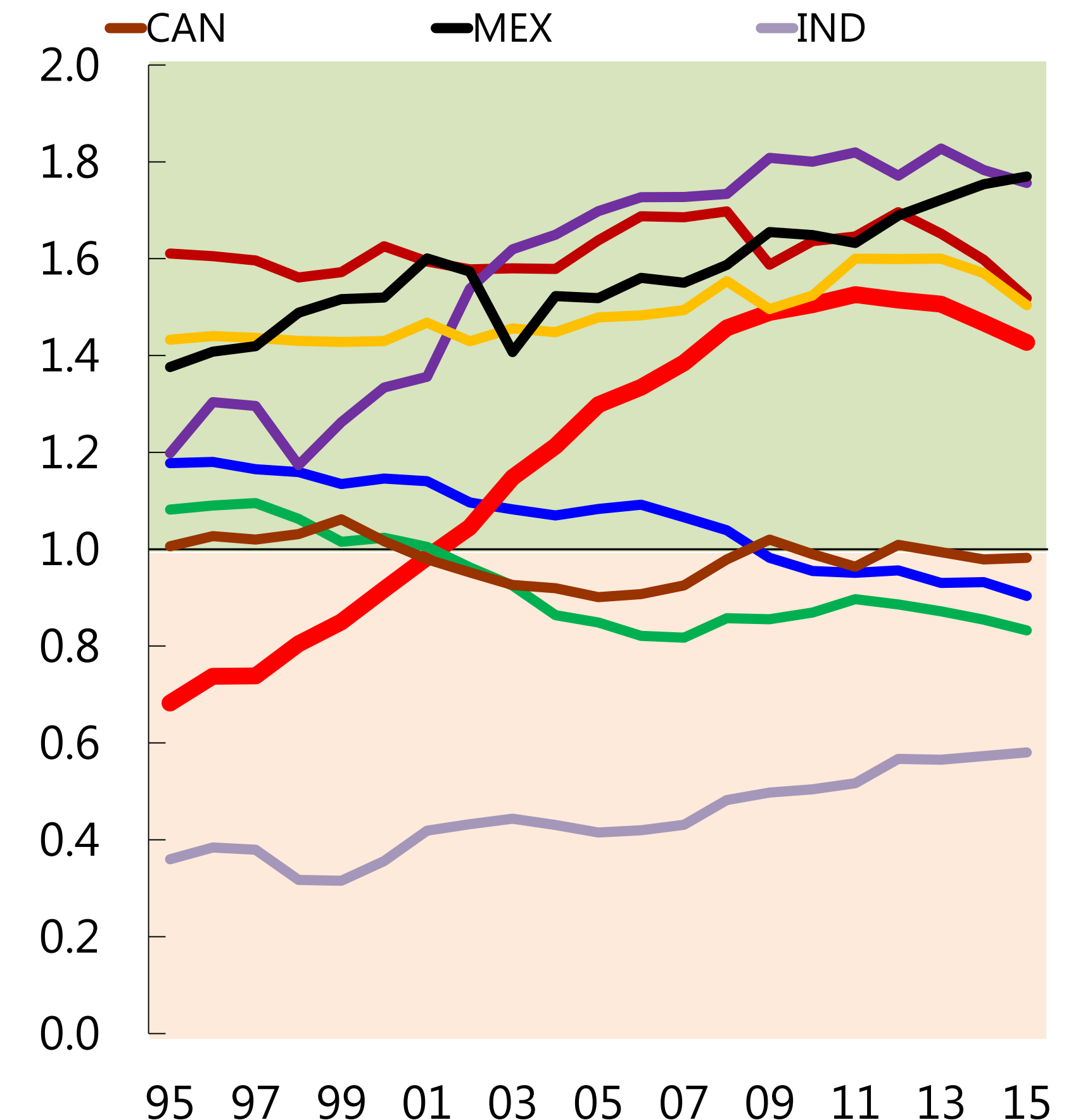
1. Manufacturing



2. Services



3. High-tech manufacturing

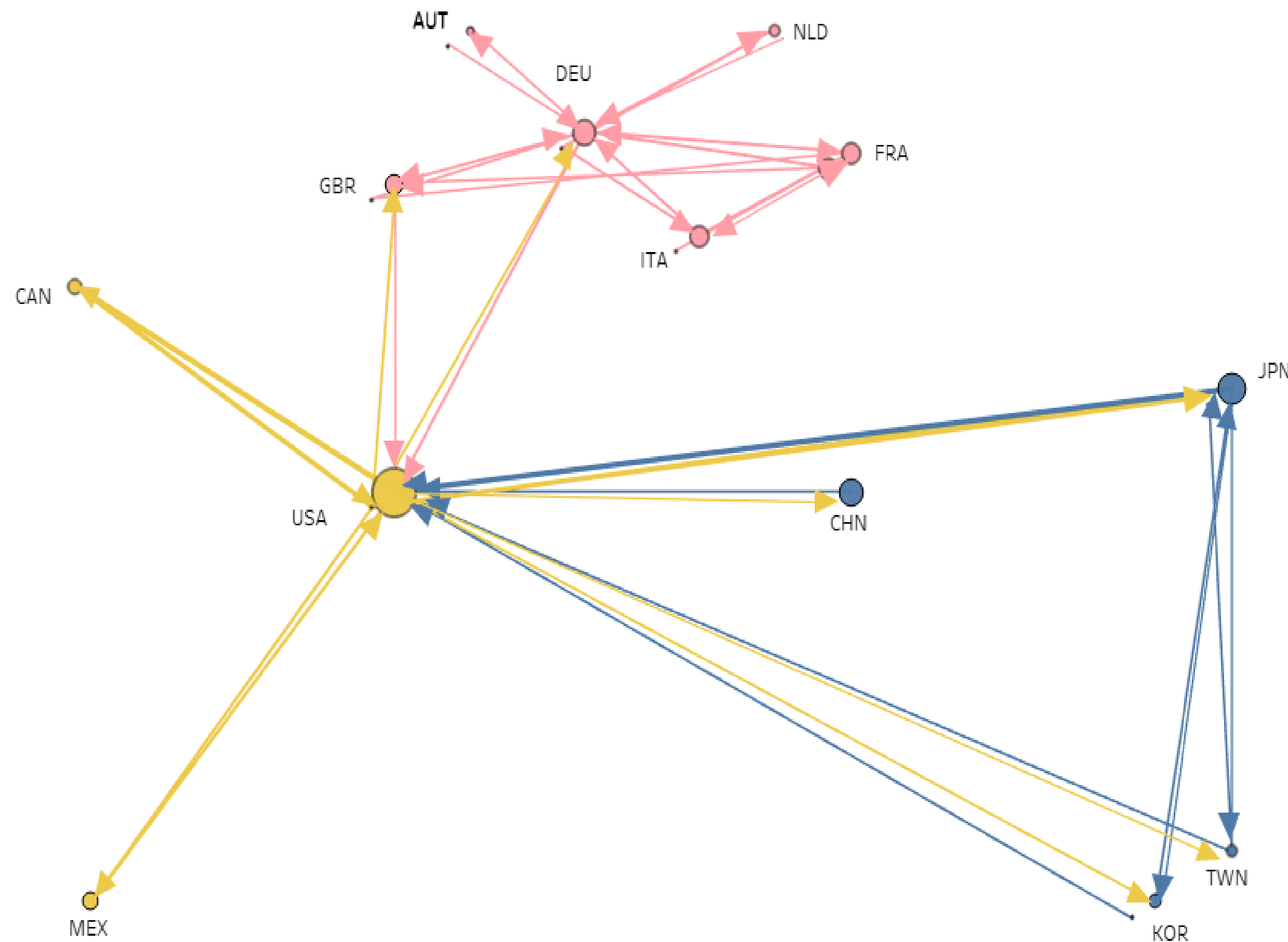


Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.

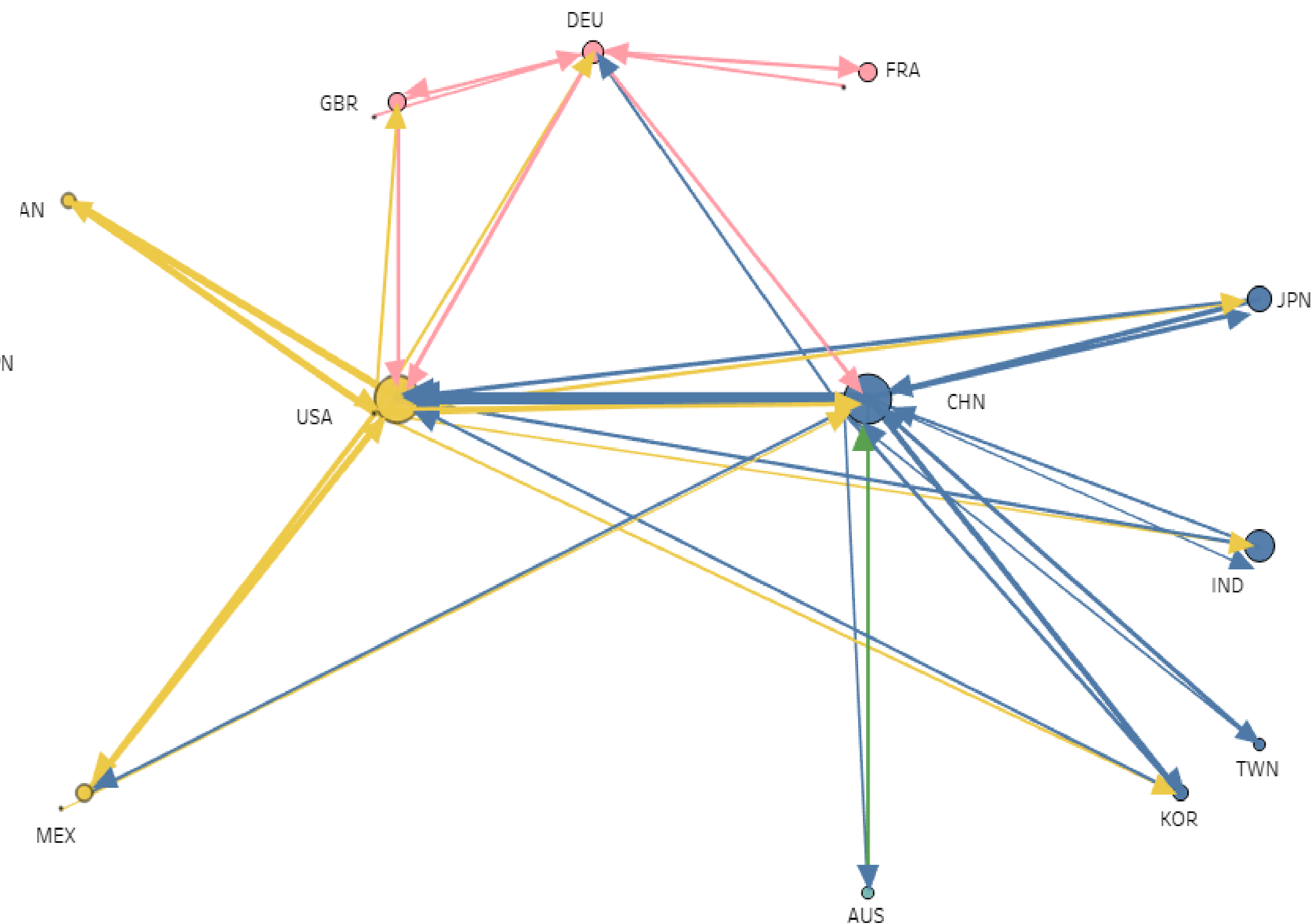
Note: Values greater than one indicate a revealed comparative advantage in the sector. Data labels in the figure use International Organization for Standardization (ISO) country codes.

Global Value Chains

Largest trade flows, 1995 1/
(Billions of US dollars)



Largest trade flows, 2015 1/
(Billions of US dollars)

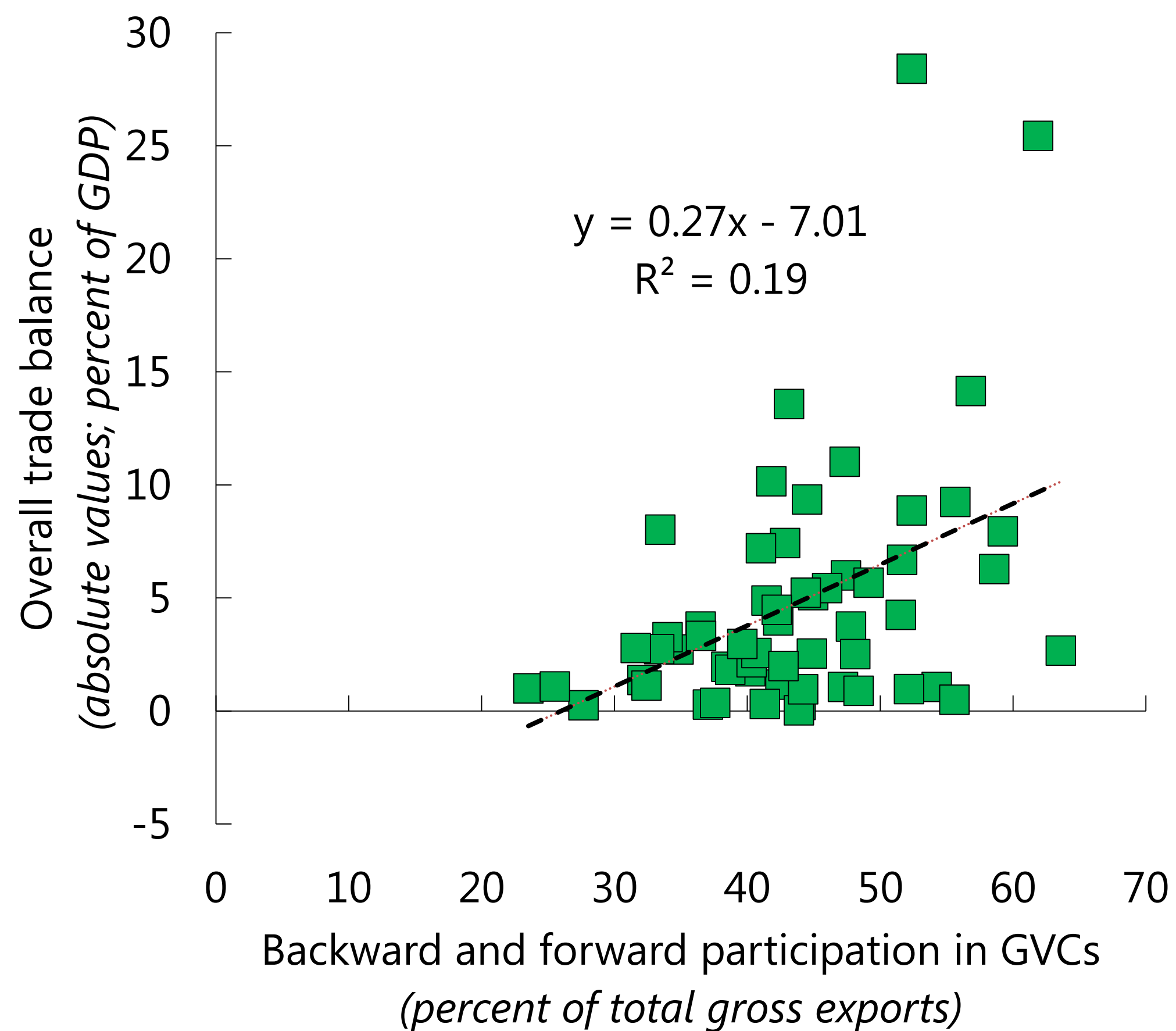


Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.

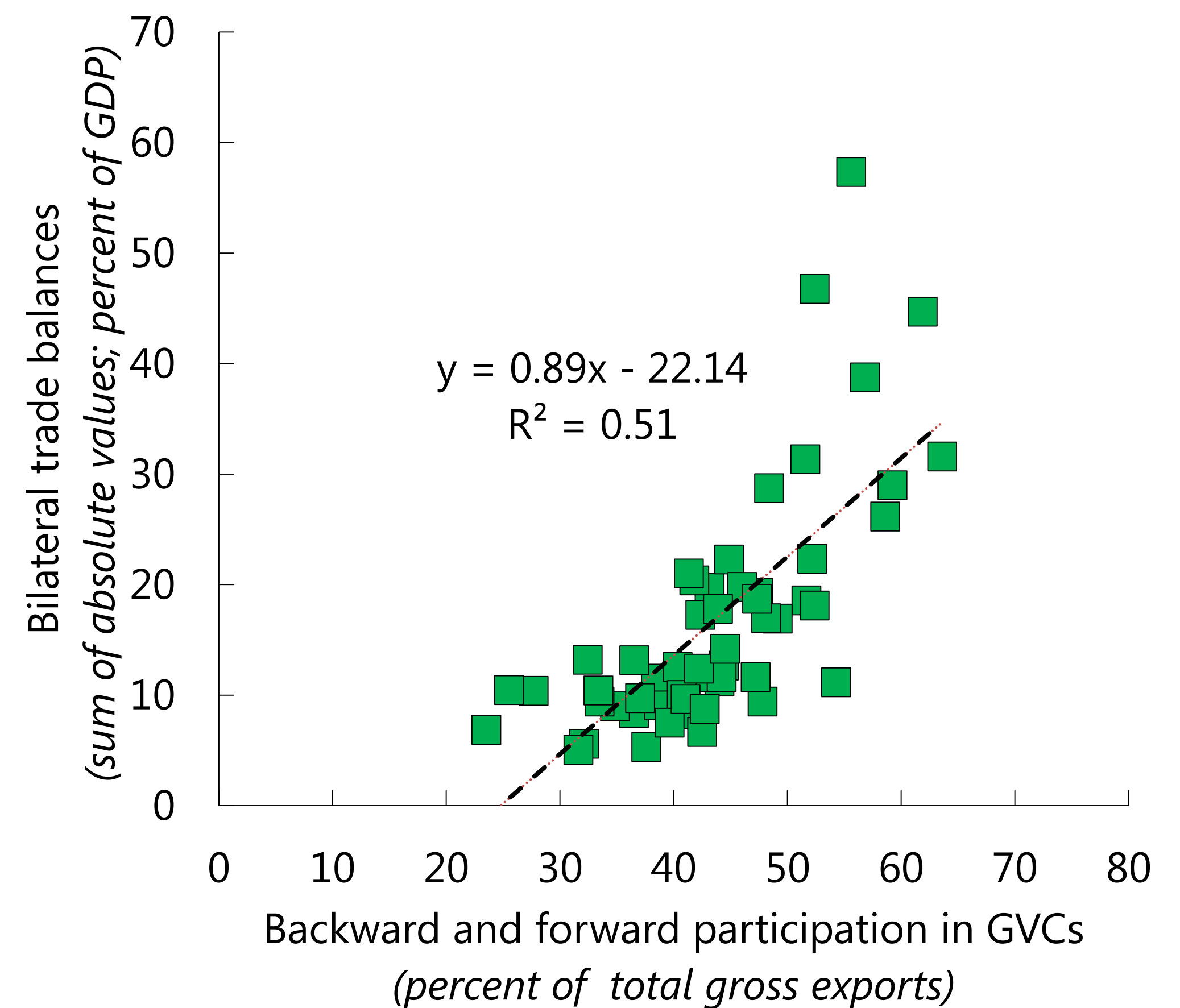
1/ Countries with largest export in year ($\geq 1\%$ of world GDP in 1995 and 2015, respectively), deflated by the US GDP deflator. The size of the bubbles represents the world share of a country's GDP.

GVCs vs. Aggregate and Bilateral Trade Balances

Participation in GVCs vs. overall trade balance, 2015



Participation in GVCs vs. bilateral trade balance, 2015



Drivers of Bilateral Trade Balances

Gravity Framework and Trade Balance

Gravity model is the standard trade **model to explain bilateral exports**. It distinguishes among the **following drivers**:

- **Macroeconomic factors:** Exports increase with gross output of the exporter and gross spending of the importer, scaled by world output;
- **Trade costs:** Can be natural (geography, language) or policy-related (tariffs, free trade agreements); both *bilateral* and *average trade costs* of importer and exporter matter;
- **Sectoral composition of supply and demand:** Bilateral trade increases if the sectoral structures are complementary (e.g., if the structure of exporter's supply matches the structure of the importer's demand).

Model estimated at sector level, with 63 countries and 34 sectors from 1995-2015

Regression Estimates – Bilateral Exports

Gravity Model: 5-Year Average Panel				
Model	Sector Level			Country Level
	Constrained (1)	Partially constrained (2)	Constrained, NTM (3)	Country-Pair FE (4)
LN(1+Tariff_ijst)	-1.769*** (0.397)	-2.260*** (0.409)	-1.834*** (0.412)	-4.207*** (0.538)
LN(World Gross Output_t)	-1.005*** (0.0273)	-1.006*** (0.0273)	-1.011*** (0.0270)	-1.075*** (0.0311)
LN(Exporter Gross Output_ist)	1 (0)	1 (0)	1 (0)	1 (0)
LN(Importer Gross Expenditure_jst)	1 (0)	1 (0)	1 (0)	1 (0)
LN(Exporter Average Trade Cost_ist)	1.020*** (0.0184)	0.749*** (0.0619)	1.021*** (0.0184)	1.082*** (0.0997)
LN(Importer Average Trade Cost_jst)	1.020*** (0.0184)	1.293*** (0.0623)	1.021*** (0.0184)	1.207*** (0.117)
Constant	-1.436*** (0.543)	-1.432*** (0.528)	-1.363** (0.530)	
Observations	474,933	474,933	474,933	15,552
R-squared	0.962	0.962	0.963	0.999
Country-Pair FE	NO	NO	NO	YES

Clustered (country-pair) standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Other control variables include: the log of distance, shared border, common language, common colony, and FTA dummy variable (all interacted with dummy variables for inter-country trade and service sector), and a dummy variable for intra-country trade. The country-pair FE model only includes the FTA dummy variable interacted with a dummy variable for inter-country trade.

Exporter and Importer average costs are the multilateral resistance costs estimated from a first stage regression that proxies multilateral resistance costs with GDP-weighted distance.

From Bilateral Exports to Bilateral Trade Balances

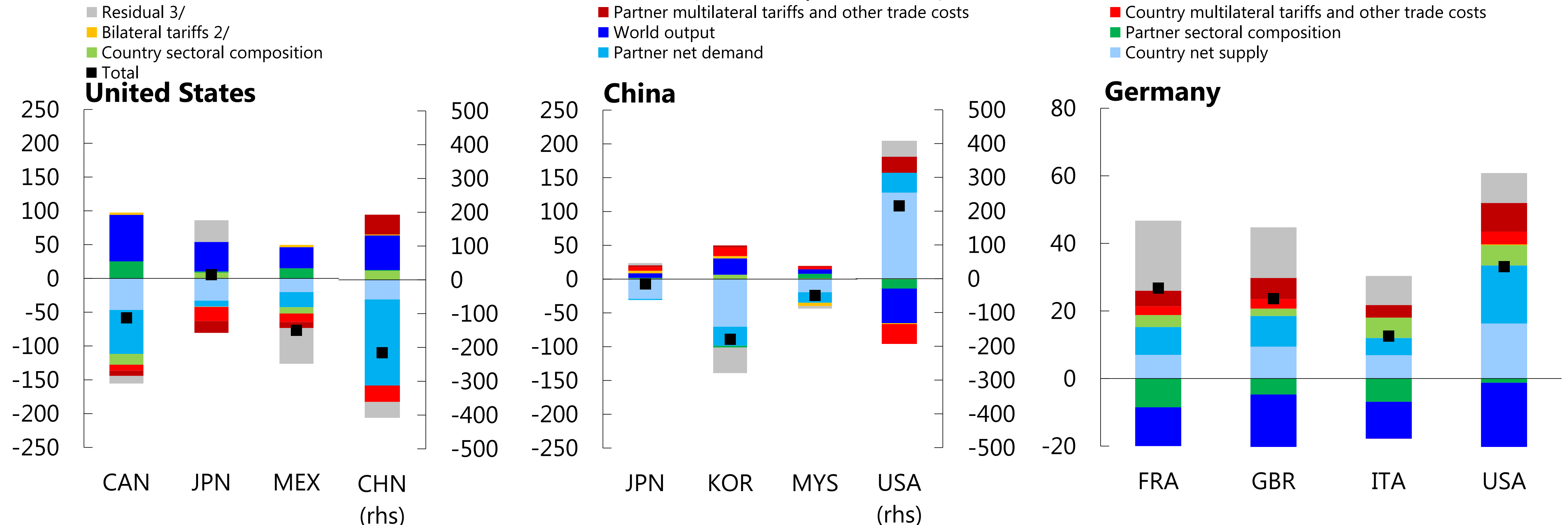
- Estimated contributions to **bilateral exports** from gravity estimation used to derive contributions to **bilateral trade balances**.
- Decompose **changes over time of bilateral** balances, since this is where the model performs best.

Regression Estimates – Bilateral Trade Balances

Trade Balance Fit					
	Sector Level			Country Level	
	<i>Model</i>	Constrained	Partially constrained	Constrained, NTM	
		(1)	(2)	(3)	
				Country-Pair FE	
		(4)			
Predicted Bilateral Trade Balance		1.053*** (0.214)	1.065*** (0.216)	1.056*** (0.217)	1.001*** (0.0286)
Observations		15,876	15,876	15,876	15,282
R-squared		0.288	0.269	0.295	0.931
R-square, subsample of largest bilateral balances		0.357	0.424	0.376	0.953
Robust standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

Changes in Bilateral Trade Balances: Prominent Contribution of Macro Factors

Contributions to changes in bilateral balances 1/
(Billions of US dollars)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.

Note: The left panel presents the macroeconomic, sectoral, and trade cost terms on a net basis. The right panel separates these net terms into their components as follows: macroeconomic factor into country net supply, partner net demand, and world output; sectoral composition into country sectoral composition and partner sectoral composition; and tariffs and other trade costs into bilateral tariffs, country multilateral trade costs, and partner multilateral trade costs.

1/ Average value 2010-2015 minus average value 1995-1999.

2/ This includes tariffs and free or preferential trade agreements.

3/ The residual is the sum of the model residuals plus the approximation error.

Limitations of the Approach

- **Limited immediate policy relevance, since the model is unable to distinguish specific underlying macroeconomic drivers**, including fundamentals (e.g., demographics, institutions) and policies, some of which are hard to measure (e.g., subsidies)
- **Highlight only partial equilibrium effects of tariffs:** Tariffs can affect macroeconomic variables, for instance by changing the international division of labor;
 - Limitations are addressed in what follows:
 - a. more details on macroeconomic factors;
 - b. direct and indirect effects of tariffs on economic outcomes.

The Role of Macroeconomic Factors

A Detailed Look at Macro Factors

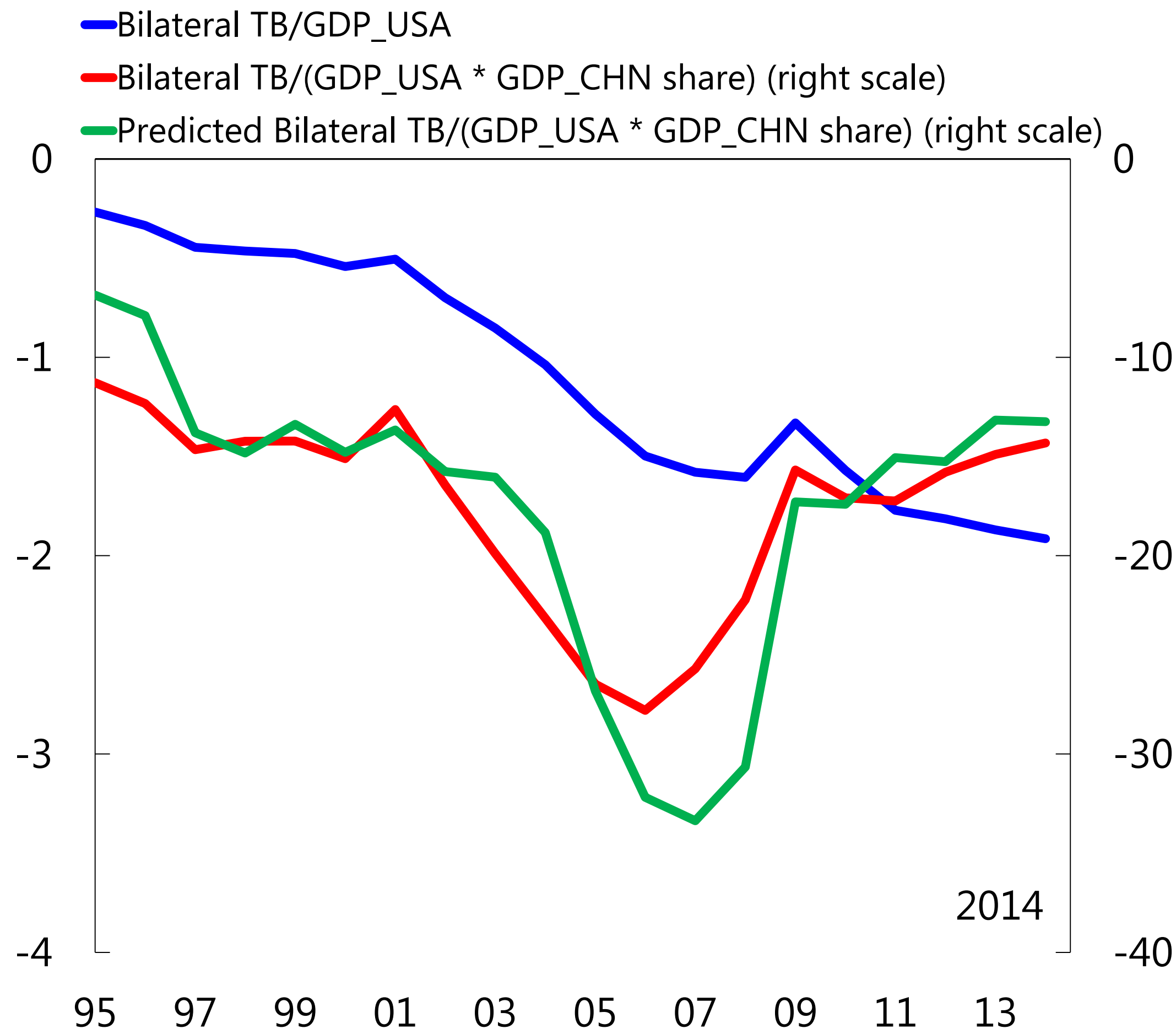
The imbalance between aggregate demand and supply (macro factors) is determined by a host of macro drivers:

1. Under mild assumptions, we can derive an explicit relation between bilateral and aggregate trade balances;
2. We then decompose aggregate trade balances into macro drivers.

Relation Between Bilateral and Aggregate Trade Balances

US–China bilateral trade balance

(Percent)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.

- **Under mild assumptions:**

$$\frac{TB_{ij}}{Y_i Y_j^W} = m_{ij} \cdot \left(\frac{TB_i}{Y_i} - \frac{TB_j}{Y_j} \right)$$

- **Theory consistent scaling** of bilateral balance by product of outputs
- Declines in aggregate trade balances of the USA and China mirrored in the **decline of their (appropriately scaled) bilateral trade balance**

Macro Drivers of Aggregate Trade Balances

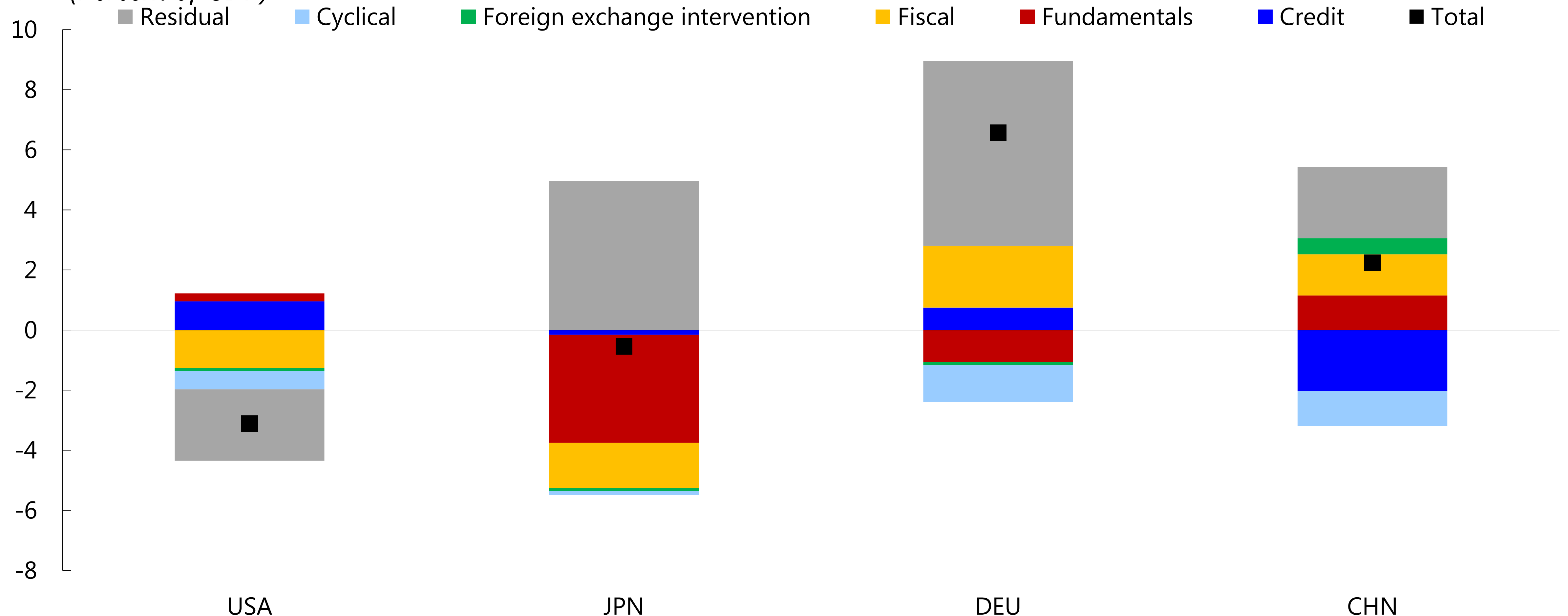
The **IMF External Balance Assessment (EBA)** estimates the macroeconomic drivers of a country's current account, but it can be also **applied to the aggregate trade balance**.

- **The main EBA determinants are:**

- Macroeconomic policies: fiscal policy (cyclically-adjusted fiscal balance) and exchange rate policy (foreign exchange interventions); macroeconomic policy distortions (e.g., widespread export or production subsidies that distort trade similarly across all trading partners). The latter are difficult to measure systematically and thus not captured explicitly.
- Credit: detrended private credit to GDP
- Cyclical factors: output gap and the commodity terms of trade
- Fundamentals: demographics, economic and institutional development, social safety nets, reliance on commodity exports, NFA position, ability to provide safe and reserve assets

Aggregate Trade Balances: Policies and Other Drivers

Contributions of macroeconomic drivers to the aggregate trade balance, average 2010-2017 1/
(Percent of GDP)

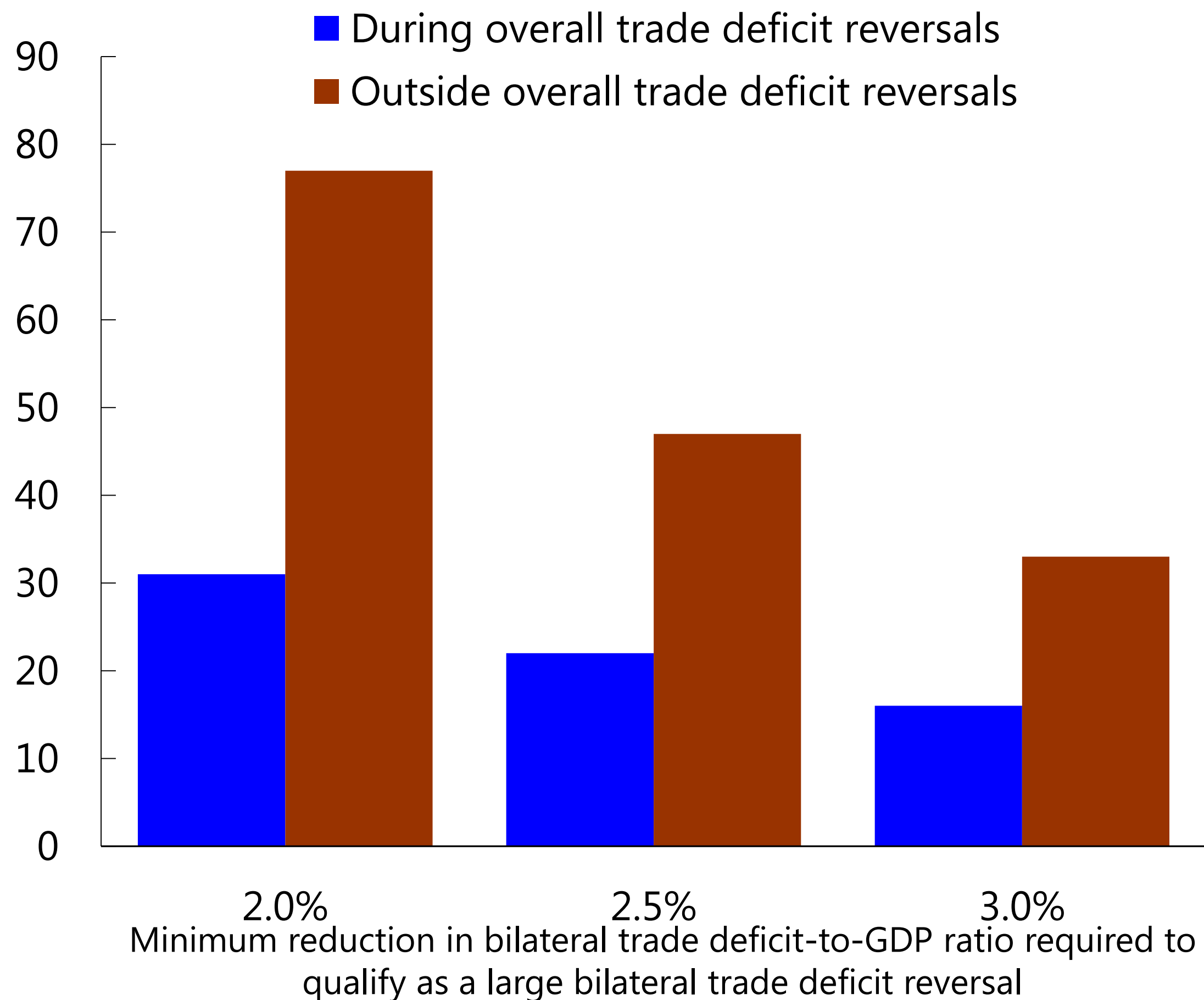


Source: IMF staff calculations.

1/ Contributions were obtained by regressing the countries' trade balance-to-GDP ratio on the standard EBA variables.

Aggregate and Bilateral Trade Balance Reversals

Bilateral trade deficit reversal episodes (Number of episodes)



Source: IMF, *Direction of Trade Statistics*.

Note: See box for definition of large overall and bilateral trade deficit reversals. There are 92 overall trade deficit reversals.

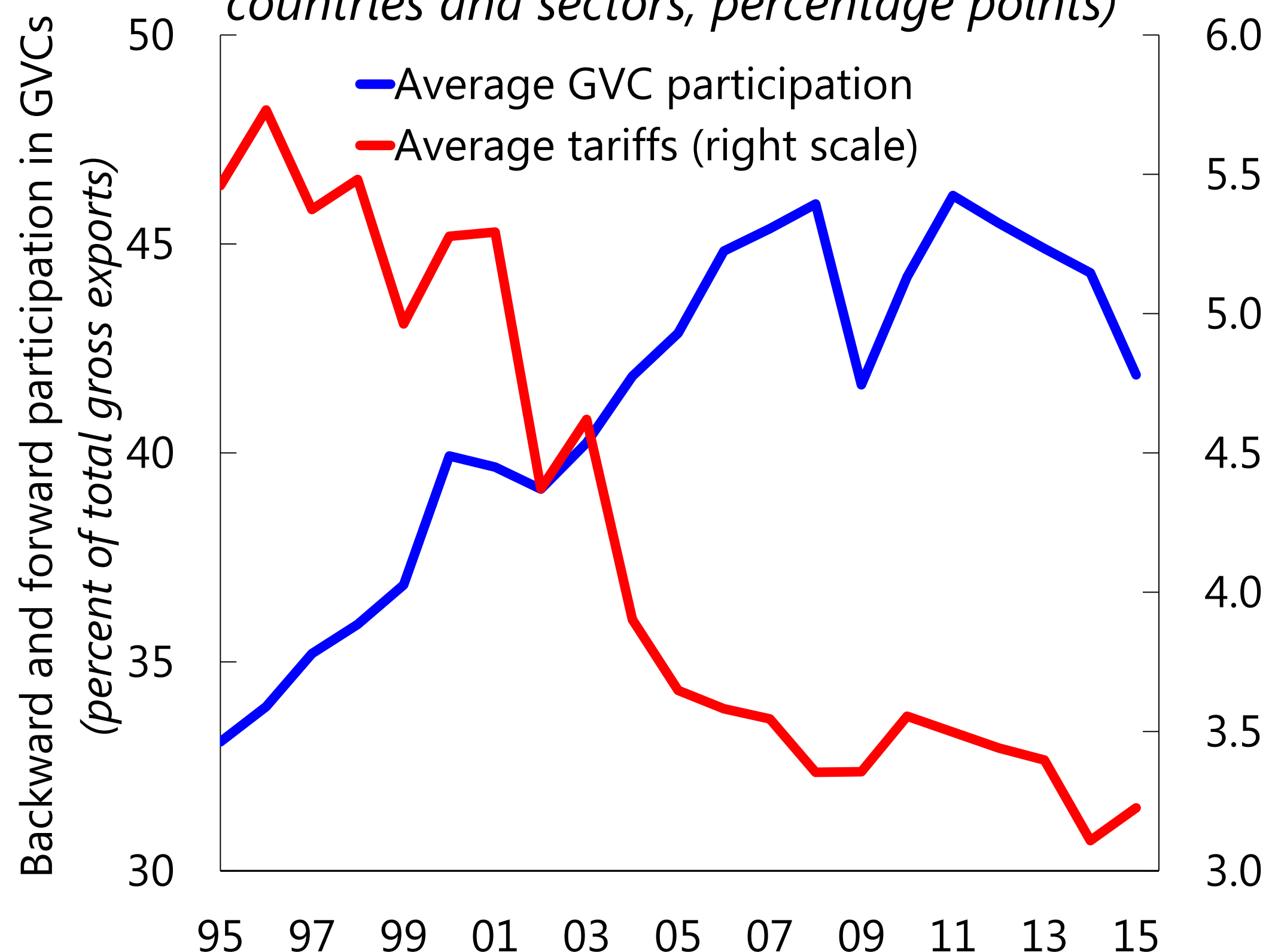
- **Aggregate drive bilateral:**
Aggregate trade balance reversals lead to bilateral ones
 - **Bilateral drive other bilateral:**
Bilateral reversals do not typically lead to aggregate ones, as other bilateral balances adjust
- Absent changes in macroeconomic conditions, large changes in one of the bilateral trade balances of a country tend to result in **compensating adjustments in other bilateral balances**

Spillovers from Tariffs

Spillovers from Tariffs

Tariffs and Global Value Chain (GVC) participation

(Value added-weighted average over countries and sectors; percentage points)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; *World Integrated Trade Solution (WITS)*; and IMF staff calculations.

Note: GVC participation is the backward and forward participation in GVCs as a percent of total exports. Tariffs are for agriculture, mining, and manufacturing sectors. 2012-15 extrapolated based on TIVA 2018.

- **Tariffs can affect international organization of production, including GVCs,**
- Tighter integration allows specialization and productivity gains, but also **increased risk of international spillovers, including from tariffs**
- **Tariff spillovers can occur** from upstream or downstream in the value chain or horizontally

Spillovers along the Value Chain

Empirical investigation of different tariff measures to capture direct effect as well as spillovers of tariffs on sectoral value added, employment and productivity

- **Upstream tariff:** average cumulative tariff applied to intermediate inputs as a share of the sector's output, affects cost of production
- **Domestic protection:** average tariff (import-weighted) imposed on imports that compete with the output of the domestic sector, affects domestic demand
- **Downstream tariff:** average cumulative tariff on direct or indirect exports, affects international demand
- **Diversification tariff:** weighted average tariff that partner countries impose on all other suppliers except the country-sector in question

Regression with 35 countries and 13 manufacturing sectors, country-sector and country-time fixed effects

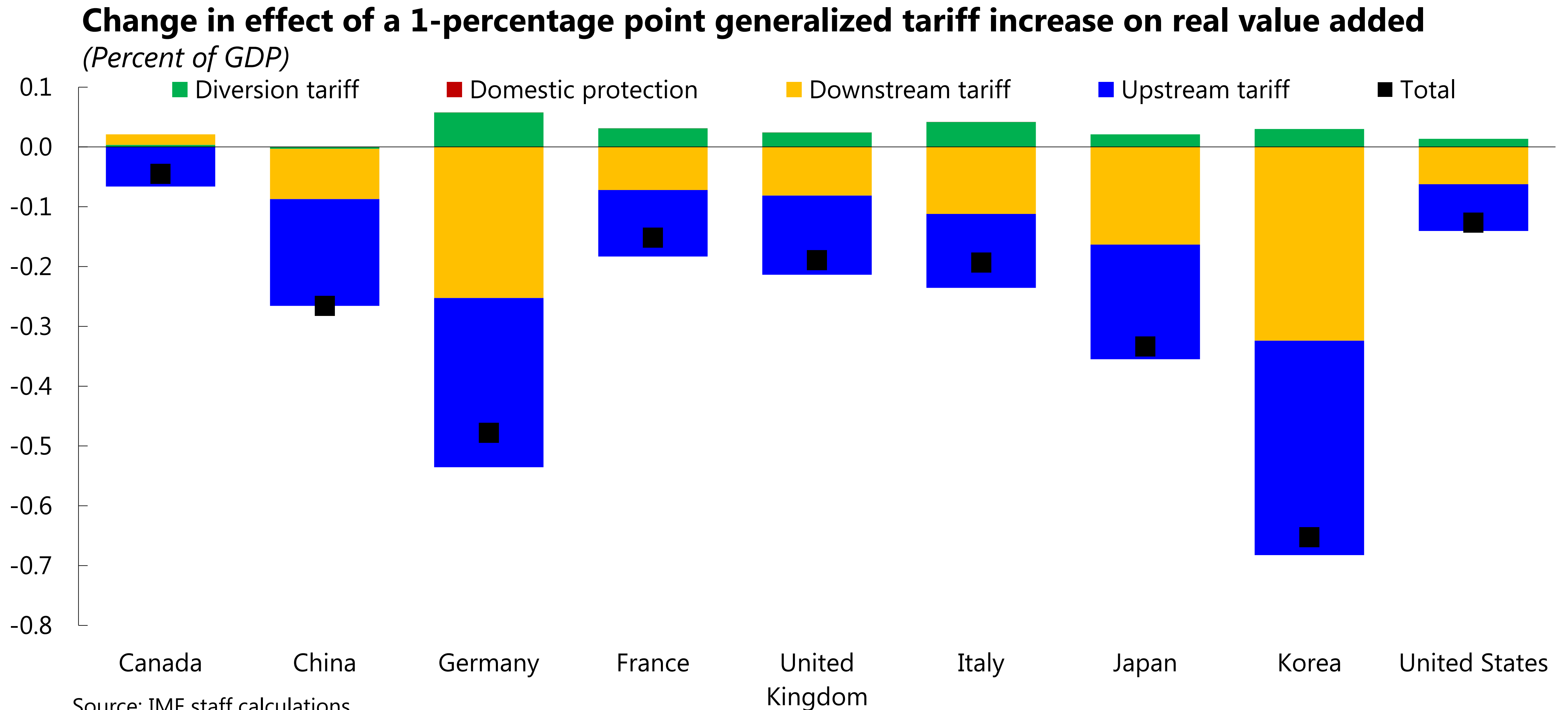
Upstream and Downstream Effects of Tariffs through GVCs

Table 4.1. Sign and Significance of Tariff Effects on Economic Variables

	(1) Real value added	(2) Number employees	(3) Labor productivity	(4) TFP
Upstream tariff	-	-	-	-
Domestic protection	+	-	-	+
Downstream tariff	-	-	-	-
Diversion tariff	+	+	+	-

Note: TFP = total factor productivity. Dependent variables are expressed in natural logarithm. Errors are clustered at the country-sector level. Pattern coding: white is not significant at the 10 percent level; light color is significant at the 10 percent level; medium color is significant at the 5 percent level; full color is significant at the 1 percent level; green for positive coefficients; red for negative ones.

Increased Costs of Tariffs Through GVCs Today vs. 1995



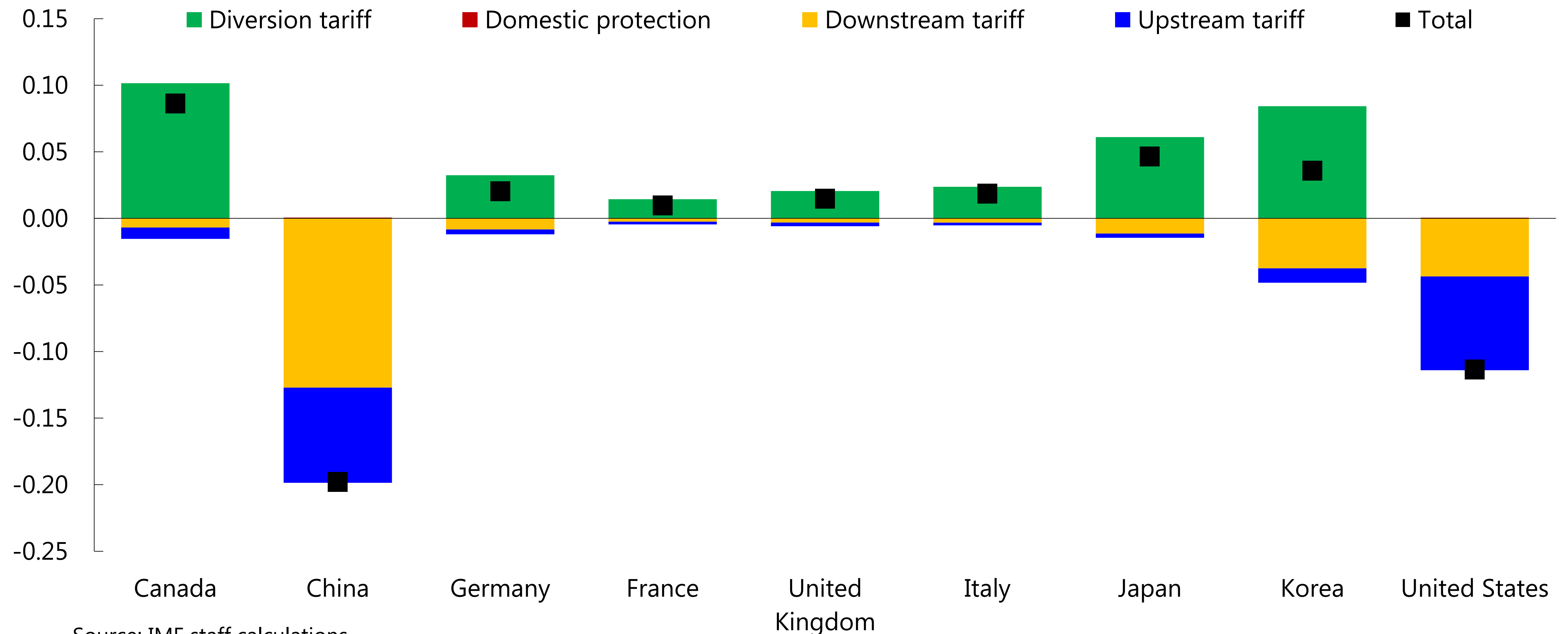
Source: IMF staff calculations.

Note: The figure shows the change in the simulated tariff spillovers between 1995 and 2011, the last year for which such an exercise is possible given data constraints. 2011 is a good approximation of current GVC links because most of the growth in GVC integration took place before 2011.

Asymmetric Tariffs: Negative Effects and Trade Diversion

Effect of a 1-percentage point reciprocal tariff increase between China and United States on real value added

(Percent of GDP)

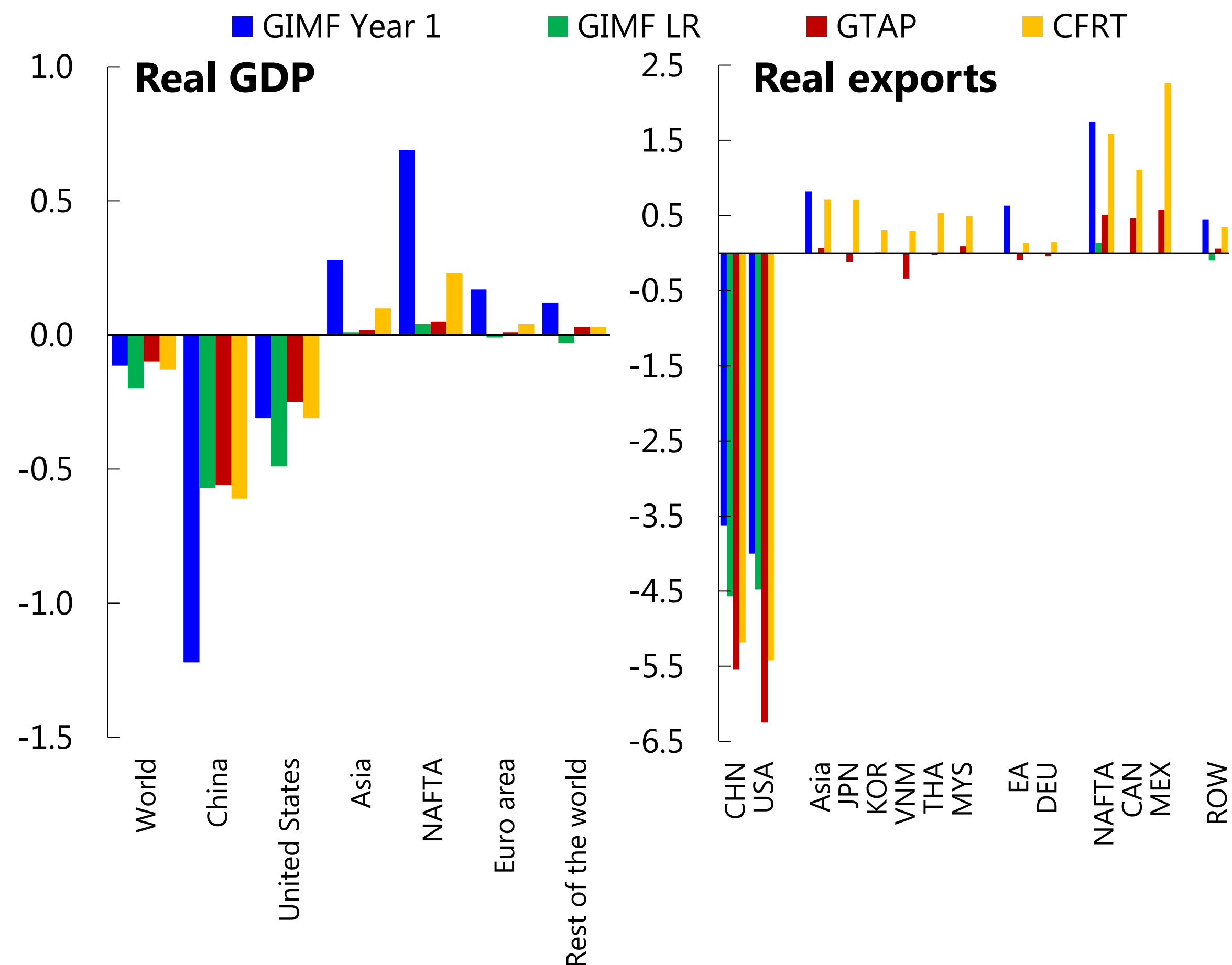


Source: IMF staff calculations.

General Equilibrium Effects of a CHN-USA Tariff War

Macro effects from a 25 percent increase in tariffs affecting all US-China trade

(Percentage point change from baseline)



- **Real exports:** USA-China bilateral trade collapses, but aggregate trade balances barely change due to trade diversion
- **Real GDP:** China and the United States are found to suffer the largest losses, with modest aggregate effects on third countries (but large sectoral reallocations). Mexico, Canada, and to a lesser extent east Asia, benefit the most.

Source: IMF calculations using the Caliendo, Feenstra, Romalis, Taylor (2017) model.

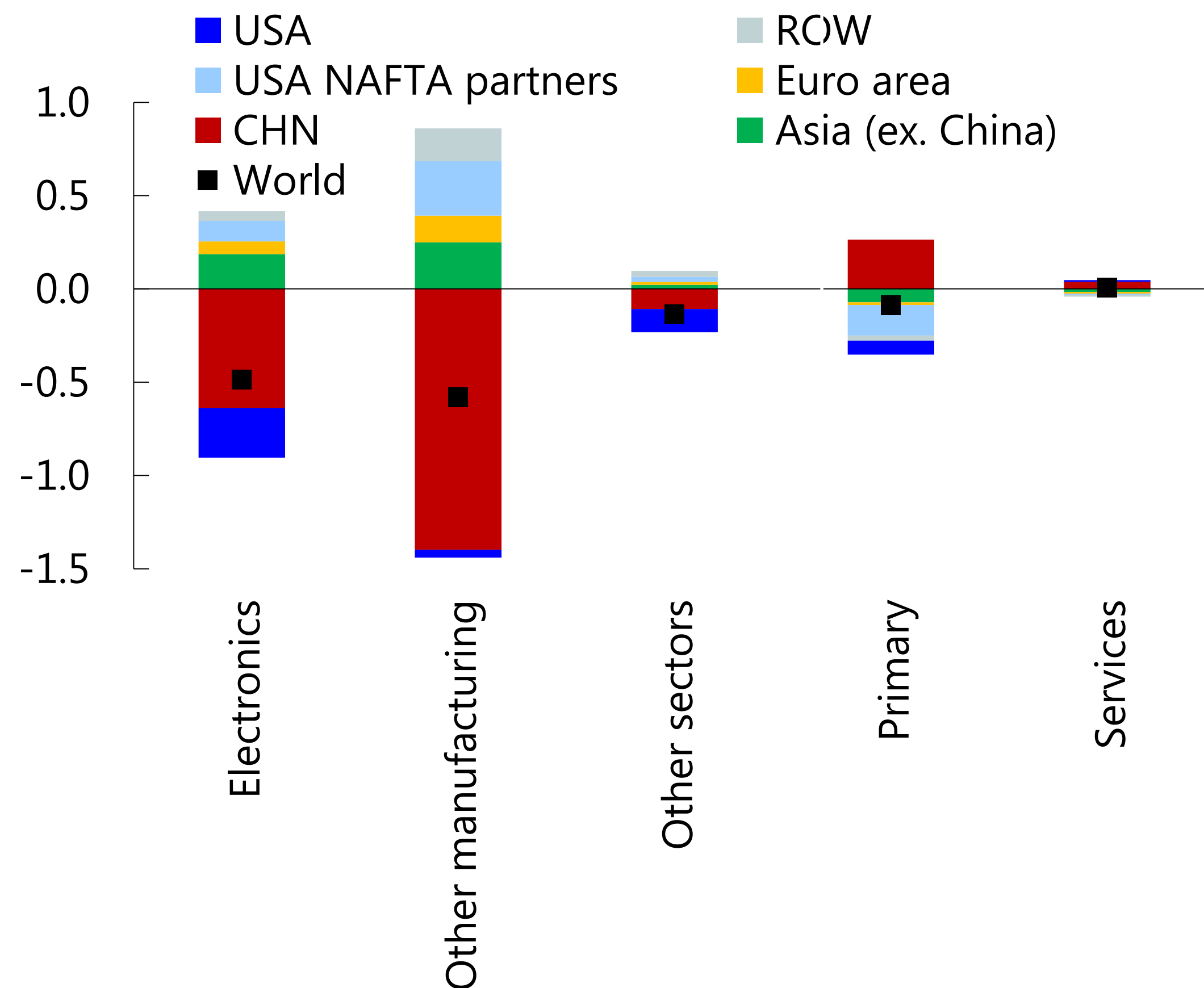
Note: EA = euro area; NAFTA = North American Free Trade Agreement; ROW = Rest of the world.

Data labels in the figure use International Organization for Standardization (ISO) country codes.

General Equilibrium Effects of a CHN-USA Tariffs War

Sectoral effects from a 25 percent increase in Tariffs affecting all US-China Trade: World real value added

(Contribution to total percent change from baseline)



Source: IMF staff calculations using the Caliendo, Feenstra, Romalis, Taylor (2017) model.

- **Trade diversion and repositioning of GVCs:** sizable shifts in manufacturing capacity away from China (and the United States) toward Mexico, Canada, and east Asia
- **Significant effects a sector level:** sizeable job losses in specific sectors, especially in the USA (agriculture, transport equipment) and China (electronics, other manufacturing sector)

Conclusions

Summing up

Main Results

- **Aggregate trade imbalances drive bilateral trade balances** but not the other way around
- **Macroeconomic factors** played a key role in explaining changes in bilateral balances
- Direct effect of the **sectoral composition** and **tariffs** on bilateral balances was more limited
- **Tariffs have significant effects on economic outcomes**, both in countries and sectors directly involved as well as through spillovers on others

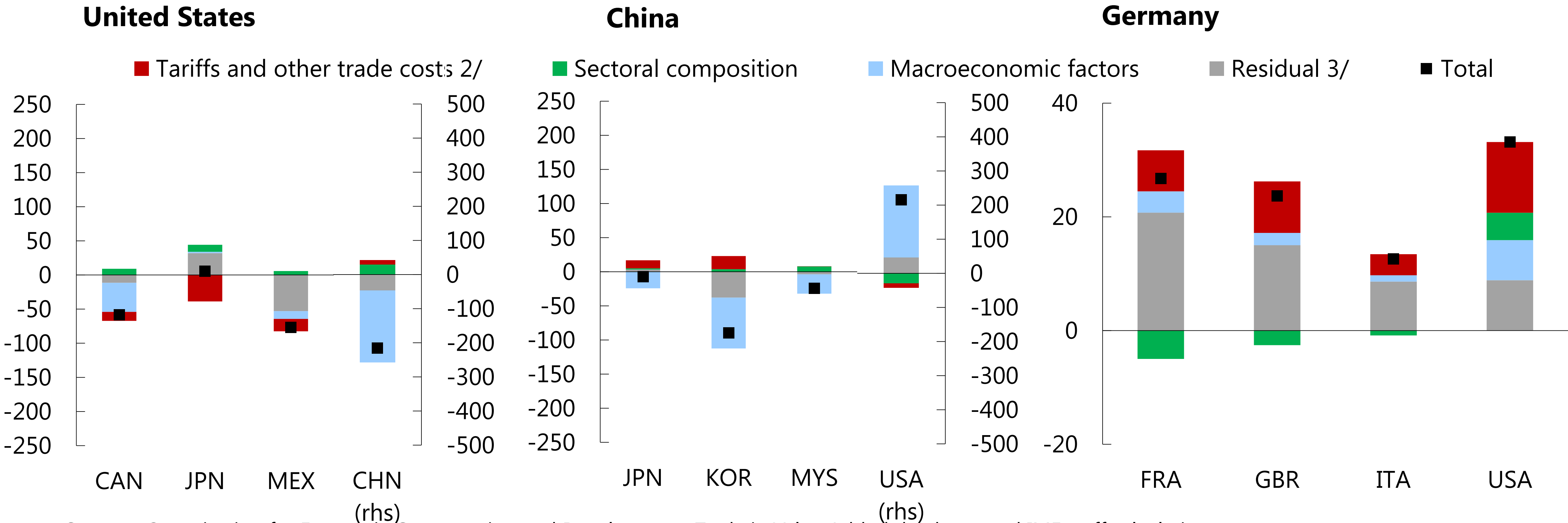
Policy Conclusions

- The discussion of external imbalances is rightly **focused on aggregate imbalances and macroeconomic drivers**
- **Lower tariffs and non-tariff barriers** will boost trade, output, employment and productivity on aggregate, but policies are needed to ensure benefits are widely shared

Support slides

Contributions to changes in bilateral trade balances

Net contributions 1/
(Billions of US dollars)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.

Note: The left panel presents the macroeconomic, sectoral, and trade cost terms on a net basis. The right panel separates these net terms into their components as follows: macroeconomic factor into country net supply, partner net demand, and world output; sectoral composition into country sectoral composition and partner sectoral composition; and tariffs and other trade costs into bilateral tariffs, country multilateral trade costs, and partner multilateral trade costs.

1/ Average value 2010-2015 minus average value 1995-1999.

2/ This includes tariffs and free or preferential trade agreements.

3/ The residual is the sum of the model residuals plus the approximation error.

Approach

Empirical investigation at sectoral level using measures that capture different possible tariff spillovers across countries and sectors.

- **Upstream** : (direct and indirect) effect on costs of inputs, supply
- **Downstream** : (direct and indirect) effect on international demand
- **Domestic** : effect on domestic demand
- **Diversion** : average tariff imposed on other countries in given sector; weighted by relative importance of export market

Estimation: **To adjust**

$$\ln(y_{c,i,t}) = \alpha + \beta_1 L.T^{up} + \beta_2 L.T^{down} + \beta_3 L.T^{dp} + \beta_1 L.T^{div} + \gamma_{c,t} + \delta_{c,i} + \varepsilon_{c,i,t}$$

- $\gamma_{c,t}$ = country-time FE
- $\delta_{c,s}$ = country-industry FE

→ Limitations: partial equilibrium, no dynamic effects, assumptions on tariff path through

Output Table of Tariff Estimation

	Tariff Effects on Economic Variables			
	(1)	(2)	(3)	(4)
	VA	Empl.	L-Prod.	TFP
L.T_upstream	-19.41*** (6.81)	-8.49** (4.25)	-6.53* (3.85)	-11.52** (4.70)
L.T_D_protect	0.02 (0.65)	-1.87** (0.88)	0.92 (0.89)	0.37 (0.38)
L.T_downstream	-14.47** (6.03)	-1.33 (4.26)	-12.61*** (4.67)	-13.19** (6.39)
L.T_diversion	5.14* (2.79)	6.02** (2.58)	1.29 (2.10)	-2.70 (4.19)
Cou-Year FE	Yes	Yes	Yes	Yes
Cou-Ind FE	Yes	Yes	Yes	Yes
N	6774	6097	6144	4112
R-sq	0.733	0.993	0.734	0.693

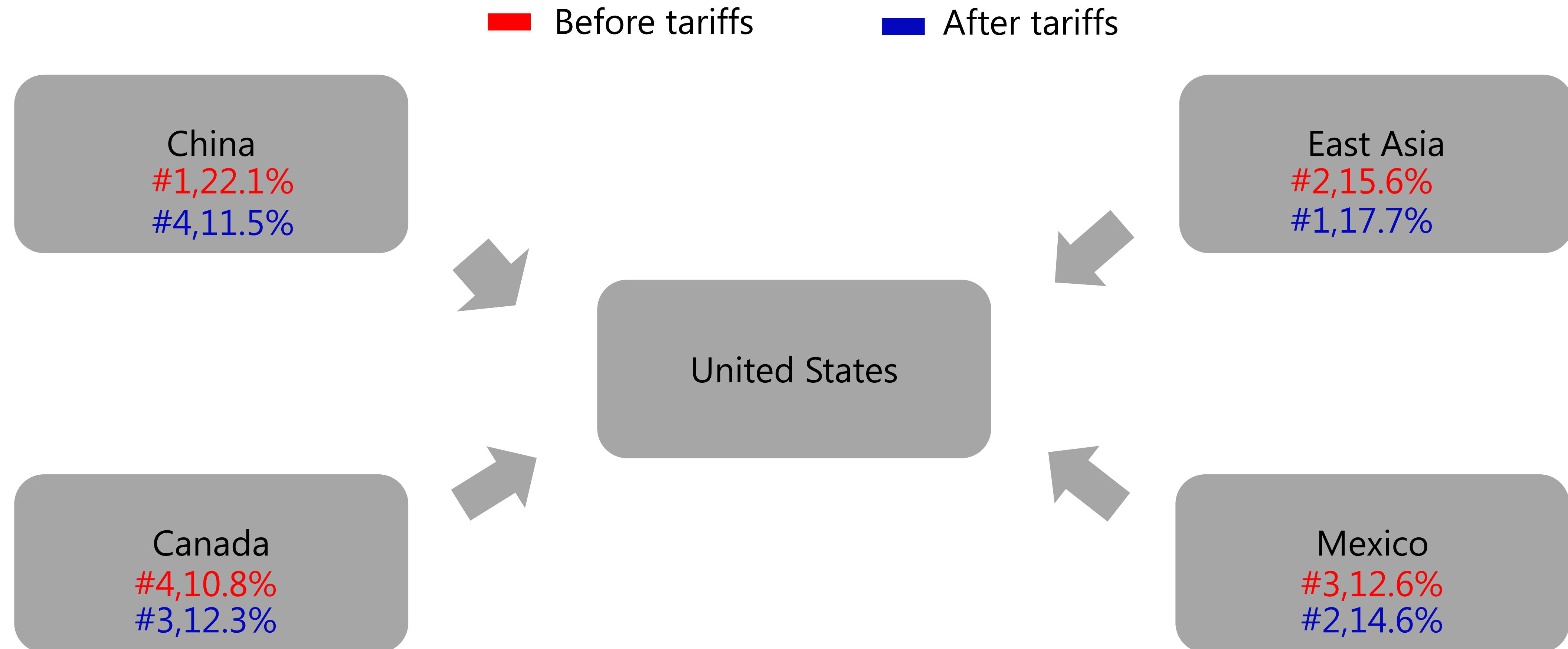
Note: VA = real value added; Empl. = number of employees; L-Prod. = labor productivity and TFP = total factor productivity. Dependent variables are expressed in natural logarithm.

Errors are clustered at the country-sector level. SE in parentheses; * p<0.10 ** p<0.05 ***

p<0.01

Model Results – US Electronics Imports

US imports of electronics and machinery before and after tariffs



Sources: Caliendo, Feenstra, Romalis, and Taylor (2017) model; and IMF staff calculations.
Note: #x means rank, xx% means share in total US imports of electronics.