Intervening against the Fed

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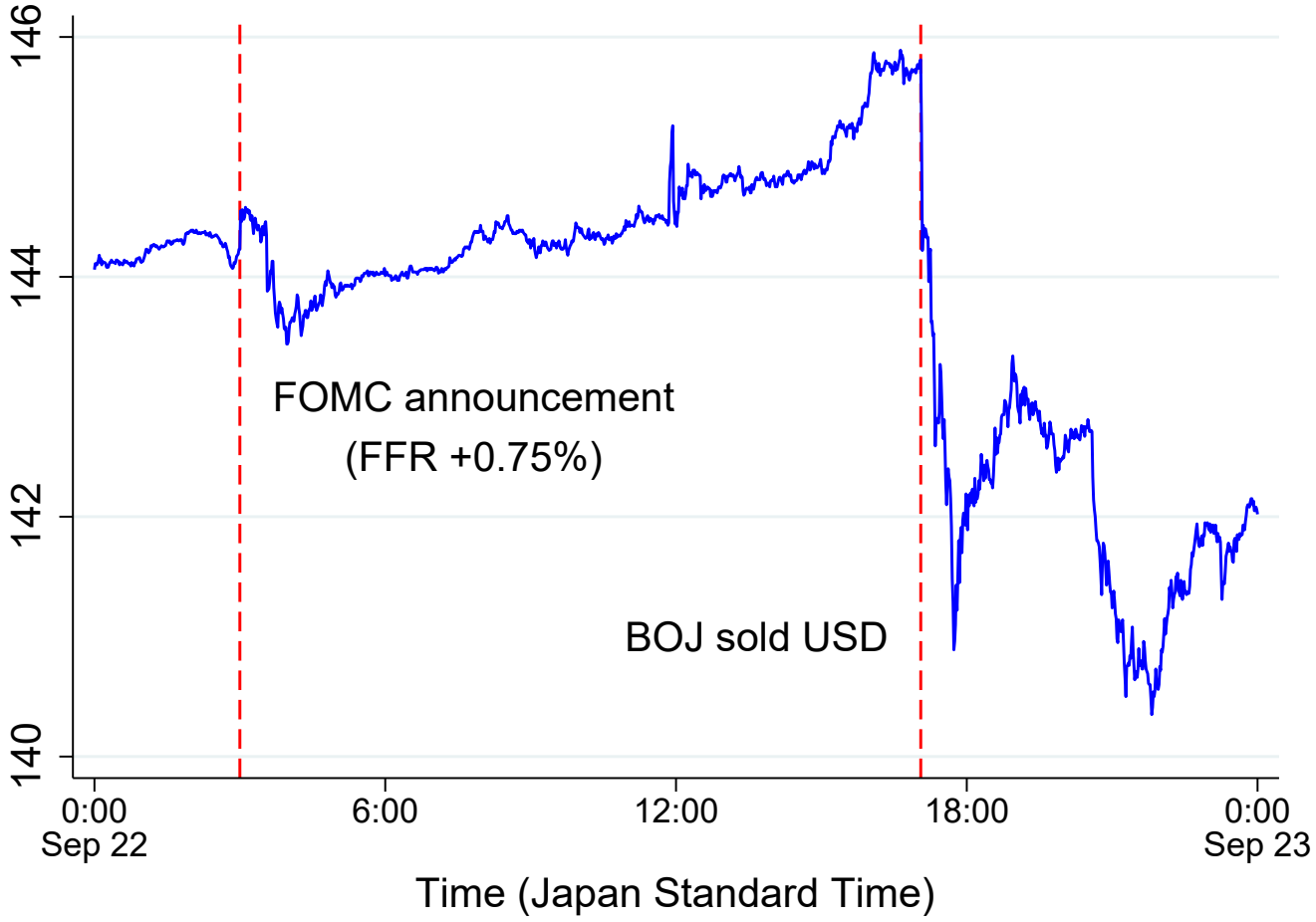
*Disclaimer: The views expressed in the paper are solely those of the authors and do not necessarily represent the views of the Federal Reserve Board or the Federal Reserve System.

Japanese Intervention against Fed: September 22, 2022

Figure 1: Spot Exchange Rate: 1USD = JPY



Note: Higher value implies dollar appreciation / yen depreciation.

Summary

Question:

- How does US monetary policy spill over to other countries?
- Can FXI mitigate the effect of US monetary shocks?
- What's the channel through which FXIs work?

Method:

- Event study using US monetary surprise
- Daily FXI, exchange rate, firm-level stock price and currency denomination of balance sheet in a panel of multiple countries
- Identify FXI via deviation from estimated FXI rule

Result: When the Fed hikes unexpectedly,

- **No FXI** $\Rightarrow$ Local currency **depreciates** + stock price of firms with dollar debt **decreases**
- **FXI** $\Rightarrow$ Exchange rate and stock price are **fully stable**, only firms with dollar debt benefit from FXI

$\Rightarrow$ US monetary policy spills over through balance sheet channel, but FXI can prevent it

Literature

- Foreign Exchange Intervention
  - Theory: Gabaix and Maggiori (2015), Cavallino (2019), Amador et al. (2020), Fanelli and Straub (2021), Itskhoki and Mukhin (2022), Hassan et al. (2022)
  - Empirics: Fatum and Hutchison (2010), Kuesteiner et al. (2018), Adler et al. (2019), Fratzscher et al. (2019)
- High-frequency identification of monetary policy shocks
  - Gurkanyak et al. (2005), Gorodnichenko and Weber (2016), Nakamura and Steinsson (2018a;b), Jarociński and Karadi (2020), Bu et al. (2021)
- Dominant currency
  - Trade: Corsetti et al. (2020), Gopinath et al. (2020), Mukhin (2021)
  - Finance: Akinci and Queralto (2019), Gopinath and Stein (2021)
- Firm Heterogeneity and international trade / finance
  - Amiti et al. (2014), Rodnyansky (2019), Maggiori et al. (2019), Casas et al. (2022), Salomao and Varela (2022)

Data Source

- Period: 2000-2019, 13 countries, 4,060 firms
  - Argentina, Australia, Brazil, Chile, Colombia, Costa Rica, Georgia, Hong Kong, Japan, Mexico, Peru, Switzerland, and Turkey
  - Criteria: daily FXI data is available + intervened against US dollar
- Daily FX intervention: central bank website, FRED, individual contacts
- US monetary shock: Nakamura and Steinsson (2018)
- Exchange rate and stock returns: Datastream
- Balance sheet (currency denomination of debt): Capital IQ
- Fundamentals: Worldscope, OECD Input-Output Table

Summary statistics | FXI Frequency | Sample firms | Firm Selection Criteria | Capital IQ Data

Estimation of FXI Policy Rule

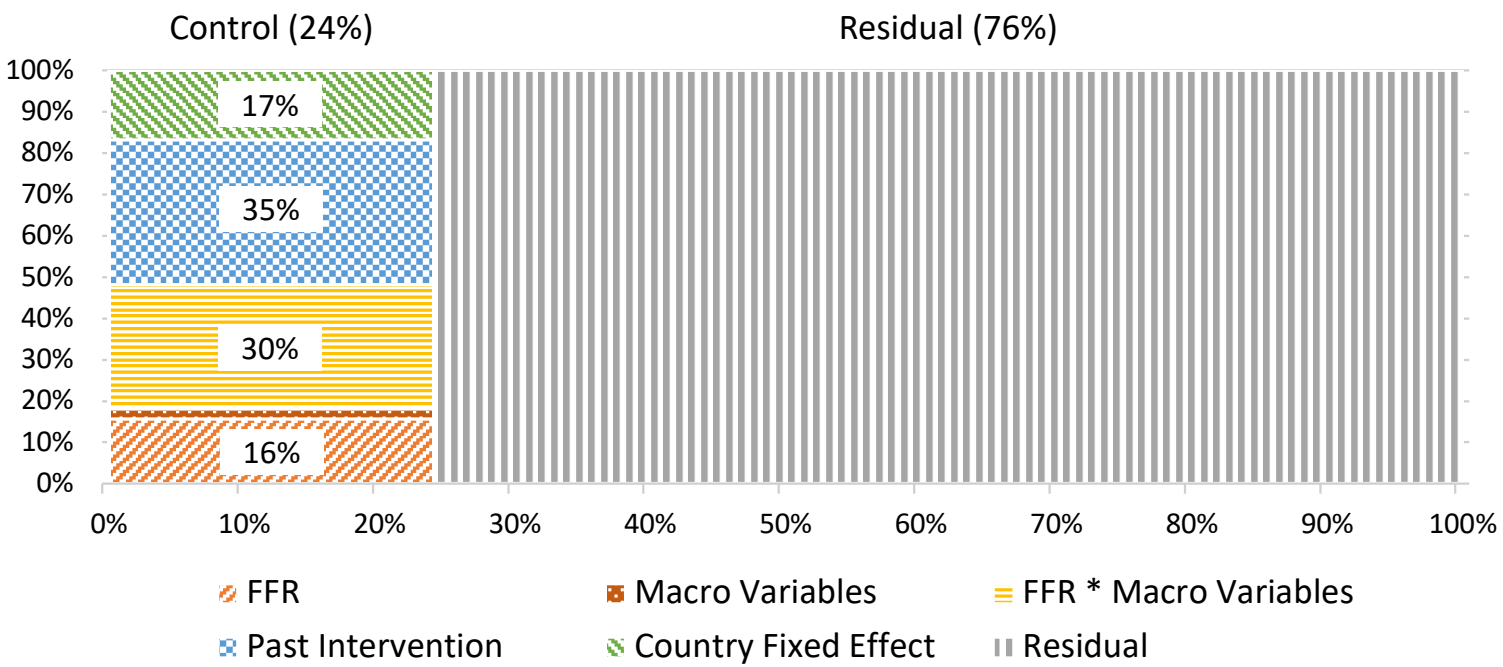
- Identify direct effect of interventions by exploiting deviations from FXI policy rule

$$\widetilde{FXI}_{c,t} = \alpha + \sum_{c} \beta_c (FFR_t \times \gamma_c) + \delta Z_{c,t} + \gamma_c + \epsilon_{c,t}. \quad (1)$$

- $\widetilde{FXI}_{c,t}$: **Counter-intervention** indicator
  - 1 if FFR $\Uparrow$ on date t, CB sells but does not buy USD b/w t and $t+5$
  - -1 if FFR $\Downarrow$ on date t, CB buys but does not sell USD b/w t and $t+5$
- FFR_t: US monetary shock on date t ($FFR_t \Uparrow$ = US tightening)
- $Z_{c,t}$: Controls
  - Past trend and volatility of exchange rate, past intervention, macro variables (policy rate, GDP, CPI inflation, unemployment rate, trade balance over GDP ratio), macro variables $\times$ FFR shock
- γ_c: Country FE

Estimation of FXI Policy Rule

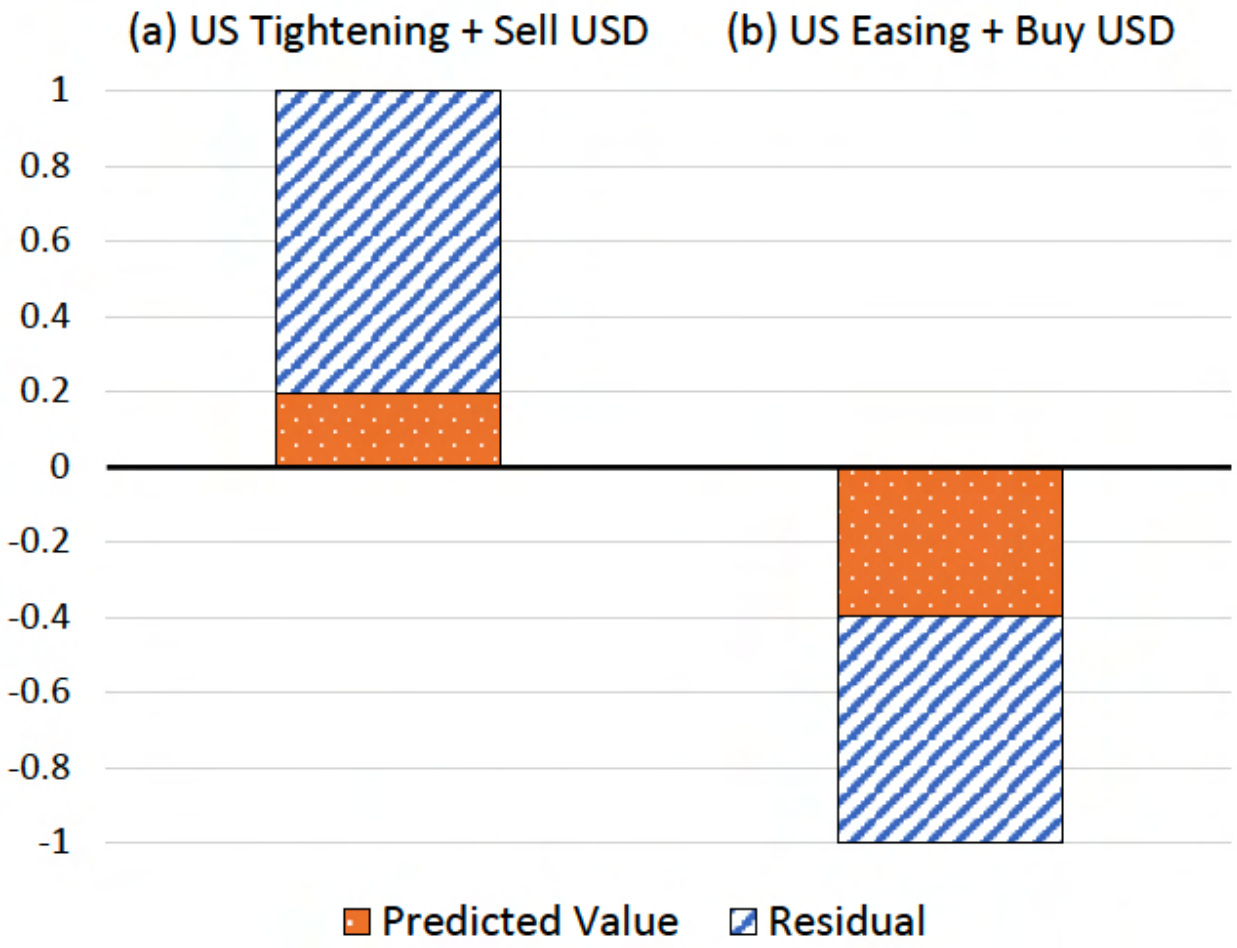
Figure 2: Variance Decomposition for Counter-Intervention



- 76% of variation in counter-intervention cannot be explained.
  - FXI is **unexpected** if residual from estimating policy rule (1) is larger than the median in absolute value

Estimation of FXI Policy Rule

Figure 3: Example for Estimating Policy Rule



- FXI is **unexpected** if the residual is large enough.

US Monetary Policy Spillover

- Testing for the balance sheet channel
  - Depreciation driven reduction in net worth for firms with Dollar debt
  - Exploit heterogeneity across firms with and without Dollar debt within country
- Estimate for countries with and without FXI separately:

$$y_{i(c),t+h} - y_{i(c),t-1} = \gamma_h \text{FFR}_t \times USD_{i(c),y-1(t)} + \mathbf{X}\delta + \alpha_{i(c)} + \alpha^h_{c,t} + \epsilon^h_{i(c),t} \tag{2}$$

- $y_{i(c),t+h}$: stock price, $\forall h =\in [-5, 5]$
- FFR_t: US monetary shock on date t ($FFR_t \Uparrow =$ US tightening)
- $USD_{i(c),y-1(t)}$: Dollar debt indicator
- δ: controls
  - **Firm-level:** total asset, export intensity, liquidity over asset ratio, firm age, **Industry-level:** import content of production + interaction with FFR shock
- $\alpha_{i(c)}$: firm FE, $\alpha^h_{c,t}$: country-time FE

(a) Without Intervention

Dependent variable:	ΔStock Price$_{i(c),t}$			
	Dollar Debt	No Dollar Debt	Both	
	(1)	(2)	(3)	(4)
FFR Shock$_t$	-0.660***	-0.094**	-0.097**	
	(0.117)	(0.045)	(0.045)	
FFR Shock$_t$ × Dollar Debt$_{i(c),y-1(t)}$			-0.314***	-0.259***
			(0.087)	(0.071)
R^2	0.093	0.032	0.031	0.083
N	1,926	103,155	105,114	105,114
Firm FE	✓	✓	✓	✓
Country × Date FE				✓

(b) With Intervention

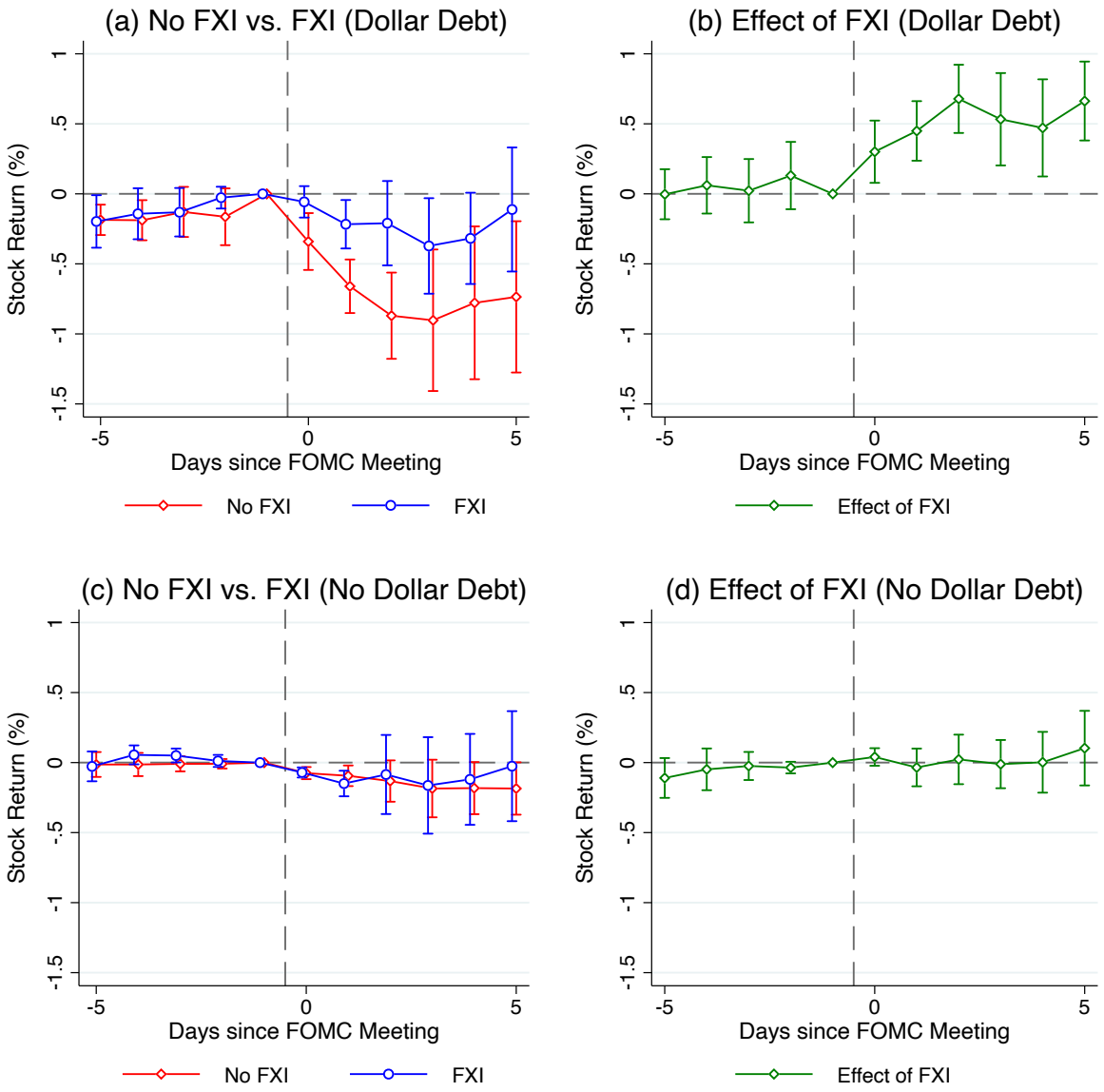
Dependent variable:	ΔStock Price$_{i(c),t}$			
	Dollar Debt	No Dollar Debt	Both	
	(1)	(2)	(3)	(4)
FFR Shock$_t$	-0.217**	-0.149***	-0.158**	
	(0.105)	(0.056)	(0.061)	
FFR Shock$_t$ × Dollar Debt$_{i(c),y-1(t)}$			-0.001	-0.033
			(0.042)	(0.035)
R^2	0.114	0.209	0.194	0.270
N	1,258	9,915	11,178	11,178
Firm FE	✓	✓	✓	✓
Country × Date FE				✓

- **No FXI** ⇒ US monetary spillover via **balance sheet channel**
  - 10bp tightening shock associated with ≈ 6% decline if no FXI
- **FXI** ⇒ spillover is **mitigated**

Table 5: Stock Price: Effect of Intervention

Dependent variable:	ΔStock Price$_{i(c),t}$			
	Dollar Debt	No Dollar Debt	Both	
	(1)	(2)	(3)	(4)
FFR Shock$_t$	-0.647***	-0.093**	-0.096**	
	(0.116)	(0.045)	(0.045)	
FFR Shock$_t$ × Intervention$_{c,t}$	0.449***	-0.035	-0.042	
	(0.130)	(0.082)	(0.079)	
FFR Shock$_t$ × Dollar Debt$_{i(c),y-1(t)}$			-0.310***	-0.259***
			(0.083)	(0.070)
FFR Shock$_t$ × Intervention$_{c,t}$ × Dollar Debt$_{i(c),y-1(t)}$			0.324***	0.232***
			(0.093)	(0.067)
R^2	0.091	0.033	0.033	0.086
N	3,206	113,534	116,754	116,754
Firm FE	✓	✓	✓	✓
Country × Date FE				✓

- FXI mitigates the stock price decline of firms with dollar debt.



- FXI has persistent effect on stock price for firms with dollar debt.

Triple interaction
Expenditure Switching Channel

Exchange Rate

- Balance sheet channel implies that US monetary policy contraction depreciates domestic exchange rate

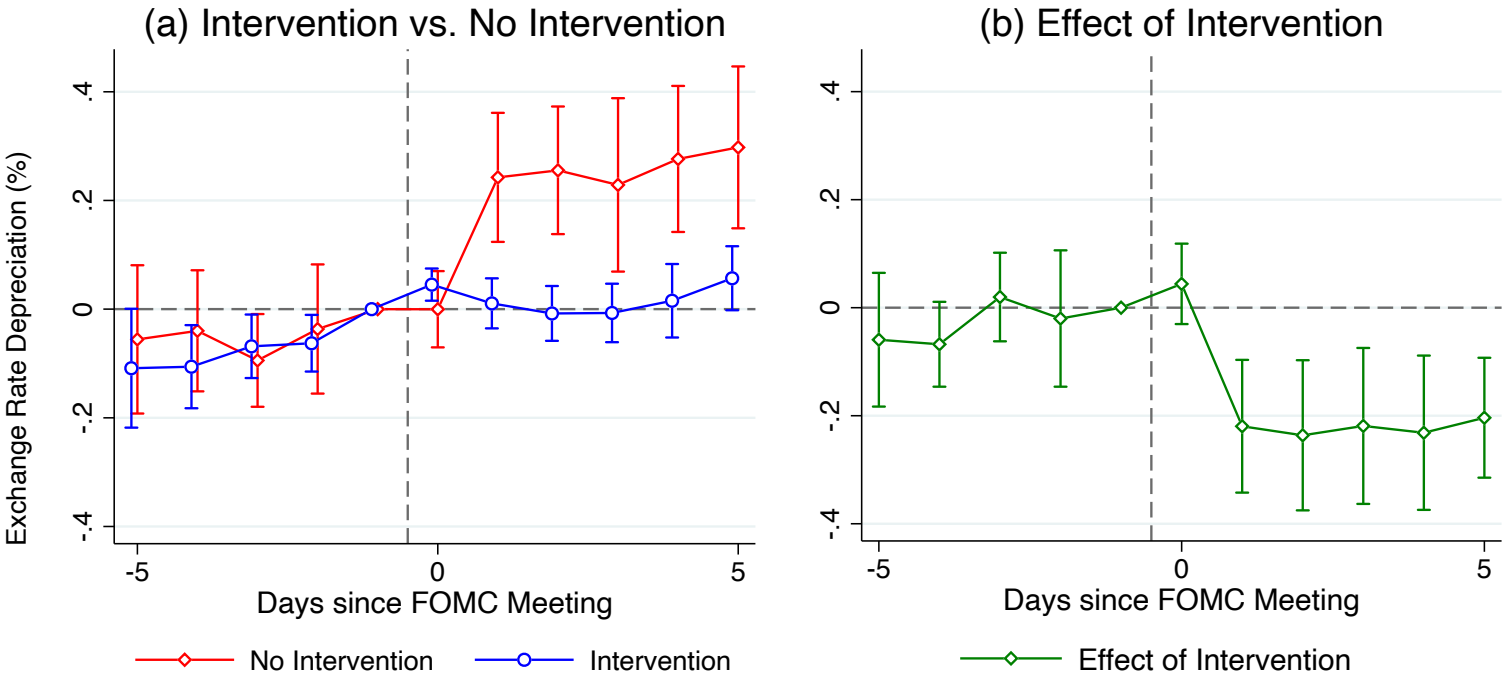
Table 6: Exchange Rate: Baseline Regression

Dependent Variable:	ΔExchange Rate$_{c,t}$		
	No Intervention	Intervention	Both
	(1)	(2)	(3)
FFR Shock$_t$	0.225***	0.004	0.201**
	(0.069)	(0.021)	(0.072)
Intervention$_{c,t}$			0.266
			(0.155)
FFR Shock$_t$ $\times$ Intervention$_{c,t}$			-0.202**
			(0.072)
R^2	0.108	0.083	0.084
N	418	417	836
Country FE	✓	✓	✓

When the Fed funds rate increases,

- **No FXI** $\Rightarrow$ local depreciation / USD appreciation
- **FXI** $\Rightarrow$ little effect

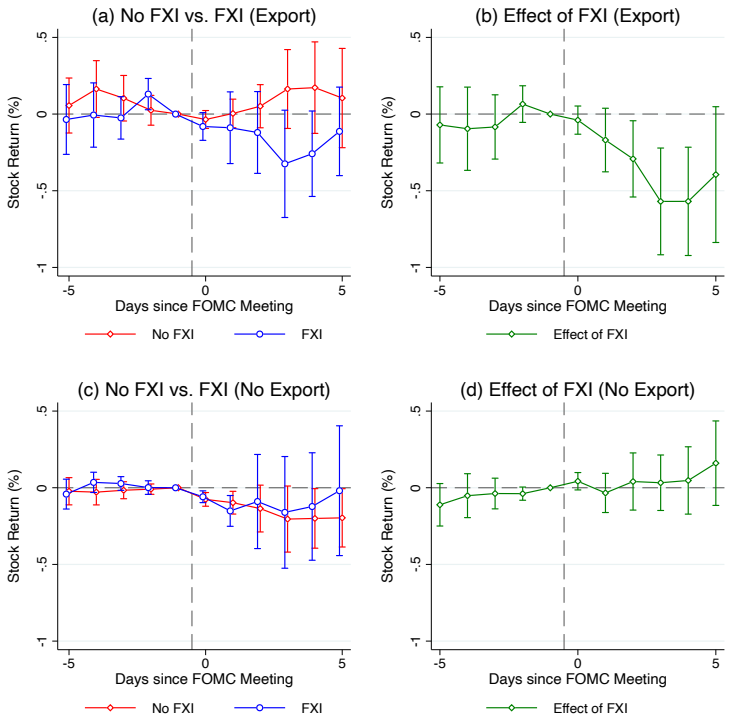
10bp tightening shock associated with $\approx$ 2% depreciation if no FXI



- FXI has persistent effect on exchange rate over time.

Expenditure Switching Channel

- Depreciation effect of US tightening may boost exports
- However, also negative demand effects
- FXI mutes the depreciation effect without mitigating demand channel



- FXI harms exporters but effect small ▸ Balance Sheet Channel

Robustness Checks

1. Intensive and extensive margins of dollar debt
2. Alternative definition for unexpected counter-intervention
3. Size of intervention
4. Control for daily policy rate
5. Control for FX reserves
6. Debt maturity
7. Control for international sales and asset
8. Currency denomination of stock price

Robustness Checks: Stock Price (Intensive Margin)

Table 8: Stock Price: Robustness Checks with Different Definitions with Dollar Debt

Dependent Variable	ΔStock Price$_{i(c),t}$			
	Low \$ Debt	High \$ Debt	All \$ Debt	Continuous \$ Debt
	(1)	(2)	(3)	(4)
FFR Shock$_t$	-0.097**	-0.098**	-0.099**	-0.102**
	(0.045)	(0.046)	(0.046)	(0.046)
FFR Shock$_t$ $\times$ Intervention$_{c,t}$	-0.039	-0.040	-0.041	-0.035
	(0.079)	(0.080)	(0.080)	(0.080)
FFR Shock$_t$ $\times$ Dollar Debt	-0.303***	-0.311***	-0.345***	-0.043***
	(0.086)	(0.083)	(0.070)	(0.011)
FFR Shock$_t$ $\times$ Intervention$_{c,t}$ $\times$ Dollar Debt	0.293***	0.345***	0.468***	0.044***
	(0.082)	(0.073)	(0.145)	(0.010)
R^2	0.033	0.033	0.033	0.033
N	116,754	116,754	116,754	116,754
Firm FE	✓	✓	✓	✓

Robustness Checks: Stock Price

Table 9: Stock Price: Other Robustness Checks

Dependent Variable	ΔStock Price$_{i(c),t}$									
	Mean FXI	p75 FXI	FXI Resid Value	FXI Volume	Large FXI	Daily Policy Rate	Zero FFR Shock	Debt Maturity	Int Asset Sales	Stock Denom.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FFR Shock$_t$	-0.100**	-0.108**	-0.111**	-0.102**	-0.096**	-0.119**	-0.115**	-0.104**	-0.089**	-0.177**
	(0.046)	(0.046)	(0.046)	(0.047)	(0.045)	(0.045)	(0.053)	(0.047)	(0.043)	(0.075)
FFR Shock$_t$ × Intervention$_{c,t}$	-0.110	0.066	-0.005	-0.030	0.010	0.016	-0.029	-0.034	-0.011	0.049
	(0.079)	(0.108)	(0.062)	(0.086)	(0.116)	(0.110)	(0.098)	(0.079)	(0.078)	(0.116)
FFR Shock$_t$ × Dollar Debt$_{i(c),y-1(t)}$	-0.247***	-0.206***	-0.153***	-0.212***	-0.316***	-0.264***	-0.294***	-0.666***	-0.323***	-0.382***
	(0.077)	(0.067)	(0.053)	(0.062)	(0.083)	(0.087)	(0.102)	(0.151)	(0.084)	(0.102)
FFR Shock$_t$ × Intervention$_{c,t}$ × Dollar Debt$_{i(c),y-1(t)}$	0.309***	0.227**	0.158*	0.135*	0.329***	0.281***	0.304**	0.620**	0.325***	0.378***
	(0.100)	(0.099)	(0.090)	(0.075)	(0.098)	(0.103)	(0.124)	(0.302)	(0.092)	(0.110)
R^2	0.033	0.033	0.033	0.033	0.034	0.034	0.022	0.033	0.034	0.038
N	116,754	116,754	115,519	115,223	112,558	109,808	188,394	116,754	110,769	116,753
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Robustness Checks: Exchange Rate

Table 10: Exchange Rate: Robustness Checks

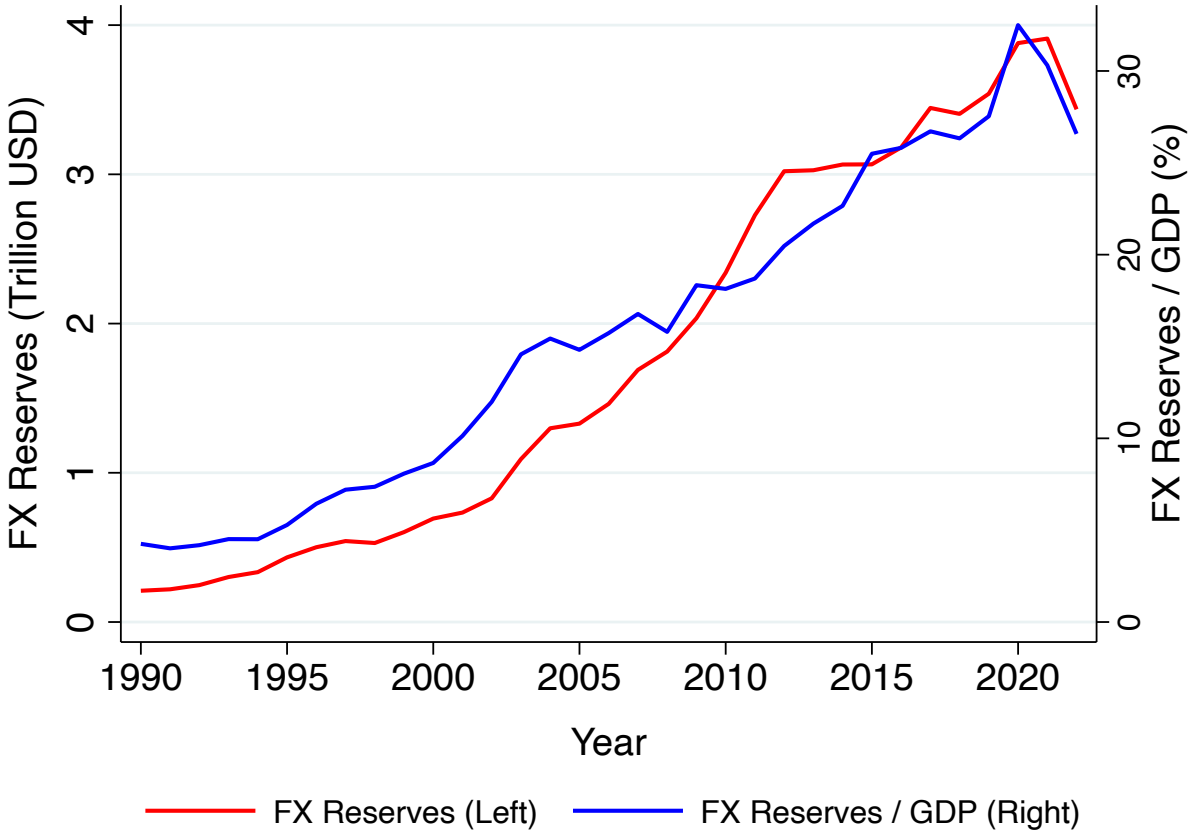
Dependent Variable:	ΔExchange Rate$_{c,t}$						
	Mean FXI	p75 FXI	FXI Resid Value	FXI Volume	Large FXI	Daily Policy Rate	Zero FFR Shock
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FFR Shock$_t$	0.146**	0.121**	0.115***	0.143**	0.206**	0.274**	0.210**
	(0.049)	(0.041)	(0.032)	(0.064)	(0.071)	(0.119)	(0.084)
Intervention$_{c,t}$	0.181	-0.047	0.041	0.058	0.223	0.303	0.157**
	(0.168)	(0.162)	(0.054)	(0.183)	(0.163)	(0.205)	(0.061)
FFR Shock$_t$ $\times$ Intervention$_{c,t}$	-0.117**	-0.150*	-0.107**	-0.140**	-0.211**	-0.363**	-0.196**
	(0.044)	(0.076)	(0.040)	(0.051)	(0.083)	(0.155)	(0.081)
R^2	0.074	0.071	0.085	0.092	0.103	0.083	0.064
N	836	836	795	829	741	683	1,289
Country FE	✓	✓	✓	✓	✓	✓	✓

Conclusion

- Identification of spillover of US monetary policy by using high-frequency US monetary shock and firm-level data
- Estimate deviation from FXI policy rule to understand how interventions can help countries insulate against spillover
- Contractionary US monetary policy depresses stock prices of firms with dollar debt
  - Balance sheet channel of exchange rates through depreciation
- Counter-interventions $\Rightarrow$ Mutes balance sheet channel
- FXI can be a tool insulate countries from global financial cycle.
- Buildup of reserves over last decades reduces US spillover effects
- Important to understand general equilibrium implications and optimality of policy (IMF's integrated policy framework)

Accumulation of FX Reserves

Figure 4: FX Reserves in Sample Countries



- FX reserves grew by more than 16 times from 1990 to 2022.

Appendix

Summary Statistics

Table 1: Summary Statistics: FFR shock, exchange rate, and stock price

	Mean	Med	S.D.	p5	p95	Obs
(1) FFR shock (basis point)	0.015	-0.48	1.81	-3.1	3.75	90
(2) Exchange rate (% change, $\log(e_{c,t+1}) - \log(e_{c,t-1})$)	0.04	0	0.72	-1.37	1.29	875
(3) Stock price (% change, $\log(p_{i,t+1}) - \log(p_{i,t-1})$)	0.02	0	3.48	-5.61	5.71	124,559

Note: t is the FOMC announcement date. $e_{c,t+1}$ is the exchange rate in country c at date $t+1$. Higher $e_{c,t+1}$ implies the appreciation of US dollar or depreciation of local currency. $p_{i,t+1}$ is the stock price of firm i at date $t+1$. The stock price is in terms of local currency. Observations are the number of FOMC announcement dates (row 1), country times FOMC announcement dates (row 2), and firm times FOMC announcement dates (row 3).

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Table 2: Interventions around 90 FOMC event dates in sample

Country	Frequency			FXI Volume (Millions USD)		Periods
	Buy USD	Sell USD	Counter	Mean	Median	
	(1)	(2)	(3)	(4)	(5)	(6)
Argentina	59	45	15	86	52	2003-2019
Australia	0	2	2	19	19	2000-2019
Brazil	11	1	8	165	114	2009-2019
Chile	6	0	4	0.091	0.096	2008-2019
Colombia	34	2	18	19	17	2000-2019
Costa Rica	34	32	3	12	8.1	2006-2019
Georgia	9	12	15	3.9	3.1	2009-2019
Hong Kong	83	58	13	70	12	2000-2019
Japan	4	0	1	0.11	0.15	2000-2019
Mexico	0	24	7	27	22	2000-2011
Peru	72	51	26	23	4.3	2000-2019
Switzerland	0	0	0	0	0	2000-2001
Turkey	1	1	0	5.9	5.9	2002-2019
Total	312	229	111	45	14	2000-2019

Counteracting intervention = FFR increases at date t and central banks sell USD at least once and never buy USD between dates t and $t+5$.

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Table 2: Sample Firms

Country	Total	Dollar Debt	Country	Total	Dollar Debt
Argentina	34	25	Colombia	22	9
Australia	1190	126	Hong Kong	480	42
Brazil	68	21	Japan	2216	4
Chile	3	1	Mexico	48	33
			Total	4060	261

- 261 firms (6%) have dollar debt (14% except Japan).
- Share of dollar debt / total debt = 66%, conditioning on firms with positive dollar debt.
- 501 firms (12%) are exporters (mostly in Japan).
  - Among the firms with dollar debt, four firms are exporters.
    = Firms with dollar debt are not naturally hedged.

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Firm Selection Criteria

Drop firm-year observations with following criteria:*

- Currency composition of debt is reported.
- Total asset belongs to either top or bottom 1%.
- Direct subsidiary of another firm (to avoid double-count).
- The sum of cash and cash equivalents + tangible assets is greater than total asset.
- The difference between **the total principal due** and **the sum of principal dues of individual debt investment** is greater than 100,000 USD.

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*The criteria are based on Kim (2019) and Kim et al. (2020).

Capital IQ Balance Sheet Data

Agrometal S.A.I. (BASE:AGRO) Financials > Capital Structure Details

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<< Return to Capital Structure Summary

Key Stats | Income Statement | Balance Sheet | Cash Flow | Multiples | Cap. Structure | Ratios | Supplemental | Industry Specific | Pension/OPEB | Segments

Period Type: Annual | Source: A 2015 filed Mar-10-2016
Currency: US Dollar | Conversion: Historical
Units: S&P Capital IQ (Default) | Decimals: Capital IQ (Default) | Go | << Fewer Options

Principal Due in Millions of USD.
** In cases where an interim filing contains less detailed information on components of debt capital structure, we have carried forward information from the previous annual.*

FY 2015 (Dec-31-2015) Capital Structure As Reported Details

Description	Type	Principal Due (USD)	Coupon/Base Rate	Floating Rate	Maturity	Seniority	Secured	Convertible	Repayment Currency
HSBC Private Bank International - Investment Loan	Term Loans	2.2	2.450%	NA	Aug-17-2016	Senior	No	No	USD
Working Capital from Banco Nacion Argentina	Revolving Credit	0.6	25.000%	NA	Sep-18-2015	Senior	No	No	ARS
Working Capital from Banco Nacion Argentina	Revolving Credit	0.0	25.000%	NA	Oct-30-2015	Senior	No	No	ARS
Working Capital from Banco Nacion Argentina	Revolving Credit	0.1	25.000%	NA	Dec-04-2015	Senior	No	No	ARS
Working Capital from Banco Nacion Argentina	Revolving Credit	0.1	25.000%	NA	Dec-09-2015	Senior	No	No	ARS
Working Capital from Banco Nacion Argentina	Revolving Credit	0.1	23.000%	NA	Mar-01-2016	Senior	No	No	ARS
Working Capital from Bank of The Province of Cordoba S. A.	Revolving Credit	0.2	35.688%	NA	Aug-11-2016	Senior	No	No	ARS
Working Capital from Bank of The Province of Cordoba S. A.	Revolving Credit	0.1	27.000%	NA	Dec-07-2016	Senior	No	No	ARS
Working Capital from Bank of The Province of Cordoba S. A.	Revolving Credit	0.0	37.500%	NA	Jan-05-2016	Senior	No	No	ARS
Working Capital from Bank of The Province of Cordoba S. A.	Revolving Credit	0.0	37.500%	NA	Mar-28-2016	Senior	No	No	ARS
Working Capital from Bank of The Province of Cordoba S. A.	Revolving Credit	0.1	13.910%	NA	Oct-18-2016	Senior	No	No	ARS

Figure: Excerpt of detailed financial statement for Agrometal S.A.I.

- Total debt $=$ **5.6** (millions USD)
- Sum of individual debts $= 2.2 + 0.6 + 0.1 + \cdots =$ **5.6**
- Dollar debt $=$ **2.2**
  - **The total debt** (from main financial statement) matches **the sum of individual debts** (from detailed statement).

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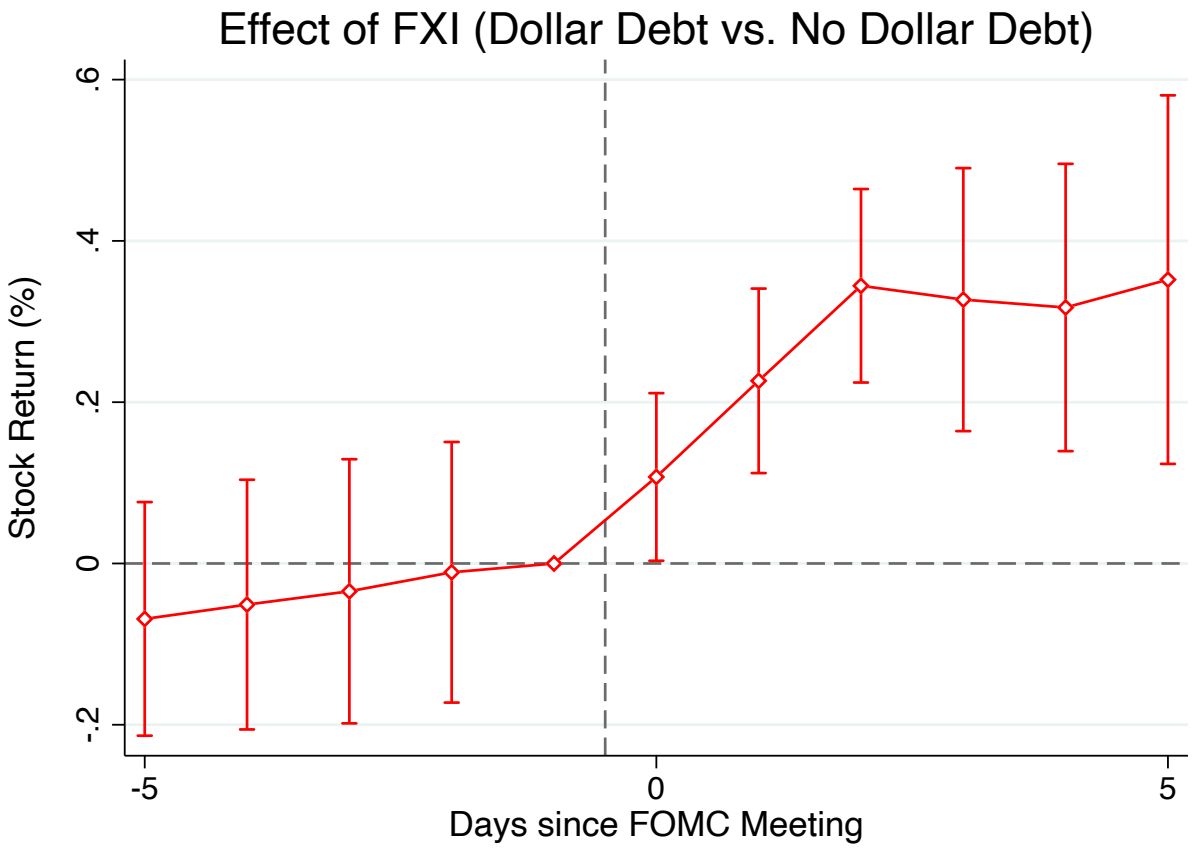
Stock Price (Triple Interaction)



- The effect of FXI is larger for firms with dollar debt.

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