FX Dealer Constraints and External Imbalances

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Conference on Fixed Income Markets 2025
Federal Reserve Bank of San Francisco

From micro to macro risk

- Health of financial intermediary sector affects asset markets
  $\Rightarrow$ 1998 hedge fund crisis, 2007–2009 subprime crisis
- **Micro perspective of this paper**: financial conditions of FX dealer banks

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- Emerging market currencies sharply sold-off during financial distress
  $\Rightarrow$ Indian rupee, Brazilian real, South African rand
- Reuters on India: *"Pressures for funding the current account deficit are already being felt in the currency, and in an environment where most global central banks are tightening and the RBI's currency reserves are declining, those pressures are likely to intensify."* (September 16, 2022)
- **Macro perspective of this paper**: country's external capital dependence

Financial constraints of intermediaries as exchange rate drivers

- Exchange rates are **jointly determined** by the risk-bearing capacity of financiers and international imbalances in the demand for financial assets (*Gamma model*) (Gabaix and Maggiori, 2015) Details

Financial constraints of intermediaries as exchange rate drivers

- Exchange rates are **jointly determined** by the risk-bearing capacity of financiers and international imbalances in the demand for financial assets (*Gamma model*) (Gabaix and Maggiori, 2015) Details

- Tightening capital constraints of intermediaries increase required risk premia (He and Krishnamurthy, 2013; Adrian and Shin, 2010; Brunnermeier and Sannikov, 2014; Du et al., 2023; Hou et al., 2024)

- Capital ratios of FX dealers are able to explain returns to carry trades (Reitz and Umlandt, 2021; He et al., 2017; Adrian et al., 2011)

- Currencies of debtor countries depreciate when global risk aversion is high (Della Corte et al., 2016; Habib and Stracca, 2012; Gardberg, 2022; Dahlquist et al., 2022)

Empirical approach

1. Identification of top FX dealer banks
2. Build an index that captures financial constraints of FX dealers
3. Intermediary asset pricing tests of imbalance portfolios
4. Panel regression analysis of exchange rate changes

Research question: Does variation in financial constraints of intermediaries price the cross-section of currencies given differences in external imbalances?

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Methodology of the *Euromoney* FX Survey

- Annual survey (1979 - 2022) of the *Euromoney* magazine
- Most comprehensive representation of FX liquidity consumption
  (2022: 1,062 responses $\rightarrow$ total of \$99trn $\approx$ 4% of daily FX turnover)
- Respondents: non-financial corporations, asset managers, insurance companies, asset owners (e.g., pension funds), hedge funds, non-market making banks (e.g., central banks)
- **Survey question of interest**: "Name the top 10 FX dealers by volume and the volume traded with these liquidity providers"

▸ Top dealer ▸ Market shares

Survey results of 2022

FX Survey 2022: Press release

Euromoney magazine has released the results of its 44th annual foreign exchange ranking, the most comprehensive quantitative and qualitative annual study available on the FX markets.

Among the key findings:

1. Deutsche Bank take the top volume ranking
2. Bank of New York Mellon takes the Customer Satisfaction (CSAT) rankings
3. Three new regional winners
4. Slight increases to the combined market share of top 5 and top 10 to 44% (2021 - 39%) and 66% (2021 - 64%) respectively

Top 10 overall global market share

Overall volume (adjusted swaps*)

2022	2021	Bank	Market Share %
1	3	Deutsche Bank	10.89%
2	2	UBS	9.69%
3	1	JPMorgan	8.67%
4	9	State Street	7.66%
5	4	XTX Markets	7.14%
6	6	Jump Trading	5.60%
7	5	Citi	4.54%
8	13	Bank of New York Mellon	4.30%
9	8	Bank of America	3.73%
10	7	Goldman Sachs	3.65%

Figure 1: Euromoney press release

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Components of intermediary constraints index

(i) Capital ratio ▸ Figure
(Huang et al., 2025; He et al., 2017; Reitz and Umlandt, 2021)

$$\eta_{it} = \frac{Market\ Equity_{it}}{Market\ Equity_{it} + Book\ Debt_{it}}$$

(ii) Credit default spread ▸ Figure

Spreads of 5y credit default swaps → higher spreads indicate higher risk of debt

(iii) Value-at-Risk ▸ Figure

Riskiness of financial assets defined as maximum $ or € amount expected to be lost over a given time horizon at pre-defined confidence level (99%, 95%)

(iv) VXY implied volatility index ▸ Figure

Turnover-weighted index of G7 currencies' volatility based on three month at-the-money forward options

Components of constraints index over time

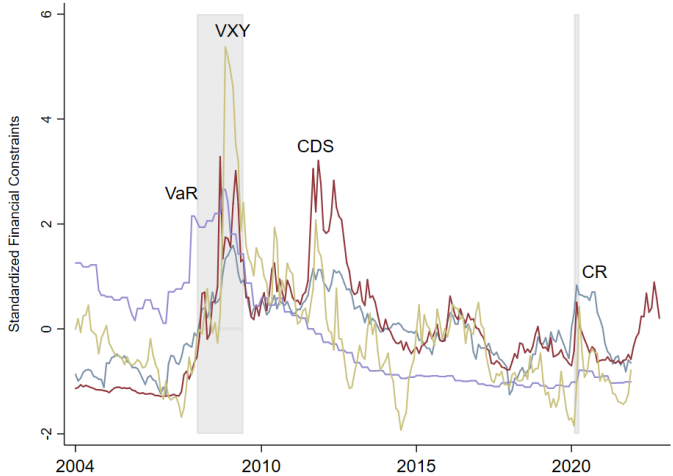

Figure 2: Time-series of standardized variables (capital ratio multiplied by -1)

Principal component analysis to derive a constraints index

Component	Eigenvalue	Difference	Proportion	Cumulative
λ_1	2.54	1.51	0.63	0.63
λ_2	1.03	0.73	0.26	0.89
λ_3	0.30	0.18	0.08	0.97
λ_4	0.12	.	0.03	1.00

Table 1: Principal components

Variable	λ_1	λ_2	λ_3	λ_4
(-)Capital ratio	0.56	-0.32	0.36	-0.67
CDS	0.55	-0.38	0.16	0.73
VaR	0.30	0.83	0.47	0.10
VXY	0.54	0.27	-0.79	-0.10

Table 2: Loadings on principal components

- **First principal component** explains $\sim$ 60% of the total variance
- $\Delta\lambda_1$ captures changes in our intermediary constraints index $\Rightarrow \Delta IntCon$

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External imbalances measure country's indebtedness to foreigners

- *External Wealth of Nations Database* by Lane and Milesi-Ferretti (2018)

  Foreign assets: Dollar value of assets a country owns abroad

  Foreign liabilities: Dollar value of domestic assets owned by foreigners

  (Equity, debt, FDI, FX reserves)

- **External imbalances**: Net foreign assets (assets minus liabilities) relative to GDP
  $\Rightarrow$ **NFA/GDP**

Average NFA/GDP by country

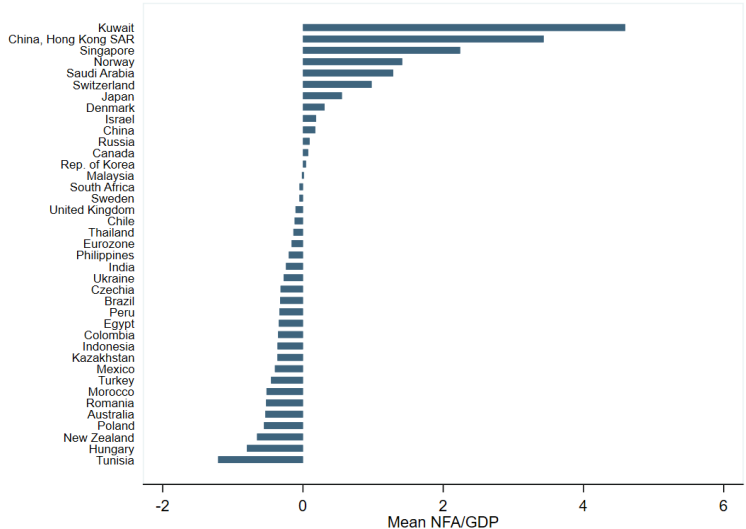

Figure 3: Net foreign assets to GDP

Motivation for intermediary asset pricing

- A specialist manages the financial intermediary and represents the decision-makers of the bank and forms an intermediary with households
  (He and Krishnamurthy, 2013; He et al., 2017; Brunnermeier and Sannikov, 2014; Reitz and Umlandt, 2021)

- **Financial intermediary is the marginal investor**, whose SDF prices assets
  Example: equity capital ratio $\downarrow \Rightarrow$ risk-bearing capacity $\downarrow \Rightarrow$ marginal utility from an additional unit of wealth $\uparrow$

- Risky currencies that depreciate in high marginal utility states are expected to provide higher excess returns to compensate for downside risk

Sorting currencies on NFA generates cross-section of currency portfolios

When there are systematic variations in the returns to investing in different currencies, how can we know these returns are due to currency risk?

$\Rightarrow$ borrow **portfolio approach** from asset pricing literature on stock returns (Fama, 1976)

Sorting currencies on NFA generates cross-section of currency portfolios

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$\Rightarrow$ borrow **portfolio approach** from asset pricing literature on stock returns (Fama, 1976)

Following Della Corte et al. (2016) and Reitz and Umlandt (2021)

1. Sort currencies based on some characteristic
   - NFA/GDP
2. Allocate currencies based on common characteristic into imbalance portfolios
   - PF1: 25% of currencies with highest NFA/GDP (creditors)

     ...
   - PF4: 25% of currencies with lowest NFA/GDP (debtors)
3. Asset pricing tests of the risk factor $\Delta IntCon$ for imbalance portfolios

▸ PF composition ▸ PF summary

Empirical intermediary asset pricing tests

SDF approach according to Cochrane (2009)

$$\mathbb{E}_t\left[\beta\frac{u'(c_{t+1})}{u'(c_t)}rx_{t+1}\right] = \mathbb{E}_t\left[m_{t+1}rx_{t+1}\right] = 0$$

with a SDF that is linear in the factors f_{t+1}

$$m_{t+1} = 1 - b'(f_{t+1} - \mu) = 1 - b^w(W_t - \overline{W}) - b^l(I_t - \overline{I}).$$

Beta pricing model: expected excess returns equal factor risk prices λ times risk quantities β

$$\mathbb{E}_t\left[rx_{t+1}\right] = \lambda'\beta = \lambda_t^W\beta_t^W + \lambda_t^I\beta_t^I$$

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$$\mathbb{E}_t\left[\beta\frac{u'(c_{t+1})}{u'(c_t)}rx_{t+1}\right] = \mathbb{E}_t\left[m_{t+1}rx_{t+1}\right] = 0$$

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Two-stage regression as in the spirit of Fama and MacBeth (1973) (FMB):

1. Time-series regression: $rx_{it} = \alpha_i + \beta_i^{DOL}DOL_t + \beta_i^{\Delta IntCon}\Delta IntCon_t + \varepsilon_{it}$ for i = 1,..., 4
2. Cross-sectional regression: $rx_i = \lambda^{DOL}\hat{\beta}_i^{DOL} + \lambda^{\Delta IntCon}\hat{\beta}_i^{\Delta IntCon} + \epsilon_i$ for i = 1,..., 4

Lower risk premia for returns that positively co-move with constraints

Panel A: Factor Betas

	α_i	β^{DOL}	$\beta^{\Delta IntCon}$	R^2
PF1 (high NFA)	-0.07*	0.63***	**0.89*** **	0.81
	(0.04)	(0.03)	**(0.19)**	
PF2	-0.04	1.03***	-0.11	0.91
	(0.03)	(0.03)	(0.24)	
PF3	0.08*	0.89***	-0.65	0.86
	(0.04)	(0.06)	(0.45)	
PF4 (low NFA)	0.03	1.33***	-0.09	0.94
	(0.04)	(0.06)	(0.32)	

Panel B: Factor Prices

	λ^{DOL}	$\lambda^{\Delta IntCon}$	R^2
FMB			
Newey-West	0.12	**-0.09***	0.75
	(0.11)	**(0.05)**	
Shanken	0.12	-0.09**	0.75
	(0.18)	(0.04)	
GMM	0.12*	-0.09	
	(0.06)	(0.08)	

Table 3: Asset pricing results with $\Delta IntCon_t$

Robustness checks of asset pricing tests

Alternative currency portfolio cross-sections ▸ More

- 16 portfolios (NFA, carry trade, momentum, value) ✓

Alternative risk factors ▸ More

- Capital ratios of Top 10 dealers by Reitz & Umlandt (2021) ✓
- Carry trade factor by Lustig et al. (2011) ✗

Alternative index

- Top-three FX dealer ✓

Subsample

- Split by Global Financial Crisis ✓

Other

- Rolling betas ✓

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Exchange rates when constraints are tightening

Panel regression model:

$$y_{it} = \alpha + \gamma_i + \delta_\tau + \beta_1 \Delta IntCon_t + \beta_2 NFA_{it-12} + \beta_3 \Delta IntCon_t \times NFA_{it-12} + \zeta X_{it} + \epsilon_{it}$$

y_{it}: Exchange rate changes (or currency excess returns)

α: Constant

γ_i: Country FE

δ_τ: Time FE

$\Delta IntCon_t$: One-month change in intermediary constraints index

NFA_{it-12}: One-year lagged NFA to GDP

X_{it}: Collection of controls ▸ Controls

ϵ_{it}: Error term

▸ Descriptive statistics

Creditors experience a less sharp currency depreciation in constrained times

	Δs_{it}	Δs_{it}	Δs_{it}	Δs_{it}	Δs_{it}
	(1)	(2)	(3)	(4)	(5)
$\Delta IntCon$	-2.93***	-3.50***	-3.29***	-3.51***	-3.04***
	(0.84)	(0.60)	(0.73)	(0.81)	(0.83)
NFA/GDP		0.06	0.15*	0.16***	0.16***
		(0.07)	(0.08)	(0.06)	(0.05)
$\Delta IntCon \times$ NFA/GDP		0.99***	1.00***	1.01***	1.03***
		(0.25)	(0.25)	(0.24)	(0.25)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	No
Quarter FE	Yes	No	No	No	Yes
Controls	Yes	No	Yes	Yes	Yes
Num. obs.	8,385	8,385	8,385	8,385	8,385
R^2	0.17	0.08	0.09	0.11	0.17

Table 4: FE panel regressions of exchange rate changes

▸ Excess returns

Marginal effects of changes in intermediary constraints index

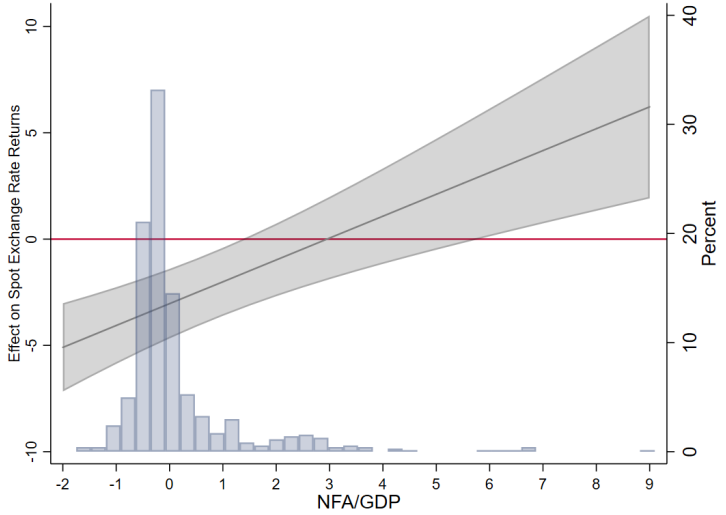

Figure 4: Average marginal effects of $\Delta IntCon$

Emerging markets drive currency depreciation in constrained times

	Δs_{it}	Δs_{it}	Δs_{it}	Δs_{it}
	(1) EME	(2) G10	(3) Crisis	(4) Post-crisis
$\Delta IntCon$	-2.91***	-3.57**	-1.89**	-3.19***
	(0.76)	(1.26)	(0.76)	(0.96)
NFA/GDP	0.17**	0.01	1.14	0.16**
	(0.06)	(0.22)	(1.06)	(0.07)
$\Delta IntCon \times$ NFA/GDP	1.00***	1.34	1.03***	1.06***
	(0.23)	(1.31)	(0.29)	(0.27)
Country FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Num. obs.	6,235	2,150	2,184	6,201
R^2	0.16	0.27	0.19	0.18

Table 5: FE panel regressions of exchange rate changes in subsamples

Foreign debt – often intermediated by banks – has higher sensitivity

	Δs_{it}	Δs_{it}	Δs_{it}	Δs_{it}
	Equity	FDI	Debt	All
$\Delta IntCon$	-2.97***	-2.87***	-2.88***	-2.93***
	(0.84)	(0.84)	(0.82)	(0.83)
Net equity/GDP	0.13*			0.10
	(0.08)			(0.09)
$\Delta IntCon \times$ Net equity/GDP	0.76			-1.39*
	(0.93)			(0.71)
Net FDI/GDP		0.21*		0.11
		(0.12)		(0.09)
$\Delta IntCon \times$ Net FDI/GDP		0.33		-0.60
		(1.03)		(0.99)
Net debt/GDP			0.20	
			(0.15)	
$\Delta IntCon \times$ Net debt/GDP			1.97***	
			(0.43)	
Net portfolio debt/GDP				-0.01
				(0.18)
$\Delta IntCon \times$ Net portfolio debt/GDP				2.63***
				(0.53)
Net other debt/GDP				0.17
				(0.22)
$\Delta IntCon \times$ Net other debt/GDP				2.06
				(1.36)
Country FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Num. obs.	8,385	8,385	8,385	8,385
R^2	0.17	0.17	0.18	0.18

Interaction with constraints remains robust when including VIX

	Δs_{it}	Δs_{it}
	(1)	(2)
	VIX	VIX & IntCon
Δ VIX	-1.54***	-1.30***
	(0.25)	(0.24)
NFA/GDP	0.15*	0.15**
	(0.07)	(0.07)
Δ VIX $\times$ NFA/GDP	0.34***	0.25**
	(0.11)	(0.09)
$\Delta IntCon$		-2.27***
		(0.61)
$\Delta IntCon$ $\times$ NFA/GDP		0.75***
		(0.18)
Country FE	Yes	Yes
Year FE	Yes	Yes
Controls	Yes	Yes
Num. obs.	8,385	8,385
R^2	0.15	0.17

Table 7: FE panel regression of exchange rate changes with VIX index

Robustness checks of panel regressions

Alternative intermediary constraints measures

- Horse race with VIX index ✓ ▸ More
- Index weighted by banks' market shares ✓ ▸ More
- Index weighted by banks' shares in total assets ✓
- Index with a constant set of 17 dealers since 2004 ✓
- Top-three FX dealer ✓

Conclusion

- Shocks to the intermediary constraints of FX dealers are a priced **risk factor**
- Financial constraints drive currencies based on country's **foreign debt**
  $\Rightarrow$ Higher returns on debtor currencies but poor performance when constraints tighten
  $\Rightarrow$ Lower returns on creditor currencies but a hedge against unfavorable changes in external financing conditions
- Rate of currency depreciation is particularly pronounced for:
  - Emerging markets
  - Large negative international debt positions
  - Low FX reserves

Appendix

Outlook

Contribution

- NFA not solely held by FX dealers (e.g., by other money managers and households)
- Intermediary constraints index maybe captures general business cycle
- Intermediary constraints factor vs. CIP factor by Du et al. (2023)
- Intermediary constraints factor vs. VXY by Della Corte et al. (2016)

Asset pricing tests

- Limited cross-sectional variation in first step of FMB
- Risk premium only hardly significant
- Show time-series regressions for alternative test assets

Panel regressions

- Month FE or other factors as controls
- Test for significance of the difference in coefficients across subsamples

In detail: Portfolio balance model by Gabaix and Maggiori (2015)

- Imbalances in the currency demand and supply are absorbed by financiers who face **financial constraints**
- Financiers intermediate capital flows from **creditor** countries to **debtor** countries
  $\Rightarrow$ long debtor currencies (who are in excess supply) and short creditor currencies
- Risk bearing capacity of financiers determines the **required compensation** for clearing countries' capital accounts
  $\Rightarrow$ **positive expected returns** on debtor currencies to incentivize financiers
- In times of **financial disruption**, debtor currencies have to depreciate in order to provide higher expected returns

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FX dealers ranked top 10 at least once (or since 2004)

ABN	Chemical	HSBC	RBC
ABN Amro	Citi Bank	IBJ	RBS
ANZ	Commonwealth Bank	JP Morgan	SBC
Bank of America	Credit Suisse	JP Morgan Chase	SEB
Bank of Montreal	Dai-Ichi Kangyo	Llyods	Standard Chartered
Bank of New York Mellon	Deutsche Bank	Manufacturers Hanover	State Street
Bankers Trust	First Chicago	Merrill Lynch	UBS
Barclays	Goldman Sachs	Morgan Stanley	WestPac
BNP Paribas	Harris	National Australia	
Chase Manhattan	Hong Kong Bank	NatWest	

Table 8: Top 10 FX dealer banks

Time-series of top FX dealer market shares

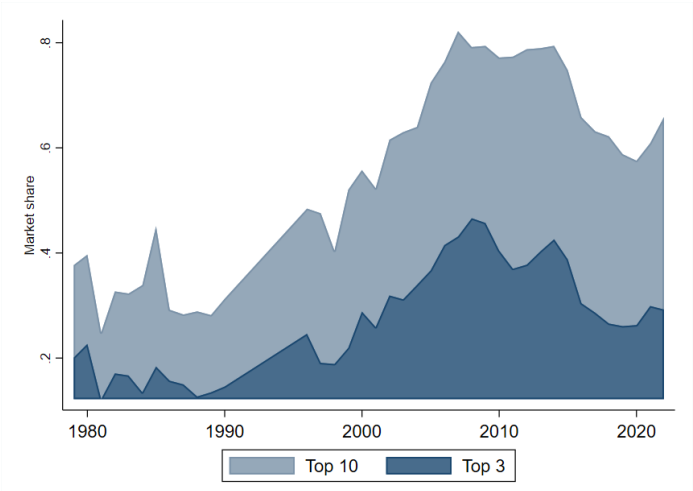

Figure 5: Time-series of market shares

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(i) Capital ratios

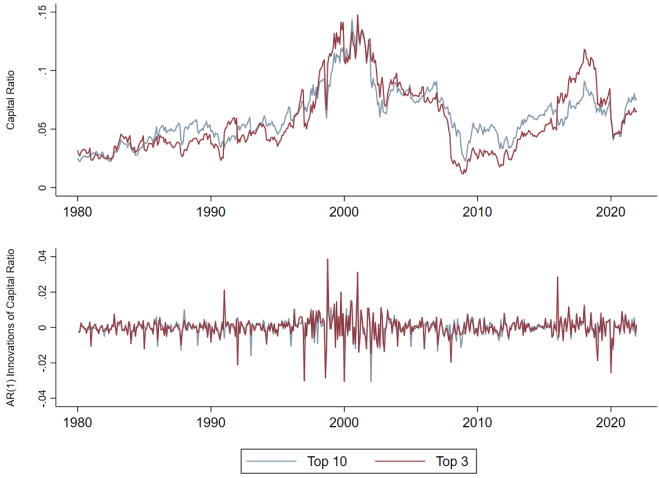

Figure 6: Time-series of average capital ratio

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(ii) Credit default spreads

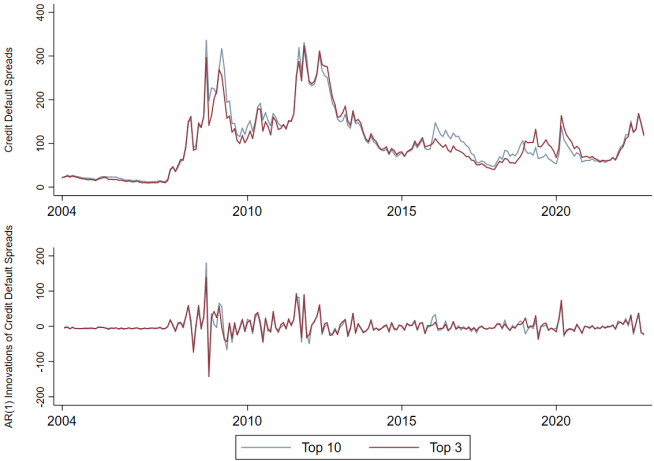

Figure 7: Time-series of average CDS

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(iii) Value-at-Risk

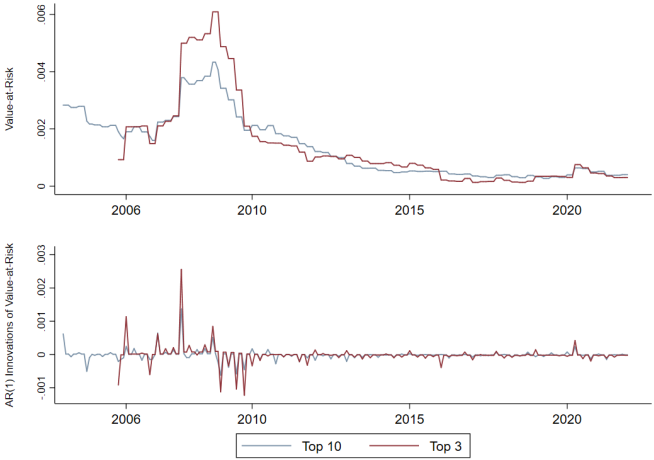

Figure 8: Time-series of average VaR

Back

(iv) VXY

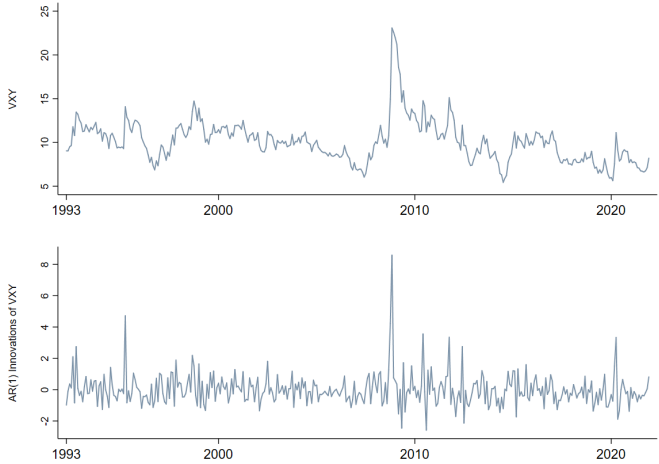

Figure 9: Time-series of FX volatility index

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Increasing index reflects tightening financial constraints

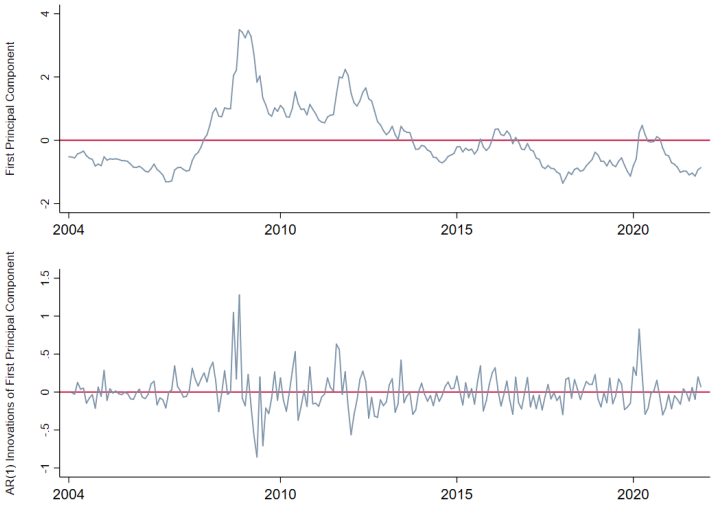

Figure 10: Time-series of intermediary constraints index

Correlations of intermediary constraints components

	(-)Capital ratio	CDS	VaR	VXY
(-)Capital ratio	1.00			
CDS	0.87	1.00		
VaR	0.19	0.13	1.00	
VXY	0.59	0.60	0.52	1.00

Table 9: Correlations of index components

NFA/GDP by country over time

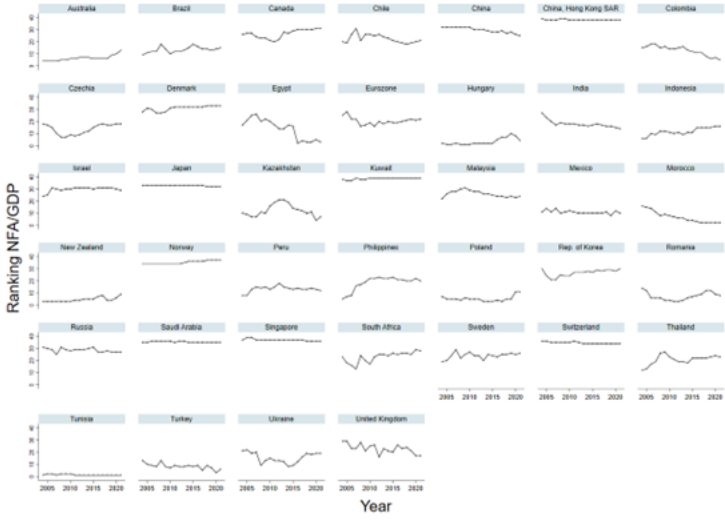

Figure 11: Ranking of countries according to NFA/GDP

Currency excess returns

Log currency excess return of US investor on foreign currency i:

$$rx_{it+1} = f_{it} - s_{it+1} = f_{it} - s_{it} - \Delta s_{it+1}$$

- f_{it}: one-month forward rate of currency i (foreign currency unit per USD)
- s_{it}: spot rate of currency i ($s \uparrow$ foreign currency depreciation)

Under covered interest parity:

$$f_{it} - s_{it} \approx i_{it} - i_{USt}$$

- i_{it} and i_{USt}: foreign and US nominal interest rate

$$rx_{it+1} \approx \underbrace{i_{it} - i_{USt}}_{\text{IR differential}} - \underbrace{\Delta s_{it+1}}_{\text{ER change}}$$

Composition of imbalance portfolios

Imbalance Portfolios							
PF1	Frequency	PF2	Frequency	PF3	Frequency	PF4	Frequency
CHF	0.11	KRW	0.10	INR	0.09	AUD	0.08
HKD	0.11	MYR	0.10	PEN	0.09	HUF	0.08
JPY	0.11	CAD	0.09	COP	0.07	NZD	0.08
KWD	0.11	SEK	0.09	EUR	0.07	PLN	0.08
NOK	0.11	RUB	0.09	UAH	0.07	TND	0.08
SAR	0.11	ZAR	0.08	BRL	0.06	RON	0.06

Table 10: Currency composition of external imbalance portfolios

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Currency excess returns increase with external debt

	Imbalance Portfolios			
	PF1 (High NFA)	PF2	PF3	PF4 (Low NFA)
NFA/GDP				
mean	1.68	0.01	-0.24	-0.58
Currency excess returns				
mean	0.06	0.88	2.28	2.14
std	7.36	10.07	11.32	12.93
skew	-0.52	-0.58	-2.44	-1.59
Forward discount				
mean	-0.46	1.75	5.17	5.18
std	0.62	1.28	3.43	2.75
Spot change				
mean	0.52	-0.88	-2.89	-3.04
std	7.45	10.09	11.66	12.89

Table 11: Summary statistics of portfolios sorted on external imbalances

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Index outperforms capital ratio factor by Reitz & Umlandt (2021)

	λ^{DOL}	$\lambda^{\Delta IntCon}$	λ^{HML}	$\lambda^{FXcore10}$	R^2
FMB					
NW	0.12	0.01	0.44*		0.92
	(0.11)	(0.12)	(0.25)		
	0.12			-0.08	0.67
	(0.11)			(0.06)	
	0.12	-0.12**		0.01	0.95
	(0.11)	(0.06)		(0.06)	
Sh	0.12		0.42**		0.68
	(0.18)		(0.18)		
	0.12			-0.08	0.67
	(0.18)			(0.05)	
GMM	0.12**	0.02	0.43		
	(0.06)	(0.32)	(0.79)		
	0.12*			-0.08	
	(0.06)			(0.09)	
	0.12*	-0.12		0.01	
	(0.06)	(0.11)		(0.16)	

Table 12: Cross-sectional asset pricing results with alternative risk factors

⇒ Constraints of financial do not have additional explanatory power beyond carry trade factor (*HML*)
⇒ Only top10 capital ratios (*FXcore*10) provide an incomplete picture for currency pricing

▸ Back

Intermediary risk factor is able to price alternative currency portfolios

	λ^{DOL}	$\lambda^{\Delta IntCon}$	R^2
FMB			
NW	0.10	-0.12***	0.33
	(0.11)	(0.04)	
Sh	0.10	-0.12**	0.33
	(0.18)	(0.05)	
GMM	0.11***	-0.11*	
	(0.03)	(0.06)	

Table 13: Cross-sectional asset pricing results with 16 portfolios (NFA, carry trade, momentum, value)

$\Rightarrow$ Robust results confirm the relevance of constraints for determining currency returns

▸ Errors ▸ Back

Pricing errors with alternative currency portfolios

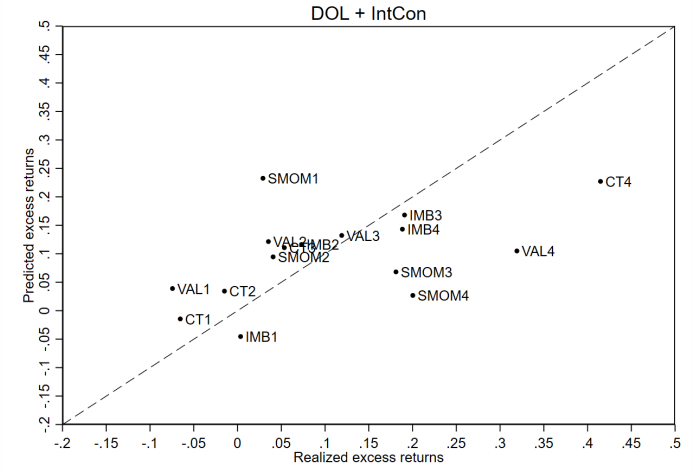

Figure 12: Cross-sectional pricing errors for 16 portfolios

Definition and data sources of controls

Variable	Definition	Source
Inflation	Inflation differentials between country i and the US ($\pi_{it} - \pi_{USt}$) are the differences in monhtly year-over-year percentage changes in CPI.	IMF (IFS)
Interest rates	Interest rate differentials between country i and the US ($i_{it} - i_{USt}$) are the differences in monthly immediate interbank rates (3-month interbank rates).	OECD (MEI) and central banks of non-OECD countries (Datastream)
Stock market	Stock market performance of country i versus the US ($\Delta\text{stock}_{it} - \Delta\text{SP500}_t$) is the difference in log changes of local stock market index and the S&P500 index.	OECD (MEI) and local stock market indices of non-OECD countries (Datastream)
Monetary policy	Monetary policy of country i versus the US ($\Delta\text{M1}_{it} - \Delta\text{M1}_{USt}$) is the difference in quarterly year-over-year percentage changes in money supply M1.	Datastream
Production	Economy activity of country i versus the US ($\Delta\text{production}_{it} - \Delta\text{production}_{USt}$) is the difference in quarterly year-over-year percentage changes in the industrial production index.	IMF (IFS)
PPP	Relative purchasing power parity (ppp_{it}) of country i is the annual log implied PPP conversion rate of national currency per US dollar.	IMF (WEO)
Current account	Current account balance relative to GDP of country i versus the US ($\text{CA}_{it} - \text{CA}_{USt}$)	External wealth of nations database
Financial crisis	The crisis dummy (crisis_t) that takes the value of one between September and December 2008, and zero otherwise.	

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Descriptive statistics of all variables

Variable	Obs.	Mean	Std. dev.	Min	Max
Exchange rate change (Δs)	8,424	-0.15	3.15	-69.40	18.18
Currency excess return (rx)	8,354	0.12	3.12	-48.90	20.27
Intermediary constraints:					
Level ($IntCon$)	8,424	0	1	-1.36	3.50
Changes ($\Delta IntCon$)	8,385	-0.0016	0.24	-0.86	1.28
NFA to GDP	8,424	0.15	1.18	-1.75	9.10
Difference to US in:					
Inflation	8,424	1.56	4.13	-6.23	61.13
Interest rate	8,424	2.80	4.03	-5.09	29.58
Stock market performance	8,424	0.01	0.05	-0.37	0.43
Money supply growth	8,424	-12.39	70.58	-351.28	122.67
Production growth	8,424	1.98	5.49	-22.38	37.31
Current account to GDP	8,424	0.05	0.08	-0.09	0.51
Log PPP	8,424	1.89	2.24	-2.25	8.47
FX reserves to imports	8,424	0.84	0.75	0.09	5.18
Gross assets and liabilities to GDP	8,424	3.71	4.84	0.54	29.93
CBOE Volatility Index:					
Level (VIX)	8,424	0	1	-1.14	4.85
Changes (ΔVIX)	8,385	0.0003	0.62	-2.31	2.53

Table 14: Descriptives of controls

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Creditors have higher excess returns when constraints tighten

	rx_{it}	rx_{it}	rx_{it}	rx_{it}	rx_{it}
$\Delta IntCon$	-2.89***	-3.53***	-3.25***	-3.45***	-3.00***
	(0.85)	(0.60)	(0.74)	(0.82)	(0.85)
NFA/GDP		-0.01	0.12*	0.14***	0.13***
		(0.06)	(0.07)	(0.05)	(0.05)
$\Delta IntCon \times$ NFA/GDP		0.98***	0.99***	1.01***	1.02***
		(0.24)	(0.24)	(0.24)	(0.24)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	No
Quarter FE	Yes	No	No	No	Yes
Controls	Yes	No	Yes	Yes	Yes
Num. obs.	8,316	8,316	8,316	8,316	8,316
R^2	0.17	0.08	0.09	0.11	0.17

Table 15: FE panel regressions of currency excess returns

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Countries with high FX reserves are less prone to constraints

	Δs_{it}	Δs_{it}	Δs_{it}	Δs_{it}
	(1)	(2)	(3)	(4)
	FX Reserves		Financial openness	
	Low	High	Low	High
$\Delta IntCon$	-3.46***	-2.49***	-2.47***	-3.34***
	(1.01)	(0.70)	(0.81)	(0.93)
NFA/GDP	0.35	0.18***	0.71	0.11***
	(0.31)	(0.05)	(0.57)	(0.04)
$\Delta IntCon \times$ NFA/GDP	1.09**	0.77***	2.17	1.02***
	(0.42)	(0.25)	(1.28)	(0.22)
Country FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Num. obs.	4,192	4,193	4,186	4,199
R^2	0.19	0.18	0.17	0.20

Table 16: FE panel regressions of exchange rate changes in subsamples

▸ Marginal effects

Marginal effects of changes in index - low FX reserves

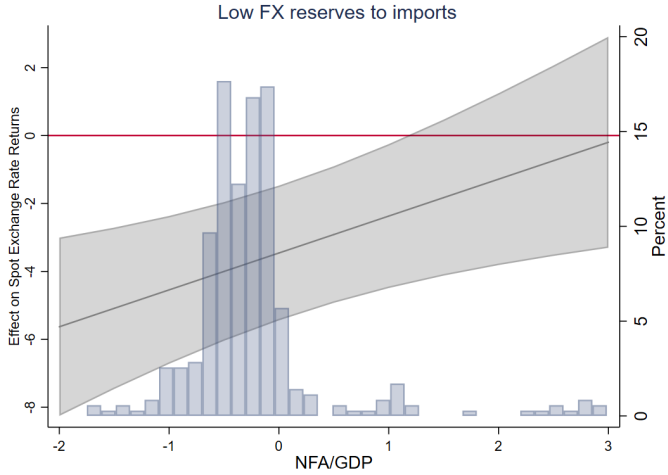

Figure 13: Average marginal effects of $\Delta IntCon$

Marginal effects of changes in index - high FX reserves

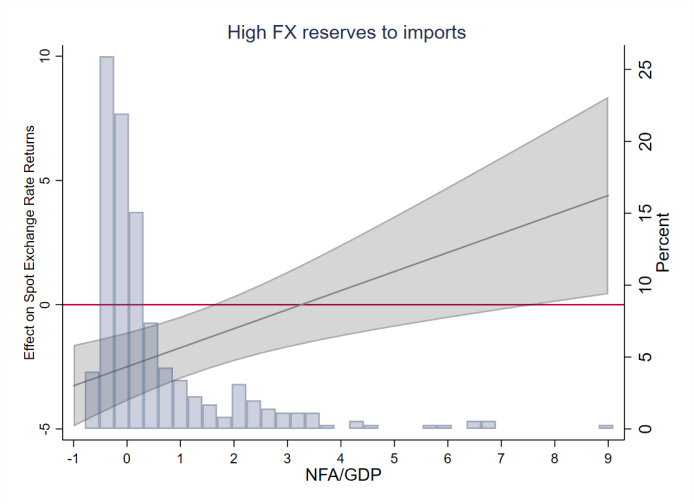

Figure 14: Average marginal effects of $\Delta IntCon$

Alternative intermediary constraints indices do not affect the findings

	Δs_{it}	Δs_{it}	Δs_{it}	Δs_{it}
	(1) Market share	(2) Total assets	(3) Top 17	(4) Top 3
$\Delta IntCon$	-2.88***	-3.01***	-3.04***	-1.38
	(0.90)	(0.73)	(0.79)	(1.02)
NFA/GDP	0.15***	0.14**	0.14**	0.15***
	(0.05)	(0.05)	(0.05)	(0.05)
$\Delta IntCon \times$ NFA/GDP	1.11***	1.07***	1.04***	0.83***
	(0.29)	(0.25)	(0.24)	(0.25)
Country FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Num. obs.	8,385	8,385	8,3856	8,3856
R^2	0.17	0.18	0.18	0.15

Table 17: FE panel regression of exchange rate changes with alternative indices

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