The Network Drivers of Trade Currency Invoicing

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Oct. 3, 2023

The bigger picture

Majority of international trade invoiced in small number of Dominant Currencies – USD has lion's share (Goldberg and Tille, 2016, Gopinath, 2015)

Dominant Currency models: suggest firms coordinate their currency invoicing

- Give theoretical foundation for coordination/ strategic complementarity in aggregate import/ export currency invoicing choices

Research Question: are currency invoicing choices of firms in a country affected by those of its trading partners?

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Closely Related Literature

- Complementarities in price setting and input-output linkages generates complementarities in currency choice (Gopinath, 2015; Doepke and Schneider, 2017; Mukhin, 2022; Eren and Malamud, 2022; Amiti, Itskhoki, and Konings, 2022)

$\Rightarrow$ Exporters coordinate on the same currency

1. to be competitive in output pricing
2. to hedge against exchange rate shocks of imported intermediate

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- Drivers of currency choice:
  1. Import intensity and import currency choice (Cheng, 2016, Amiti, Itskhoki, and Konings, 2022)
  2. Safety/ liquidity of (dominant) currency (Maggiori, 2017, Bahaj and Reis, 2022, Gourinchas and Rey, 2022)
  3. Financing in (dominant) currency (Gopinath and Stein, 2021)

This paper: control for factors proposed in literature and examine whether the currency invoicing decisions of the firms in a country are affected by those of its trading partners.

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Contribution of this paper

In a nutshell:

- Using an equilibrium network model and a large international panel of cross-border trade, we analyse empirically the drivers of currency invoicing

Main findings today:

1. Strong evidence of network spillovers in currency invoicing choice across countries
2. Evidence of strategic complementarity in currency invoicing
   $\Rightarrow$ leads to amplification of domestic shocks through the trade network
3. Strong evidence of natural hedging between export and import currencies, and substitution between Dollar and Euro as vehicle currency

Additional findings in paper:

1. Key players for a given currency: countries that invoice exports in foreign currency extensively (e.g., South Korea and Russia), but also countries that are central in trade network (e.g., Germany and the UK)
2. Fragility of Dollar-DC equilibrium to both BRICS and EU abandonment

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Excessive Currency Invoicing

We study excessive currency invoicing (ECI)

Focus on *excessive* currency invoicing (and use aggregate invoicing as robustness)

- ECI: invoicing in a currency above the bilateral trade volume with currency's home countries (e.g. country *i*'s total US Dollar exports *minus* exports by *i* to the US)

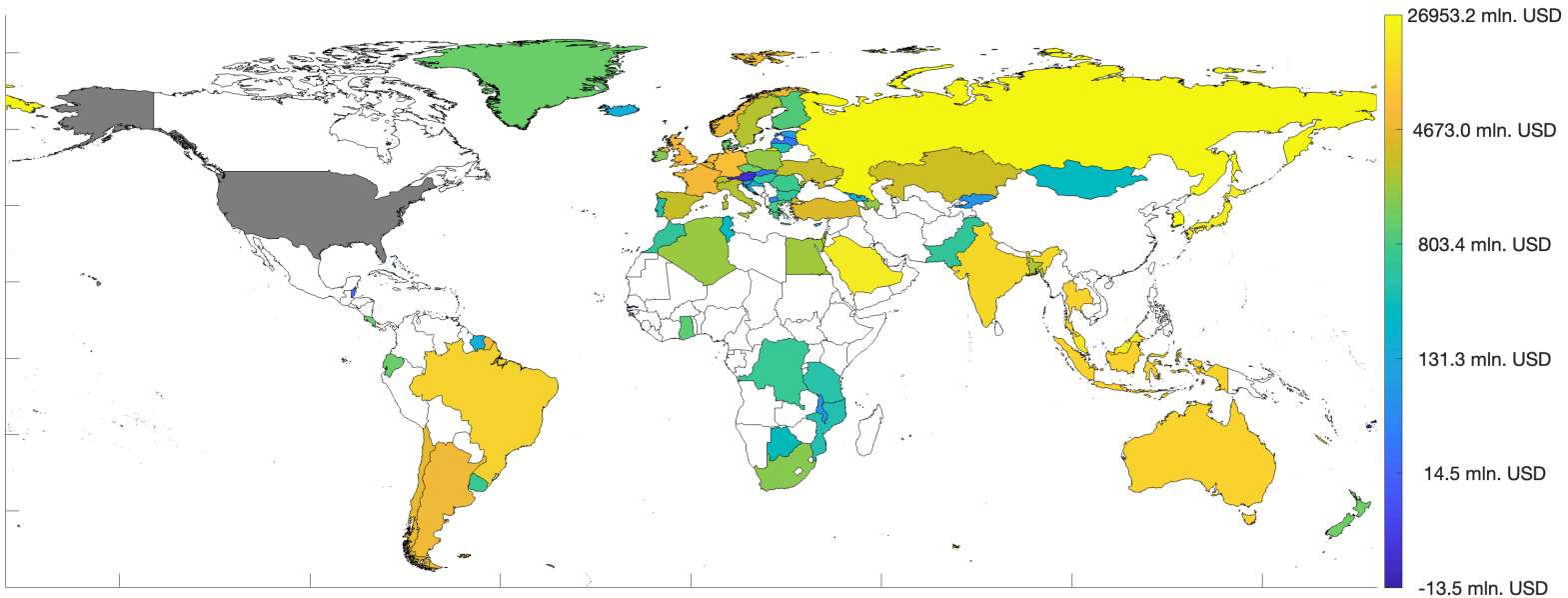

Figure 1: US Dollar Export-based Excessive Currency Invoicing

Excessive currency invoicing is calculated from bilateral trade data from the IMFs *Direction of Trade Statistics* and data on the shares of aggregate imports/exports invoiced by US Dollars and Euros from Boz et al. (2022).

Stylised facts:

1. USD ECI is overwhelmingly positive
2. Euro ECI is mostly negative but for Euro-block countries

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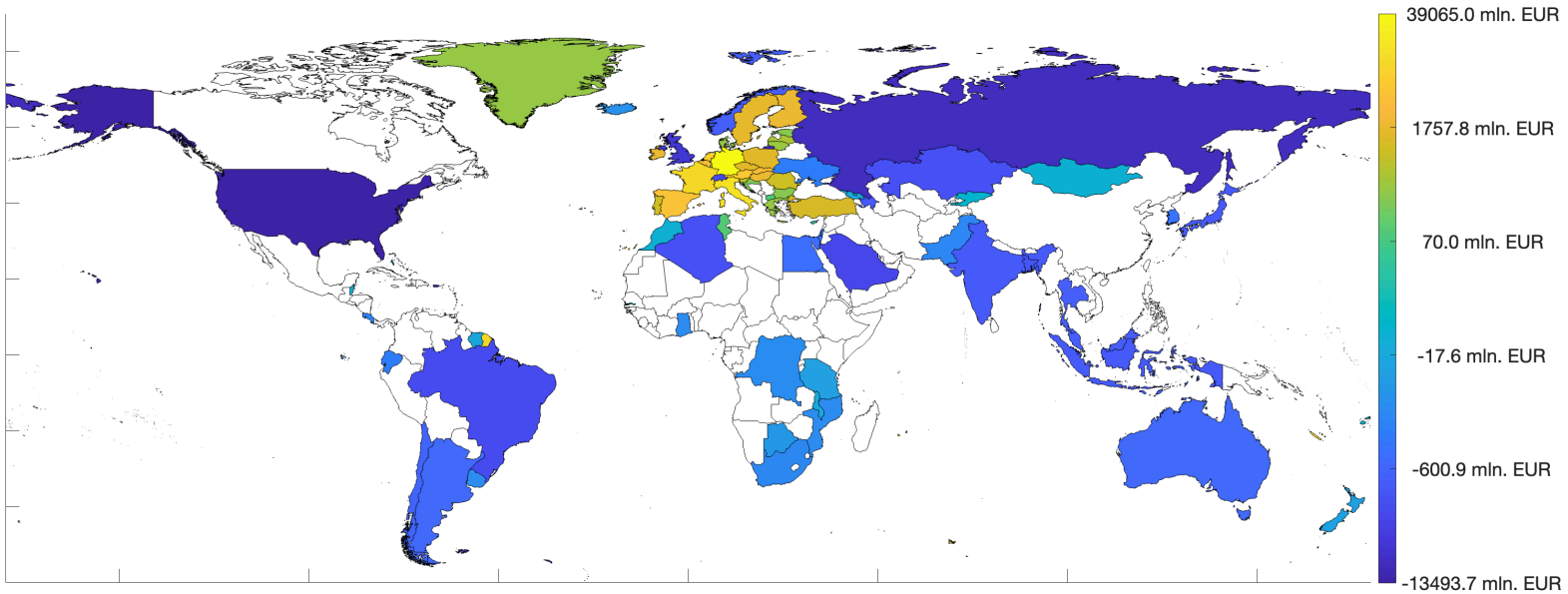

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Network Model

The network model

- Linear quadratic network model (e.g., Ballester, Calvo-Armengol, Zeno (2006)) where countries simultaneously decide in which currency to invoice

$\Rightarrow$ shadow value of ECI as function of peers decisions and economic conditions

- Given a network structure $\mathbf{G}_t$, optimal invoicing decisions (potentially) depends on:
  - own characteristics and aggregate conditions
  - connected countries invoicing decisions and characteristics

$\mathbf{G}_t$: Adjacency matrix of (lagged) bilateral trade intensities; $g_{ij,t}$ = share of imports (exports) of country i to country j out of total total imports (exports) of i; $g_{ii,t} = 0$

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A Linear Quadratic model of (excessive) currency invoicing

Assuming quadratic cost of holding excessive currency invoicing $y_{i,t}$, country i's payoff function is:

$$u_i(y_t|\mathbf{G}_t) \quad = \quad \tilde{\mu}_{i,t} y_{i,t} - \frac{1}{2} y_{i,t}^2. \tag{1}$$

where the per unit shadow value is:

$$\tilde{\mu}_{i,t} := \underbrace{\mu_{i,t}}_{:=\bar{\mu}_i + \epsilon_{i,t}} + x_{i,t}\delta + x_{p,t}\rho + \underbrace{\phi \sum_{j \neq i} g_{ij,t} y_{j,t} + \sum_{j \neq i} g_{ij,t} x_{j,t} \theta}_{\text{network spillovers}} \tag{2}$$

and: $x_{i,t} = i$'s characteristics and $x_{p,t} =$ common controls

The bilateral network influences are captured by the cross-derivatives for $i \neq j$:

$$\frac{\partial^2 u_i(y_{i,t}, \{y_{j,t}\}_{j \neq i} | \mathbf{G}_t)}{\partial y_{i,t} \partial y_{j,t}} = \phi g_{ij,t},$$

$\phi > 0$: strategic complementarity

$\phi < 0$: strategic substitution

$\theta \neq 0$: direct externalities of trading partners' characteristics

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From model to data

- The FOCs of the model yield a so called Spatial Durbin Model (SDM)

$$y_{i,t} = \bar{\mu}_i + x_{i,t}\delta + x_{p,t}\rho + \phi \sum_j g_{ij,t} y_{j,t} + \sum_j g_{ij,t} x_{j,t}\theta + \epsilon_{i,t} \tag{3}$$

  that can be estimated consistently via MLE/QMLE/GMM methods

⇒ Bayesian estimation via Gibbs sampling ($\delta,\ \rho,\ \theta\ ,\ \mathbf{\Sigma}_\epsilon | \ \phi$ and $\phi \mid \delta,\ \rho,\ \theta\ ,\ \mathbf{\Sigma}_\epsilon$)

- The above nests other (spatial) formulations:
  1. Spatial Autoregressions (SAR/SLM, e.g. Ozdagli and Weber (2023)), i.e. $\theta = \mathbf{0}$.
  2. Spatial Error Model (SEM, e.g. Denbee et al. (2021)), i.e. spatial dependency only via the error structure ($\equiv$ to $\theta = -\phi\ \delta$)
  3. Panel ($\phi = 0$ and $\theta = \mathbf{0}$) i.e. no spatial dependency.

⇒ (robust) Bayesian model selection as test of network spillovers

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Empirical Evidence

Dataset construction

We construct a large international panel of cross-border currency invoicing

- Combine IMF *Direction of Trade Statistics* database with Boz et. al (2022) currency invoicing shares $\rightarrow$ aggregate imports/exports in Dollar/Euro for each country
- Deducting bilateral trade with USA/Euro Area $\rightarrow$ excessive currency invoicing
- Combine this with
  - CPI and GDP data (IMF)
  - Exchange rate data (Reuters and the BIS)
  - Firm-level USD/Euro denominated debt (Mrkaic, Kim and Mano (2020))
  - SWAP line data from Tokuoka et. al (2021) and the *The Yale Program on Financial Stability* database
  - Financial market development index (Svirydzenka (2016))
  - Foreign Direct investment flows (Worldbank)

Full dataset: 73 countries, 2004:01 to 2019:12 (covers on on average 72-74% of trade)

Note: ECIs, FDIs and FDs normalized by GDP, and all variables are standardised

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Result 1: Are there network spillovers?

Table 1: The posterior likelihood of trade-network spillovers: **ECI**

Specification:		ECI^{Ex}_{USD}	ECI^{Ex}_{EUR}	ECI^{Im}_{USD}	ECI^{Im}_{EUR}
Panel	ln p_m	215.203	-947.234	783.950	-2362.849
	$prob_m$	0.000	0.000	0.000	0.000
SEM	ln p_m	201.572	-888.400	779.850	-2381.743
	$prob_m$	0.000	0.000	0.000	0.000
SAR	ln p_m	225.890	-909.454	799.965	-2323.090
	$prob_m$	0.000	0.000	0.000	0.000
SDM	ln p_m	272.245	-799.016	903.468	-2286.918
	$prob_m$	1.000	1.000	1.000	1.000

The table reports the logarithm of the marginal likelihood (ln p_m) of the data given the model and the posterior model probabilities ($prob_m$). Models are separately estimated on each dataset using our baseline specification.

Data overwhelmingly supports network spillovers, and the SDM in particular.

Also using Aggregate Currency Invoicing data

Result 1: Are there network spillovers?

Table 1: The posterior likelihood of trade-network spillovers: **ACI**

Specification:		ACI^{Ex}_{USD}	ACI^{Ex}_{EUR}	ACI^{Im}_{USD}	ACI^{Im}_{EUR}
Panel	ln p_m	1649.287	2035.639	1577.739	213.969
	$prob_m$	0.000	0.000	0.000	0.000
SEM	ln p_m	1630.335	2109.841	1603.161	295.518
	$prob_m$	0.000	0.000	0.000	0.000
SAR	ln p_m	1669.081	2098.875	1602.787	290.647
	$prob_m$	0.000	0.000	0.000	0.000
SDM	ln p_m	1791.431	2326.812	1770.862	512.618
	$prob_m$	1.000	1.000	1.000	1.000

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Result 2: What type of network spillovers do we observe?

Table 2: The Drivers of Export-based Dollar Excess Currency Invoicing

	Independent Variables												
	(1)		(2)				(3)	(4)				(5)		(6)
	CPI	$CPIVol$	$FXChng_{USD}$	$FXChng_{EUR}$	$FXVol_{USD}$	$FXVol_{EUR}$	TS^{Ex}	FD_{USD}	$FDChng_{USD}$	FD_{EUR}	$FDChng_{EUR}$	$SWAP_{USD}$	$SWAP_{EUR}$	FMI
Direct Effect	0.010	0.023***	-0.018	0.014	-0.018	0.000	-0.080***	0.058***	0.012	0.024***	-0.000	0.093***	-0.104**	0.003
	(0.145)	(0.001)	(0.178)	(0.144)	(0.132)	(0.971)	(0.000)	(0.000)	(0.158)	(0.002)	(0.975)	(0.004)	(0.010)	(0.618)
Total Effect	-0.046**	0.010	-0.092	-0.043	0.094	-0.023	-0.138***	-0.016	0.035	0.003	-0.013	-0.105	-0.391***	0.070**
	(0.091)	(0.351)	(0.205)	(0.254)	(0.175)	(0.394)	(0.000)	(0.673)	(0.204)	(0.924)	(0.747)	(0.272)	(0.000)	(0.041)
ϕ	0.241***		0.241***				0.256***	0.310***				0.231***		0.229***
	(0.000)		(0.000)				(0.000)	(0.000)				(0.000)		(0.000)
R^2	0.944		0.944				0.944	0.949				0.944		0.944
NObs	9766		9822				9822	8294				9822		9822
log marginal	251.719		250.807				318.716	5.384				253.470		236.432

The table reports the posterior means of the estimated effects and their respective p-values in brackets. In addition to the listed independent variables, we always include country- and time-fixed effects, lags of inward foreign direct investments, outward foreign direct investments, USD export-, USD import-, EUR export-, and EUR import-based excessive currency invoicing as control variables. Direct effect is the time series average of the diagonal of partial derivatives. Total effect is the time series average of the average row sum of partial derivatives.

Key feature:

1. Large and significant $\phi > 0$, stable across specifications and currencies

$\Rightarrow$ Invoicing decisions are strategic complements

2. Very similar estimates using ACI (somehow larger ϕ)

Note VAR-like structure for lagged ECIs

Result 2: What type of network spillovers do we observe?

Table 2: The Drivers of Export-based Euro Excess Currency Invoicing

	Independent Variables													
	(1)		(2)				(3)	(4)				(5)		(6)
	CPI	*CPIVol*	$FXChng_{USD}$	$FXChng_{EUR}$	$FXVol_{USD}$	$FXVol_{EUR}$	TS^{Ex}	FD_{USD}	$FDChng_{USD}$	FD_{EUR}	$FDChng_{EUR}$	$SWAP_{USD}$	$SWAP_{EUR}$	*FMI*
Direct Effect	0.014**	0.017**	-0.011	-0.005	-0.004	0.020**	0.015**	0.009	0.023**	0.001	0.014	-0.130***	0.024	0.008
	(0.074)	(0.032)	(0.453)	(0.648)	(0.786)	(0.036)	(0.050)	(0.380)	(0.013)	(0.909)	(0.134)	(0.000)	(0.600)	(0.271)
Total Effect	0.034	0.038***	-0.116	-0.043	-0.008	0.124***	0.044**	0.018	0.021	0.075**	-0.121**	0.260**	-0.341**	-0.007
	(0.341)	(0.004)	(0.206)	(0.366)	(0.929)	(0.000)	(0.024)	(0.686)	(0.509)	(0.057)	(0.011)	(0.036)	(0.010)	(0.876)
ϕ	0.333***		0.320***				0.340***	0.340***				0.326***		0.339***
	(0.000)		(0.000)				(0.000)	(0.000)				(0.000)		(0.000)
R^2	0.971		0.971				0.971	0.974				0.971		0.971
NObs	9737		9793				9793	8295				9793		9793
log marginal	-797.956		-792.069				-800.447	-933.405				-795.674		-806.300

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Result 3: Are there contemporaneous effects across imports and exports?

- Analysed USD and Euro ECI, with lagged ECIs as controls

$\Rightarrow$ estimated spatial spillovers (*contemporaneous across countries*) but so far silent on *contemporaneous within country* links of the different currency export/import ECIs

But: SDM consistently estimates conditional mean; leaves us with reduced form Vector Autoregression (VAR) equations of currency export/import ECIs for each country

$$\begin{bmatrix} y_{USD,t+1}^{Im\top} \\ y_{EUR,t+1}^{Im\top} \\ y_{USD,t+1}^{Ex\top} \\ y_{EUR,t+1}^{Ex\top} \end{bmatrix}^{\top} = \begin{bmatrix} \mathbb{E}_t[y_{USD,t+1}^{Im\top}] \\ \mathbb{E}_t[y_{EUR,t+1}^{Im\top}] \\ \mathbb{E}_t[y_{USD,t+1}^{Ex\top}] \\ \mathbb{E}_t[y_{EUR,t+1}^{Ex\top}] \end{bmatrix}^{\top} + \begin{bmatrix} \eta_{USD,t+1}^{Im\top} \\ \eta_{EUR,t+1}^{Im\top} \\ \eta_{USD,t+1}^{Ex\top} \\ \eta_{EUR,t+1}^{Ex\top} \end{bmatrix}^{\top} \tag{4}$$

$\Rightarrow$ as in structural VAR, Γ_0, the contemporaneous relation matrix, is related to covariance matrix of residuals, $Var(\eta) = \Gamma_0^{-1} \left(\Gamma_0^{-1}\right)^{\top}$

Result 3: Are there contemporaneous effects across imports and exports?

- Analysed USD and Euro ECI, with lagged ECIs as controls

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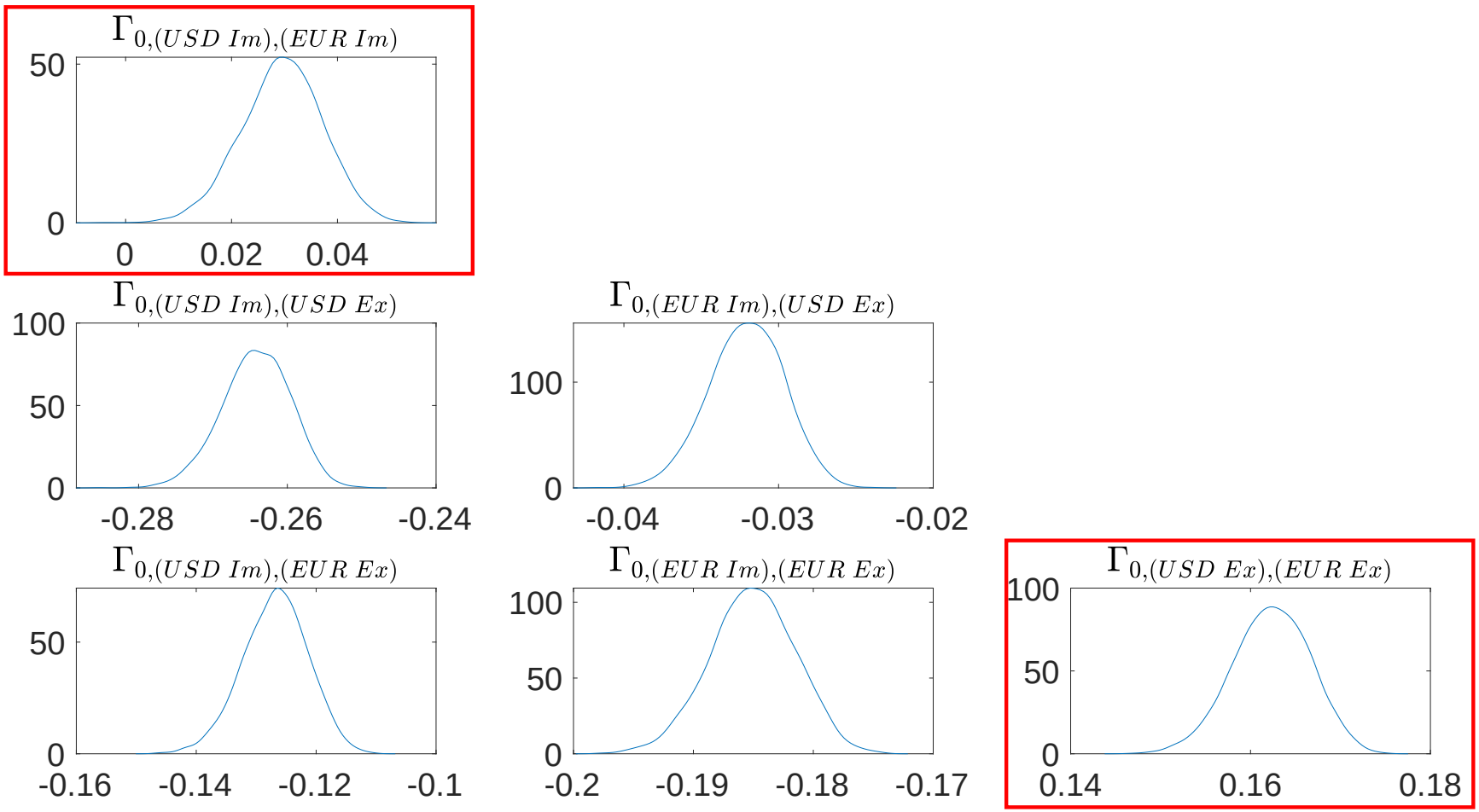
- Identify Γ_0 by imposing lower triangular structure, i.e. an ordering restriction:
  1. export ECI reacts contemporaneously to the shocks of import ECI
  2. a pecking order between currencies; EUR react to USD quantities

$\Rightarrow$ recover *contemporaneous within country* links, Γ_0, between USD/ EUR export/ import ECIs averaged across countries

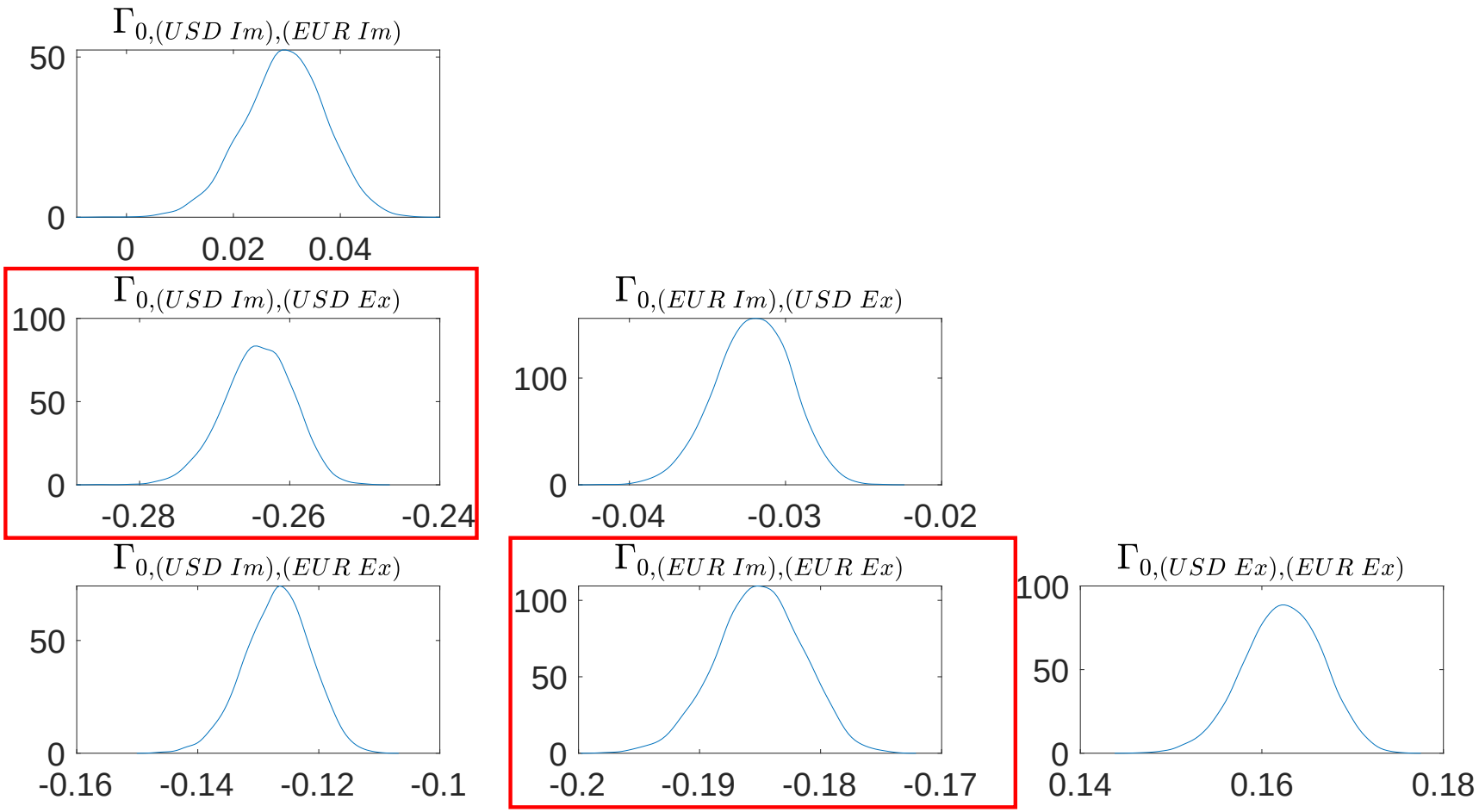
Result 3: S-VAR contemporaneous effects



Posterior distribution of the off-diagonal elements of Γ_0 corresponding to the SDM of import-based and export-based excessive currency invoicing denominated in dollars and in euros. The ordering of the variables is $\eta = [\eta^{Im}_{USD}, \eta^{Im}_{EUR}, \eta^{Ex}_{USD}, \eta^{Ex}_{EUR}]$. Negative Γ_0 coefficient implies a positive contemporaneous relationship and vice versa.

1. Substitution between EUR and USD ECI for exports and imports

Result 3: S-VAR contemporaneous effects



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2. Evidence of natural hedging: tend to invoice exports in currency of imports

Conclusion

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Research Question: are currency invoicing choices of firms in a country affected by those of its trading partners?

- We find strong evidence of network spillovers in currency invoicing after taking into account variables proposed in DC literature; data clearly prefers SDM
- There is evidence of strategic complementarity in currency invoicing across countries for both USD and EUR ($\phi > 0$)
- Significant evidence of natural hedging between export and import currencies, and substitution between Dollar and Euro as a vehicle currency.

Further results in paper:

- Strategic complementarity amplifies shocks in system. Key currency players are countries that use a currency extensively (e.g. Russia, South Korea), but also countries central to the trade network (e.g. Germany, Netherlands)
- Counterfactual exercise: show that BRI(CS) countries matter as much as EU countries for the standing of the Dollar (but via very different channels); strategic complementarity generates fragility for Dollar

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Appendix

Result 4: The Network Key Players – Spatiotemporal IRFs

Estimated SDM allows us to identify country whose shocks are expected to have the largest impact on the overall ECI through network.

- Shock propagation is both across countries and time.

$$STIRF_{i,t,\tau} = \frac{\partial \mathbf{1}^\top y^{\$}_{t+\tau}}{\partial \epsilon^{\$}_{i,t}} \sigma^{\$}_{i,t} = \begin{cases} \mathbf{1}^\top \{D_t^{-1} \Lambda^{-1} M_t\}_{\cdot,i} \sigma \text{ for } \tau = 0 \\ \mathbf{1}^\top \{D_{t+\tau}^{-1} \Lambda^{-1} \prod_{j=0}^{\tau-1} M_{t+\tau-j} A_{t+\tau-j} M_t\}_{\cdot,i} \sigma \text{ for } \tau \geq 1 \end{cases}$$

  where $\{\}_{\cdot,i}$ is the operator returning the ith row of a matrix, $M_t = (I - \phi G_t)^{-1}$ (spatial propagation), $A_t = (\alpha I + \eta G_t)$ (temporal propagation), $D_t = diag(GDP_{i,t}^{-1})$, $\Lambda = diag(\sigma_i^{-1})$, $\sigma_i = Var(y_{i,t}/GDP_{i,t})^{1/2}$, $y_t = \Lambda D_t y_t^{\$}$, and $y_t^{\$}$ is ECI in currency units.

- $STIRF^e \equiv STIRF - shock \rightarrow$ isolates the network amplification of the shock.

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Result 4: Key players for a currency

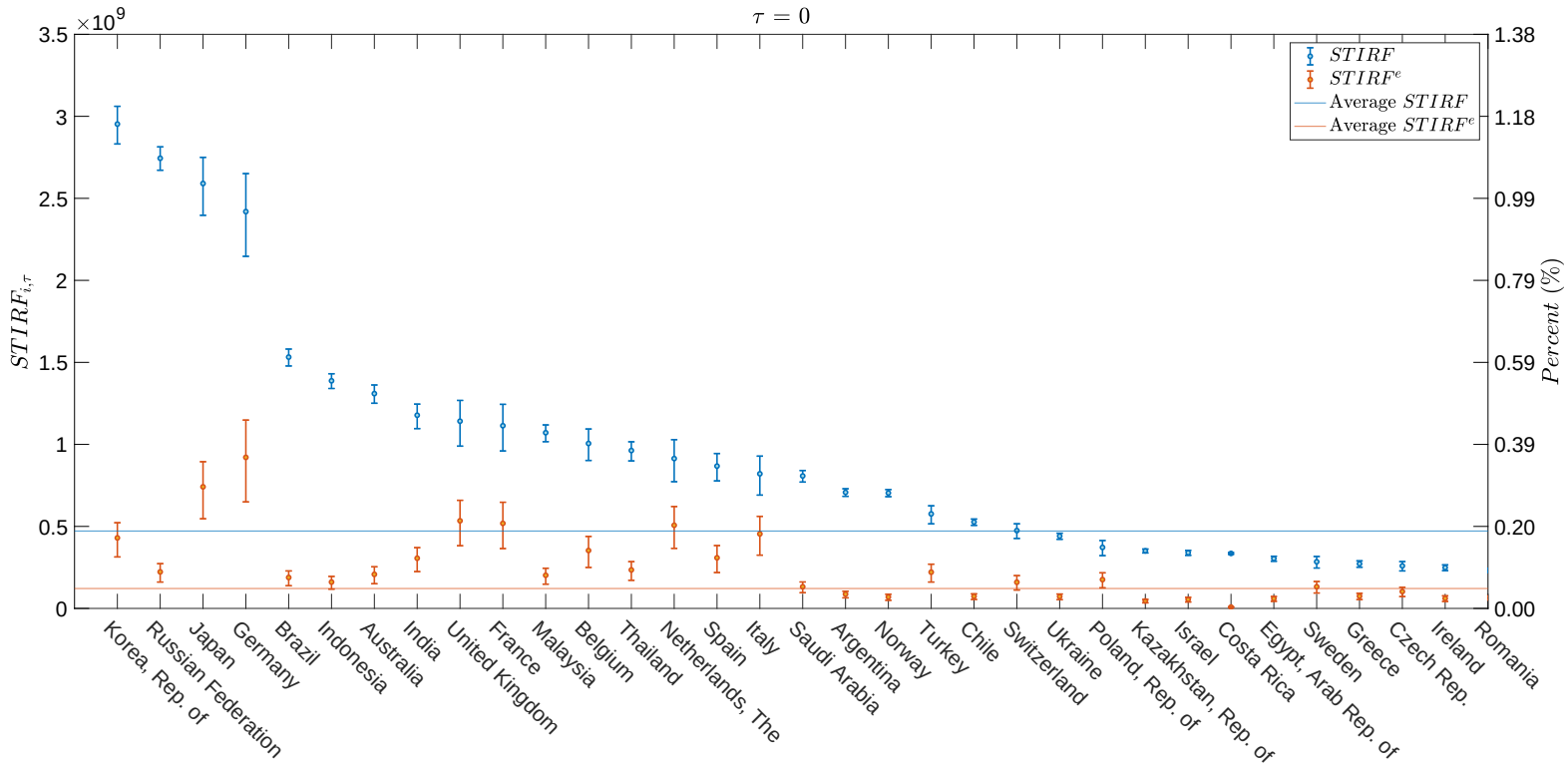

Figure 2: ECI Impulse Response Function of Dollar Exports

Spatiotemporal impulse response function to a domestic one standard deviation shock. Left axis is in Dollars. Right axis is in percentage of monthly export-based excess currency invoicing. Box-plots report posterior means and centred 95% posterior coverage.

1. Some usual suspects; oil exporters and big trading nations
2. Very heterogeneous direct/network effect – central to trade vs. pure exporters

Result 4: Key players for a currency

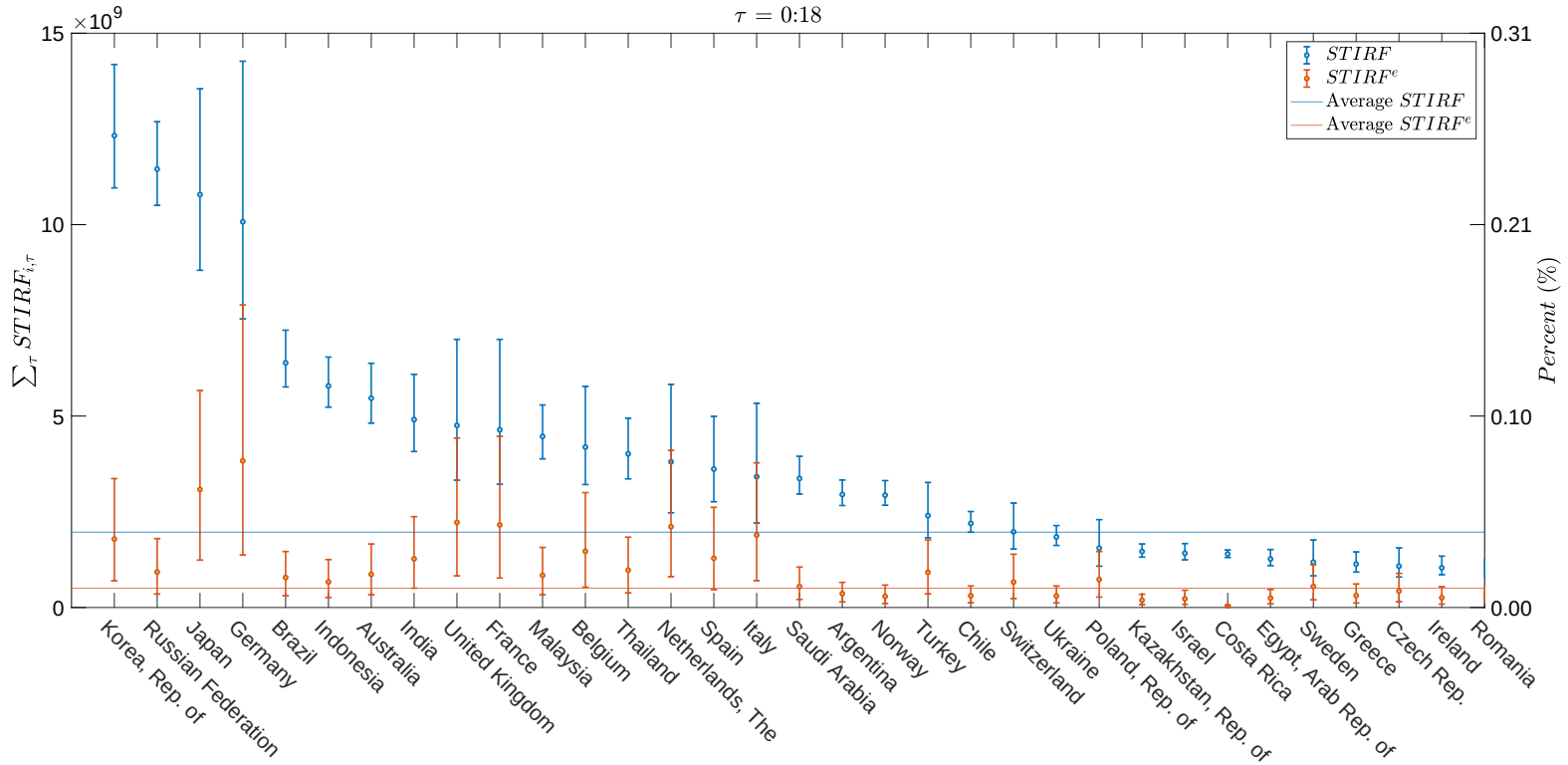

Figure 2: ECI Impulse Response Function of Dollar Exports: 18 months cumulative

Cumulative spatiotemporal impulse response function to a domestic one standard deviation shock. Left axis is in Dollars. Right axis is in percentage of monthly export-based excess currency invoicing. Box-plots report posterior means and centred 95% posterior coverage.

3. Sizable and persistent effects of shocks

Result 4: Key players for a currency

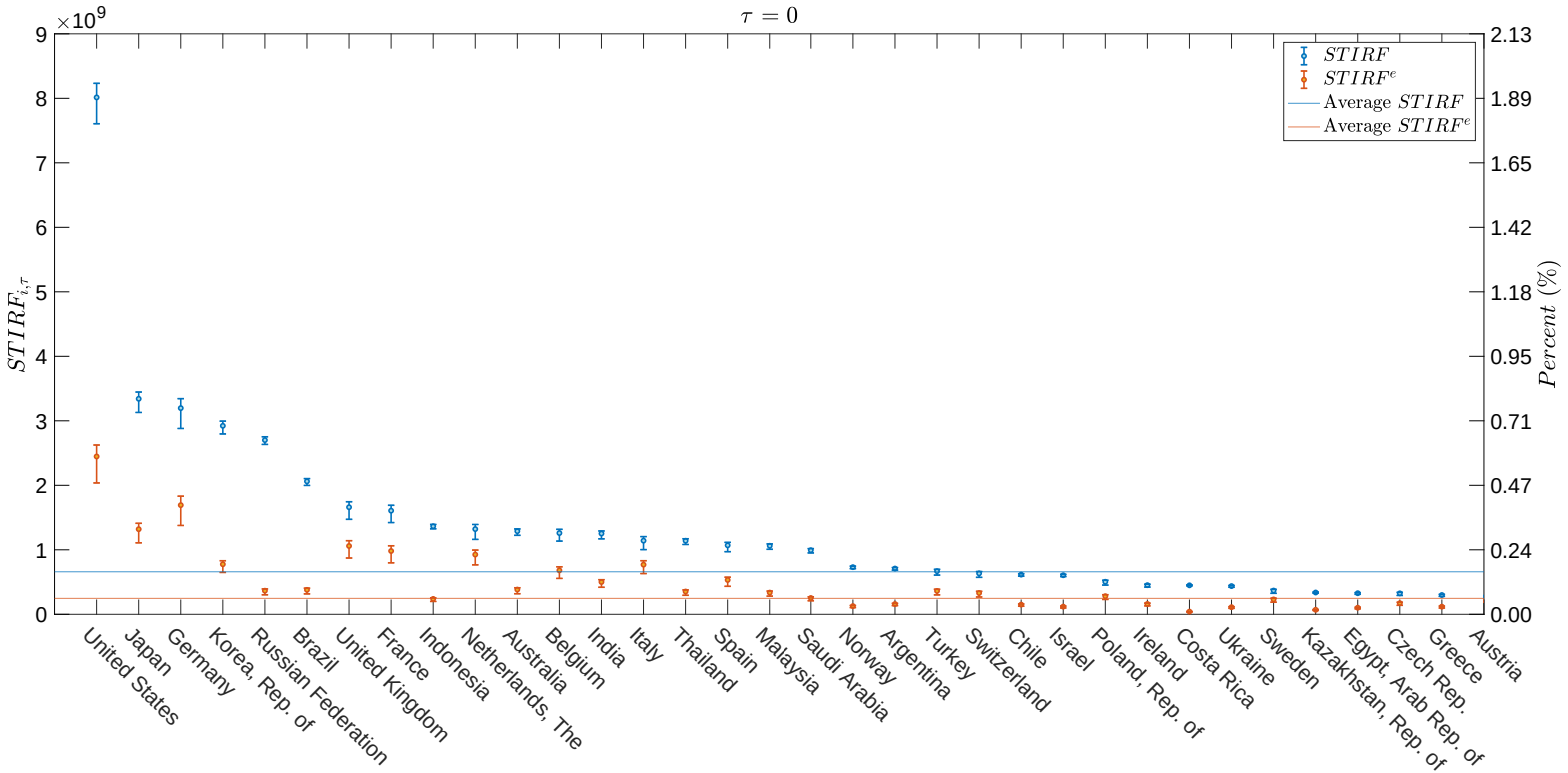

Figure 2: ACI Impulse Response Function of Dollar Exports

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4. Very similar for ACI (and US becomes the key player).

Result 4: Key players for a currency

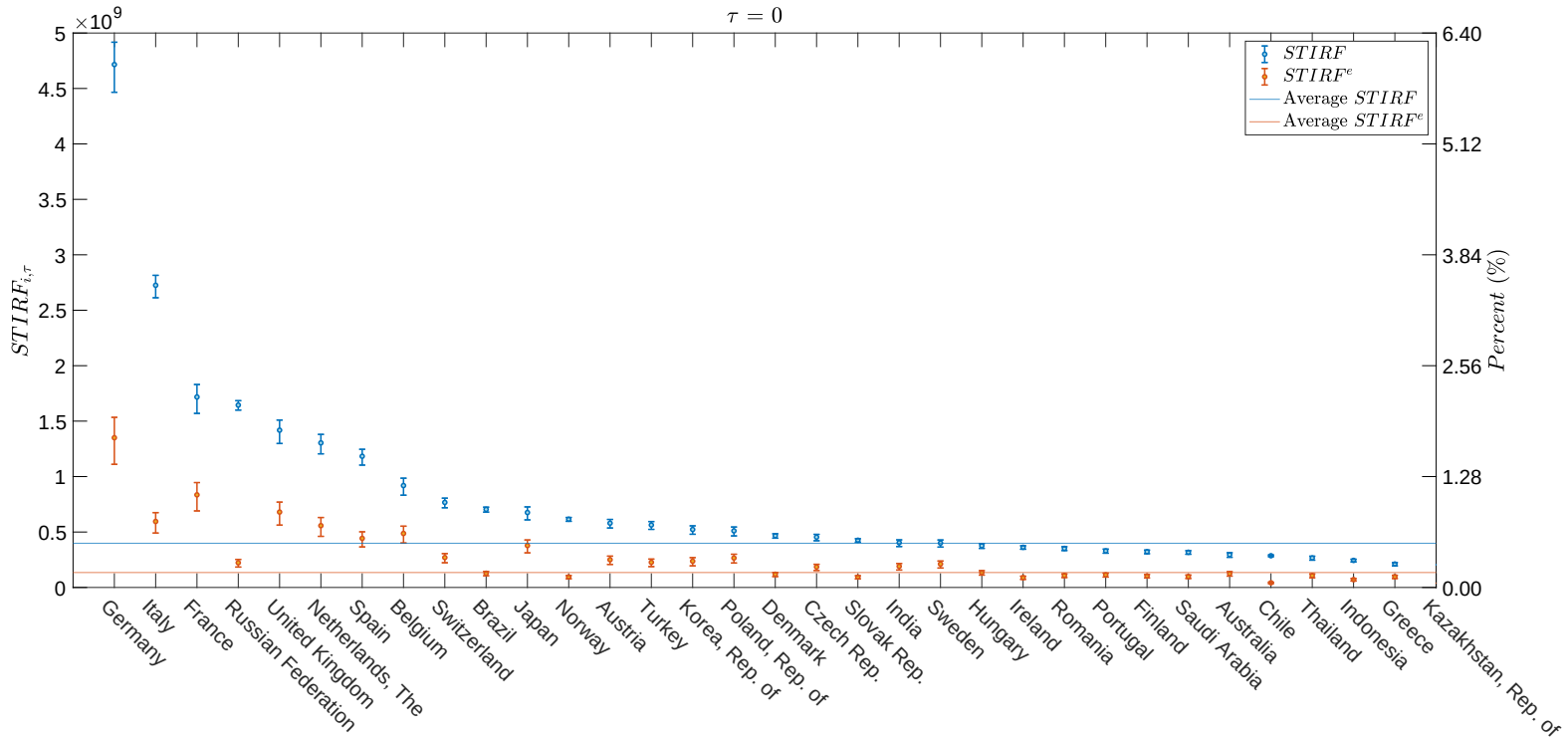

Figure 2: ECI Impulse Response Function of Euro Exports

Spatiotemporal impulse response function to a domestic one standard deviation shock. Left axis is in Dollars. Right axis is in percentage of monthly export-based excess currency invoicing. Box-plots report posterior means and centred 95% posterior coverage.

5. Effects much larger for EUR (large ϕ)
6. European trade centres are key players

Result 4: Key players for a currency

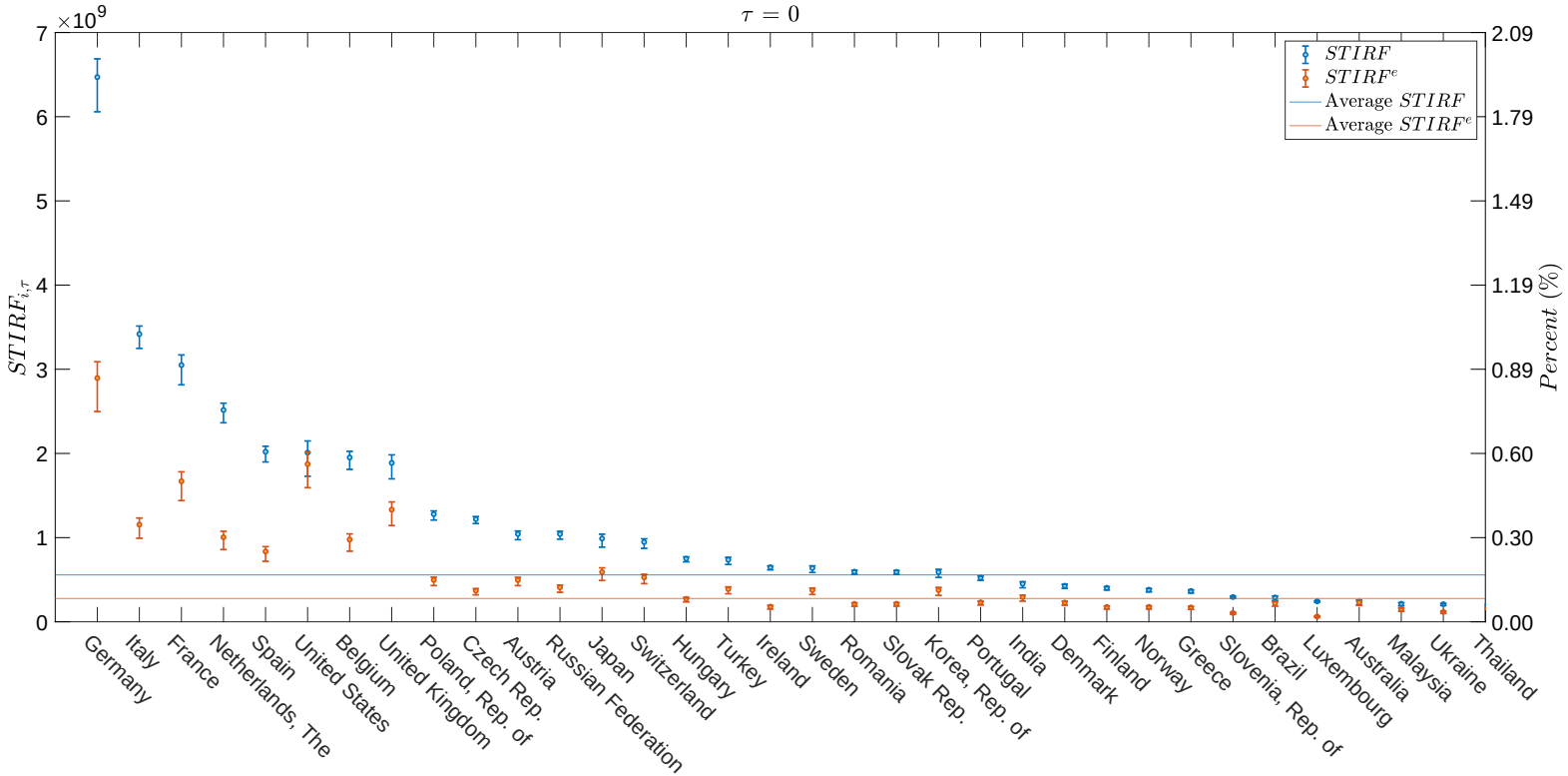

Figure 2: ACI Impulse Response Function of Euro Exports: 18 months cumulative

Spatiotemporal impulse response function to a domestic one standard deviation shock. Left axis is in Dollars. Right axis is in percentage of monthly export-based aggregate currency invoicing. Box-plots report posterior means and centred 95% posterior coverage.

7. Very similar picture with ACI
8. US effect on EUR is almost entirely network generated.

Result 5: Counterfactual analysis: What if some stop using the Dollar?

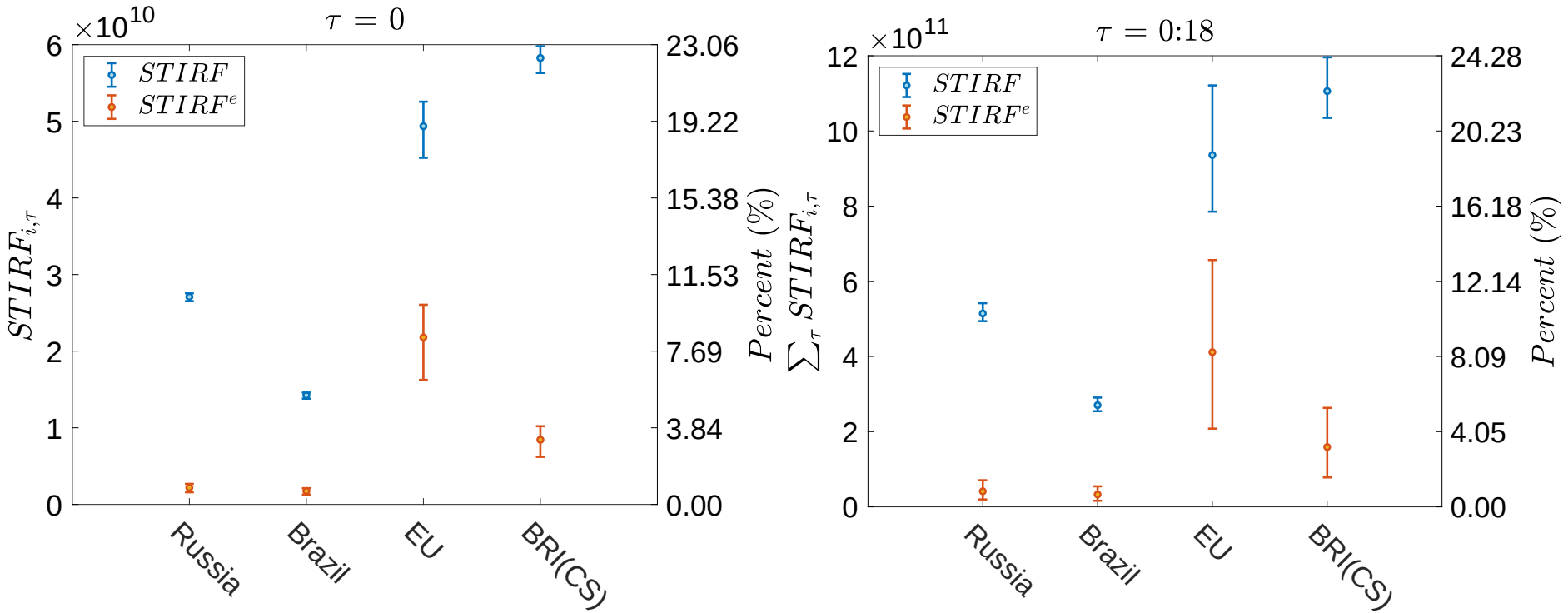

Figure 3: Counterfactual: abandonment of Dollar as vehicle currency – ECI

Spatiotemporal impulse response functions to a shock sequence that sets the excessive currency invoicing of the specified countries to zero permanently. BRICS countries excludes China and South Africa due to missing observations. Left axis is in Dollars. Right axis is in percentage of monthly export-based excess currency invoicing. Box-plots report posterior means and centred 95% posterior coverage.

1. BRI(CS) have similar impact as EU
2. Different channel: almost half of EU effect is due to trade network.
3. Effect of abandonment are very large, for both ECI and ACI.

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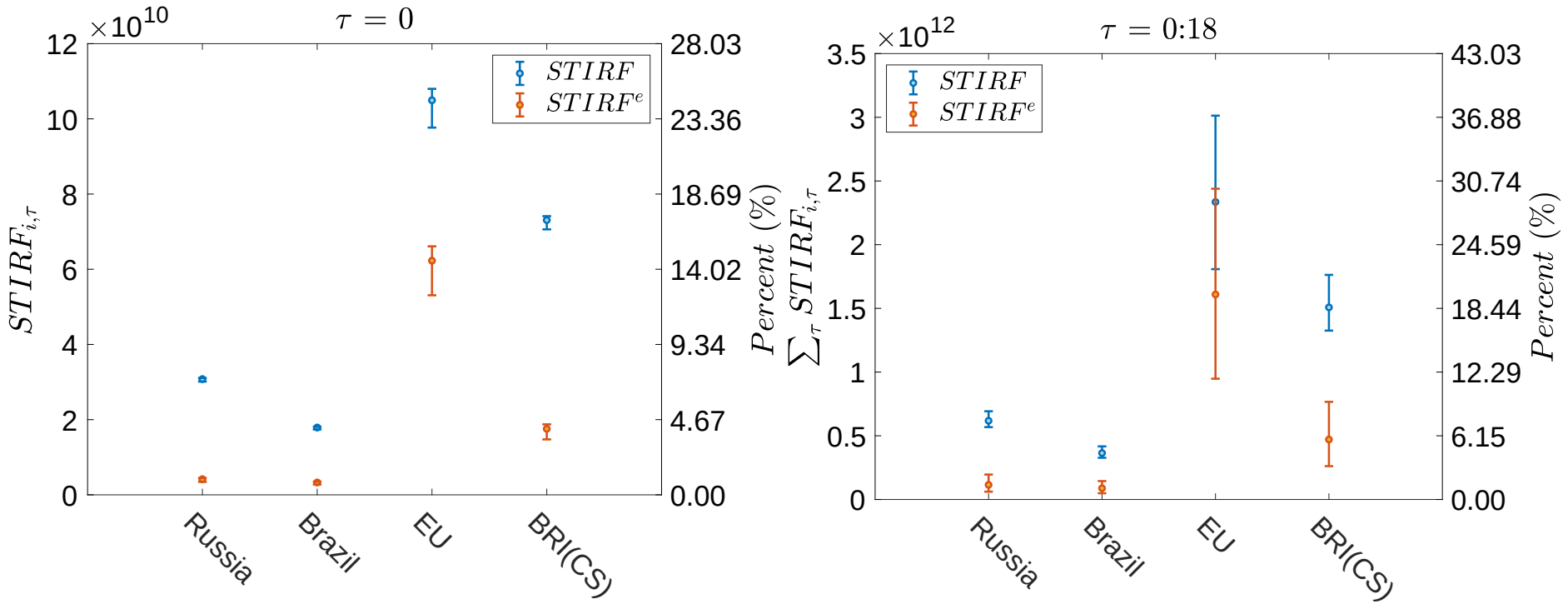

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Import-based excessive currency invoicing

Focus on *excessive* currency invoicing:

- ECI: invoicing in a currency above the bilateral trade volume with a currency's home countries (e.g. country *i*'s total US Dollar imports *minus* imports by *i* to the US)

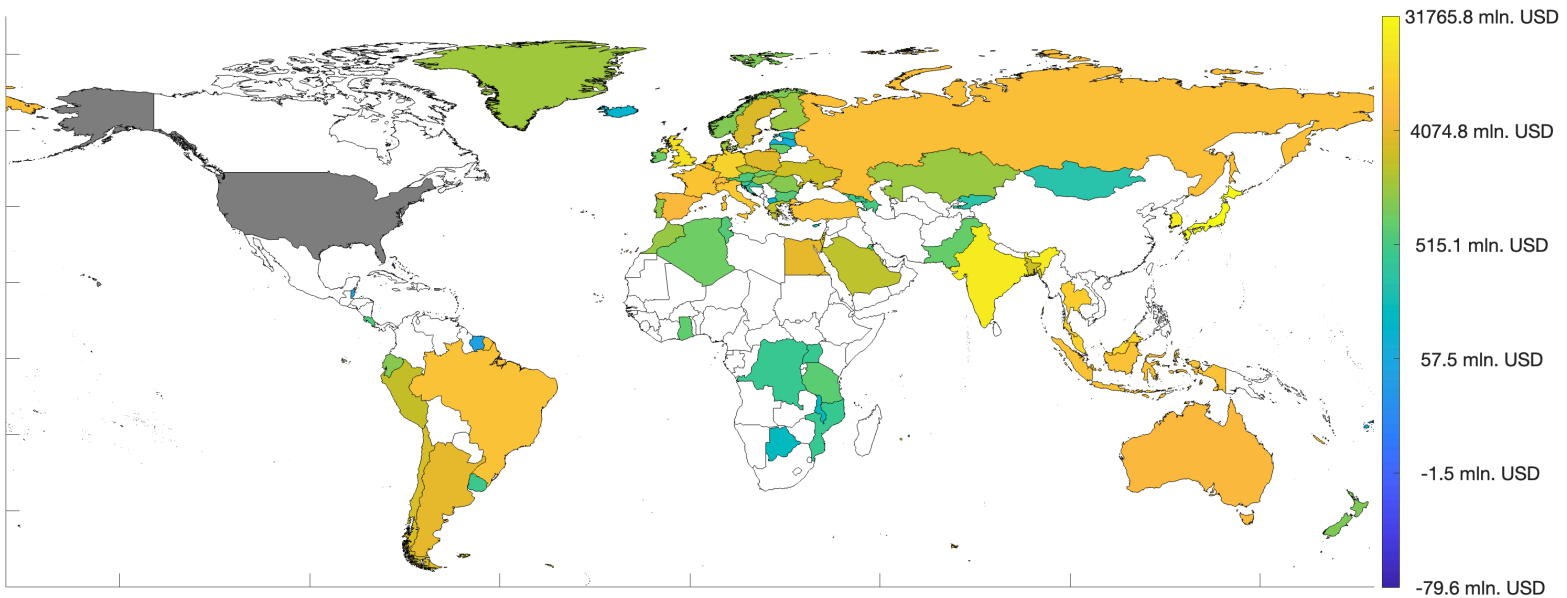

Figure 4: US Dollar Import-based Excessive Currency Invoicing.

Excessive currency invoicing is calculated from bilateral trade data from the IMFs *Direction of Trade Statistics* and data on the shares of aggregate imports/ exports invoiced by US Dollars and Euros from Boz et al. (2022).

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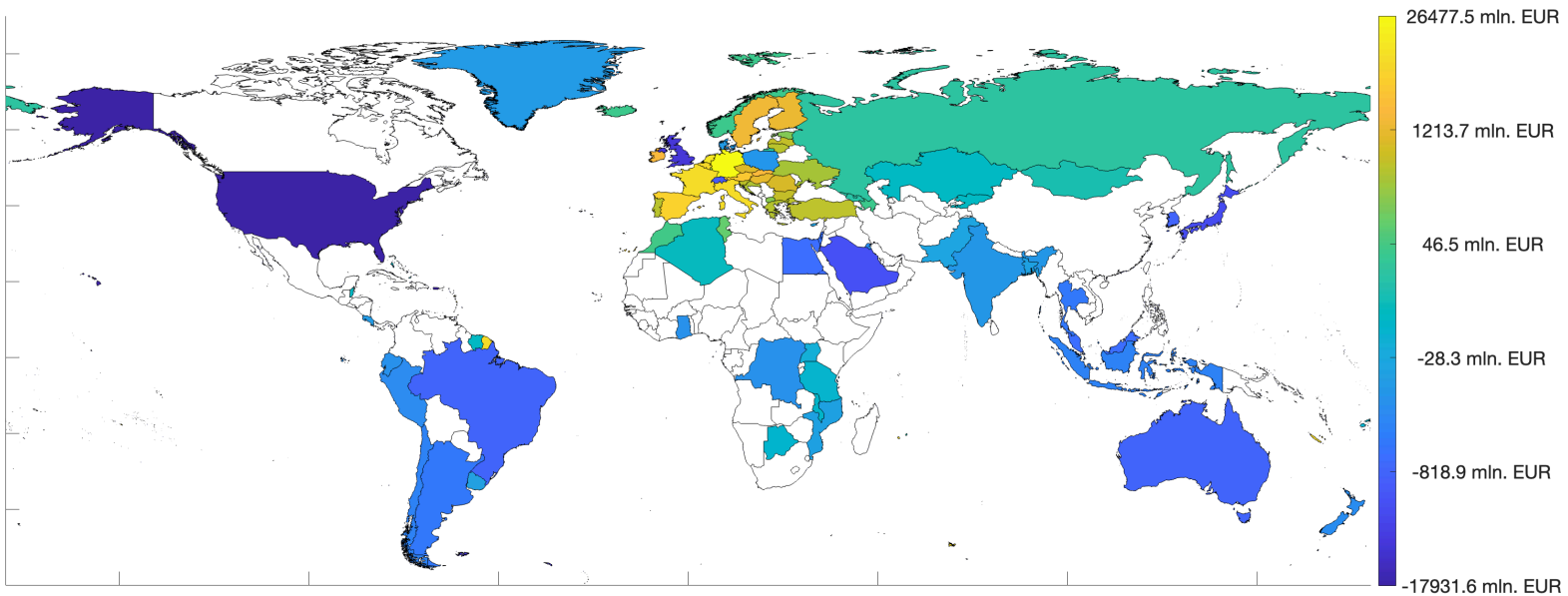

Figure 4: Euro Import-based Excessive Currency Invoicing.

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Spillovers in aggregate currency invoicing

Table 3: The Drivers of Export-based Dollar Aggregate Currency Invoicing

	Independent Variables													
	(1)		(2)				(3)	(4)				(5)		(6)
	CPI	*CPIVol*	$FXChng_{USD}$	$FXChng_{EUR}$	$FXVol_{USD}$	$FXVol_{EUR}$	TS^{Ex}	FD_{USD}	$FDChng_{USD}$	FD_{EUR}	$FDChng_{EUR}$	$SWAP_{USD}$	$SWAP_{EUR}$	*FMI*
Direct Effect	0.000	0.021***	-0.023**	0.014	-0.012	-0.015**	-0.109***	0.024***	0.029***	0.009	-0.016**	0.019	0.012	0.003
	(0.990)	(0.000)	(0.051)	(0.115)	(0.248)	(0.081)	(0.000)	(0.001)	(0.000)	(0.156)	(0.020)	(0.507)	(0.713)	(0.621)
Total Effect	-0.136***	0.002	-0.193**	-0.107***	0.164**	-0.043	-0.164***	0.019	0.026	0.027	-0.101**	0.338***	-0.501***	0.018
	(0.000)	(0.854)	(0.021)	(0.002)	(0.034)	(0.173)	(0.000)	(0.613)	(0.383)	(0.459)	(0.018)	(0.001)	(0.000)	(0.616)
ϕ	0.382***		0.370***				0.347***	0.437***				0.360***		0.359***
	(0.000)		(0.000)				(0.000)	(0.000)				(0.000)		(0.000)
R^2	0.958		0.960				0.960	0.960				0.960		0.960
NObs	9915		9971				9971	8384				9971		9971
ln p_m	1685.075		1677.814				1810.058	1147.844				1673.824		1656.758

The table reports the posterior means of the estimated effects and their respective p-values in brackets. In addition to the listed independent variables, we always include country- and time-fixed effects, lags of inward foreign direct investments, outward foreign direct investments, USD export-, USD import-, EUR export-, and EUR import-based aggregate currency invoicing as control variables.

Key feature:

1. Large and significant $\phi > 0$, stable across specifications and currencies

$\Rightarrow$ Invoicing decisions are strategic complements

Spillovers in aggregate currency invoicing

Table 3: The Drivers of Export-based Euro Aggregate Currency Invoicing

	Independent Variables													
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Direct Effect	0.007	0.021***	-0.034***	0.005	-0.001	-0.006	-0.094***	0.010	0.037***	0.005	-0.016**	-0.020	0.034	-0.004
	(0.235)	(0.000)	(0.002)	(0.552)	(0.883)	(0.473)	(0.000)	(0.157)	(0.000)	(0.361)	(0.015)	(0.452)	(0.271)	(0.433)
Total Effect	-0.083**	0.003	-0.264***	-0.146***	0.176**	-0.011	-0.179***	-0.044	0.040	-0.000	-0.190***	0.444***	-0.665***	-0.061
	(0.018)	(0.792)	(0.005)	(0.000)	(0.043)	(0.758)	(0.000)	(0.276)	(0.225)	(0.994)	(0.000)	(0.000)	(0.000)	(0.130)
ϕ	0.495***		0.481***				0.477***	0.528***				0.450***		0.471***
	(0.000)		(0.000)				(0.000)	(0.000)				(0.000)		(0.000)
R^2	0.964		0.964				0.965	0.967				0.965		0.964
NObs	9916		9972				9972	8385				9972		9972
ln p_m	2207.525		2221.762				2331.518	1774.462				2232.833		2202.865

The table reports the posterior means of the estimated effects and their respective p-values in brackets. In addition to the listed independent variables, we always include country- and time-fixed effects, lags of inward foreign direct investments, outward foreign direct investments, USD export-, USD import-, EUR export-, and EUR import-based aggregate currency invoicing as control variables.

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SVAR identifies spillovers - alternative identification

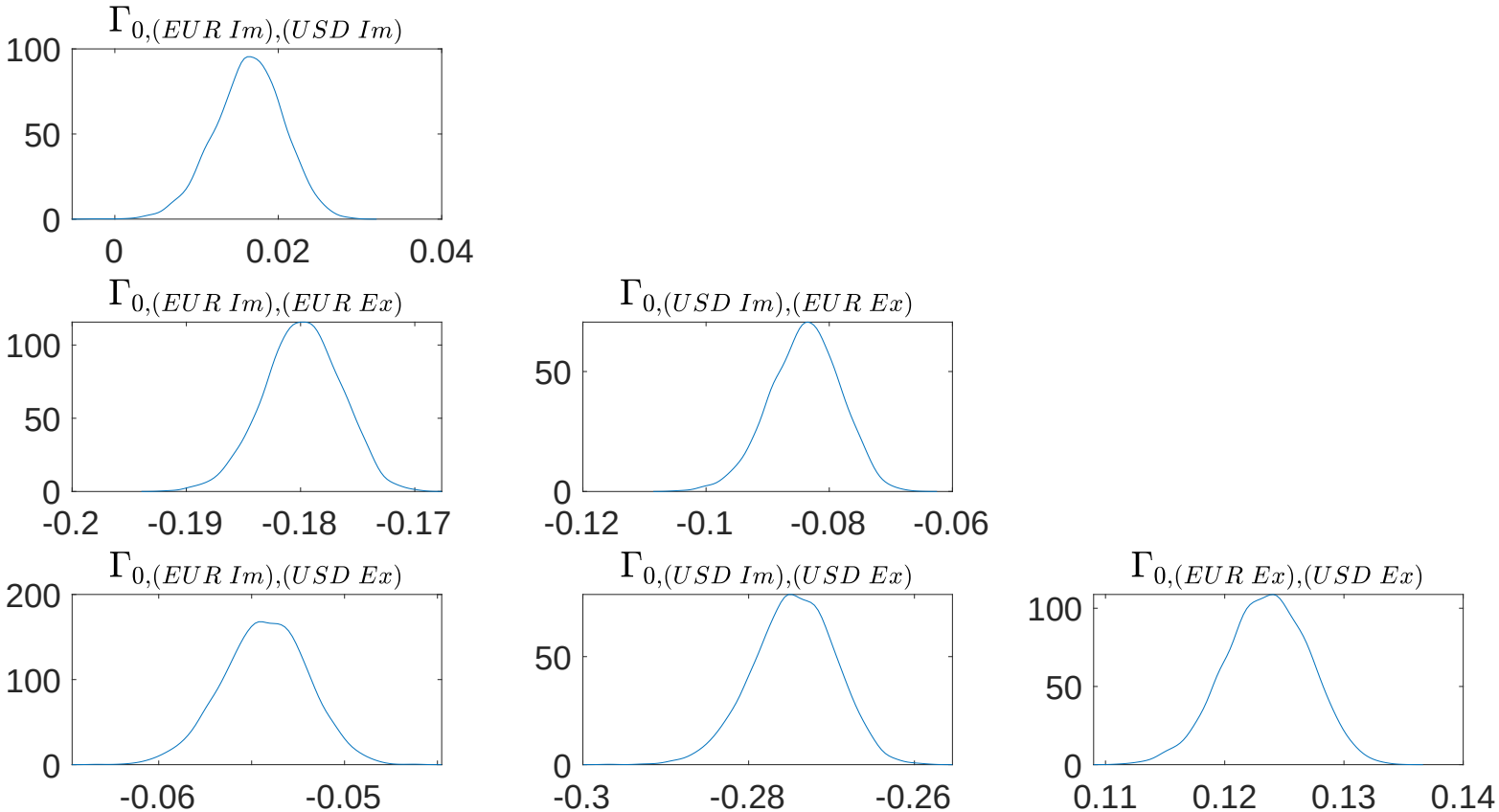

Figure 5: Cross-currency and export-import spillovers - alternative ordering

Posterior distribution of the off-diagonal elements of Γ_0 corresponding to the SDM of import-based and export-based excessive currency invoicing denominated in dollars and in euros. The ordering of the variables is $\eta = [\eta^{Im}_{EUR}, \eta^{Im}_{USD}, \eta^{Ex}_{EUR}, \eta^{Ex}_{USD}]$.