Macroeconomic Volatility and External Imbalances

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Causes and Macroeconomic Consequences of Uncertainty
Dallas Fed, October 2013

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.

Tim Geithner, 2006

Contributions

- Study new *observable* determinant of evolution of external imbalances: time varying macro risk (volatility/uncertainty)

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- Empirically
  - Document relation between changes in imbalances and changes in macro risk
- Theoretically/quantitativelly
  - Develop simple consumption/saving/investment open economy model with time varying macro risk
  - Model quantitatively captures the relationship between risk and imbalances in the data
  - Importance of open economy in recent literature on "volatility" shocks
- Overall
  - Macro risk major determinant of external imbalances

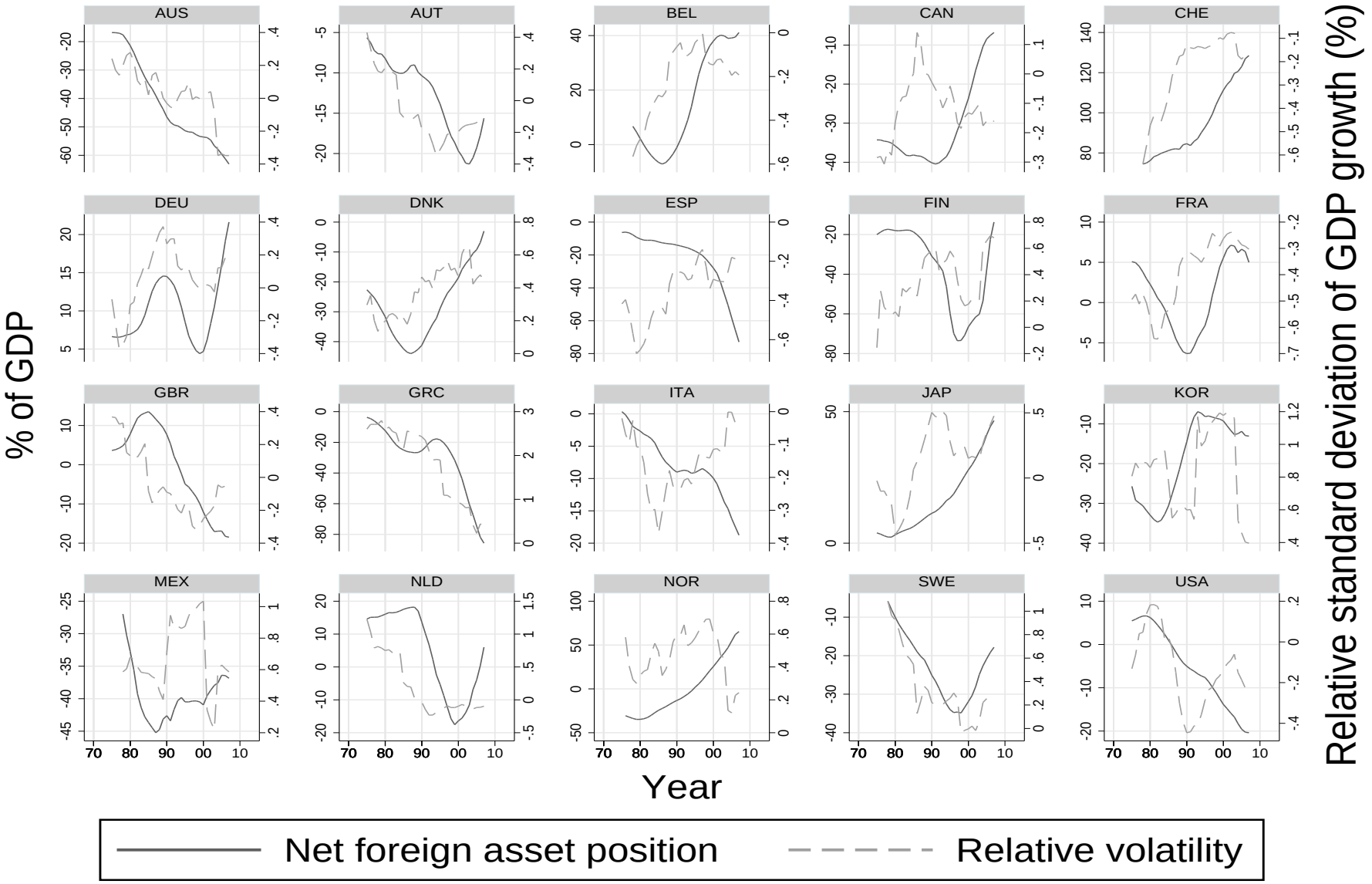
Sample

- Largest subset of OECD countries for which could find long quarterly macro series consistent across countries and time: 20 countries, 1970.1-2012.4

Variables of interests

- Macroeconomic volatility (risk): Standard deviation of quarterly real GDP growth over a 10 yrs window, relative to average volatility of other countries in sample
- Imbalances: NFA position (include all assets and liabilities) / GDP over the same window

Risk and NFA: the data, 1970-2012



Risk and NFA: empirical issues

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

Risk and NFA, Controlling for third factors

	Dependent variable is Net Foreign Assets						
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
Volatility of GDP Growth	18.62***	17.22***	17.22***	17.33***	15.14***	15.59***	
	(3.812)	(4.876)	(4.471)	(5.757)	(5.023)	(4.848)	
Average GDP Growth		-5.790	-4.745	-5.810	-6.924	-2.569	-10.72
		(9.336)	(9.523)	(9.777)	(10.96)	(11.35)	(11.26)
Average Inflation			1.802	3.710*	4.030*	3.225	2.544
			(1.686)	(2.028)	(2.300)	(2.270)	(2.595)
Volatility of Inflation			-0.904	-2.299	-2.000	-1.698	-0.699
			(3.540)	(3.528)	(3.207)	(3.232)	(3.344)
Volatility of Govm. Cons. Growth				-4.893	-6.824	-7.008	-8.003
				(4.419)	(4.960)	(5.102)	(5.502)
Financial Openness 1					-0.698	-0.101	0.551
					(4.003)	(4.200)	(4.542)
Financial Openness 2					2.123	1.148	1.729
					(4.386)	(3.843)	(3.833)
Trade Openness						-54.06	-50.56
						(66.78)	(67.79)
N	662	662	662	646	633	633	633
adj. R^2	0.814	0.814	0.815	0.820	0.796	0.801	0.790

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

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

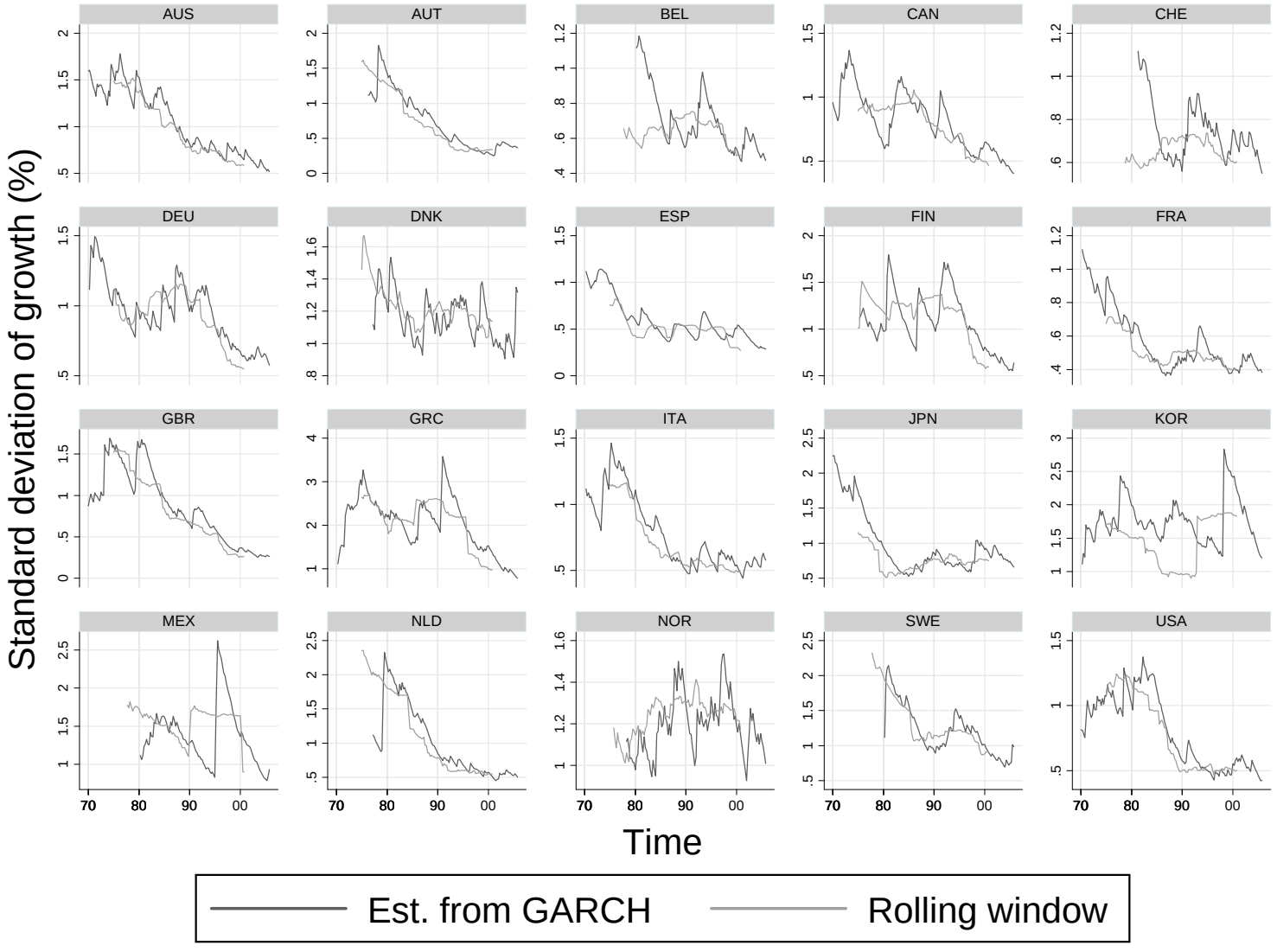
Measuring Risk differently

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)	(vii)	(viii)
Vol. GDP Growth (5 yrs)	14.83***	14.41***						
	(4.395)	(4.753)						
Av. GDP Growth (5 yrs)		-2.613						
		(5.737)						
Vol. GDP Growth (7 yrs)			16.65***	15.73***				
			(4.105)	(4.627)				
Av. GDP Growth (7 yrs)				-5.171				
				(7.222)				
Vol. GDP Growth (from GARCH)					14.02***	14.61***		
					(4.841)	(4.858)		
Av. GDP Growth (1 yr)						1.966		
						(2.198)		
Vol. GDP Growth (1985-2012)							16.46***	16.67**
							(5.609)	(6.386)
Av. GDP Growth (1985-2012)								0.626
								(12.05)
N	720	720	698	698	764	764	475	475
adj. R^2	0.756	0.756	0.779	0.780	0.710	0.710	0.845	0.844

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 0.5% change in relative macro-risk (in the medium-long run, experienced by most countries) associated with change in NFA/Y between 7% and 8%

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

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
- Investment: Changing relative volatility change international allocation of capital, leads to imbalances

The goal

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- Write simple open economy model which allows
  - 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

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

$$V_{it} = (1 - \rho_V) + \rho_V V_{it-1} + \eta_{it}$$

$$\begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \rightarrow N(0, \Sigma_\varepsilon), \begin{bmatrix} \eta_{1t} \\ \eta_{2t} \end{bmatrix} \rightarrow N(0, \Sigma_\eta)$$

Equilibrium

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

International diversification

We impose

$$\begin{aligned} \lambda_{10} &= \lambda_{1t} = \lambda_{2t} = \lambda \quad \text{for every } t \\ \lambda^F_{10} &= \lambda^F_{1t} = \lambda^F_{2t} = 1 - \lambda \quad \text{for every } t \end{aligned}$$

- $\lambda = 1$ model is equivalent to Baxter and Crucini (1995): standard incomplete markets.
- $\lambda < 1$ more international risk diversification

Key parameters

- Preferences

$$
\begin{aligned}
U(c,l) &= \frac{1}{1-\sigma}\left[c^{\mu}(1-l)^{1-\mu}\right]^{1-\sigma} \quad \text{Standard} \\
&= \frac{1}{1-\sigma}(c-\frac{1}{v}l^{v})^{1-\sigma} \quad \text{GHH}
\end{aligned}
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- Process for TFP and Volatility shocks

Key parameters

- Preferences

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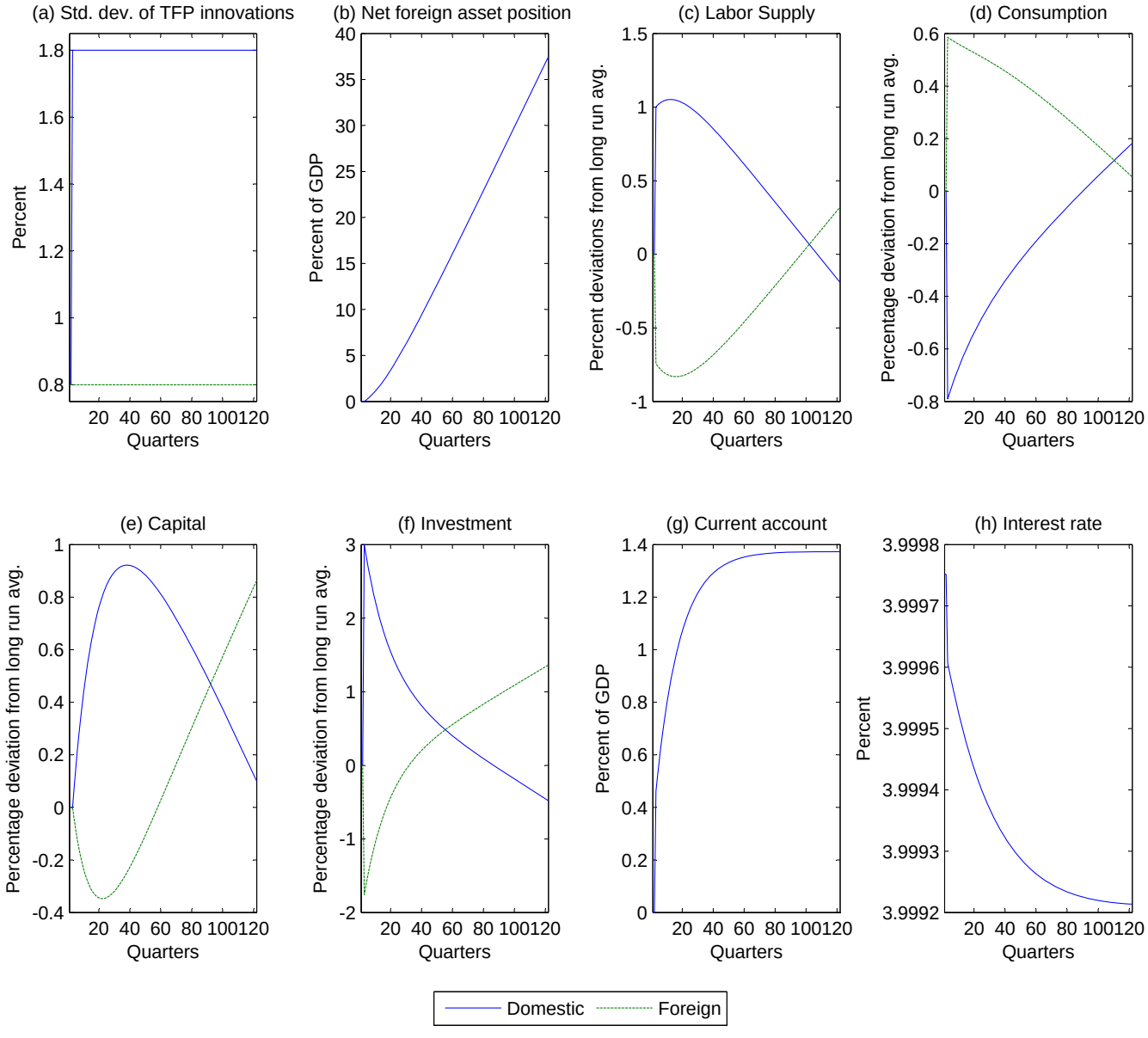
\begin{aligned}
U(c,l) &= \frac{1}{1-\sigma}\left[c^{\mu}(1-l)^{1-\mu}\right]^{1-\sigma} && \text{Standard} \\
&= \frac{1}{1-\sigma}(c-\frac{1}{v}l^{v})^{1-\sigma} && \text{GHH}
\end{aligned}
$$

- Process for TFP and Volatility shocks
- International diversification, $1-\lambda$

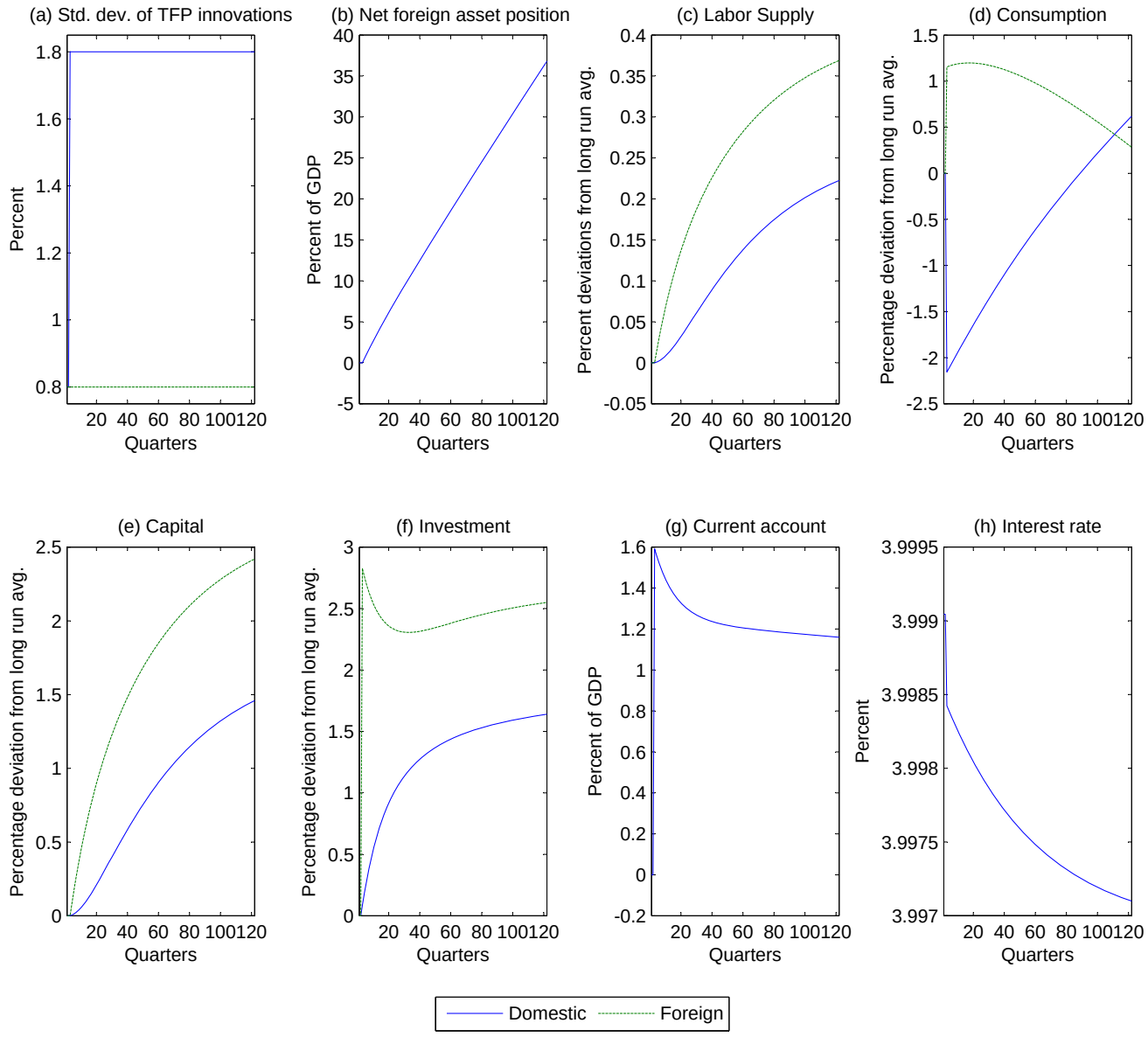
Qualitative results

- Increase in volatility leads to accumulation of external position
  - For all plausible preferences
  - For all plausible levels of international diversification
  - Size of the effect very sensitive to persistence of shocks

The impact of a volatility shock (Standard preferences)



The impact of a volatility shock (GHH preferences)



Quantitative results

- Choose parameters of shock process to match relevant cross sectional moments

Name	Data	Model
Business Cycle Statistics[a]		
St. Dev. of GDP Growth	1.13%	0.95%
Relative St. Dev. of Consumption to GDP Growth	0.94	0.98
Relative St. Dev. of Investment to GDP Growth	3.27	3.52
St. Dev. of Change in Net-Exports-to-GDP Ratio	1.12%	0.82%
Other Moments[b]		
St. Dev. of Relative Volatility (de-meaned)	0.30%	0.36%
Persistence of Relative Volatility	0.87	0.96
St. Dev. of NFA (de-meaned)	14.5%	16.0%

-

Result 1. Model captures well the observed relation between Risk and NFA

Dependent variable is Net Foreign Assets

	Data		Model	
Window	V	VG	V	VG
20 years	21.82***	19.05***	19.11	20.14
	(5.938)	(6.610)		
		-12.06		-16.92
		(9.964)		
15 years	20.62***	18.12***	18.21	19.39
	(4.868)	(5.899)		
		-9.75		-18.22
		(9.130)		
10 years	18.62***	17.22***	17.02	18.15
	(3.812)	(4.876)		
		-5.79		-13.50
		(9.336)		
5 years	14.83***	14.41***	13.52	14.29
	(4.395)	(4.753)		
		-2.61		-15.64
		(5.737)		

Result 2. How important are risk shocks?

- Eliminating risk shock from model reduce standard deviation of NFA from 16% to 13%
- Risk shocks not fundamental
- Relation between risk and NFA driven also by realized (ex post) not ex-ante risk
- Essential element is the persistence of shocks
- If shocks not persistent model generates no relation between risk and NFA. NFA movements dominated by intertemporal borrowing/lending and not by precautionary motives.

Conclusions

- Data and theory suggest time-varying country-specific macroeconomic volatility is an important factor to understand evolution of external imbalances
- This is consistent with the importance of precautionary motive in driving imbalances
- Imbalances not good or bad per se, reflect underlying macroeconomic conditions/policies