Macroeconomic Volatility and External Imbalances

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Motivation

The size and durability of the imbalances that characterize the world economy today reflect a myriad of different forces: from differences in actual and potential growth rates, the degree of openness of financial and product markets, the type of exchange rate regime in place, the borrowing requirements of the sovereign, the degree of financial market development, the extent of the official safety nets, to differences in attitudes toward risk and expectations about the future. The interactions of these forces are complex and vary over time. And this limits our capacity to judge the sustainable level of imbalances.

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Tim Geithner 2006

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- Empirically
  - Document robust and systematic relation between changes in imbalances and changes in macro risk
- Theoretically/quantitativelly
  - Develop simple consumption/saving/investment model with time varying macro risk
  - Model quantitatively captures the relationship between risk and imbalances in the data -> risk a major factor in understanding the evolution of imbalances
  - Importance of open economy in recent literature on "volatility" shocks

Sample of analysis

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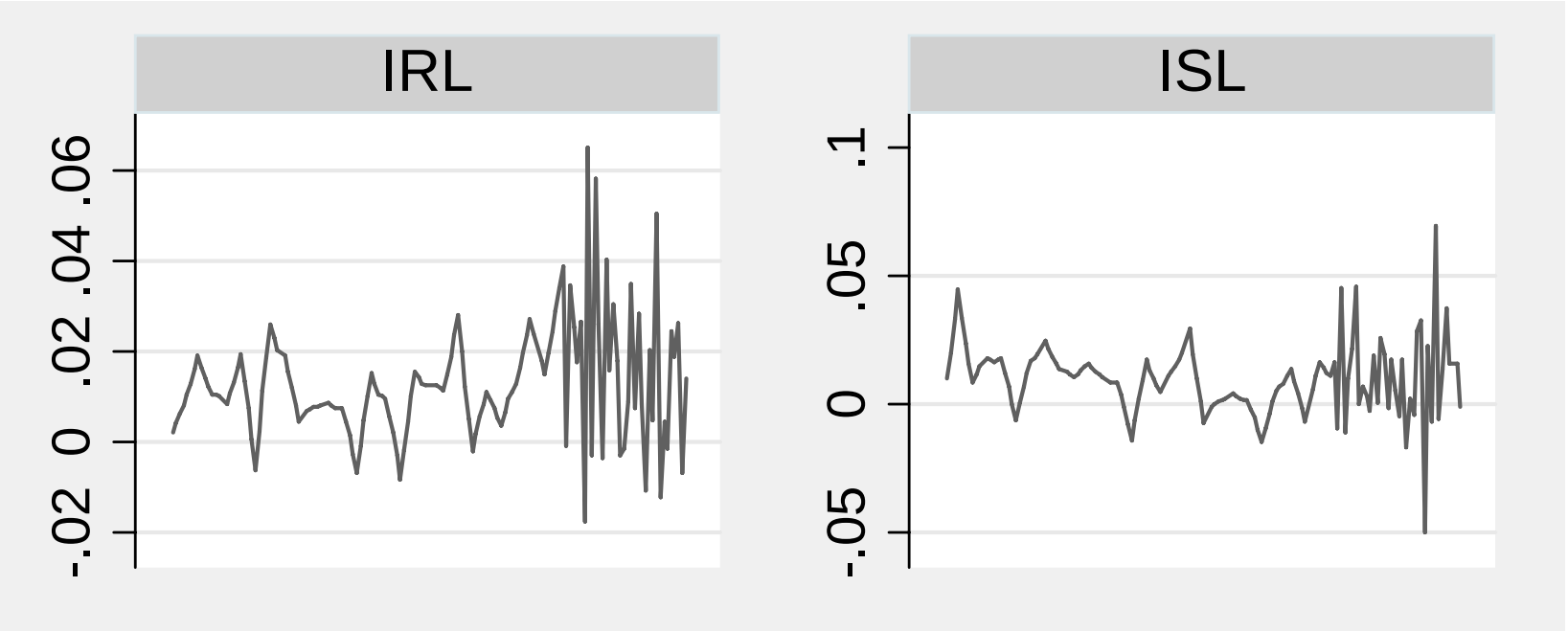
- Largest subset of OECD countries for which could find long quarterly macro series consistent across countries and time: 20 countries, 1970.1-2005.4 (2009.4)
- Why not larger group? Consistency across time crucial for analyzing time varying volatility and harder to get even in OECD

Ireland and Iceland changes in risk?

Growth rate of real GDP:

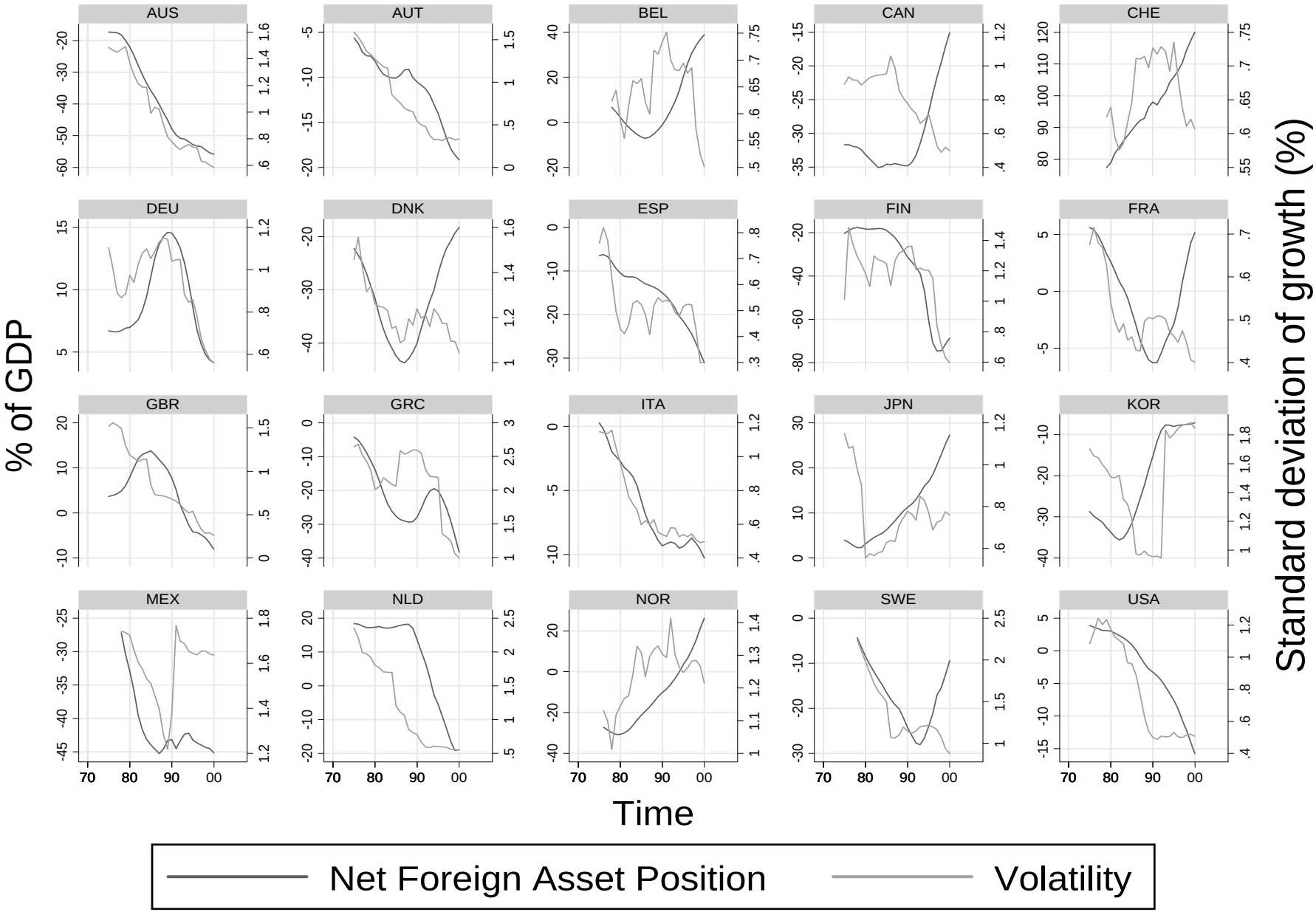


Straight from OECD Economic Outlook

Variables of interests

- Macroeconomic volatility (risk): Standard deviation of real GDP growth over a 10 yrs window
- Imbalances: NFA position (include all assets and liabilities) / GDP over the same window

Risk and NFA: the data, 1970-2005



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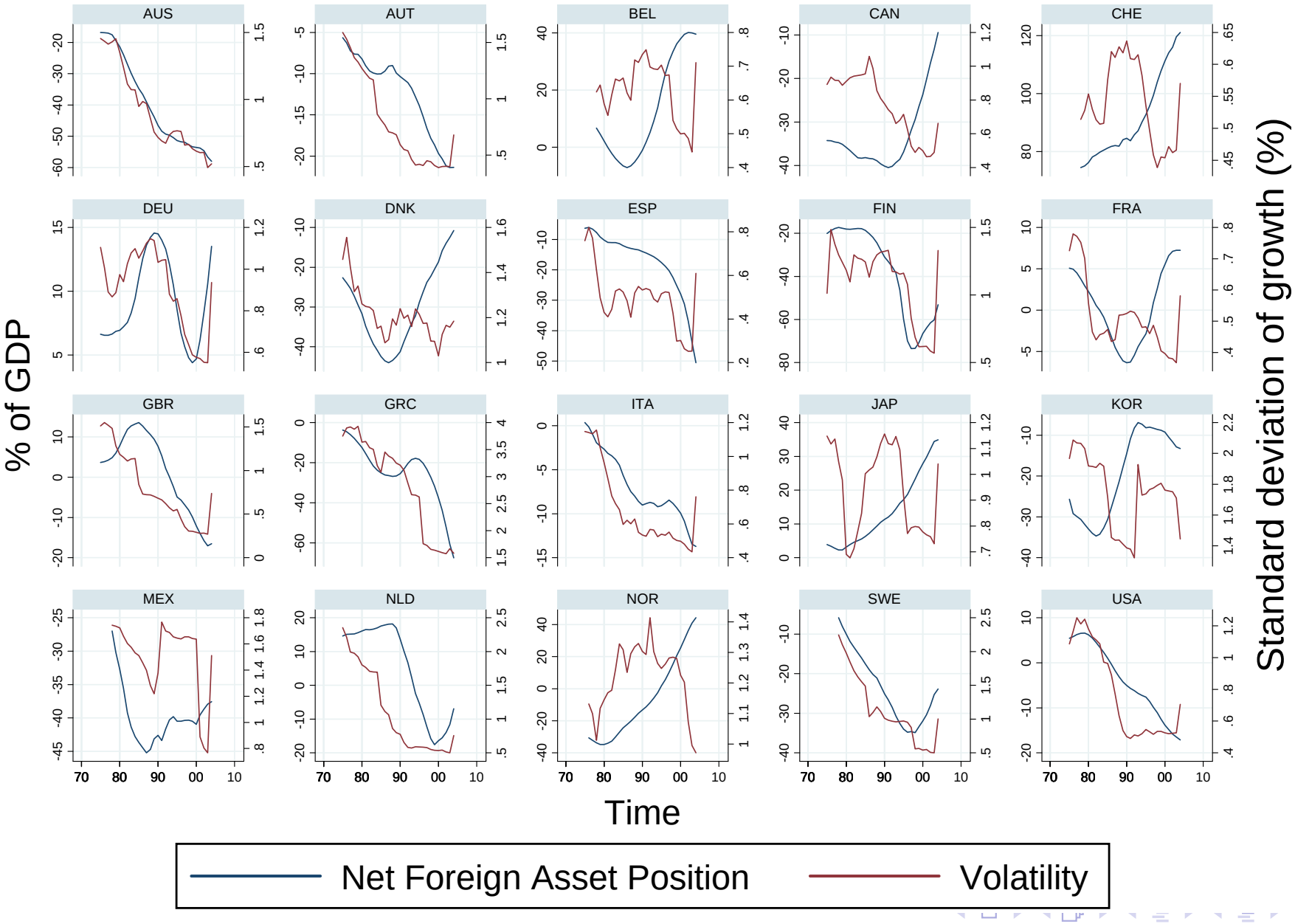
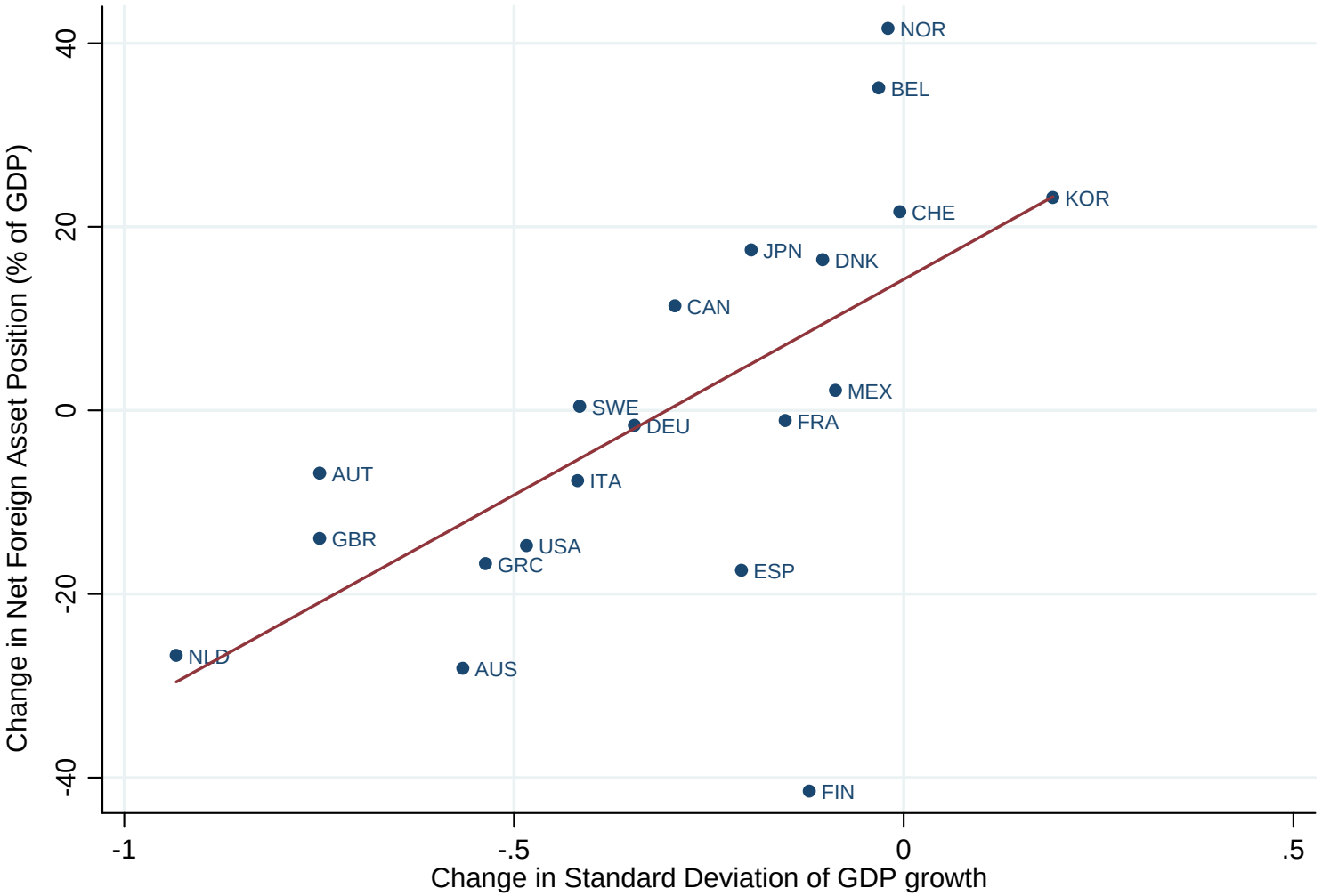


Risk and NFA: empirical issues

- Data suggest that changes in NFA strongly associated with changes in macro risk
- Potential issues
  - Common trend (globalization and great moderation)
  - Third factors driving both independently (i.e. good policies at the same lower risk and NFA)
  - Measurement of Risk
  - Diff in Diff v/s fixed effects
  - Length and structure of windows

Risk and NFA: Long NO windows, DD



The change in volatility and NFA is between the 1990-2005 period and the 1970-1985 period.

Risk and NFA: Various windows, DD

Window	Non Overlapping	R^2	#Obs
18 yrs	36.3***	0.52	20
	(10.3)		
12 yrs	17.9***	0.15	40
	(5.3)		
8 yrs	7.32**	0.06	55
	(3.18)		
5 yrs	2.42	0.02	107
	(2.32)		

All regressions include controls for average growth and inflation in window. SE are clustered at the country level.

Risk and NFA, Long O windows, FE

	Dependent variable is Net Foreign Assets					
	(i)	(ii)	(iii)	(iv)	(iv)	(iv)
Volatility of GDP Growth	18.15***	18.49***	19.48***	17.90***	16.90***	
	(4.407)	(4.93)	(5.52)	(5.54)	(4.85)	
Average GDP Growth		1.213	3.01	4.86	8.591	-2.05
		(6.48)	(6.49)	(8.13)	(6.53)	(6.39)
Average Inflation			1.25	1.55	0.406	-1.66
			(1.73)	(1.58)	(1.64)	(1.44)
Volatility of Inflation			0.08	0.66	0.845	2.85
			(3.21)	(3.26)	(2.63)	(3.11)
Financial Openess 1				1.611	-0.078	-0.52
				(2.32)	(2.20)	(2.58)
Financial Openess 2				-3.61	-2.49	-2.86
				(4.90)	(4.63)	(5.83)
Trade Openess					-0.82	-0.90
					(0.53)	(0.58)
N	506	506	506	494	494	494
adj. R^2	0.897	0.897	0.898	0.870	0.879	0.861

Robust standard errors in parentheses account for clustering at the country level.

All regressions include a constant, country and year fixed effects.

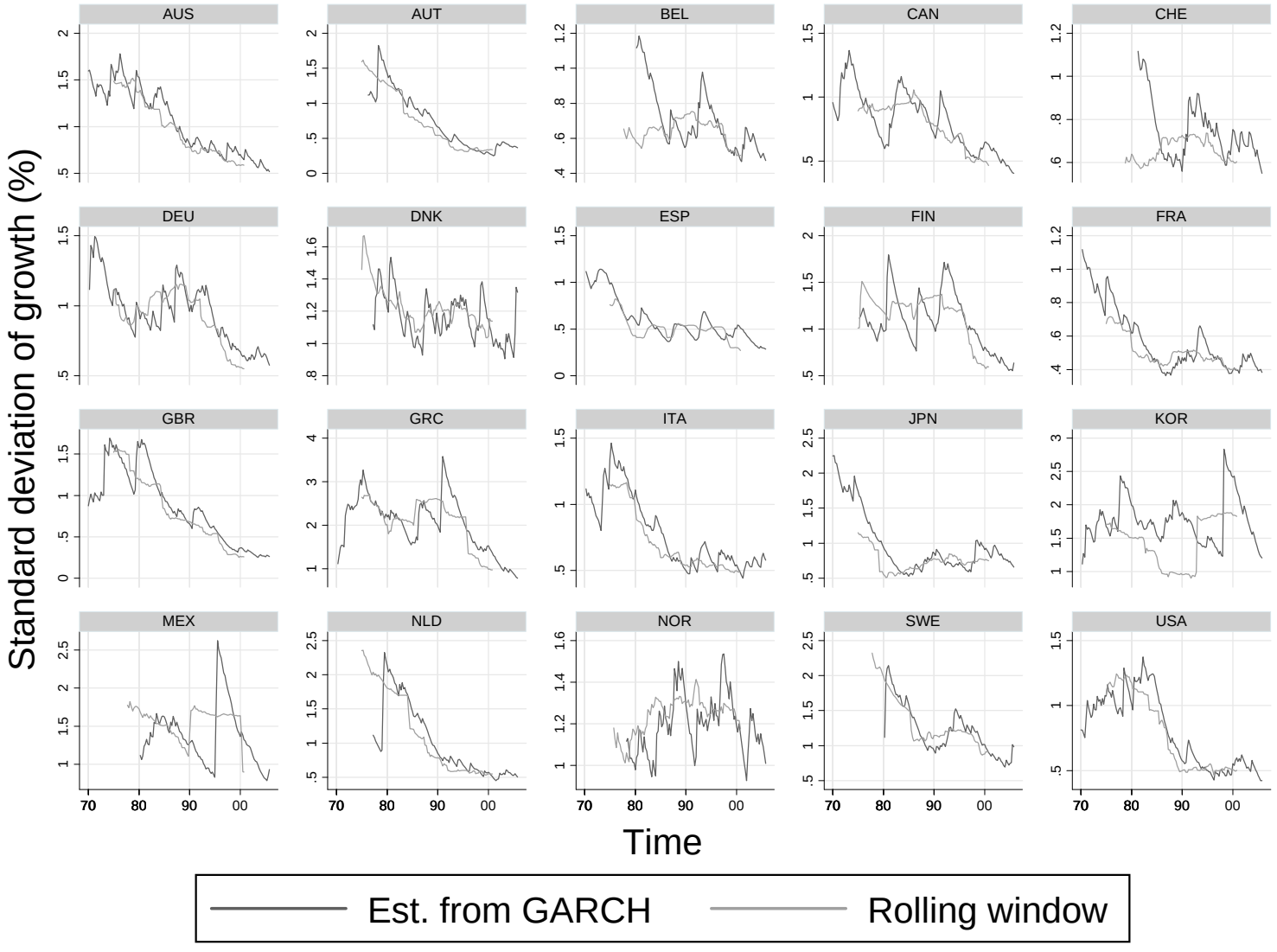
Measuring volatility differently

Use GARCH(1,1) and estimate

$$\begin{aligned} y_t &= \rho y_{t-1} + \varepsilon_t \\ \sigma_{\varepsilon,t} &= \beta_1 \sigma_{\varepsilon,t-1} + \beta_2 \varepsilon_{t-1}^2 \end{aligned}$$

where y_t is real GDP growth

GARCH volatility



Risk and NFA, additional cases

	Dependent variable is Net Foreign Assets[a]					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Volatility GDP Growth_5yrs	10.41***	10.11***				
	(3.028)	(2.954)				
Growth_5yrs		-1.111				
		(4.172)				
Volatility GDP Growth			14.23**	14.41**		
(from GARCH)			(5.098)	(5.148)		
Growth_1yr				0.598		
				(1.296)		
Volatility GDP Growth					16.42**	15.21**
(1985-2005)					(6.628)	(7.217)
Average GDP Growth						-2.599
						(8.103)
N	582	582	626	626	320	320
adj. R^2	0.825	0.825	0.763	0.762	0.923	0.923

a) Net foreign asset position in each specification is computed on the same window used for computing volatility

Robust standard errors in parentheses account for clustering at the country level.

All regressions include a constant, country and year fixed effects.

Quantitative summary

- A 1% increase in macro-risk (in the medium-long run) associated with increase in NFA/Y between 10% and 20%, not driven by difference in average growth

Why should volatility affect imbalances?

- Consumption: If international risk-sharing incomplete changing relative volatility affects relative precautionary motive, relative “risk adjusted" rate of time preference", increases scope for international inter-temporal trade, leads to imbalances

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- Consumption: If international risk-sharing incomplete changing relative volatility affects relative precautionary motive, relative “risk adjusted" rate of time preference", increases scope for international inter-temporal trade, leads to imbalances
- Investment: Changing relative volatility change international allocation of capital, leads to imbalances

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- Write simple open economy model which allows

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  - Quantification of these effects
  - Understanding of how these effects depend on structural features of economy

Model overview

- Two countries, one good
- Macro volatility driven by country specific TFP shocks, with time varying volatility
- Competitive factor markets and full risk sharing within a country (repr. agent)
- Potential menu of assets traded internationally
- Agents choose consumption and international assets portfolios
- Firms choose investment

Households

$$\max_{c_{it},l_{it},\lambda_{it},\lambda^F_{1t},b_{1t}} E_0 \sum_{t=0}^{\infty} \beta^t U(c_{it}, l_{it})$$

$$\begin{aligned} & c_{1t} + b_{1t} + \lambda_{1t} p_1 + \lambda^F_{1t} p_{2t} \\ \leq \quad & l_{1t} w_{1t} + \lambda_{1t}(d_{1t} + p_{1t}) + \lambda^F_{1t-1}(d_2 t + p_{2t}) + b_{1t-1} R_{t-1} \end{aligned}$$

$\lambda_{10}, \lambda^F_{10}, b_{10}$ given

Firms

$$\max_{l_{it},k_{it},x_{it}} E_0 \sum_{t=1}^{\infty} d_{it} Q_{it}$$

$$s.t.$$

$$d_{it} = A_{it} l_{it}^{1-\alpha} k_{it}^{\alpha} - w_{it} l_{it} - x_{it}$$

$$k_{it} = (1-\delta) k_{it-1} + x_{it} - \phi k_{it-1} \left[\frac{x_{it}}{k_{it-1}} - \delta \right]^2$$

k_{i0} given

Shocks

$$\begin{bmatrix} A_{1t} \\ A_{2t} \end{bmatrix} = \begin{bmatrix} \rho & \psi \\ \psi & \rho \end{bmatrix} \begin{bmatrix} A_{1t-1} \\ A_{2t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

$$\begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \rightarrow N(0, \Sigma_t), \qquad \Sigma_t = \begin{bmatrix} \sigma_{1,t}^2 & \chi\sigma_{1,t}\sigma_{2,t} \\ \chi\sigma_{1,t}\sigma_{2,t} & \sigma_{2,t}^2 \end{bmatrix}$$

$$\sigma_{i,t}^2 = \bar{\sigma}(1-\kappa) + \kappa\sigma_{i,t-1}^2 + \eta_{i,t}$$

$$\begin{bmatrix} \eta_{1t} \\ \eta_{2t} \end{bmatrix} \rightarrow N(0, \Sigma_\eta) \qquad \Sigma_\eta = \begin{bmatrix} \sigma_\eta^2 & 0 \\ 0 & \sigma_\eta^2 \end{bmatrix}$$

Equilibrium

$$
\begin{aligned}
c_{1t} + x_{1t} + c_{2t} + x_{2t} &= y_{1t} + y_{2t} \\
b_{1t} + b_{2t} &= 0 \\
\lambda_{1t} + \lambda_{2t}^{F} &= 0, \quad \lambda_{2t} + \lambda_{1t}^{F} = 0
\end{aligned}
$$

A special case

If impose

$$\begin{aligned} \lambda_{10} &= \lambda_{1t} = \lambda_{2t} = 1 \quad \text{for every } t \\ \lambda_{10}^{F} &= \lambda_{1t}^{F} = \lambda_{2t}^{F} = 0 \quad \text{for every } t \end{aligned}$$

model is equivalent to Baxter and Crucini (1995) standard incomplete markets

Key parameters

- Preferences

$$\begin{aligned} U(c,l) &= \frac{1}{1-\sigma}\left[c^{\mu}(1-l)^{1-\mu}\right]^{1-\sigma} \\ \sigma &= 2 \end{aligned}$$

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- Process for TFP shocks

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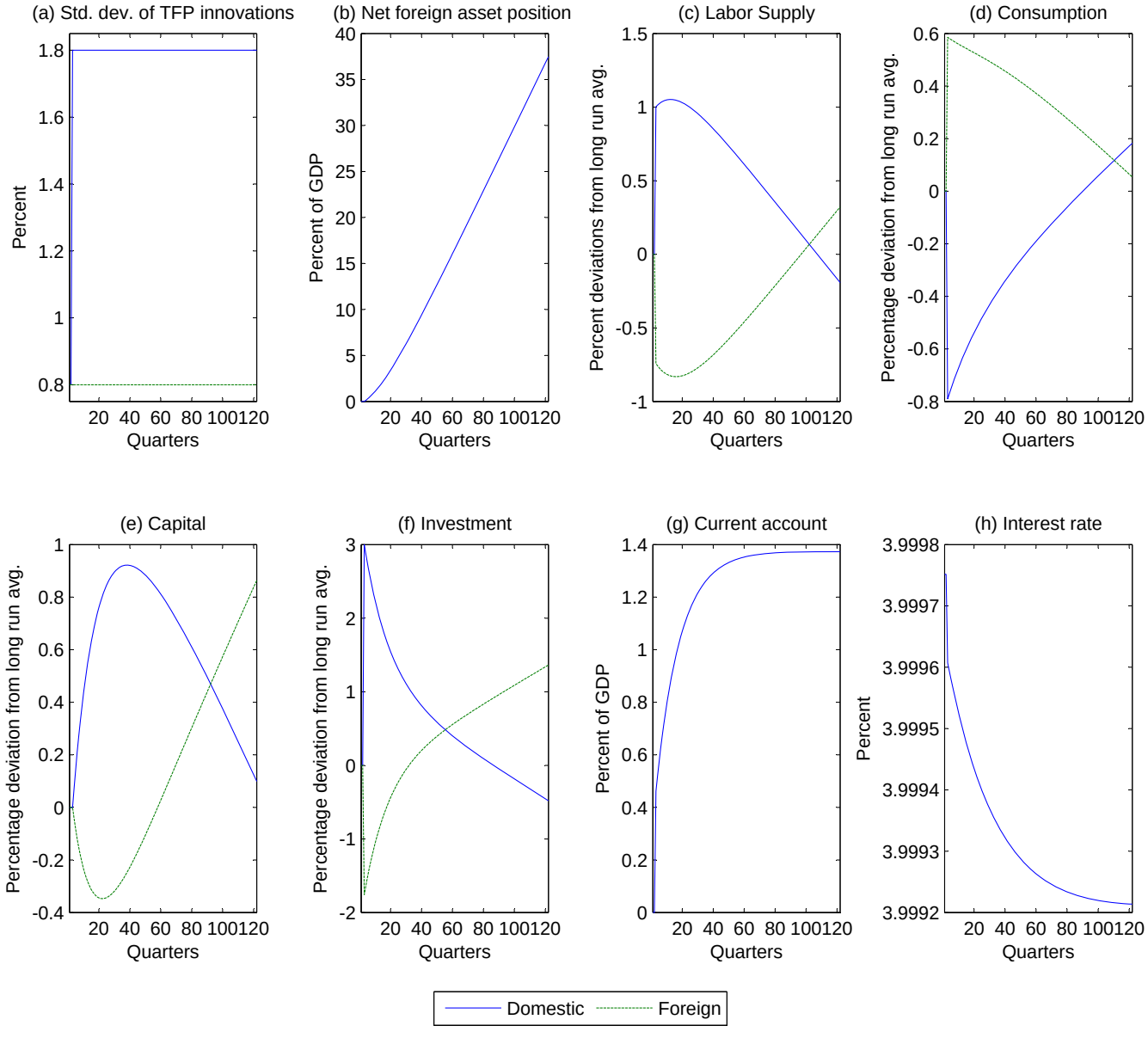
- Process for volatility shocks

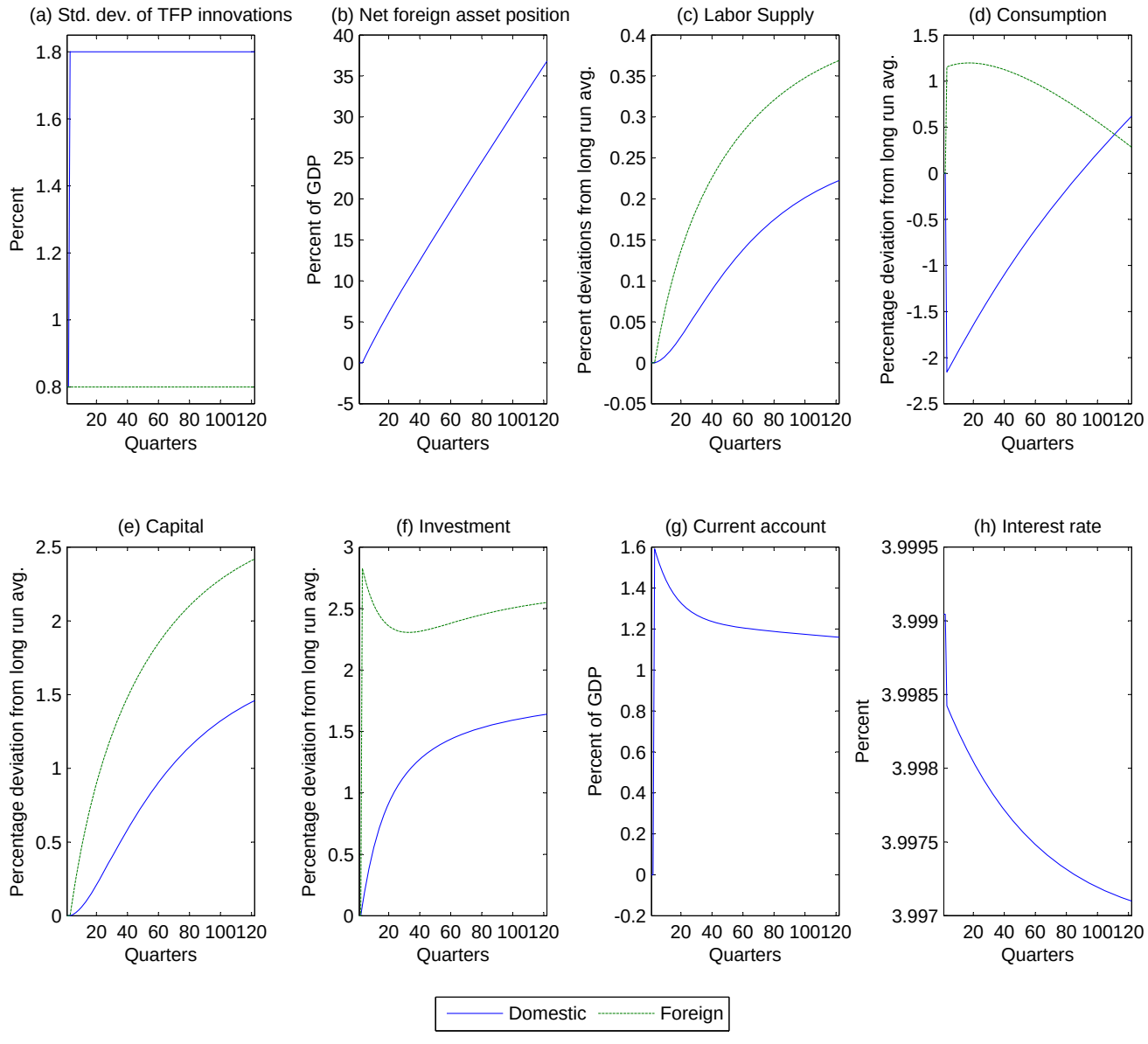
$$\begin{aligned} \sigma_{i,t}^2 &= \bar{\sigma}(1-\kappa) + \kappa\sigma_{i,t-1}^2 + \eta_{i,t} \\ \kappa &= 0.97, \sigma_{\eta} = 0.03\% \end{aligned}$$

Estimated on our sample

The impact of a volatility shock (Standard preferences)



The impact of a volatility shock (GHH preferences)



Result 1. Impact of risk on NFA: model and data

	Data		Model	
Window		R^2		R^2
18 yrs	36.3^{***}	0.52	9.8^{***}	0.17
	(10.3)		(3.0)	
12 yrs	17.9^{***}	0.15	9.7^{***}	0.21
	(5.3)		(1.3)	
8 yrs	7.32^{**}	0.06	7.4^{***}	0.25
	(3.18)		(0.5)	
5 yrs	2.42	0.02	5.0^{***}	0.31
	(2.32)		(0.4)	

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All regressions (in model and data) include controls for average growth in window

- Model captures a substantial part of the medium run co-movement between volatility and NFA

Result 2. How much volatility shocks contribute to imbalances?

Cross sectional (residual) dispersion of NFA GDP ratio (measure of imbalances)

Data (2005)	30%
Model (with TFP shocks and volatility shocks)	30%
Model (with only TFP shocks)	22%
Fraction of dispersion explained by risk	25%

Sensitivity to structural parameters

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- More risk sharing (through stock holdings) -> weaker response of imbalances

Additional test of the mechanism

Model suggests risk effect on imbalances strongest for small economies

	Dependent variable is net foreign asset position				
	(i)	(ii)	(iii)	(iv)	(v)
	All countries	Small countries			Large
		<=Sweden	<=Mexico	<=Canada	
Mean growth	1.213	6.643	7.034	4.129	-11.88
	(6.476)	(4.373)	(5.303)	(5.249)	(11.65)
Volatility	18.49***	24.25**	21.22***	19.25***	13.74**
	(4.931)	(9.522)	(6.270)	(5.838)	(4.650)
N	506	197	298	350	156
adj. R^2	0.897	0.912	0.900	0.896	0.693

Standard errors in parentheses account for clustering at the country level

All regressions include country and year fixed effects

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Conclusions

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- Imbalances not good or bad per se, reflect underlying macroeconomic conditions/policies
- Imposing capital controls to avoid imbalances not necessarily desirable