The Long or Short of it: Determinants of Foreign Currency Exposure in External Balance Sheets

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May 2009

Introduction

- Stylized fact: Rapid expansion in cross-border financial holdings
- Theoretical literature: 'New' macro-finance models with endogenous portfolios to hedge macro risks
- Empirical basis for these models very cursory
- Our goal is to establish basic empirical analysis of key dimension of international portfolios: aggregate foreign-currency exposure
- Examine XS and TS variation in foreign-currency exposure

Related Literature

- EM literature. "Original Sin" (Eichengreen et al; Goldstein and Turner)
- United States: Tille (2003), LMF (various), Gourinchas and Rey (2007)
- Major advanced economies: LMF (Economic Policy, 2007)
- Database: Lane and Shambaugh (AER, forthcoming)

Plan for the Talk

- Conceptual Framework
- Dataset
- Decomposition of Foreign-Currency Exposure
- Panel Econometrics
- Summary

Conceptual Framework

Consider a two-period small open economy model
The endowment of the home agent in period 1 is fixed at y_1 but her period-2 endowment y_2 is stochastic. In particular, the process for output is

$$y_2 = \overline{y} + \beta_y S + \varepsilon \tag{1}$$

S is the period-2 rate of exchange rate depreciation
β_y is the beta from a regression of y_2 on S
ε is the orthogonal stochastic component

Consumption only takes place in the second period.

There are two assets:
domestic-currency asset D which offers a fixed gross return $R_D = \overline{R}$
foreign-currency asset F
The domestic-currency return on the foreign asset is

$$R_F = \alpha_F + \beta_F S + v \tag{2}$$

β_F is the beta from a regression of R_F on S
v is the orthogonal stochastic component

With this setup, we can derive the equilibrium holdings of F as a function of β_y, β_F and other factors.

The agent maximises utility over

$$V(c_2) = \left(\frac{1}{1+\delta}\right)\left(\frac{-1}{A}\right) E \exp[-Ac_2] \tag{3}$$

δ is the discount rate
A is the coefficient of absolute risk aversion
The level of period-2 consumption is

$$c_2 = y_2 + (\omega_D R_D + \omega_F R_F) \tag{4}$$

where ω_D, ω_F are the domestic and foreign portfolio allocations respectively.

The joint normality of y_2 and R_F means that we can write the optimality condition for consumption as

$$ACov(c_2, R_F) = E(R_F) - R_D = RP \tag{5}$$

RP is the risk premium
The agent chooses portfolio allocations such that any remaining volatility in consumption that is correlated with the volatility in R_F is compensated through the risk premium.

With an optimal portfolio allocation, we can write consumption in the format equilibrium consumption can be written as

$$c_2 = \alpha + \beta_c R_F + \zeta \tag{6}$$

where

$$\beta_c = \frac{RP}{AV(R_F)} \tag{7}$$

β_c is the agent's *desired exposure* to the foreign-currency asset.
If the foreign-currency asset offers a risk premium, the agent will want some positive exposure to the foreign-currency asset.
If the risk premium is zero, the agent will desire to have a consumption profile that has zero foreign-currency risk.

The agent's *endowed exposure* to the foreign-currency asset is β_y.
Accordingly, the optimal portfolio allocation to the foreign-currency asset is

$$\omega_F = \beta_c - \beta_y \tag{8}$$

$$\omega_F = \frac{RP}{A\beta_F^2 V(S)} - \frac{Cov(y_2, S)}{V(S)} \tag{9}$$

$$\omega_F = \frac{1}{V(S)}\left[\frac{RP}{A\beta_F^2} - Cov(y_2, S)\right] \tag{10}$$

The optimal portfolio foreign-currency position is
increasing in the risk premium offered on the foreign-currency asset
declining in the volatility of the exchange rate and the degree of absolute risk aversion A
it is decreasing in the covariance between the exchange rate and domestic output

The New Macro-Finance Literature

- Devereux-Saito (2006): negative covariance btwn productivity and inflation; trade only in nominal bonds. Result: long position in FC bond (short in DC bond) achieves full risk sharing.
- Devereux-Sutherland (2006): shocks to output and money stocks, trade in nominal bonds. Optimal portfolio:

$$FC = \frac{\sigma_Y^2}{2(\sigma_Y^2 + \sigma_M^2)(1 - \beta\rho_Y)}$$

- Engel-Matsumoto (2008): sticky prices, home bias in consumption, two-good model. Result: go short in FC bond.
- Overall message: covariance between exchange rate and key macro variables determines optimal FC position.

Moving from Theory to Empirics

$$FX_{it}^{AGG} = \omega_{it}^{A} * \left(\frac{A_{it}}{A_{it} + L_{it}} \right) - \omega_{it}^{L} * \left(\frac{L_{it}}{A_{it} + L_{it}} \right) \tag{11}$$

$$\begin{aligned} FX_{it}^{AGG*} &= \alpha + \phi_t + \gamma * COV(Y_{it}, E_{it}) - \varphi_H * VOL(\pi_{it}) - \varphi_F * VOL(E_{it}) \\ &\quad + \rho * OPEN_{it} + \beta * VOL(Y_{it}) + \varepsilon_{it} \end{aligned} \tag{12}$$

$$FX_{it}^{AGG} = FX_{it}^{AGG*} - C(F_{it}) \tag{13}$$

$$\begin{aligned} FX_{it}^{AGG} &= \alpha + \phi_t + \gamma * COV(Y_{it}, E_{it}) - \varphi_H * VOL(\pi_{it}) - \varphi_F * VOL(E_{it}) \\ &\quad + \rho * OPEN_{it} + \beta * VOL(Y_{it}) - \sigma F_{it} + \varepsilon_{it} \end{aligned}$$

Components of the Net Foreign Currency Asset Position

$$FX_{it}^{AGG} = \left(\frac{NFA_{it}}{A_{it}+L_{it}}\right) + \left[\omega_{itDC}^{L} * \left(\frac{L_{it}}{A_{it}+L_{it}}\right) - \omega_{itDC}^{A} * \left(\frac{A_{it}}{A_{it}+L_{it}}\right)\right] \quad (14)$$

$$FX_{it}^{AGG} = \left(\frac{NFA_{it}}{A_{it}+L_{it}}\right) + FX_{it}^{AGG,0} \quad (15)$$

$$\begin{aligned} FX_{it}^{AGG} = & \left[\left(\frac{A_{NRit}-L_{it}}{A_{it}+L_{it}}\right) + \frac{FXR_{it}}{A_{it}+L_{it}}\right] + \\ & \left[\left(\frac{PEQL_{it}+FDIL_{it}}{A_{it}+L_{it}}\right) + \left(\frac{DEBTL_{it}^{DC}}{A_{it}+L_{it}}\right) - \left(\frac{A_{NRit}^{DC}}{A_{it}+L_{it}}\right)\right] \end{aligned}$$

Additional Measures

$$NETFX = FX^{AGG} * IFI \tag{16}$$

$$FXDEBT_{it}^{AGG} = \frac{\begin{array}{c}(FXR_{it} + PDEBTA_{it}^{FC} + ODEBTA_{it}^{FC} \\ -PDEBTL_{it}^{FC} + ODEBTL_{it}^{FC})\end{array}}{DebtA_{it} + DebtL_{it}} \tag{17}$$

The Dataset

- Draw on dataset constructed by Lane and Shambaugh (*AER*, forthcoming)
- Focus here on split between foreign currency and domestic currency (LS dataset also reports composition of FC component)
- Assets: FXRES, PEQA, FDIA in FC; DEBTA (PDEBTA, ODEBTA) split between FC and DC.
- Liabilities: PEQL, FDIL in DC; DEBTL (PDEBTL, ODEBTL) split between FC and DC.
- 117 countries, 1990 to 2004.

Table: Aggregate Foreign Currency Exposure

	1994		2004	
	mean	median	mean	median
		FX^{agg}		
All	-0.23	-0.24	-0.03	-0.01
Advanced	0.04	0.08	0.12	0.09
Developing & Emerging	-0.30	-0.41	-0.07	-0.09
Developing	-0.41	-0.47	-0.14	-0.19
Emerging	-0.10	-0.06	0.06	0.06
		$FXDEBT^{agg}$		
All	-0.33	-0.39	-0.12	-0.12
Advanced	-0.12	-0.05	-0.07	-0.04
Developing & Emerging	-0.38	-0.51	-0.13	-0.16
Developing	-0.50	-0.57	-0.19	-0.25
Emerging	-0.17	-0.17	-0.01	-0.06
		$NETFX$		
All	-0.31	-0.24	0.18	-0.002
Advanced	0.18	0.08	0.54	0.42
Developing & Emerging	-0.44	-0.33	0.07	-0.10
Developing	-0.71	-0.58	-0.16	-0.16
Emerging	0.05	-0.03	0.44	0.06

Note: $FX^{AGG} = \omega^A s^A - \omega^L s^L$; $NETFX = FX^{AGG} * IFI$. Sample includes the 102 countries with data from 1994 to 2004.

Source: Lane and Shambaugh (2007).

Table: Foreign Currency Exposure (FX^{AGG}) and Subcomponents

Variable	Mean	Std. Dev.	Min	Max	Median
FX^{AGG}	-0.03	0.27	-0.72	0.66	-0.03
$(A-L)/(A+L)$	-0.28	0.28	-0.87	0.55	-0.30
$FX^{AGG,0}$	0.25	0.14	-0.03	0.87	0.23
$(A_{NR}-L)/(A+L)$	-0.40	0.26	-0.90	0.14	-0.46
$FXR/(A+L)$	0.12	0.10	0.00	0.55	0.11
$(PEQL+FDIL)/(A+L)$	0.25	0.13	0.03	0.87	0.22
$DEBTL^{DC}/(A+L)$	0.03	0.09	0.00	0.45	0.00
$A_{NR}^{DC}/(A+L)$	-0.03	0.09	-0.42	0.00	0.00
$NETFX$	0.15	0.87	-0.75	6.25	-0.02
$FXDEBT^{AGG}$	-0.12	0.32	-0.85	0.66	-0.12

Summary statistics for 2004.

Table: Variance Decomposition of Foreign Currency Exposure: Pooled Analysis

	(FX^{AGG}, IFI)	$(NFA, FX^{AGG,0})$	(NFA_{NR}, FXR)	$(EQSH_L, DCSHARE)$	$(DCDEBT_L, A^{DC}_{NR})$
ALL	(0.56,0.34,0.28)	(0.83,0.11,-0.10)	(0.91,0.14,0.08)	(0.94,0.08,0.04)	(0.01,0.16,-0.87)
ADV	(0.47,0.53,0.29)	(0.65,0.03,-0.43)	(0.97,0.02,-0.33)	(0.66,0.47,0.13)	(0.01,0.30,-0.79)
EMU	(0.45,0.62,0.25)	(0.37,0.12,-0.53)	(0.92,0.10,-0.58)	(0.40,0.48,-0.12)	(0.00,0.38,-0.76)
NON-EMU	(0.47,0.76,0.41)	(0.75,0.01,-0.40)	(0.99,0.00,-0.19)	(0.87,0.50,0.41)	(0.36,0.00,-0.78)
EM	(0.37,0.82,0.43)	(0.86,0.23,0.12)	(0.93,0.05,-0.04)	(1.00,0.02,0.12)	(0.48,0.04,-0.84)
DEV	(0.65,0.41,-0.21)	(0.76,0.15,-0.11)	(0.92,0.66,0.62)	(1.00,0.00,-0.03)	(1.00,0.00,)

Each cell reports $(R^2_{N1}, R^2_{N2}, \rho[N1, N2])$ where $Q = N1 + N2$ and R^2_{N1} denotes the R^2 from a regression of Q on $N1$, R^2_{N1} denotes the R^2 from a regression of Q on $N2$, and $\rho[N1, N2]$ is the correlation between $N1$ and $N2$. Pooled data over 1994 to 2004.

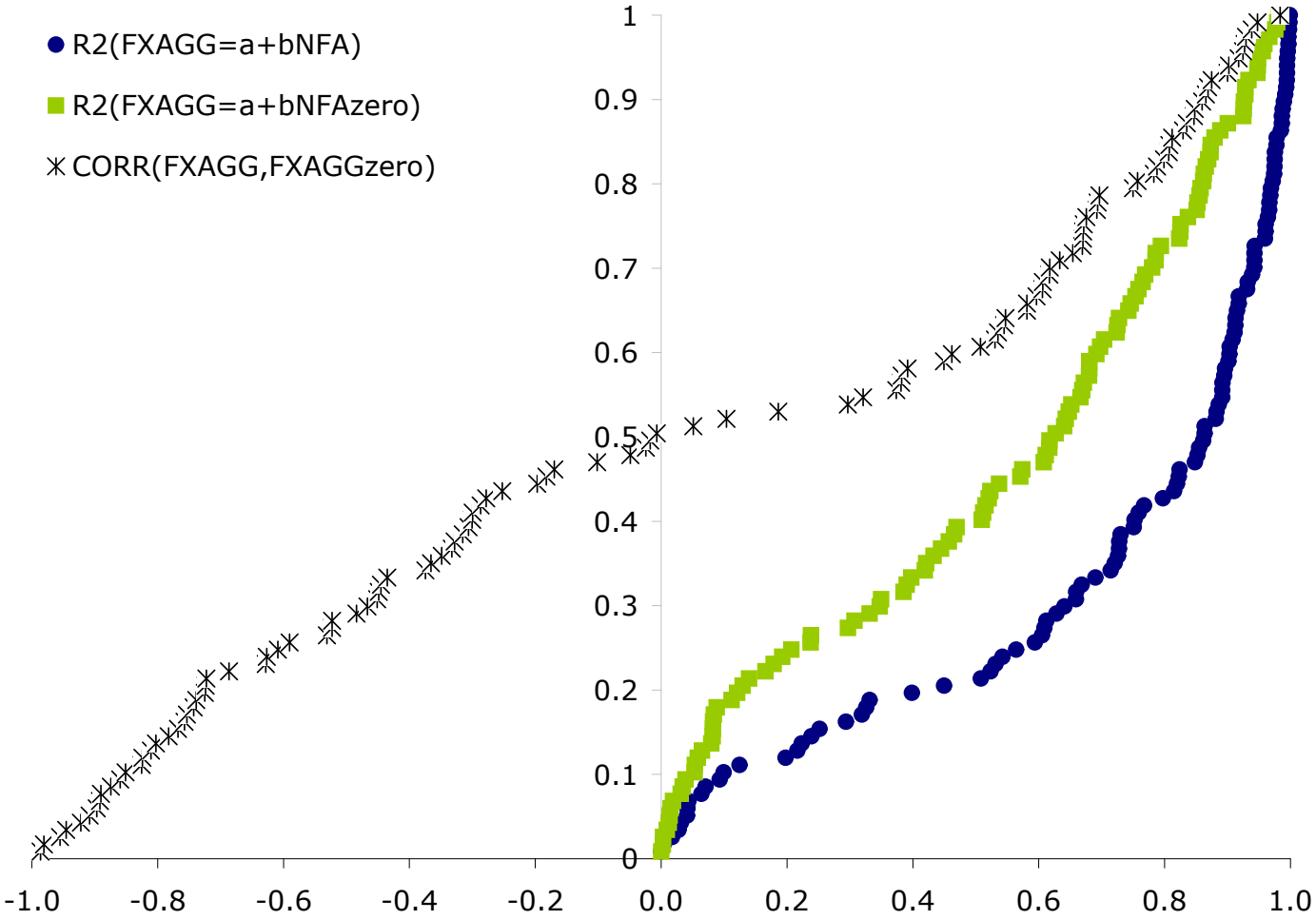

Figure: Decomposition $FX^{AGG} = NFA + FX^{AGGm,0}$. Cross-country distribution of statistics.

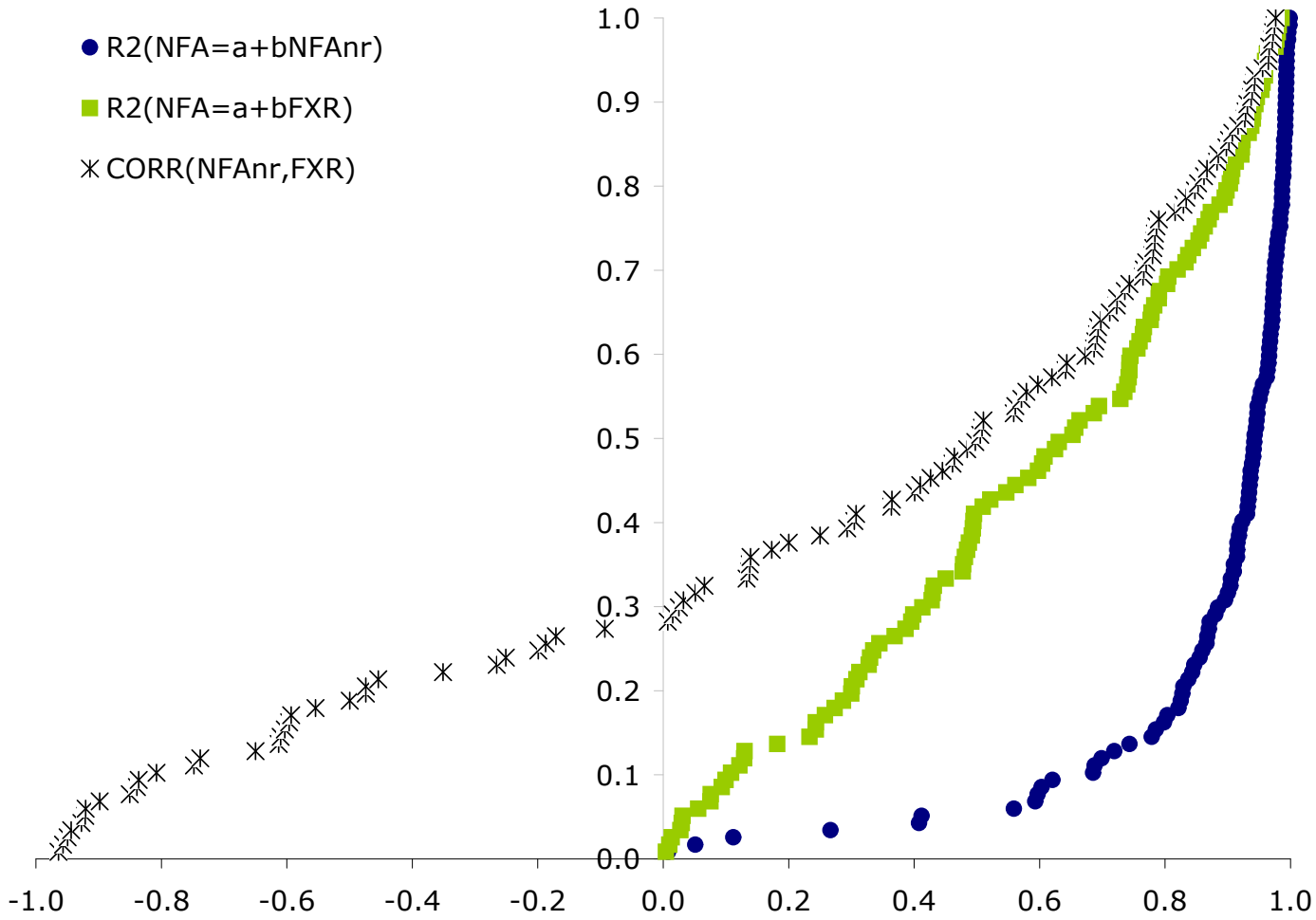

Figure: Decomposition of $NFA = NFA_{NR} + FXR$. Cross-country distribution of statistics.

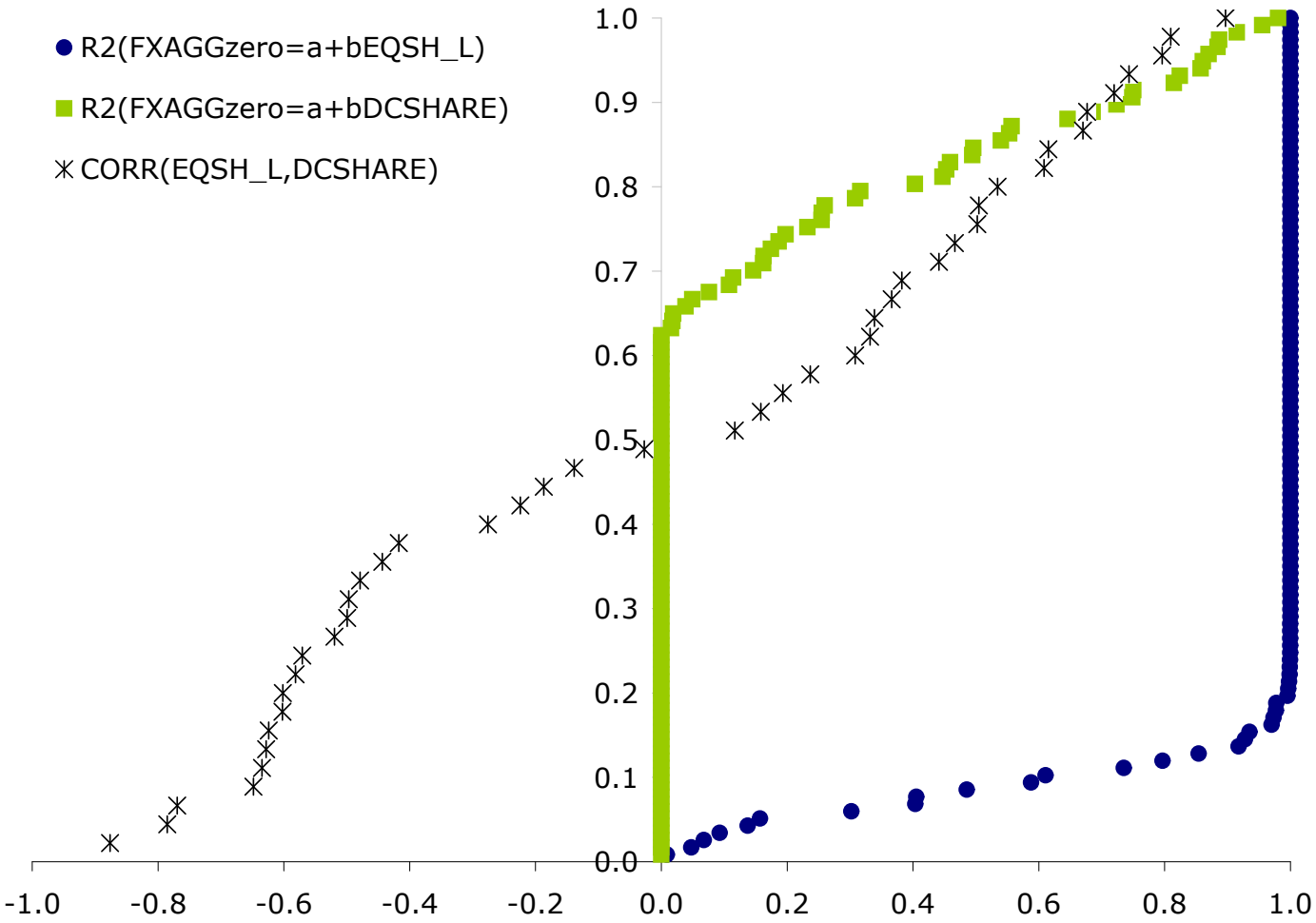

Figure: Decomposition $FX^{AGG,0} = EQSH_L + DCSHARE$. Cross-country distribution of statistics.

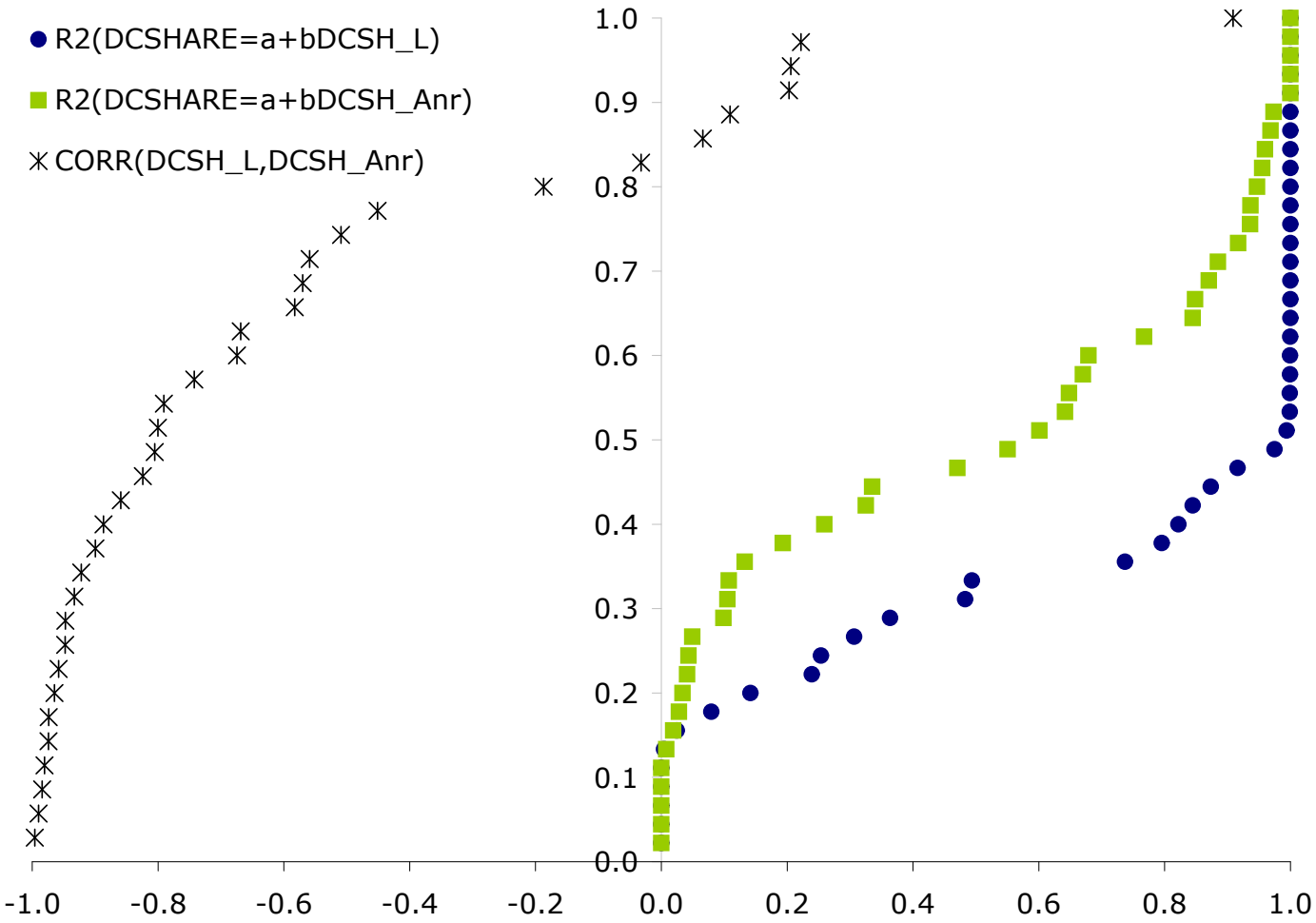

Figure: Decomposition of $DCSHARE = DEBTL^{DC} - A_{NR}^{DC}$. Cross-country distribution of statistics.

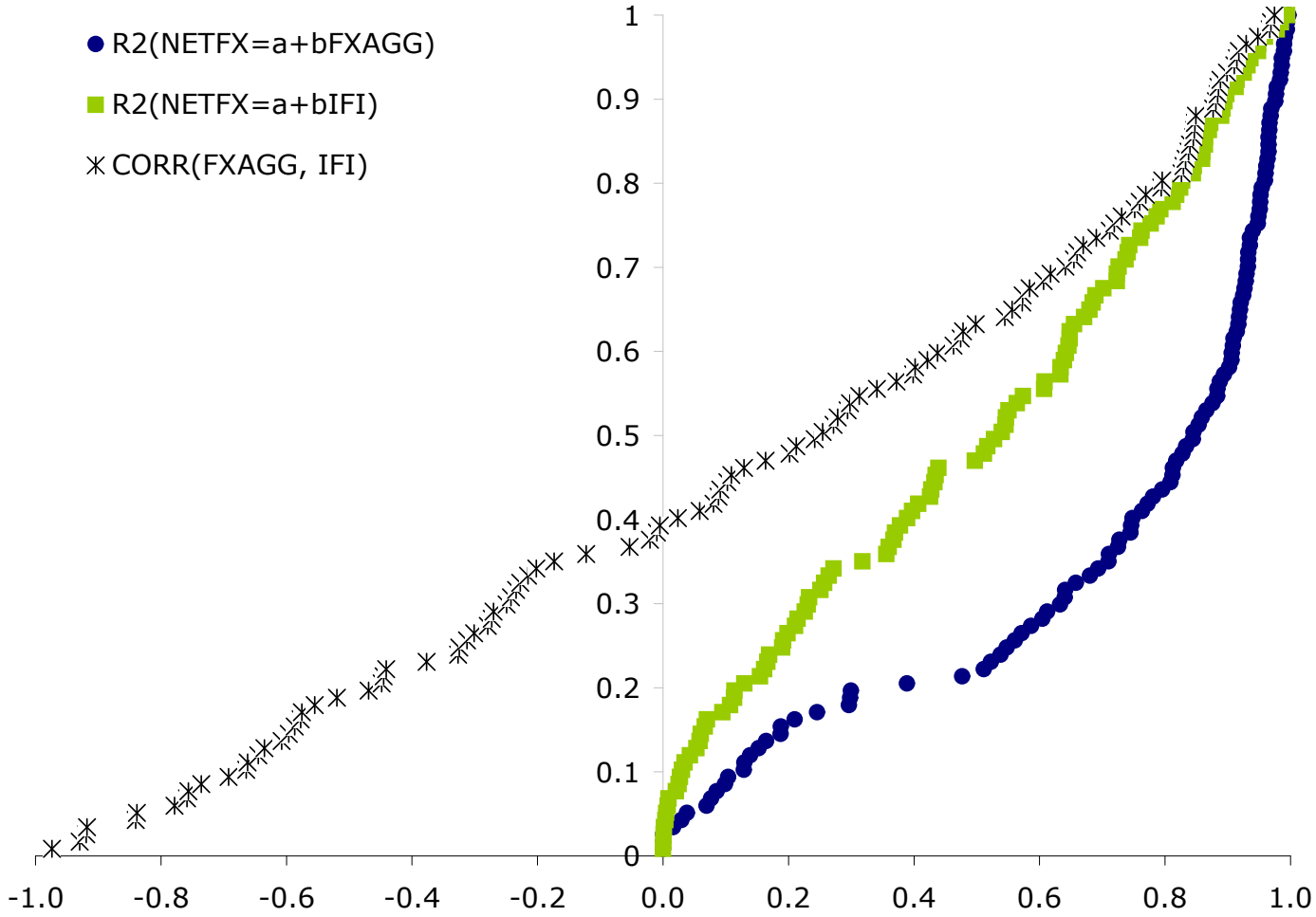

Figure: Decomposition of $NETFX = FX^{AGG} * IFI$. Cross-country distribution of statistics.

Determinants of FXAGG

	(1)	(2)	(3)	(4)	(6) CFE	(8) Δ
Trade	0.16	0.10	0.10	0.10	0.03	0.05
	(0.04)**	(0.03)**	(0.03)**	(0.03)**	(0.06)	(0.09)
$Vol(Y)$	-0.79	0.21	0.68	0.65	-0.21	-0.49
	(0.85)	(0.37)	(0.37)+	(0.36)+	(0.61)	(0.82)
$Cov(Y,E)$	3.68	0.24	-1.42	-1.66	5.82	9.07
	(1.79)*	(1.44)	(1.30)	(1.26)	(3.55)	(4.53)*
$Vol(\pi)$	0.22	-0.13	-0.20	-0.26	0.61	0.76
	(0.24)	(0.21)	(0.17)	(0.17)	(0.36)+	(0.44)+
$Vol(E)$	-1.69	0.19	0.48	0.49	-1.04	-1.64
	(0.59)**	(0.50)	(0.47)	(0.44)	(0.75)	(0.77)*
IQual		0.17		0.00	0.03	0.06
		(0.03)**		(0.05)	(0.06)	(0.09)
EMU		-0.06		-0.14	-0.13	-0.17
		(0.05)		(0.04)**	(0.04)**	(0.04)**
Ypc			0.13	0.13	0.15	0.02
			(0.01)**	(0.02)**	(0.10)	(0.14)
POP			0.03	0.03	0.64	0.62
			(0.02)	(0.02)	(0.27)*	(0.29)*
R^2	0.19	0.44	0.56	0.58	0.92	0.23

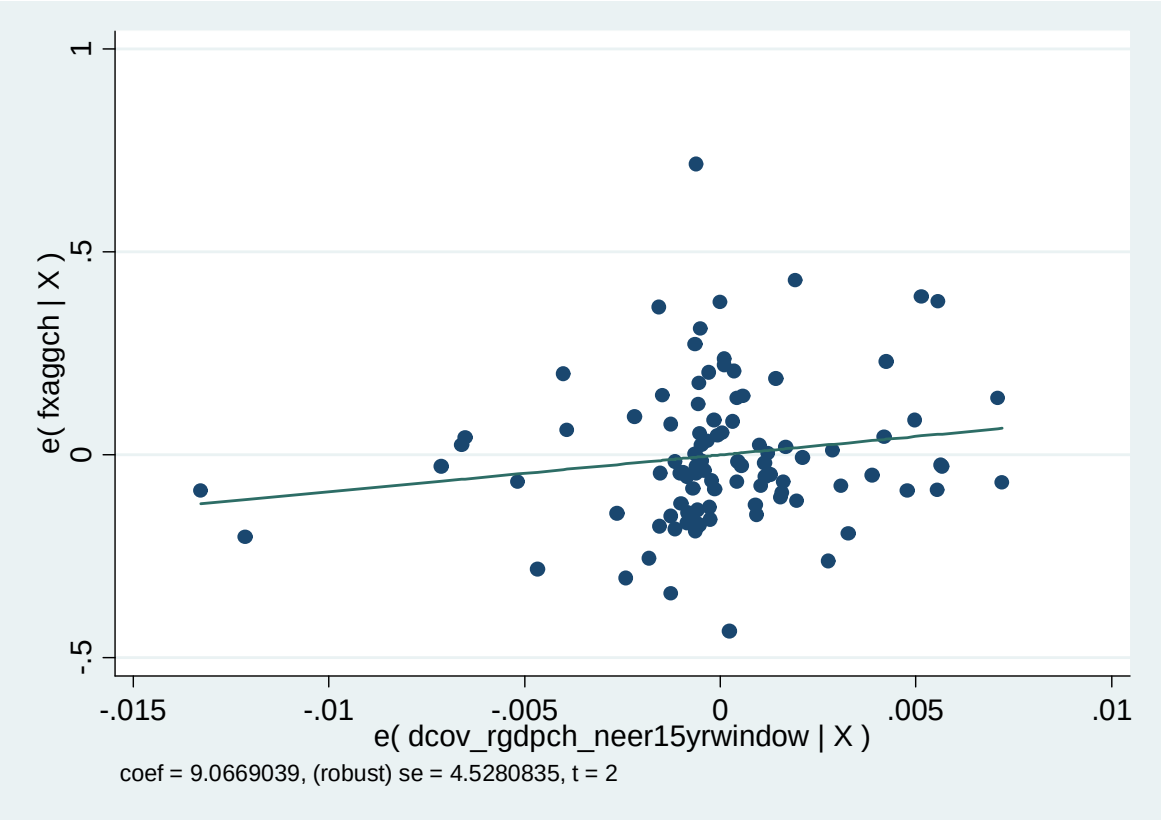

Figure: Scatter of Partial Relation between $\Delta COV(GDP, NEER)$ and ΔFX^{AGG}.

Determinants of FXDEBTAGG

	(1)	(2)	(3) CFE	(4) CFE	(5) Δ	(6) Δ
Trade	0.10	0.15	0.03	0.00	0.05	0.05
	(0.03)**	(0.04)**	(0.06)	(0.09)	(0.09)	(0.13)
$Vol(Y)$	0.65	0.87	-0.21	-0.08	-0.49	-0.28
	(0.36)+	(0.50)+	(0.61)	(0.78)	(0.82)	(1.05)
$Cov(Y,E)$	-1.66	-1.35	5.82	8.53	9.07	12.29
	(1.26)	(1.87)	(3.55)	(4.81)+	(4.53)*	(6.09)*
$Vol(\pi)$	-0.26	-0.23	0.61	1.07	0.76	1.42
	(0.17)	(0.23)	(0.36)+	(0.47)*	(0.44)+	(0.60)*
$Vol(E)$	0.49	0.22	-1.04	-1.64	-1.64	-2.53
	(0.44)	(0.52)	(0.75)	(0.92)+	(0.77)*	(0.95)**
IQUAL	0.00	-0.07	0.03	0.00	0.06	0.04
	(0.05)	(0.06)	(0.06)	(0.07)	(0.09)	(0.11)
EMU	-0.14	-0.07	-0.13	-0.12	-0.17	-0.16
	(0.04)**	(0.06)	(0.04)**	(0.04)**	(0.04)**	(0.05)**
Ypc	0.13	0.14	0.15	0.15	0.02	0.00
	(0.02)**	(0.03)**	(0.10)	(0.15)	(0.14)	(0.21)
POP	0.03	0.02	0.64	0.64	0.62	0.61
	(0.02)	(0.03)	(0.27)*	(0.31)*	(0.29)*	(0.35)+
R^2	0.58	0.4	0.92	0.9	0.23	0.19

Table 6: Determinants of Subcomponents: Pooled Estimates

	(1) FX^{AGG}	(2) NFA	(3) $FX^{AGG,zero}$	(4) $A_{NR}-L$	(5) FXR	(6) $EQSH_L$	(7) DC_{DL}	(8) DC_{NRA}	(9) $NETFX$
Trade	0.10	0.05	0.05	0.03	0.02	0.06	-0.02	0.01	0.85
	(0.03)**	(0.03)	(0.02)+	(0.03)	(0.01)	(0.03)*	(0.01)**	(0.01)	(0.29)**
$Vol(GDP)$	0.65	0.53	0.13	0.41	0.12	0.12	0.07	-0.06	1.09
	(0.36)+	(0.37)	(0.18)	(0.28)	(0.15)	(0.17)	(0.05)	(0.03)+	(1.01)
$Cov(GDP,E)$	-1.66	-2.23	0.57	-2.77	0.54	0.62	-0.48	0.43	-3.18
	(1.26)	(1.62)	(1.09)	(1.48)+	(0.62)	(1.08)	(0.26)+	(0.20)*	(3.75)
$Vol(\pi)$	-0.26	-0.30	0.04	-0.32	0.02	0.05	-0.04	0.03	-0.38
	(0.17)	(0.23)	(0.15)	(0.20)	(0.07)	(0.15)	(0.03)	(0.02)	(0.45)
$Vol(E)$	0.49	0.37	0.12	0.48	-0.10	0.13	0.01	-0.02	0.93
	(0.44)	(0.61)	(0.39)	(0.53)	(0.17)	(0.38)	(0.04)	(0.03)	(1.14)
Institutions	0.00	0.00	0.00	0.01	-0.02	0.00	0.01	0.00	0.09
	(0.05)	(0.05)	(0.02)	(0.04)	(0.02)	(0.02)	(0.01)	(0.01)	(0.11)
Capital controls	-0.02	-0.01	-0.01	-0.03	0.02	-0.01	-0.02	0.02	-0.11
	(0.04)	(0.04)	(0.02)	(0.04)	(0.01)	(0.02)	(0.01)**	(0.01)**	(0.10)
Peg	-0.03	-0.03	0.00	-0.01	-0.02	0.00	0.01	0.00	0.05
	(0.03)	(0.03)	(0.02)	(0.02)	(0.01)	(0.02)	(0.004)+	(0.003)	(0.10)
EMU	-0.14	-0.01	-0.13	0.06	-0.07	-0.06	0.18	-0.25	-0.42
	(0.04)**	(0.04)	(0.05)**	(0.04)	(0.02)**	(0.03)*	(0.03)**	(0.03)**	(0.20)*
GDP per capita	0.13	0.12	0.01	0.12	0.00	0.01	0.01	-0.01	0.20
	(0.03)**	(0.03)**	(0.01)	(0.02)**	(0.01)	(0.01)	(0.003)*	(0.003)*	(0.05)**
POP	0.03	0.02	0.00	0.03	0.00	0.00	0.01	-0.01	0.13
	(0.02)	(0.02)	(0.01)	(0.01)+	(0.01)	(0.01)	(0.004)*	(0.003)**	(0.05)**
y2000	0.07	0.02	0.05	0.02	0.01	0.05	-0.01	0.01	0.07
	(0.01)**	(0.01)	(0.01)**	(0.01)	(0.01)	(0.01)**	(0.003)**	(0.003)**	(0.04)+
y2004	0.14	0.06	0.07	0.04	0.02	0.07	0.00	0.01	0.18
	(0.02)**	(0.02)**	(0.01)**	(0.02)*	(0.01)**	(0.01)**	(0.003)	(0.003)*	(0.06)**
Constant	-1.33	-1.38	0.05	-1.45	0.07	0.05	-0.04	0.04	-2.70
	(0.21)**	(0.23)**	(0.09)	(0.17)**	(0.09)	(0.09)	(0.03)	(0.02)*	(0.61)**
Obs.	306	306	306	306	306	306	306	306	300
R^2	0.58	0.5	0.17	0.64	0.15	0.17	0.77	0.86	0.57

Table 7: Determinants of Subcomponents: Fixed-Effects Estimates

	(1) FX^{AGG}	(2) NFA	(3) $FX^{AGG,zero}$	(4) $A_{NR}-L$	(5) FXR	(6) $EQSH_L$	(7) DC_{DL}	(8) DC_{NRA}	(9) $NETFX$
Trade	0.03	-0.02	0.05	-0.02	-0.01	0.07	-0.02	0.00	0.54
	(0.06)	(0.07)	(0.05)	(0.06)	(0.02)	(0.04)	(0.01)*	(0.009)	(0.45)
$Vol(GDP)$	-0.21	-0.16	-0.05	0.18	-0.34	-0.08	0.03	0.00	2.77
	(0.61)	(0.62)	(0.32)	(0.57)	(0.36)	(0.33)	(0.05)	(0.03)	(1.40)+
$Cov(GDP,E)$	5.82	3.50	2.31	2.38	1.12	1.82	0.36	0.14	2.28
	(3.55)	(2.89)	(1.91)	(2.54)	(1.22)	(1.93)	(0.44)	(0.20)	(10.03)
$Vol(\pi)$	0.61	0.74	-0.13	0.41	0.33	-0.20	0.06	0.01	1.19
	(0.36)+	(0.33)*	(0.19)	(0.26)	(0.11)**	(0.18)	(0.04)	(0.02)	(1.03)
$Vol(E)$	-1.04	-0.71	-0.33	-0.40	-0.32	-0.23	-0.06	-0.05	-0.13
	(0.75)	(0.56)	(0.36)	(0.45)	(0.20)	(0.34)	(0.05)	(0.03)	(1.40)
Institutions	0.03	-0.01	0.04	-0.03	0.02	0.03	0.00	0.01	-0.08
	(0.06)	(0.06)	(0.03)	(0.05)	(0.02)	(0.03)	(0.005)	(0.005)	(0.09)
Capital controls	0.04	0.08	-0.04	0.06	0.02	-0.03	-0.01	0.00	0.03
	(0.04)	(0.04)*	(0.02)*	(0.03)+	(0.01)+	(0.02)	(0.01)	(0.002)	(0.07)
Peg	0.03	-0.02	0.05	-0.02	0.01	0.03	0.01	0.01	0.07
	(0.03)	(0.03)	(0.02)**	(0.02)	(0.02)	(0.01)*	(0.01)	(0.01)	(0.09)
EMU	-0.13	-0.04	-0.10	0.00	-0.04	-0.04	0.16	-0.21	-0.17
	(0.04)**	(0.03)	(0.03)**	(0.03)	(0.01)**	(0.02)+	(0.02)**	(0.02)**	(0.12)
GDP per capita	0.15	0.15	0.00	0.13	0.02	0.03	-0.02	-0.01	0.08
	(0.11)	(0.13)	(0.10)	(0.11)	(0.05)	(0.09)	(0.01)+	(0.02)	(0.27)
POP	0.64	0.59	0.06	0.36	0.22	0.09	-0.04	0.01	0.72
	(0.27)*	(0.27)*	(0.17)	(0.24)	(0.08)**	(0.16)	(0.03)	(0.03)	(0.56)
y2000	0.03	-0.01	0.04	0.01	-0.01	0.03	0.00	0.00	0.06
	(0.02)	(0.03)	(0.02)+	(0.02)	(0.01)	(0.02)+	(0.003)	(0.003)	(0.06)
y2004	0.08	0.02	0.06	0.02	0.00	0.05	0.02	0.00	0.18
	(0.04)+	(0.05)	(0.04)	(0.04)	(0.02)	(0.03)	(0.01)*	(0.01)	(0.10)+
Constant	-3.02	-3.04	0.01	-2.41	-0.62	-0.31	0.31	0.01	-3.30
	(1.20)*	(1.48)*	(1.12)	(1.26)+	(0.49)	(1.03)	(0.16)+	(0.21)	(3.01)
Obs.	306	306	306	306	306	306	306	306	300
R^2	0.92	0.92	0.87	0.94	0.85	0.87	0.95	0.97	0.93

Summary of Empirical Results

- NFA a key driver of FX^{AGG}
- Non-reserve component most important for most countries
- Equity share of liabilities more important than denomination of debt liabilities
- XS: richer countries that trade a lot are longer in FC
- TS: more positive covariance btwn exchange rate and GDP leads to a longer FC position
- TS: increase in exchange rate volatility leads to a less long FC position
- FX^{AGG} easier to explain than individual subcomponents

Conclusions

- Stylized facts should inform next generation of theoretical modelling
- FX^{AGG} systematically related to macro characteristics
- Broad perspective on FX^{AGG} vital, in view of potential for offsets across individual subcomponents