

# Cross-Border Portfolio Diversification under Trade Linkages

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# Motivation

- ▶ Since the 80's, the amount of cross-border financial asset holdings has risen strongly. Also, the level of international goods and services trade is high.
- ▶ How is goods and services trade related to cross-border risk-sharing and the portfolio choice?

## **Contribution** of this paper:

- ▶ Analysing how bilateral trade is related to the *composition* of a cross-border portfolio (including *long-term debt and equity*).
- ▶ **Empirical finding:** The share of equity in a bilateral portfolio decreases with bilateral trade.
- ▶ Main driver: rising bilateral long-term debt holdings.
- ▶ The results are in line with the predictions of a two-country/two-goods model where in equilibrium cross-border equity insures against *supply shocks* and cross-border real bonds insure against *global preference shocks*.

## Relevance:

- ▶ Davis (2014): equity-market integration vs. debt-market integration have different impact on business cycles comovement.
- ▶ Large foreign debt inflows can have unintended consequences for the receiving countries (Bernanke 2005, Shin 2011, Quadrini 2015).
- ▶ Lane and McQuade (2014): Debt inflows fuel credit growth (not the case for equity inflows).
- ▶ Implications for financial stability (*cf. inter alia* Jorda et al. 2011, Gourinchas and Obstfeld 2012, Schularick and Taylor 2012), especially because of housing (*cf. Favara and Imbs 2015 and Jorda et al. 2015*).

## Related Literature

Empirical relation between trade in goods and trade in financial claims

- ▶ Lane and Milesi-Ferretti (2004,2008), Portes and Rey (2005), Aviat and Coeurdacier (2007), Coeurdacier and Guibaud (2013), Pericoli et al. (2013).

Portfolio choice in open economy models

- ▶ Complete Markets and international equity diversification: *inter alia* Lucas (1982), Baxter and Jermann (1997), Obstfeld and Rogoff (2001), Heathcote and Perri (2013).
- ▶ Models with trade in equity and bonds: *inter alia* Pavlova and Rigobon (2007); Devereux and Sutherland (2010); Coeurdacier, Kollmann and Martin (2009, 2010); Coeurdacier and Gorinchas (2011).

# Empirical Model

The variable of interest is the **share of equity in a bilateral portfolio**

$$equityshare_{AB,t} = \frac{equity_{AB,t}}{equity_{AB,t} + debt_{AB,t}}$$

where  $equity_{AB,t}$  is the total amount of country B issued equity that country A holds at the end of period t and  $debt_{AB,t}$  is the total amount of country B issued long-term debt securities that country A holds at the end of period t. FDI, trade credit and foreign currency reserves are excluded.

- ▶ **Fixed effects panel** regression allows to control for unobserved heterogeneity (within estimation)

$$equityshare_{AB,t} = \alpha + \beta_{trade} trade_{AB,t} + \beta'_{controls} x_{AB,t} + \delta_t + \gamma_{AB} + u_{AB,t}$$

- ▶  $trade_{AB,t}$  measures bilateral trade intensity.
- ▶  $x_{AB,t}$  are controls: especially changes in Home and third-country equity share and host country credit market risk.
- ▶ Time dummies  $\delta_t$  to control for a trend.
- ▶ Country pair fixed effects  $\gamma_{AB}$  with  $\sum_{AB} \gamma_{AB} = 0$ .

## Panel Data 2001-2012

- ▶ **IMF Coordinated Portfolio Investment Survey:** Cross-border equity and debt holdings
- ▶ **IMF directions of trade:** bilateral amount of exports, imports and trade (normalized by country aggregates, 5-year backward looking moving average)
- ▶ **Standard & Poors Global Stock Market Factbook:** domestic equity market capitalization
- ▶ **BIS Quarterly review:** domestic debt market capitalization
- ▶ **International Country Risk Guide :** measure of foreign debt market "safety"
- ▶ **Science Po CEPII gravity database, base year 2006:** distance, contiguity, common language, source and host country area, colony, time difference, common currency, common legal origin, economic size (population) source and host country

# Data description

- ▶ Benchmark estimation: Advanced and emerging economies 2001-2012
- ▶ 3111 observations, 344 country pairs
- ▶ Small open economies with a financial center are excluded as source and host countries (e.g. Luxembourg, Cayman Island, Jersey, ...); the same holds for bigger tax havens (Switzerland, Hong Kong, Singapore, Ireland). (cf. Lane, Milesi-Ferretti 2008 or Pericoli et al. 2013).
- ▶ Only country pairs with *relevant* amount of bilateral portfolio holdings are included ( $\geq 1\%$  of total holdings of a source country).

## Descriptive statistics:

Variable	Mean	Std.Dev.	Min	Max
Share of Equity in Bilateral Portfolio	<b>0.3522</b>	0.2897	0	1
Bilateral Trade / GDP (5Y MA)	<b>0.0422</b>	0.0622	0.0003	0.5287
Bilateral Trade Share (5Y MA)	<b>0.0581</b>	0.0704	0.0009	0.7641

## Dependent Variables Takes Values $\in [0, 1]$

- ▶ Share of equity in bilateral portfolio is observed to be between zero and one, i.e. the variable looks like a fraction.
- ▶ With OLS under a linear model estimators are biased and errors are non-normally distributed.

Possibilities to deal with fractions on the LHS

1. Log-odds-transformation of all the fractions in the regression model

$$\bar{y}_{AB,t} = \ln\left(\frac{y_{AB,t}}{1 - y_{AB,t}}\right)$$

2. Tobit (censored regression)
3. Papke and Wooldridge 2008, fractional regression approach



# Results I

Dependent variable: **share of equity in bilateral portfolio**. Sample: Advanced and emerging countries, 2001-2012.

	Log-odds transformation		Tobit			Papke, Wooldridge (2008)		Trade per GDP (Tobit)
Bilateral Trade	-0.682*** (0.133)	-0.606*** (0.128)	-1.426*** (0.243)	-1.288*** (0.231)	-0.434*** (0.154)	-1.203* (0.692)	-1.249* (0.682)	-1.447*** (0.226)
Partner Debt Safety		0.051*** (0.009)		0.005*** (0.001)	0.006*** (0.0011)		0.006*** (0.021)	0.005*** (0.001)
Third-country equityshare		0.683*** (0.042)		0.507*** (0.028)	0.549*** (0.0276)		0.450*** (0.068)	0.510*** (0.028)
Domestic equityshare		0.091*** (0.033)		-0.001 (0.001)	-0.001 (0.002)		-0.000 (0.001)	-0.001 0.001
Constant	-2.859*** (0.434)	-4.282*** (0.550)	0.835*** (0.032)	0.255*** (0.059)	-0.099* (0.052)			0.196*** (0.057)
Time dummies	x	x	x	x	x	x	x	x
Fixed effects	x	x	x	x		x	x	x
Gravity controls					x			
N	3060	3022	3111	3109	3103	3111	3109	3109
# Country Pairs	340	340	344	344	343	344	344	344

Standard errors are reported in parentheses. \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% confidence level, respectively.

# Results II

Dependent variable: **equity or debt holdings** (respectively). Sample: Advanced and emerging countries, 2001-2012.

	All variables in in level (log transformed), OLS		All variables normalized, (Tobit)		All variables normalized (Papke, Wooldridge, 2008)		Dependent variable in level, Trade per GDP (all log transformed)		All variables normalized, Trade per GDP (Tobit)	
	Equity	LT-Debt	Equity	LT-Debt	Equity	LT-Debt	Equity	LT-Debt	Equity	LT-Debt
Bilateral Trade	0.788*** (0.085)	1.112*** (.0712)	0.091 (0.081)	0.781*** (0.089)	-0.032 (0.175)	0.466** (0.230)	0.070 (0.109)	0.483*** (0.092)	-0.460*** (0.079)	0.471*** (0.088)
Constant	13.520*** (0.756)	11.324*** (0.629)	0.173*** (0.011)	0.129*** (0.011)			20.756*** (0.425)	23.014*** (0.362)	0.180*** (0.010)	0.159*** (0.011)
Time dummies	x	x	x	x	x	x	x	x	x	x
Fixed Effects	x	x	x	x	x	x	x	x	x	x
N	3075	3096	3111	3109	3109	3109	3075	3096	3075	3096
# Country Pairs	342	343	344	344	344	344	342	343	342	343

Standard errors are reported in parentheses. \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% confidence level, respectively.

# Empirical Findings

- ▶ **Finding 1:** Within a country pair, the share of equity in the foreign portfolio decreases with goods and services trade.
  - ▶ A **1 percentage point increase in the bilateral trade share** (in the bilateral trade to domestic GDP ratio) **decreases the share of equity in bilateral portfolio by 1.2 percentage point** (1.4 percentage point).
- ▶ **Finding 2:** Bilateral long-term debt holdings are strongly positively related with trade while bilateral equity holdings are not.

# Robustness checks

- ▶ Using sum of long-term and short-term debt in computing dependent variable
- ▶ Different definitions of a "relevant" bilateral financial portfolio relationship
- ▶ Sub-sample with only advanced countries
- ▶ Add source countries that participate in the CPIS but not in the BIS survey
- ▶ Measuring trade not as moving averages
- ▶ Inclusion of bilateral FDI on RHS (data available from 2009 onwards)

# Trade and Cross-Border Portfolio Choice in a Model

## Theoretical Framework

- ▶ **Two-country/two goods endowment model** with trade in goods and services as well as financial asset trade (Home and Foreign equity and real long-term bonds).
- ▶ **Analysis:** Changes in steady state trade intensity due to variation in home bias in consumption.
- ▶ **How does the steady state share of equity in the foreign portfolio change with changing trade intensity?**

In steady state following empirical observations should be matched

1. Long positions in equity and bond holdings (*cf.* Lane and Milesi Feretti 2006 and CPIS data)
2. Equity home bias

# Trade and Cross-Border Portfolio Choice in a Model

- ▶ Basic framework as in Devereux and Sutherland (2010), (also *cf.* Pavlova and Rigobon 2007 and Coeurdacier et. al 2009)
- ▶ Two identical countries, two country specific goods with **home bias in consumption**
- ▶ Representative agent owns property rights in **endowments of capital and labour income**
- ▶ Each country issues risky **equity** (claims on capital endowment) and relatively risk-free **long-term real bonds**
- ▶ Full financial integration
- ▶ Domestic capital and labour income shocks (**supply shocks**) with imperfect correlation
- ▶ Global relative **demand shock**
- ▶ Incomplete financial markets

# Consumption, Trade and Global Demand Shifting Shock

The domestic **representative agent** maximizes

$$U_0 = E_0 \sum_{t=0}^{\infty} \Lambda_t \left[ \frac{C_t^{1-\rho}}{1-\rho} \right].$$

where  $\Lambda_{t+1} = \Lambda_t \beta (C_{A,t} / \overline{C_{A,t}})^{\eta}$  with  $C_{A,t}$  denoting aggregate consumption.

The Home **consumption good** consists of Home and Foreign goods

$$C_t \equiv \left[ \omega_t^{1/\theta} (C_{H,t})^{\frac{\theta-1}{\theta}} + (1 - \omega_t)^{1/\theta} (C_{F,t})^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}.$$

**Global demand shifting shock**

$$\omega_t = \overline{\omega} \exp(D_t) \quad \omega_t^* = \overline{\omega} \exp(-D_t)$$

where

$$\log D_t = \phi_D \log D_{t-1} + \varepsilon_{D,t}$$

and  $\phi_D \in [0,1]$  and  $\varepsilon_D$  zero mean i.i.d. symmetrically distributed over  $[-\varepsilon, \varepsilon]$  with variance  $\sigma_D^2$ .

# Endowment, Supply Shocks and Imperfect Capital/Labour Correlation

Endowment consists of **capital and labour income component**. Claims on the capital component can be internationally traded without frictions (labour income component is non-insurable)

$$Y_t = Y_{K,t} + Y_{L,t}.$$

Domestic **income processes and supply shocks**:

$$\log(Y_{K,t}/\bar{Y}_K) = \phi_K \log(Y_{K,t-1}/\bar{Y}_K) + \varepsilon_{K,t}$$

$$\log(Y_{L,t}/\bar{Y}_L) = \phi_L \log(Y_{L,t-1}/\bar{Y}_L) + \varepsilon_{L,t}$$

where  $\phi_K, \phi_L \in [0,1]$  and  $\varepsilon_K$  and  $\varepsilon_L$  zero mean i.i.d. symmetrically distributed over  $[-\varepsilon, \varepsilon]$  with

$$\Sigma_{K,L} = \begin{pmatrix} \sigma_K^2 & \sigma_{KL} \\ \sigma_{KL} & \sigma_L^2 \end{pmatrix}.$$



# Menu of available assets

## ***Domestic and Foreign Equity***

$$r_{E,t+1} = \frac{Y_{kt+1}P_{H,t+1} + Z_{E,t+1}}{Z_{E,t}} \quad r_{E^*,t+1} = \frac{Y_{k,t+1}^*P_{F,t+1} + Z_{E^*,t+1}}{Z_{E^*,t}}$$

where  $r_E$ ,  $r_E^*$  and  $Z_E$ ,  $Z_E^*$  denote returns and prices of equity (in terms of home consumption good).

## ***Domestic and Foreign Long-Term Real Bond***

$$r_{B,t+1} = \frac{P_{H,t+1} + Z_{B,t+1}}{Z_{B,t}} \quad r_{B^*,t+1} = \frac{P_{F,t+1} + Z_{B^*,t+1}}{Z_{B^*,t}}$$

where  $r_B$ ,  $r_B^*$  and  $Z_B$ ,  $Z_B^*$  denote returns and prices of real bonds (in terms of home consumption good).

# Net Foreign Assets and Asset Market Clearing

Domestic agents can hold shares in domestic and foreign equity and domestic and foreign bonds such that the **net foreign asset position** of the domestic agent evolves as

$$NFA_t = B_{F,t} + s_{E^*,t}Z_{E^*,t} - s_{E,t}^*Z_{E,t} - B_{H,t}^*$$

where  $s_{E^*,t}$  are Home agents shares in Foreign equity,  $s_{E,t}^*$  are Foreign agents shares in Home equity,  $B_{F,t}$  denote Home agents net holdings of Foreign bonds and  $B_{H,t}^*$  denote Foreign agents net holdings of Home bonds.

Asset market clear for **home issued assets** such that

$$B_{H,t} = -B_{H,t}^* \quad s_{E,t} + s_{E_t}^* = 1,$$

and for **foreign issued assets**

$$B_{F,t} = -B_{F,t}^* \quad s_{E^*,t} + s_{E_t^*}^* = 1.$$

# Budget Constraint and Asset Holdings

The budget constraint of the domestic agent can be rewritten in term of the net foreign asset position

$$NFA_t = NFA_{t-1}r_{B_t} + Y_t * P_{H,t} - C_t + \\ + \alpha_{E,t-1}(r_{E,t} - r_{B_t}) + \alpha_{E^*,t-1}(r_{E^*,t} - r_{B_t}) + \alpha_{B^*,t-1}(r_{B^*,t} - r_{B_t})$$

where  $\alpha_{E,t-1}$ ,  $\alpha_{E^*,t-1}$ ,  $\alpha_{B^*,t-1}$  denote real holdings of home equities, foreign equities and foreign bonds, respectively, with

$$\alpha_{E,t-1} = Z_{E,t-1}(s_{E,t-1} - 1),$$

$$\alpha_{E^*,t-1} = Z_{E^*,t-1}s_{E^*,t-1},$$

$$\alpha_{B^*,t-1} = B_{F,t}.$$

# Optimal Portfolio Holdings

## (Devereux/Sutherland approach, 2011)

In steady state:  $\overline{NFA} = 0$ ,  $\overline{Y} = \overline{Y}^*$ ,  $\overline{C} = \overline{C}^*$ ,  $r_B = r_{B^*} = r_E = r_{E^*} = 1/\beta$ .

Up to a second-order-approximation, the Home and Foreign FOC combine to

$$E_{t-1} \left[ \left( \hat{C}_t - \hat{C}_t^* - \frac{1}{\rho} \hat{Q}_t \right) \hat{R}_{X_{k,t}} \right] = 0$$

The solution for the optimal portfolio is given by

$$\tilde{\alpha} = [R_2 \Sigma D_2' R_1' - D_1 R_2 \Sigma R_2']^{-1} R_2 \Sigma D_2' \quad (1)$$

where realized excess are temporarily treated as auxiliary i.i.d. variable  $\xi_t$  and then the two terms in (1) can then be expressed as

$$\hat{R}_{X_{k,t}} = R_1 \xi_{t-1} + R_2 \varepsilon_{t-1}$$

$$\hat{C}_t - \hat{C}_t^* - \frac{1}{\rho} \hat{Q}_t = D_1 \xi_{t-1} + D_2 \varepsilon_{t-1}.$$

Solution to the policy functions obtained with the approach of Sims (2001).

# Comparative Statics: Change in the Trade Intensity $1 - \bar{\omega}$

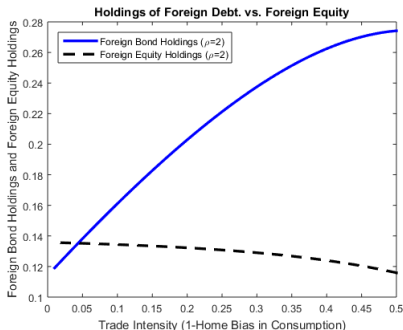
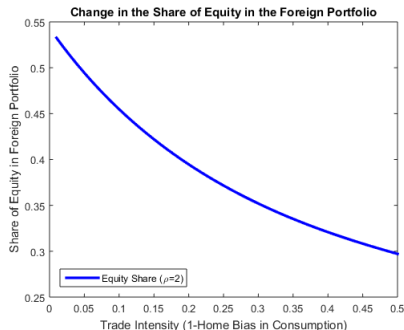
## Intuition for equilibrium portfolio holdings

- ▶ Real long-term bonds are used to hedge global demand shocks
  - ▶ Global demand shock for Foreign good induces Foreign prices to increase, at the same time purchasing power of Home decreases because of Foreign goods. Effect is amplified with rising trade  $\Rightarrow$  **more Foreign bonds with rising goods and services trade.**
- ▶ Equity is used to hedge supply shocks
  - ▶ In case of perfect correlation of labour and capital income shocks: full equity diversification.
  - ▶ Imperfect correlation lowers foreign equity holdings.
  - ▶ Foreign supply shock induces Home prices to increase: Home equity good hedge since holding it results in more net imports. Effect is amplified with rising trade  $\Rightarrow$  **less Foreign equity with rising goods and services trade.**

# Calibration

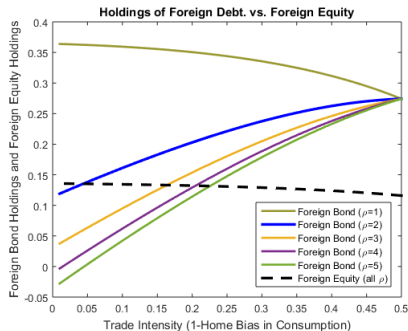
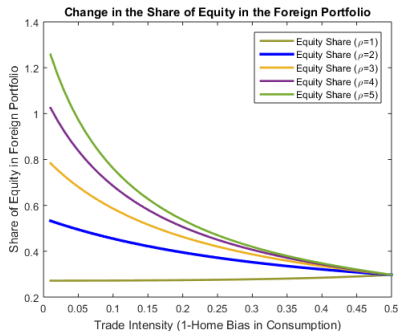
- ▶ Discount factor:  $\beta = 0.96$
- ▶ Relative risk aversion:  $\rho = 2$  (Coeurdacier et al. 2009)
- ▶ Shock autocorrelations:  $\phi_K = \phi_{K^*} = \phi_L = \phi_{L^*} = \phi_D = \phi_{D^*} = 0.90$
- ▶ Share of steady state capital income in total income: 0.4 (Coeurdacier et al. 2009)
- ▶ Elasticity of substitution between Home and Foreign goods:  $\theta = 1.5$  (benchmark, cf. Backus et al. 1994, Kose and Yi 2006)
- ▶ Shock standard deviations and cross correlations
  - ▶ Capital income shock: 0.0159 (Coeurdacier et al. 2009)
  - ▶ Labour income shock: 0.0159 (Coeurdacier et al. 2009)
  - ▶ Demand shock: 0.0159 (benchmark, same as supply shock)
  - ▶ Correlation Labour, Capital Income Shock: -0.214 (to match mean cross-border equity share in the data; also cf. Bottazzi et al. 1996, Lustig and Nieuwerburgh 2006)

# Comparative Statics: Change in the Trade Intensity $1 - \bar{\omega}$



- ▶ Foreign bond holdings increase relatively strongly with trade.
- ▶ Foreign Equity holdings slightly decrease with trade.
- ▶ Share of equity in bilateral portfolio decreases with trade.

# Sensitivity analysis: Different relative risk aversion $\rho$



- ▶ Foreign bond holdings increase relatively strongly with trade.
- ▶ Foreign Equity holdings slightly decrease with trade.
- ▶ Share of equity in bilateral portfolio decreases with trade.
- ▶ Result is **robust** for large enough relative risk aversion



# Conclusion

- ▶ How does goods and services trade relate to cross-border risk sharing and portfolio diversification?
- ▶ **Novelty:** considering composition of a bilateral portfolio between equity and long-term debt.
- ▶ **Empirical finding:** The **share of equity in a bilateral portfolio decreases with bilateral trade**. The main driver behind this result are rising bilateral long-term debt holdings.
- ▶ A calibrated **two-country/two goods model** of an endowment economy with supply shocks, demand shocks and imperfect correlation of labour and capital income predicts pattern in line with empirical findings while matching long positions in cross-border equity and real bond holdings as well as equity home bias.
- ▶ **Policy implications:** Trade integration affects pattern of risk-sharing, this matters for designing capital controls and macroprudential policy.
- ▶ **Future work:** Studying business cycle comovement in a model with trade in goods and services and portfolio choice between different asset classes.