Equity Home Bias when Firms are Indebted

Andrés Mesa-Toro Antonio Moreno
Julieta Sammartino Tommaso Trani

University of Navarra

EEA-ESEM Congress
August 22, 2022

Motivation

- Equity home bias (EHB) useful to hedge against the labor income risk: relative *dividends* and relative *labor income* should be *imperfectly correlated*
    - differentiated products + investment **if** 1 type of traded assets and Cole-Obstfeld preferences (Heathcote-Perri '13)
    - + investment shocks **if** multiple traded assets and more general preferences (Coeurdacier et al. '10)
- However, all this is true in a Modigliani-Miller (MM) world, whereas labor income and the financial distress from leverage are negatively correlated in the data and recent theories (Quadrini-Sun '18; Michaels et al. '19; Bocola-Lorenzoni '22)

Literature

- Speaks to two strands of literature:
  1. country portfolio choice/risk sharing
  2. credit market imperfections and macro/labor market outcomes

- Selected related contributions
  - risk sharing (for labor income and exchange rate) and EHB

    Baxter and Jermann ('97), Fidora et al. ('07), Coeurdacier et al. ('10), Benigno and Nisticó ('12), Heathcote and Perri ('13), Coeurdacier and Rey ('13), Coeurdacier and Gourinchas ('16), Burger et al. ('18), Maggiori et al. ('20), ...

    <u>+ methodology (local)</u>: Devereux-Sutherland ('11), Tille-Van Wincoop ('10)
  - corporate leverage, labor earnings and firm/macro dynamics

    Benmelech et al. ('12), Jermann and Quadrini ('12), Agrawal and Matsa ('13), Chodorow-Reich ('14), Quadrini and Sun ('18), Michaels, Beau Page and Whited ('19), Benmelech et al. ('21), Mehrotra and Sergeyev ('21), Bocola and Lorenzoni ('22), ...

Preview

- Equities = hedge against both labor income and exchange rate risks
  - The latter (i.e., its long-run component) especially when just trade in corporate bonds—short-term assets by assumption
  - (Exchange rate hedging $\uparrow$ if no bonds are traded)
- The effect of corporate leverage on EHB is predominantly (**–**)
  - Credit market imperfections hamper the labor market and magnify the comovement between labor and dividend incomes through: **a)** the tax advantage of debt (demand-like channel); **b)** financial shocks
  - Numerically, considering the behavior of leverage and EHB in data for AEs
- Less volatile terms of trade (*high* trade elasticities): $\uparrow$ home bias in assets, but financial shocks (alone *if* GHH preferences) and long-term bonds mitigate this especially for equities

Model

Setup

- Two countries, two goods: $i = H$ (Home), F (Foreign)
- Functionally equivalent to BKK model (Backus, Kehoe, Kydland '94)
  - Differentiated products: p_i = price of good i
  - Goods home bias: $\gamma \in (0.5, 1]$ = local goods in total demand
  - Elasticity of substitution between goods: θ
- Endogenously incomplete markets (credit market imperfections), following Jermann-Quadrini ('12)

Households

- Income from labor (in domestic firms) and financial assets
- Expenditures for consumption and the purchase of financial assets (H,F equities and H,F corporate bonds)
- Display GHH preferences

$$u\left(C_{i,t}, N_{i,t}\right) = \left\{ \left[C_{i,t} - \chi N_{i,t}^{1+\nu} / \left(1+\nu\right) \right]^{1-\sigma} - 1 \right\} / \left(1-\sigma\right)$$

where $C_{i,t} - \chi N_{i,t}^{1+\nu} / \left(1+\nu\right)$ also affects $\beta_{i,t}$ (for stationarity as in Schmitt-Grohé and Uribe '03)

Firms

- Tax benefit of debt: equity financing $\neq$ debt financing
- Features of debt financing: 1) imperfect enforcement under uncertainty; 2) low substitutability bonds-equity; 3) timing mismatch revenues-payroll
- Shocks: TFP (Z); IST (ζ)

$$
\begin{aligned}
D_{i,t} &= p_{i,t}Y_{i,t} - W_{i,t}N_{i,t} - P_{i,t}X_{i,t} + \underbrace{\frac{p_{i,t}}{1+r_{i,t}(1-\tau_i)}B_{i,t} - p_{i,t}B_{i,t-1}}_{\text{intertemporal}} \\
Y_{i,t} &= e^{Z_{i,t}}K_{i,t-1}^{\alpha}N_{i,t}^{1-\alpha} - \underbrace{\frac{\kappa_i}{2}\left(D_{i,t}-\bar{D}_i\right)^2}_{(2)} \\
\underbrace{W_{i,t}N_{i,t}}_{\text{(3), intratemporal}} &\leq \underbrace{\xi_i}_{(1)}\left(P_{i,t}K_{i,t} - \frac{p_{i,t}}{1+r_{i,t}}B_{i,t}\right) \\
K_{i,t} &= (1-\delta)K_{i,t-1} + e^{\zeta_{i,t}}\left[1 - \frac{\psi}{2}\left(\frac{X_{i,t}}{X_{i,t-1}} - 1\right)^2\right]X_{i,t}
\end{aligned}
$$

- With binding borrowing constraints, FOC for bonds is

$$1 - \frac{\mu_{i,t}}{\lambda_{i,t}} \xi_i \left[\frac{1 + r_{i,t}(1 - \tau_i)}{1 + r_{i,t}} \right] = \mathbb{E}_t m_{i,t+1} \frac{\lambda_{i,t+1}}{\lambda_{i,t}} R_{b_i,t+1},$$

  where

  - $\mu_{i,t}/\lambda_{i,t} > 0$ is the *debt-equity multiplier*—$\lambda_{i,t}$ depending inversely on κ_i
  - $\mu_{i,t}/\lambda_{i,t}$ **affects** the demand for $K_{i,t}, N_{i,t}$

- *Modigliani-Miller (MM) benchmark*: for $\tau_i, \kappa_i \to 0$, $\mu_i \to 0$ and

$$D_{i,t} = p_{i,t} e^{Z_{i,t}} K_{i,t-1}^{\alpha} N_{i,t}^{1-\alpha} - W_{i,t} N_{i,t} - P_{i,t} X_{i,t} + l P_{i,t} K_{i,t} - p_{i,t} B_{i,t-1}$$

  where

  - $p_{i,t} B_{i,t} / (1 + r_{i,t}) = l P_{i,t} K_{i,t}$, and l takes any value in $[0, 1]$
  - **no effect** on the FOCs

Implications for Portfolio Choice

- Limited contract enforcement (w/ low substitutability debt-equity financing) **increases** $corr\left(WN_{\mathcal{R}}, D_{\mathcal{R}}\right)$
- **Why?** Raising equity ($\downarrow D$) is key to reboot investment and production (thus hiring)
  - $\boldsymbol{\tau}$ **:** (heterogeneity firm-households that) sets the level of the credit spread:

$$\tau_i r_{i,t} = \frac{\mathbb{E}_t m_{i,t+1} \tilde{R}_{b_i,t+1}\left(\Delta\lambda_{i,t+1} - 1\right) + \frac{\mu_{i,t}}{\lambda_{i,t}}\xi_i}{\mathbb{E}_t m_{i,t+1} \Delta p_{i,t+1}\left(\Delta\lambda_{i,t+1} + \frac{\mu_{i,t}}{\lambda_{i,t}}\xi_i\right)}$$

  - $\boldsymbol{\kappa}$ **:** for how long borrowing cannot be fully compensated by equity financing

Simplify for analytical purposes: $\psi = \tau_i = 0 \; \forall i$. And focus on, e.g., TFP shocks

$$\frac{1-\alpha}{1+\mu}\left(\hat{w}_{\mathcal{R},t} + \frac{1-\xi\mu}{1+\xi}\hat{N}_{\mathcal{R},t}\right) \leq \frac{\xi}{1+\xi}\left\{\begin{array}{c} Z_{\mathcal{R},t} + \left[\alpha + (1-\delta)\frac{K}{Y}\right]\hat{K}_{\mathcal{R},t-1} \\ -\left(1-\frac{B}{Y}\right)\widehat{ToT}_t - \frac{D}{Y}\hat{D}_{\mathcal{R},t} - \frac{B}{Y}\hat{B}_{\mathcal{R},t-1} \end{array}\right\}$$

Let $Z_{\mathcal{R},t} < 0$

- $\hat{K}_{\mathcal{R},t-1}$ and $\hat{B}_{\mathcal{R},t-1}$ are both given
- Adjust by raising equity ($\hat{D}_{\mathcal{R},t} < 0$) or reducing the payroll ($\hat{w}_{\mathcal{R},t} + \hat{N}_{\mathcal{R},t} < 0$)
  - for $\kappa = 0$: immediate issuance of equity, so short-lived real effects
  - for $\kappa \to \infty$: strong fall in the payroll, as firms lack resources
  - for intermediary $\kappa > 0$: both dividends and payroll must fall
- $\widehat{ToT}_t$ also plays a role, responding endogenously to the shock and how the economy reacts to it

Numerical Exercise

Calibrate the countries symmetrically, matching the Borrowing/GDP ratio and Spread in the data for 1980-2018 $\rightarrow$ implied portfolio and its sensitivity to τ

Mean borrowing/GDP ratio (or NFCC)	81.02%
Mean US spread	2.33%
Mean equity portfolio (i.e., EHB index)	77.84%

GDP-weighting for cross-country aggregates.

- EHB, Borrowing/GDP, ...: annual data for a sample of 19 advanced countries (*MAIN sample*), which excludes the financial centers, from Lane and Milesi-Ferretti ('17), IMF, World Bank, WFE, Catini et al. ('10) and BIS
- Baa-10y Treasuries spread: annualized monthly data for the US from FRED (Behaves similarly to the spreads constructed by Krylova ('16), Krishnamurthy and Muir ('17), Krishnamurthy and Li ('20) for several countries.)

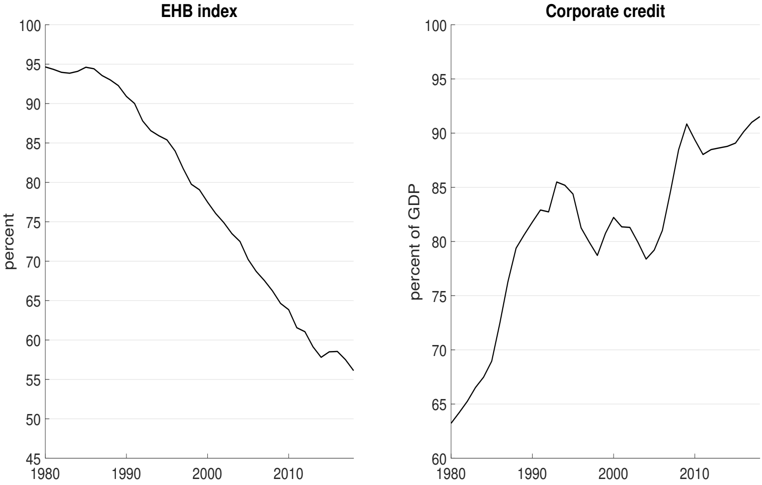

Figure: GDP-weighted average EHB and NFCC in the MAIN sample.

Regression analysis

	Value	Source
Tax benefit: τ	0.3725	IMF ('16, '17)
Discount factor: β	0.9846	mean US spread
Elasticity of discounting: φ	0.0541	investors' bond Euler
Depreciation of capital: δ	0.025	standard
Relative risk aversion: σ	2	standard
Capital share: α	0.3249	labor income share (64%)
Probability of recovery: ξ	0.1051	mean Borrowing/GDP
Labor supply exponent: ν	0.5	conservative (Peterman '16)
Labor disutility: χ	3.2490	N = 1/3
Goods home bias: γ	0.815	mean trade share
Elasticity of substitution: θ	1	standard
Persistence TFP,IST: ρ_Z, ρ_ζ	0.90	normalization
Volatility TFP: σ_Z	0.4%	Kollmann '13
Volatility IST: σ_ζ	0.7%	Kollmann '13
Corr$(\varepsilon_{Z_H}, \varepsilon_{Z_F})$	0.3	Heathcote and Perri '04-Coeurdacier et al. '10
Corr$(\varepsilon_{\zeta_H}, \varepsilon_{\zeta_F})$	0.2	Coeurdacier et al. '10
Investment adj. costs: ψ	1.460	$\sigma(X)/\sigma(Y) = 3$
Dividend payout costs: κ	0.285	Jermann and Quadrini '12

Table: Sensitivity of the equity portfolio, steady-state credit spread and steady-state borrowing/GDP ratio to τ.

Tax advantage	Model	Baseline	Low τ (0.336)	High τ (0.4085)
Sample period	Data	1980-2018	1980-99	2000-18
Borrowing/GDP (% per annum)	Model	81.25	76.65	85.91
	MM benchmark	81.25	76.65	85.91
	Data	81.02	76.66	85.91
Spread (% per annum)	Model	2.33	2.1	2.56
	MM benchmark	N/A	N/A	N/A
	Data	2.33	2.03	2.64
Equity portfolio (%)	Model	66.69	70.48	61.71
	Model, low κ (0.15)	65.50	69.70	59.85
	MM benchmark	84.97	84.97	84.97
	Data	77.84	89.49	65.57

The theoretical equity portfolios in the bottom part of the table are given by s_{HH}, while the empirical equity portfolios are the GDP-weighted average EHBs in the data.

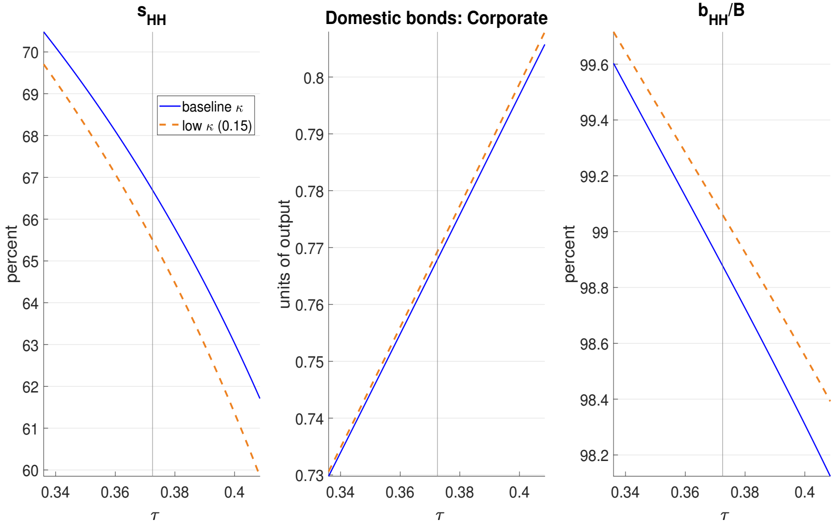

Figure: Sensitivity of country portfolios to τ.

Key extensions

1. Shocks to the expected liquidation value of capital when borrowing
   - Such unexpected disagreements (borrower-lender) affect the credit spread

$$\tau_i r_{i,t} = \frac{\mathbb{E}_t m_{i,t+1} \tilde{R}_{b_i,t+1} \left(\Delta\lambda_{i,t+1} - 1\right) + \frac{\mu_{i,t}}{\lambda_{i,t}} \xi_{i,t}}{\mathbb{E}_t m_{i,t+1} \Delta p_{i,t+1} \left(\Delta\lambda_{i,t+1} + \frac{\mu_{i,t}}{\lambda_{i,t}} \xi_{i,t}\right)}$$

   - $corr(\text{spread}, \text{payroll}) < 0$, while the relative labor income and relative dividends comove ▸ IRFs
2. Trade coupon/long-term bonds (bonds that pay 1 unit of the local good at any future time t)
   - Like equities, these bonds provide hedging against the long-run component of the terms-of-trade risk, which is large especially for low θ's

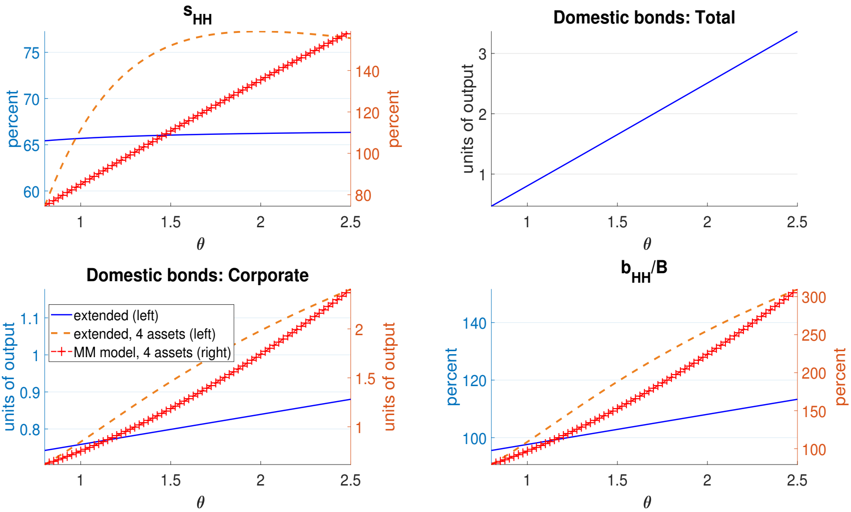

Figure: Sensitivity of the country portfolios to the elasticity of substitution between goods in the extended model w/ and w/o trade in coupon bonds.

Role of Preferences

Baseline assumption: households display GHH preferences and their optimal portfolio share is

$$s_{HH} = 1 - \frac{\widetilde{\Gamma}}{2(V/Y)}\beta\frac{\mathrm{Cov}\left(\hat{R}_{s_{\mathcal{R}},t+1}, \eta_{ToT,t+1}\right)}{\mathrm{Var}\left(\hat{R}_{s_{\mathcal{R}},t+1}\right)} - \frac{1}{2(V/Y)}\beta\frac{\mathrm{Cov}\left(\hat{R}_{s_{\mathcal{R}},t+1}, \eta_{y,t+1}\right)}{\mathrm{Var}\left(\hat{R}_{s_{\mathcal{R}},t+1}\right)},$$

where

$$\begin{aligned}\eta_{\mathrm{y},t+1} \quad = \quad & \sum_{k=1}^{\infty}\beta^{k-1}\mathbb{E}_{t+1}\left[\left(1-\frac{\varsigma_{WN}}{1+\nu}\right)\hat{Y}_{\mathcal{R},t+k} - \varsigma_X\hat{X}_{\mathcal{R},t+k}\right.\\ & \left. + \frac{\varsigma_{WN}\mu}{(1+\nu)(1+\mu)}\left(\hat{\mu}_{\mathcal{R},t+k} - \hat{\lambda}_{\mathcal{R},t+k}\right)\right]\end{aligned}$$

Separable preferences (SP): $u(C_i, N_i) = C_i^{1-\sigma}/(1-\sigma) - \chi^{(sp)}N_i^{1+\nu}/(1+\nu) \Longrightarrow$ the expression for s_{HH} is similar, but

$$\eta_{\mathrm{y},t+1}^{(sp)} = \sum_{k=1}^{\infty}\beta^{k-1}\mathbb{E}_{t+1}\left(\hat{Y}_{\mathcal{R},t+k} - \varsigma_X\hat{X}_{\mathcal{R},t+k}\right)$$

Tax advantage	Model	Baseline	Low τ (0.336)	High τ (0.4085)
Sample period	Data	1980-2018	1980-99	2000-18
Equity portfolio (%)	GHH Model	66.69	70.48	61.71
	GHH Model, low κ (0.15)	65.50	69.70	59.85
	GHH MM benchmark	84.97	84.97	84.97
	SP Model	93.34	94.83	91.59
	SP Model, low κ (0.15)	92.24	93.97	90.19
	SP MM benchmark	99.62	99.62	99.62
	Data	77.84	89.49	65.57

Moreover, home bias $\uparrow$ as ToT_t becomes less volatile ($\theta \uparrow$), but, conditional on financial shocks, GHH are generally sufficient for the $\tau - s_{HH}$ link to remain (–). It may instead turn (+) under SP utility

Conclusions

- In a two-country portfolio model, corporate leverage makes labor earnings riskier, *but* it also favors international risk diversification, which pays off so long as leverage does not comove too strongly across countries

- Indeed, it is difficult to pay out dividends when borrowing is tight and, hence, the payroll is low
- AEs data for 1980-2018: correct to think in terms of reduced EHB and large corporate leverage
- Bonds absorb most (but not all) of the exchange rate risk
- Bond home bias can also fall as corporate leverage rises (especially for high trade elasticities), although the domestic holdings of the safest assets rise as well. See Coeurdacier and Rey ('13) for evidence on the decline in AEs' bond home bias over time

Appendix

Robustness and Extensions: More Comprehensive Ovierview

- **Empirics**: results from panel regressions hold
  - in a sample w/ financial centers (FS = 25 countries); almost balanced sample (BS = 12 countries) ▸ Table (w/o controls)
  - when differencing the data over windows of different size ($s = 0.3,\ 0.7$)

- **Model with just trade in equity**: results hold
  - for $\theta \lesseqgtr 1$ because of IST shocks
  - true also under SP preferences but EHB more muted as $\theta \uparrow$

- **Sensitivity of the model with trade in equities and corporate bonds to θ**
  - The (long-term component of) exchange rate risk magnifies EHB, as in the data
  - While IST shocks discourage/encourage home bias for $\theta \lesseqgtr 1$, financial shocks do just the opposite ▸ Graph
  - Introducing financial shocks is sufficient for the $\tau - s_{HH}$ link to remain (–) under GHH ▸ Table *but not* under SP

- **Fully extended model**: capital utilization, financial shocks, and trade in coupon/long-term bonds (+ that in equities & corporate bonds)
  - Coupon bonds compete with equities for the long-term component of the exchange rate risk
  - Utilization is mostly an amplification channel ▸ Table

$$\Delta_k EHB_{i,t} = \alpha + \gamma_i + \delta_t + \beta \cdot \Delta_k NFCC_{i,t} + \theta' \cdot \Delta_k X_{i,t} + \varepsilon_{i,t}$$

Δ_k ($k = 5$): inspired by Heathcote and Perri ('13)

$X_{i,t}$ (controls): trade share, Chinn-Ito, Market cap./GDP, population, GDP correlation, GDP per capita, RER

Table: Regressions using 5-year differenced data for the MAIN sample.

VARIABLES	EHB	EHB
NFCC	-0.267***	-0.315***
	(-3.224)	(-3.832)
Trade share		-0.020
		(-0.136)
Chinn-Ito		-0.430
		(-0.130)
Market cap./GDP		0.070***
		(3.422)
Log population		142.768**
		(2.815)
GDP correlation		-0.179
		(-0.211)
Log GDP per capita		6.563
		(0.679)
Log RER		13.172**
		(2.359)
Constant	-0.544	-15.103***
	(-1.001)	(-3.325)
Observations	468	453
R-squared	0.286	0.372
SAMPLE	MAIN	MAIN

*** $p<0.01$, ** $p<0.05$, * $p<0.1$; t-statistics in parentheses; country FE and time effects as well as double-clustered s.e. (country and time).

Back

Table: Regressions without controls, using 5-year differenced data.

VARIABLES	(1) EHB	(2) EHB	(3) EHB
NFCC	-0.267***	-0.187***	-0.299***
	(-3.224)	(-3.059)	(-3.193)
Constant	-0.544	2.732***	-5.325***
	(-1.001)	(5.763)	(-8.171)
Observations	468	601	393
R-squared	0.286	0.226	0.288
SAMPLE	MAIN	FS	BS

*** p<0.01, ** p<0.05, * p<0.1; t-statistics in parentheses; country FE and time effects as well as double-clustered s.e. (country and time) in all regressions.

$$[\Delta_k EHB_{i,t} = \alpha + \gamma_i + \delta_t + \beta \cdot \Delta_k NFCC_{i,t} + \varepsilon_{i,t} \quad (k = 5)]$$

Back

Role of IST Shocks

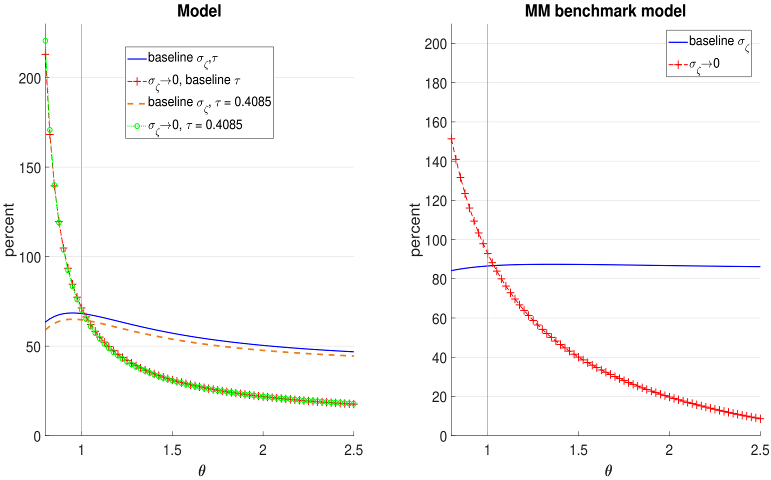

Figure: Sensitivity of the portfolio share invested in domestic equities (s_{HH}) to the elasticity of substitution between goods (θ) w/ and w/o IST shocks.

Table: Cumulative (percent) responses to an increase in $\zeta_{H,t}$.

	Baseline τ	High τ (0.4085)	MM benchmark
Model			
Labor (H-F relative)	0.313	0.283	0.633
Debt-equity multiplier (H-F relative)	5.193	5.417	N/A
Extended model, 4 assets			
Labor (H-F relative)	0.524	0.487	0.941
Debt-equity multiplier (H-F relative)	5.981	6.111	N/A
Complete extended model			
Labor (H-F relative)	0.521	0.490	N/A
Debt-equity multiplier (H-F relative)	5.968	6.120	N/A

Table: Sensitivity of the equity portfolio to τ for alternative elasticities of substitution between goods (θ) in the 4-asset model when financial shocks replace IST shocks.

Utility	θ	s_{HH} (baseline τ)	growth in s_{HH} for $\tau \uparrow$
GHH	0.8	70.08%	-2.088%
	1	64.88%	-1.876%
	1.5	60.45%	-1.566%
	2.5	53.60%	-1.329%
SP	0.8	98.08%	-0.970%
	1	82.49%	-0.696%
	1.5	60.49%	-0.080%
	2.5	41.55%	0.892%

In the last column, the tax advantage, τ, goes from 0.336 to 0.4085.

Back

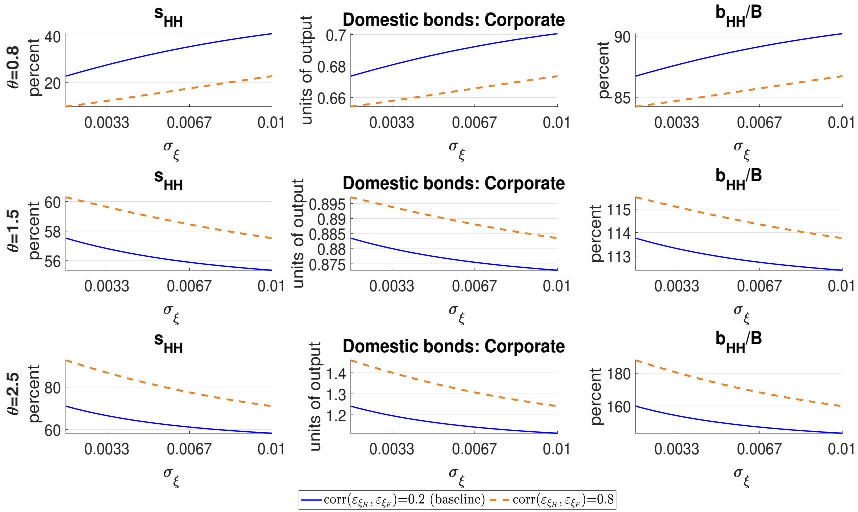

Figure: Sensitivity of country portfolios to the standard deviation of the financial shocks in the extended model w/ only 4 assets traded.

Back

FIN shocks ($\varepsilon^z_{i,t} = 0, \varepsilon^\zeta_{i,t} = 0, \varepsilon^\xi_{i,t} \neq 0$)

$$\begin{aligned}
\frac{1-\alpha}{1+\mu}\left(\hat{w}_{\mathcal{R},t} + \frac{1-\xi\mu}{1+\xi}\hat{N}_{\mathcal{R},t}\right) \quad \leq \quad & \frac{1-\alpha}{(1+\mu)(1+\xi)}\hat{\xi}_{\mathcal{R},t} \\
& + \frac{\xi}{1+\xi}\left\{ \begin{array}{c} \left[\alpha + (1-\delta)\frac{K}{Y}\right]\hat{K}_{\mathcal{R},t-1} - \frac{B}{Y}\hat{B}_{\mathcal{R},t-1} \\ -\left(1-\frac{B}{Y}\right)\widehat{ToT}_t - \frac{D}{Y}\hat{D}_{\mathcal{R},t} \end{array} \right\}
\end{aligned}$$

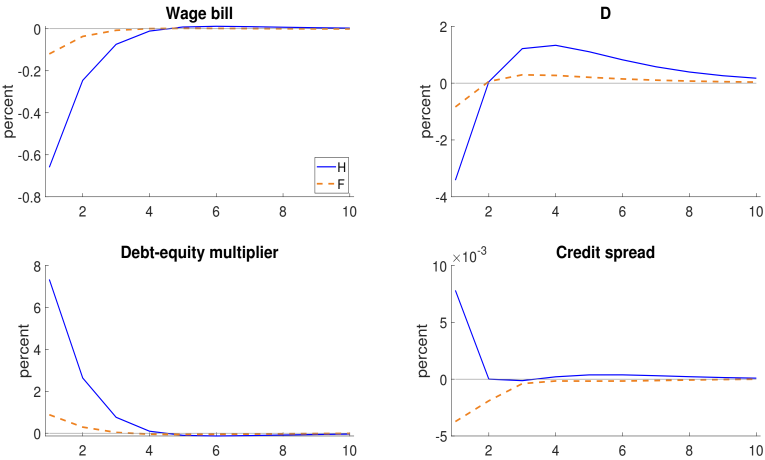

Figure: The responses of wage bills, dividends and credit spreads to negative Home financial shock in the extended model.

Back

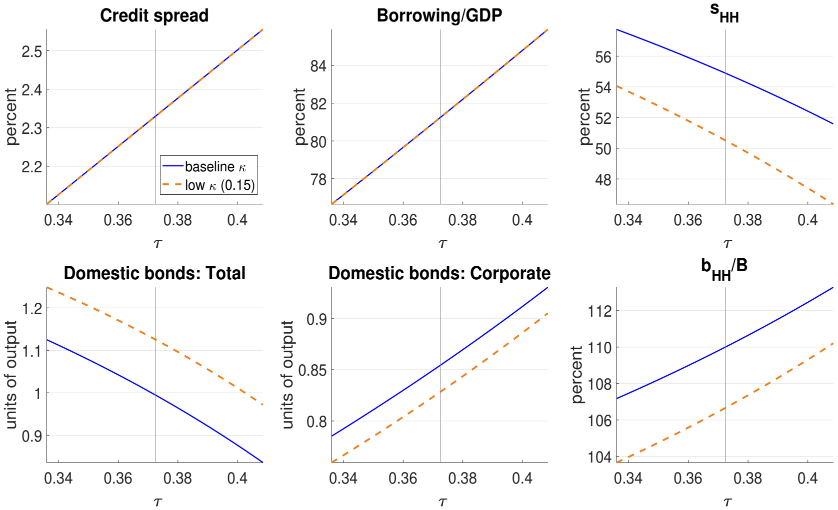

Figure: Sensitivity of the country portfolio to the steady-state credit spread and debt-to-output ratio in the extended model.

Table: Sensitivity of country portfolios to τ for alternative elasticities of capital depreciation to utilization (ϕ_2) and elasticities of substitution between goods (θ) in the (complete) extended model.

ϕ_2	s_{HH} (growth)	Domestic bonds: Total (change)	Domestic bonds: Corporate (change)	b_{HH}/B (growth)
		Low θ (0.8)		
Low (1.30)	-33.431%	-0.394	0.187	10.779%
1.54	-16.326%	-0.162	0.143	6.666%
High (1.82)	-11.571%	-0.091	0.129	5.315%
		$\theta = 1.5$		
Low (1.30)	-19.215%	-0.531	0.182	8.665%
1.54	-10.661%	-0.289	0.145	5.698%
High (1.82)	-7.960%	-0.206	0.132	4.591%
		High θ (2.5)		
Low (1.30)	-14.032%	-0.730	0.192	7.856%
1.54	-8.346%	-0.450	0.154	5.217%
High (1.82)	-6.426%	-0.347	0.140	4.131%

Domestic bonds: Total and *Domestic bonds: Corporate* are expressed in units of output as follows: $[pb_{HH}/(1+r)+p_a a_{HH}]/(pY)$ and $b_{HH}/[(1+r)Y]$, respectively. The tax advantage, τ, goes from 0.336 to 0.4085.

Back