Securitized Markets, International Capital Flows, and Global Welfare

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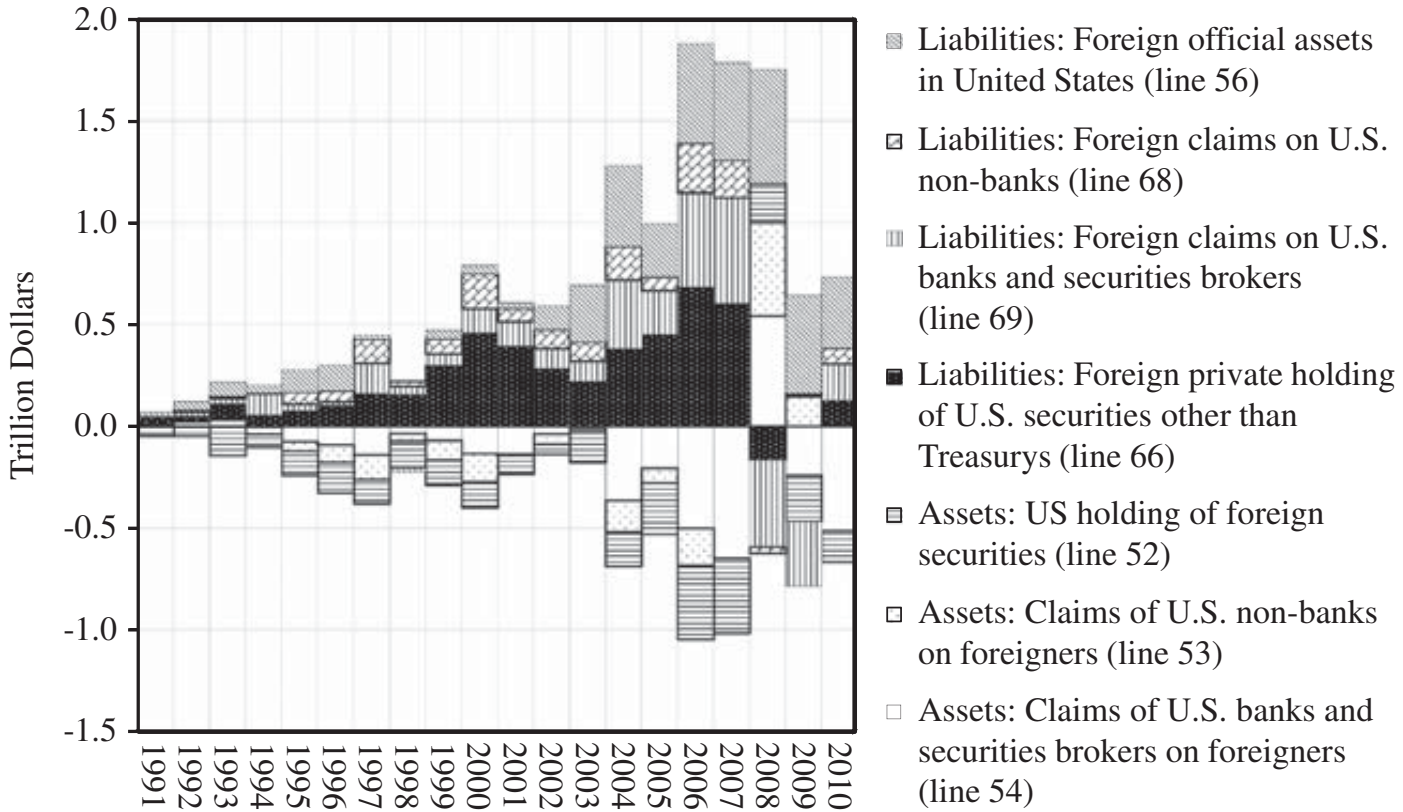
Gross Financial Flows

From Shin (2012)

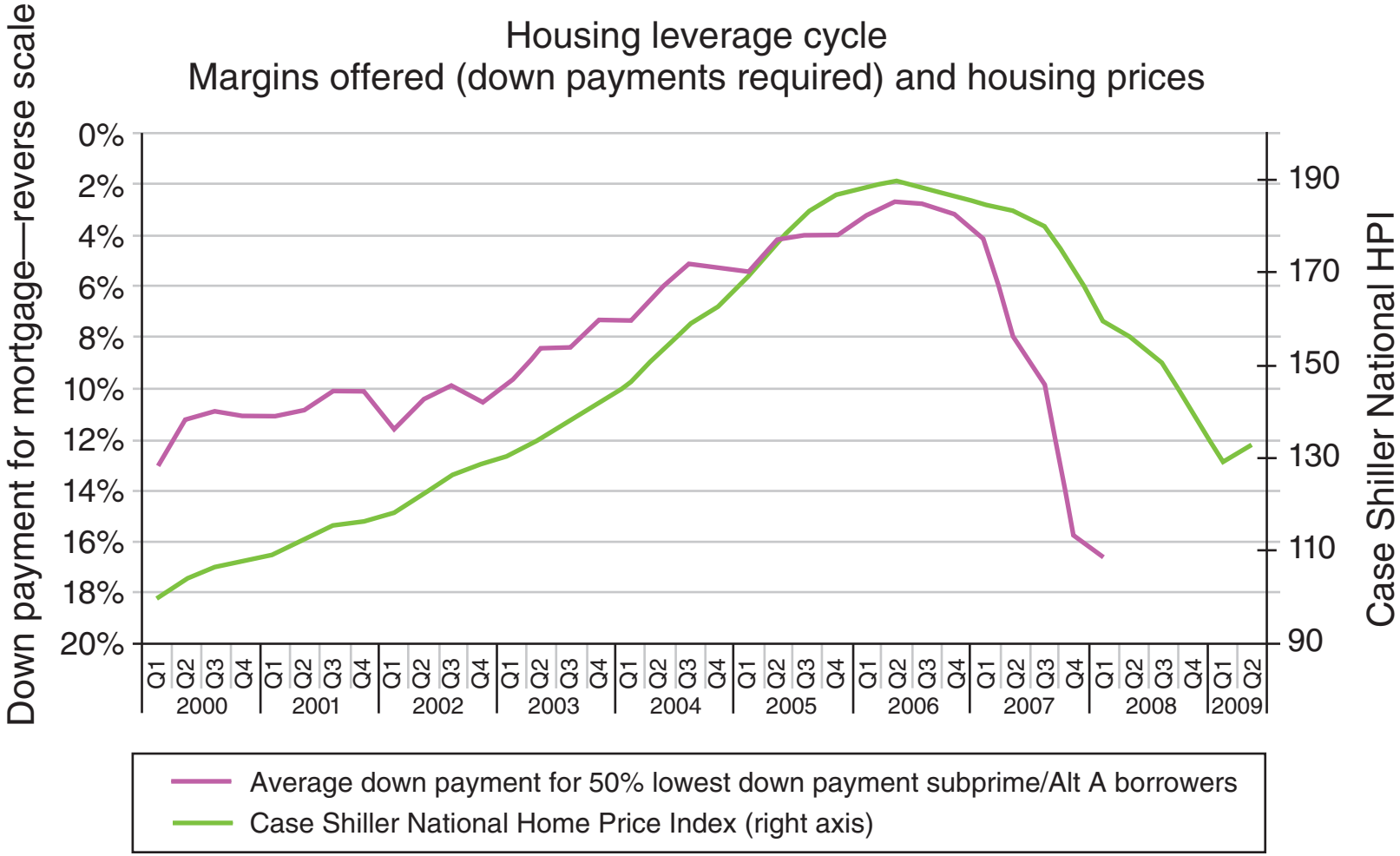
Figure 2. U.S. Gross Capital Flows by Category



Source: U.S. Bureau of Economic Analysis. Increase in U.S. liability to foreigners is indicated by positive bar, increase in U.S. claims on foreigners is indicated by negative bar. Only a subset of gross flows is included, so that flows do not sum to zero.

Leverage in Housing Markets

From Fostel & Geanakoplos (2012)



Introduction

Background

- Proliferation of securitized financial markets since 90's
- Net and gross capital flows into U.S. increased persistently until 2007 and collapsed following the 2007–2009 financial crisis
- Loan down payments in the U.S. very low pre-crisis, very high post-crisis

Question

1. How do securitized markets affect international capital flows?
2. What are effects on welfare, growth, and inequality?

Contribution

What we do

- Develop a two country general equilibrium model with uninsurable idiosyncratic investment risk and securitized loan markets
- Study the effect of financial integration on capital flows, growth, welfare, and inequality

Main results

1. Capital flows from high-margin (Foreign) to low-margin (Home) country
2. Upon financial integration,
   - Home: interest rate $\downarrow$, growth $\uparrow$, inequality $\uparrow$
   - Foreign: welfare $\uparrow$, growth $\downarrow$, inequality $\downarrow$

Intuition

- Foreign demands "safe enough" assets
- Home can endogenously supply "safe enough" assets through more lending and high leverage

Related Literature

- **"Global Imbalances"**: Willen (2004), Caballero, Farhi, & Gourinchas (2008), Mendoza, Quadrini, & Ríos-Rull (2009), Angeletos & Panousi (2011), Maggiori (2015)
- **Capital Flows**: Gourinchas & Jeanne (2006), Caballero & Krishnamurthy (2009), Bertaut, DeMarco, Kamin, & Tryon (2012), Obstfeld (2012), Shin (2012)
- **Collateral Equilibrium**: Geanakoplos (1997, 2003), Fostel & Geanakoplos (2008, 2012), Fostel, Geanakoplos, & Phelan (2015), Toda (2013)

Setup

- Two countries, Home and Foreign
- Two periods, $t = 0, 1$
- Unit continuum of ex ante identical entrepreneurs indexed by $i \in [0, 1]$ with risky investment projects
- Unit continuum of financial intermediaries (risk-neutral, perfectly competitive, profit-maximizing) who service loans and issue asset-backed securities (ABS)

Entrepreneurs/Investors

- Identical preferences over final consumption

$$U(C) = \mathrm{E}[u(C)],$$

  where $u' > 0$, $u'' < 0$
- Agents in country $j = H, F$ endowed with W^j units of capital good at $t = 0$, no endowment at $t = 1$
- Linear investment technology with stochastic productivity A^i
  - Investor i's investment of k^i yields $A^i k^i$ in $t = 1$
  - $A^i \sim$ i.i.d. across agents (no aggregate risk for now)

Financial Structure: Collateralized Loans

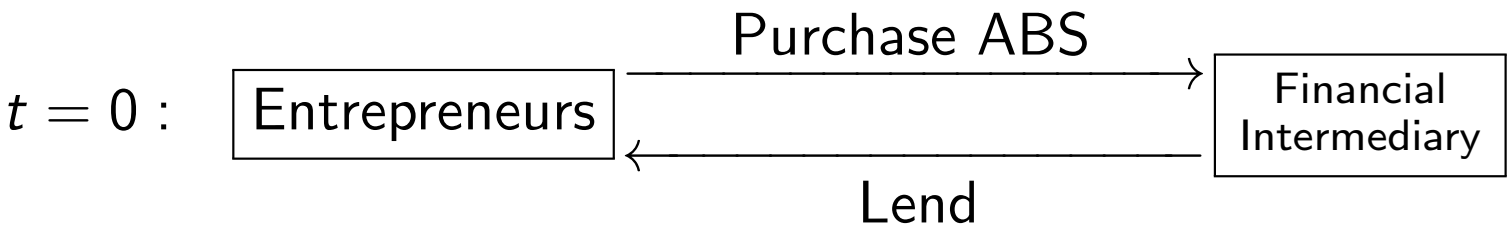
- Markets are incomplete: investors can only borrow from intermediary using loan by putting up their investments as collateral
- A loan in country j is characterized by (exogenous) collateral requirement $c_j \geq 1$ (down payment $d_j = 1 - 1/c_j$) and (equilibrium) borrowing rate R_b^j; assume $c_H < c_F$
- For each dollar borrowed, entrepreneur in country j must invest c_j dollars in the project and put up its return, $A^i c_j$, as collateral
- Loans are non-recourse: agent i in country j delivers

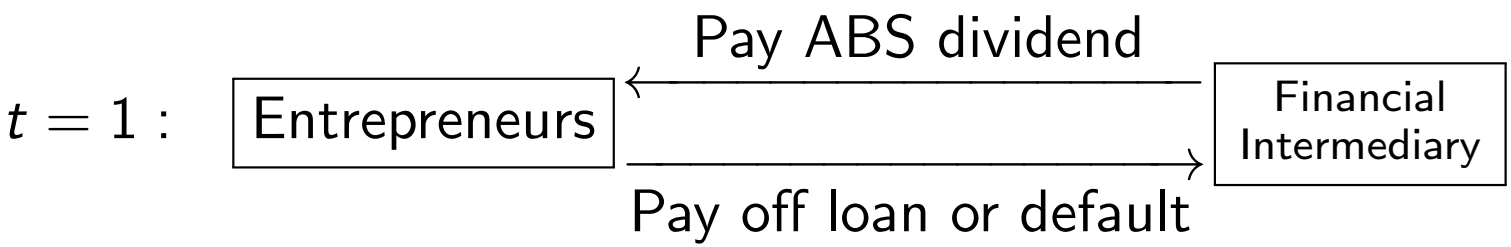
$$\min \left\{ A^i c_j, R_b^j \right\}$$

for each dollar borrowed

Financial Structure: ABS

- Financial intermediaries lend to entrepreneurs and pool loan contacts to issue asset-backed securities (ABS)
- Closest thing in real world is collateralized loan obligations (CLO)
- Perfect competition implies ABS are pass-through securities that pay $R^j_{ABS} = \mathrm{E}\left[\min\left\{A^i c_l, R^j_b\right\}\right]$





Portfolio

- Agents can borrow only from domestic loans but can invest in ABS of either country
- Portfolio in country j denoted by $\pi^j = (\theta^j, \phi^j_H, \phi^j_F, \psi^j)$, where
  - $\theta^j \geq 0$: fraction of capital invested in the risky project
  - ϕ^j_H (ϕ^j_F) ≥ 0: fraction invested in Home (Foreign) asset-backed security
  - $\psi^j \geq 0$: fraction borrowed from loan
- Budget constraint is

$$\theta^j + \phi^j_H + \phi^j_F - \psi^j = 1$$

- Collateral constraint is

$$\theta^j \geq c_j \psi^j$$

Equilibrium and Properties

- A collateral equilibrium with ABS is defined by borrowing rates and portfolio choices such that (i) agents optimize and (ii) markets clear
- Since there are no aggregate shocks, all ABS pools are risk-free (idiosyncratic risks are diversified away)
  - In autarky equilibrium, markets clear in each country (with different risk-free rates)
  - In financial integration equilibrium, markets clear globally (with identical risk-free rates but not borrowing rates)

Equilibrium and Properties

Proposition

Consider a country with autarky risk-free rate R_f^{Aut}. If the country faces a higher interest rate $R_f^{\text{Int}} > R_f^{\text{Aut}}$ after financial integration, then the country reduces real investment θ, increases investment in the ABS ϕ, and reduces borrowing ψ. Furthermore, the country gains from financial integration in terms of welfare.

Equilibrium and Properties

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Intuition:

- Since $R_f = \mathrm{E}[\min\{A^i c, R_b\}]$, risk-free rate and borrowing rate move in same direction
- Since $\min\{A^i c, R_b\} = c \min\{A^i, R_b/c\}$, default threshold is R_b/c (non-recourse loan is essentially convertible bond)
- Hence higher interest rates improve welfare because more down side risk sharing (endogenous risk sharing)

Equilibrium and Properties

Theorem

Suppose that $R_f^{\text{Int}} > R_f^{F,\text{Aut}}$. *Then* $R_f^{\text{Int}} < R_f^{H,\text{Aut}}$,

1. *Home increases and Foreign decreases real investment:*

$$\theta^{H,\text{Int}} > \theta^{H,\text{Aut}} = 1 = \theta^{F,\text{Aut}} > \theta^{F,\text{Int}},$$

2. *Home decreases and Foreign increases investment in ABS:*

$$\sum_{j=H,F} \phi_j^{H,\text{Int}} < \phi^{H,\text{Aut}}, \quad \sum_{j=H,F} \phi_j^{F,\text{Int}} > \phi^{F,\text{Aut}},$$

3. *Home increases and Foreign decreases borrowing:* $\psi^{H,\text{Int}} > \psi^{H,\text{Aut}}$, $\psi^{F,\text{Int}} < \psi^{F,\text{Aut}}$,

4. *The global supply of safe assets increases:*

$$\frac{W^H \theta^{H,\text{Int}}}{c^H} + \frac{W^F \theta^{F,\text{Int}}}{c^F} > \frac{W^H \theta^{H,\text{Aut}}}{c^H} + \frac{W^F \theta^{F,\text{Aut}}}{c^F} = \frac{W^H}{c^H} + \frac{W^F}{c^F}.$$

Welfare Implications

- By previous results, Foreign gains from financial integration
- Home welfare is ambiguous

Proposition

Suppose that Foreign wealth W^F is sufficiently large. Let $V^{H,\mathrm{Aut}}, V^{H,\mathrm{Int}}$ be the Home welfare in autarky and after financial integration.

1. *If Home collateral requirement c_H is sufficiently low and $u(\infty) = \infty$, then Home welfare after financial integration exceeds the complete market level (perfect risk sharing): $V^{H,\mathrm{Int}} > u(\mathrm{E}[A^i]W^H)$.*
2. *If u is CRRA with relative risk aversion $\gamma > 1$ sufficiently large, then Home loses from financial integration: $V^{H,\mathrm{Int}} < V^{H,\mathrm{Aut}}$.*

Intuition: endogenous risk sharing

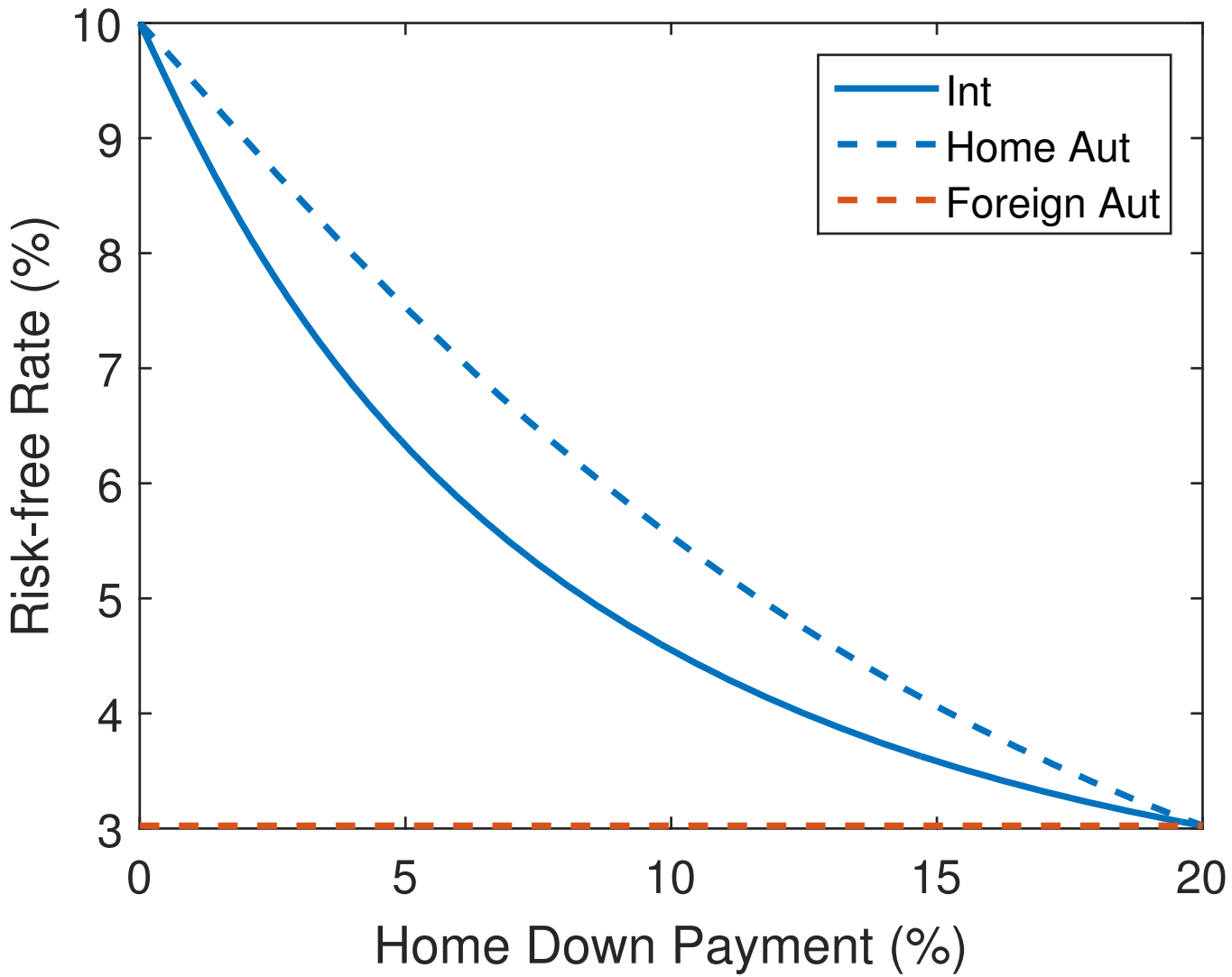
Numerical Example

- Utility is CRRA, $u(C) = \frac{1}{1-\gamma} C^{1-\gamma}$, with $\gamma = 2$
- Productivities are log-normally distributed,

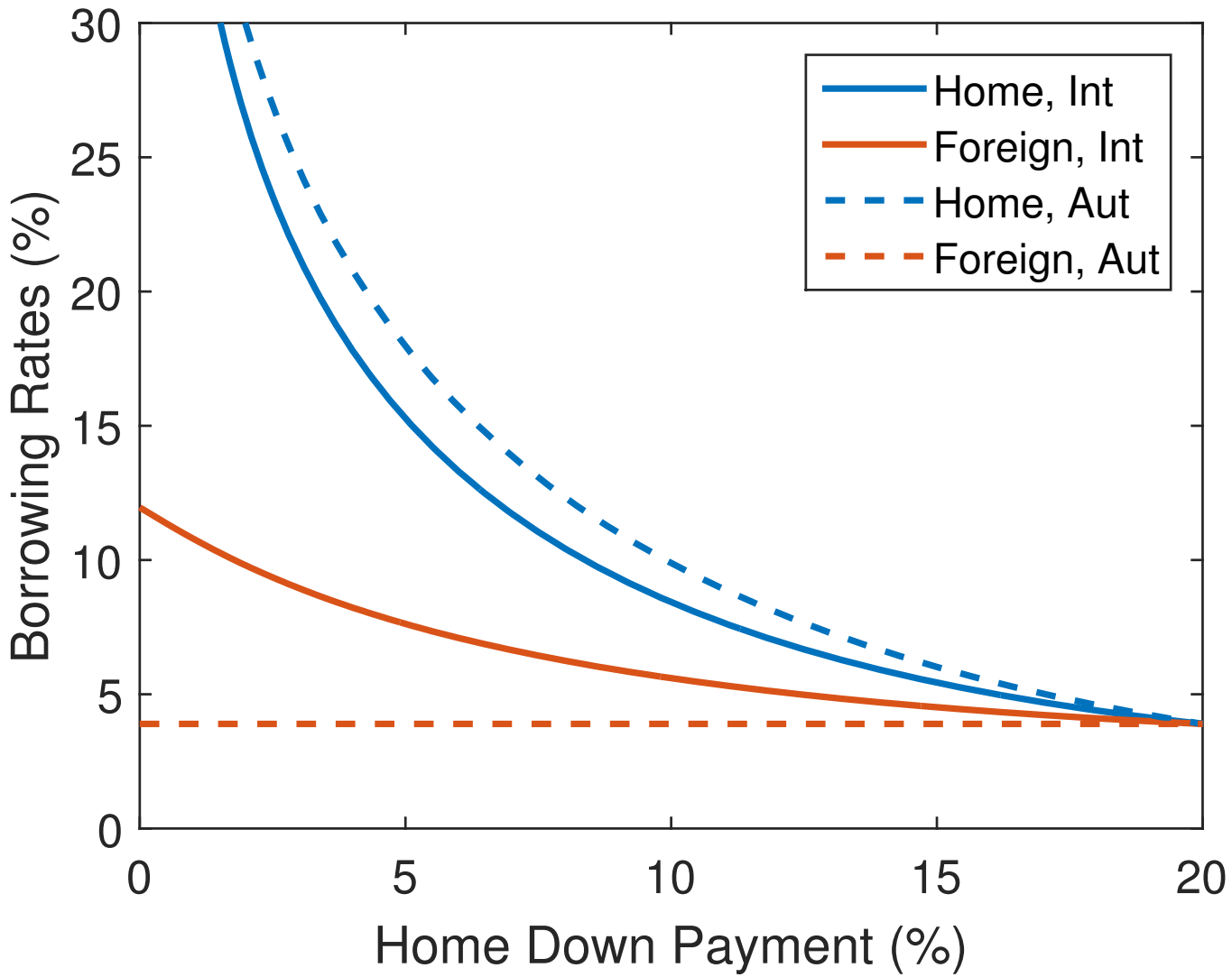
$$\log A^i \sim N(\mu - \sigma^2/2, \sigma^2),$$

  with $e^{\mu} = 1.1$ (expected return $= 10\%$) and $\sigma = 20\%$
- $c_F = 1.25$ (down payment $= 20\%$)
- Vary $c_H \in [1, 1.25]$ (down payment $\in [0, 20\%]$)

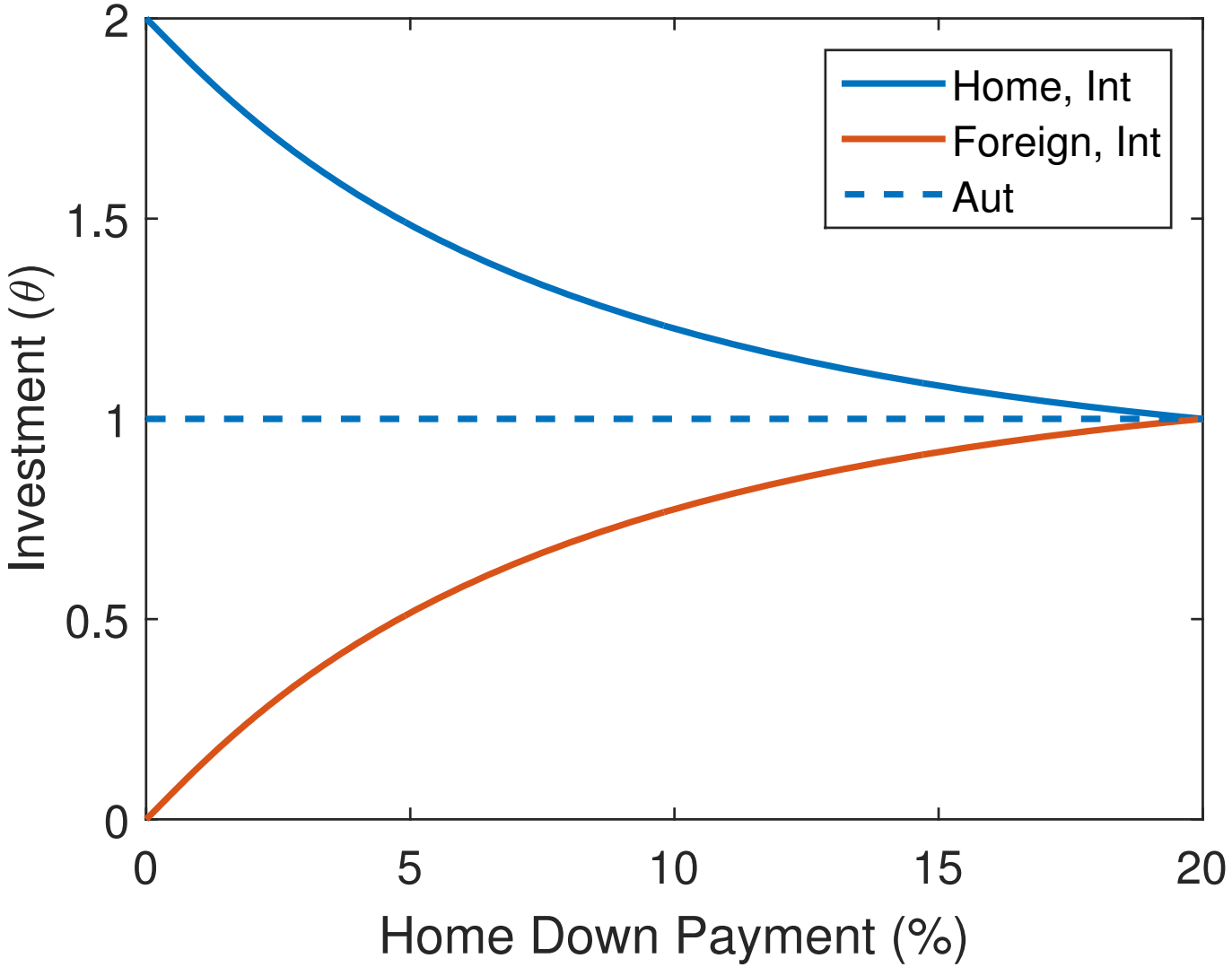
Risk-free rates



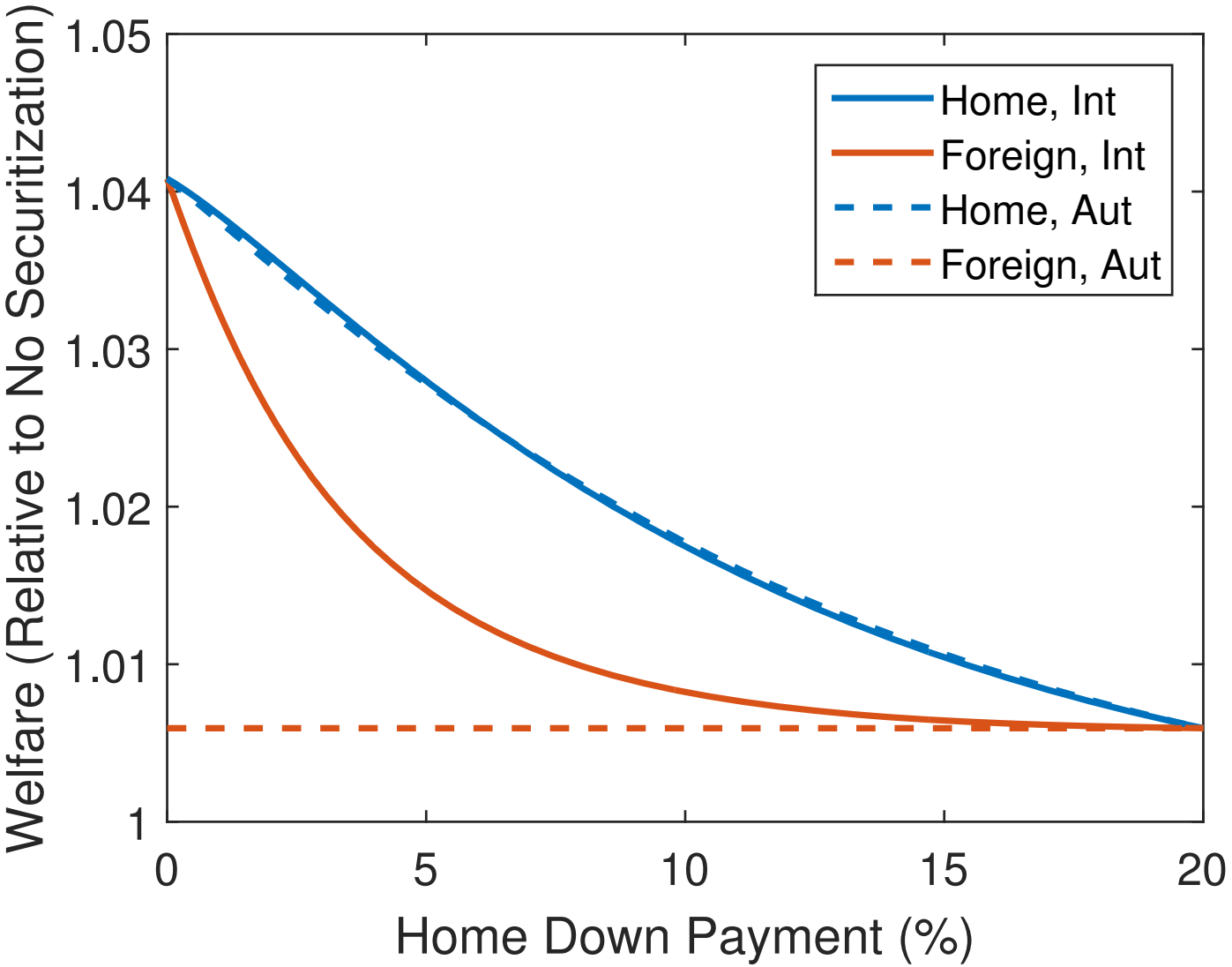
Borrowing rates



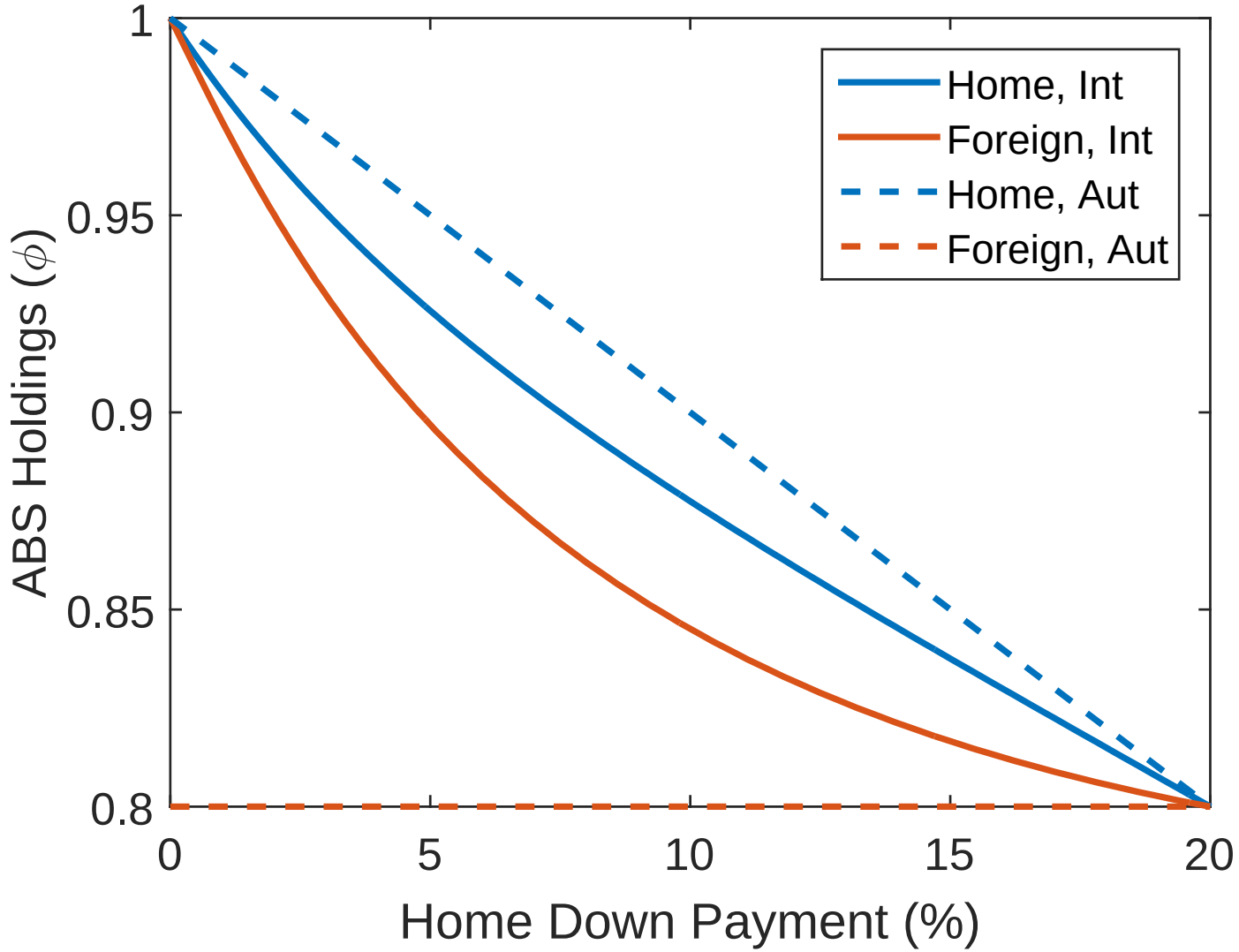
Investment


Home, Int
Foreign, Int
Aut
Investment (θ)
Home Down Payment (%)
0
0.5
1
1.5
2
0
5
10
15
20

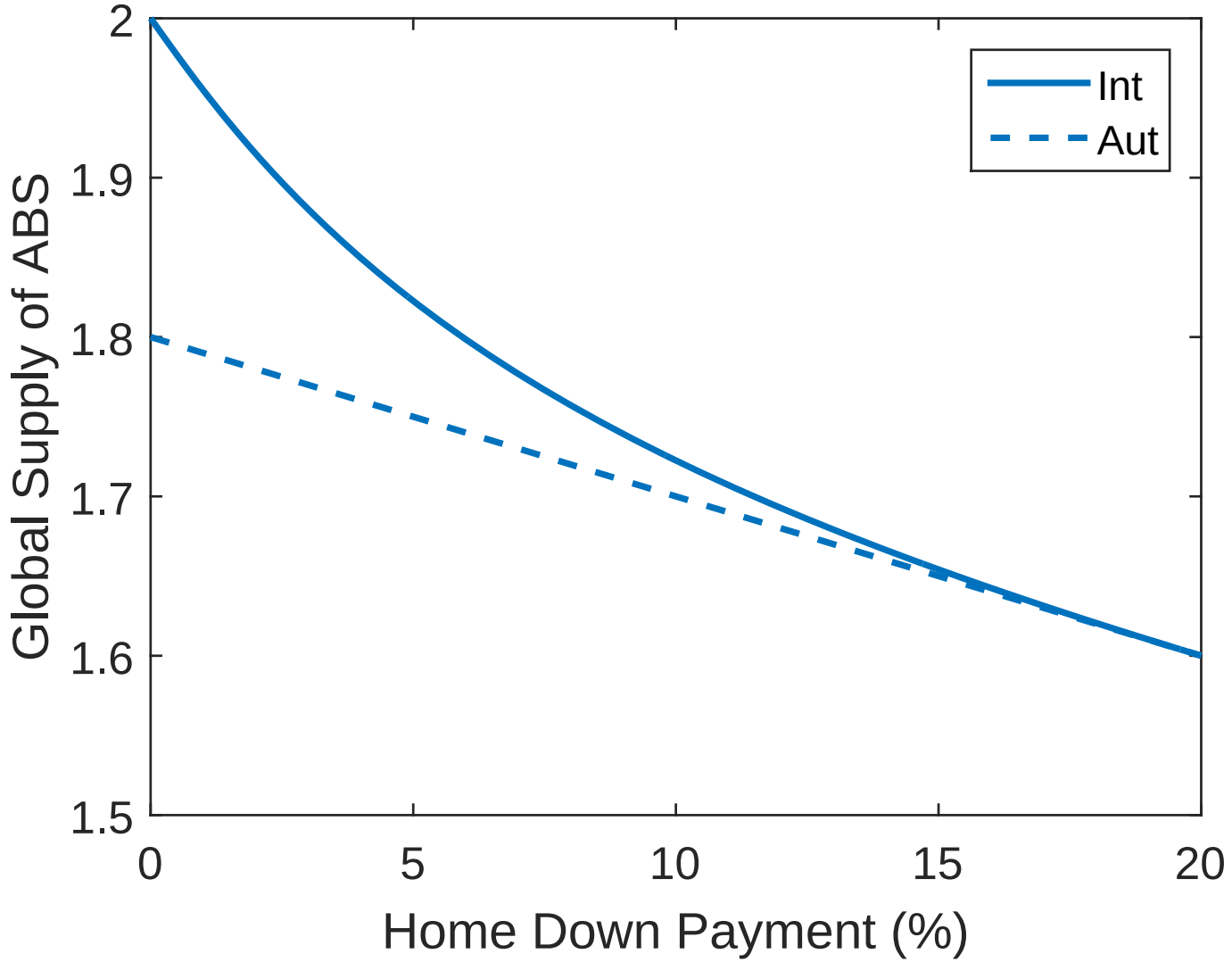
Welfare


Welfare (Relative to No Securitization)
1.05
1.04
1.03
1.02
1.01
1
0
5
10
15
20
Home Down Payment (%)
Home, Int
Foreign, Int
Home, Aut
Foreign, Aut

ABS holdings



Global supply of safe assets



Changes in Welfare

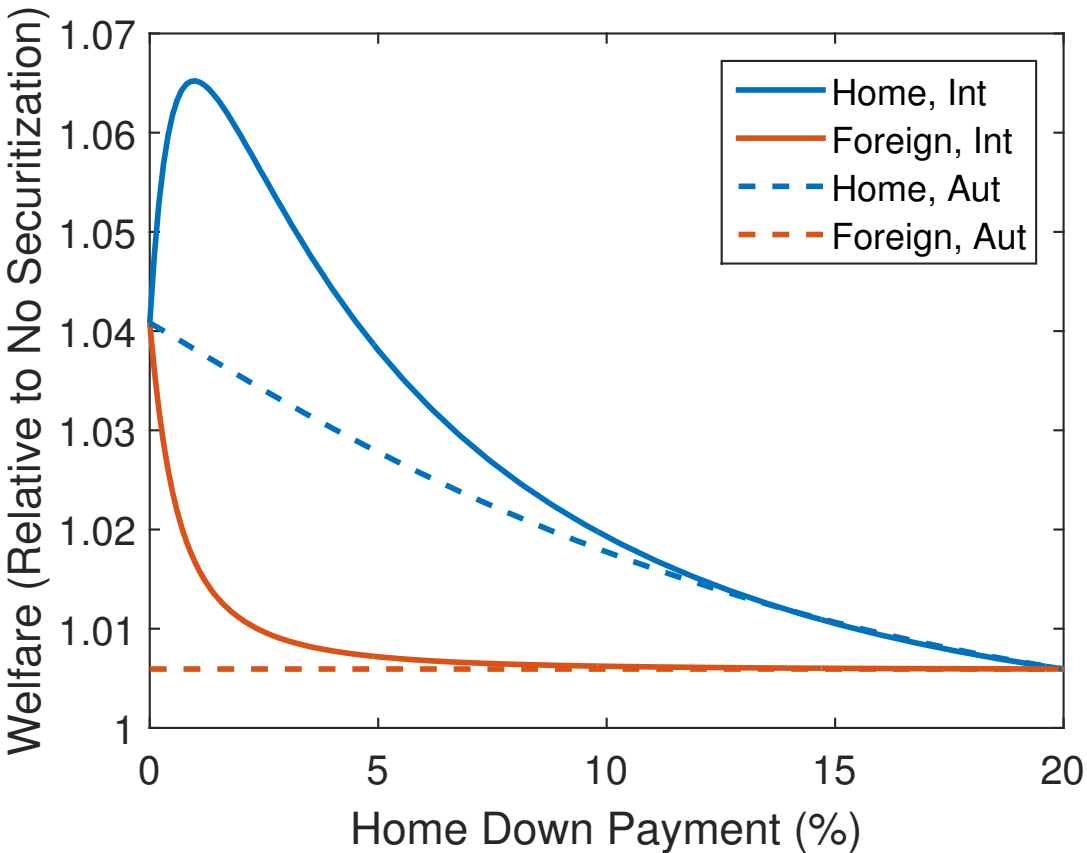
- Models in existing literature get different welfare results (different financial frictions and financial structures)
- In those models the degree of risk sharing is not affected by financial integration—always the same fraction of idiosyncratic risk that is insured
- In our model the degree of risk sharing is endogenous:

$$A^i c \gtrless R_b \iff A^i \gtrless R_b/c,$$

so default threshold (degree of risk sharing) depends on borrowing rate R_b

"Saving Glut" Economy

- Risk sharing depends endogenously on the changes in interest rates, which depend on the size of capital flows
- Consider when Foreign is much larger (9 times Home, "saving glut") to better understand how capital flows affect welfare



Introducing Aggregate Risks

Skip aggregate risks

- Aggregate states, $s = 1, \ldots, S$, occurring with probability p_s
- States index the distribution of payoffs to investors' projects $F_s(\cdot)$
- To isolate the effect of securitization on international flows, we assume that the productivity distributions in each country are the same ("world shocks")
- Gross return on country j's ABS in state s is

$$R^j_{\text{ABS}}(s) = \mathsf{E}\left[\min\left\{Ac_j, R^j_b\right\} \middle| s\right] = \int_0^\infty \min\left\{c_j x, R^j_b\right\} \mathrm{d}F_s(x)$$

Nature of Shocks

- For simplicity we consider 2 aggregate states for numerical examples
- Consider two types of aggregate shocks:
  1. First-moment: expected return

$$\begin{aligned} \mathrm{E}\left[A^i \,\middle|\, s=1\right] &> \mathrm{E}\left[A^i \,\middle|\, s=2\right] \\ \mathrm{Var}\left[A^i \,\middle|\, s=1\right] &= \mathrm{Var}\left[A^i \,\middle|\, s=2\right] \end{aligned}$$

  2. Second-moment: variance of returns

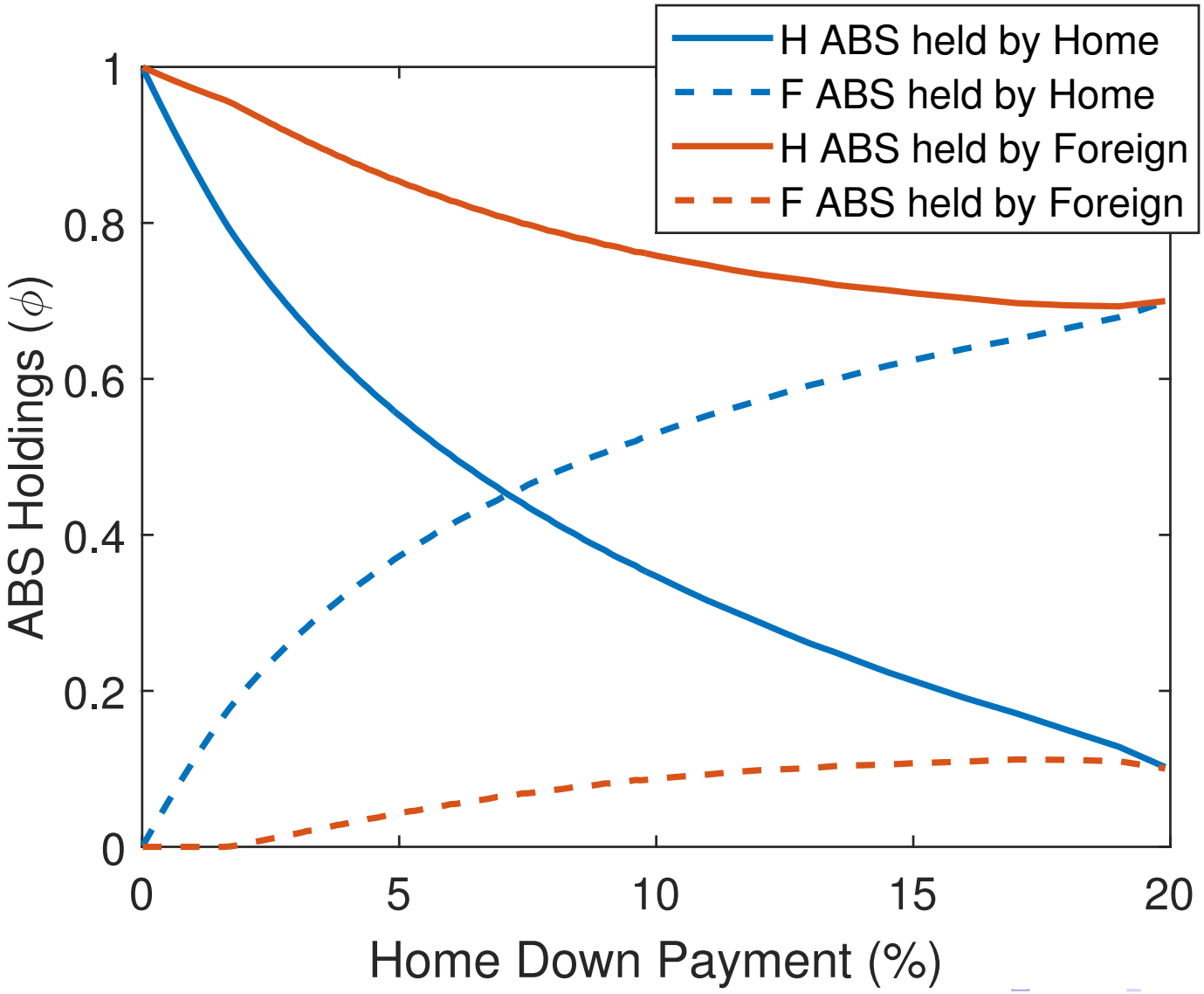
$$\begin{aligned} \mathrm{E}\left[A^i \,\middle|\, s=1\right] &= \mathrm{E}\left[A^i \,\middle|\, s=2\right] \\ \mathrm{Var}\left[A^i \,\middle|\, s=1\right] &< \mathrm{Var}\left[A^i \,\middle|\, s=2\right] \end{aligned}$$

Numerical Example: First-Moment Shocks

- States equiprobable, $p_1 = p_2 = 0.5$
  - $\mu_1 = 20\%$, $\mu_2 = 0$
  - $\sigma_1 = \sigma_2 = 20\%$
- Equilibrium with first-moment shocks essentially the same
  - Investment essentially identical
  - Welfare changes from integration essentially identical
- Portfolio holdings of Home and Foreign ABS are not indeterminate—not both risk-free, not perfectly substitutable
- Results are robust to size of first-moment shock

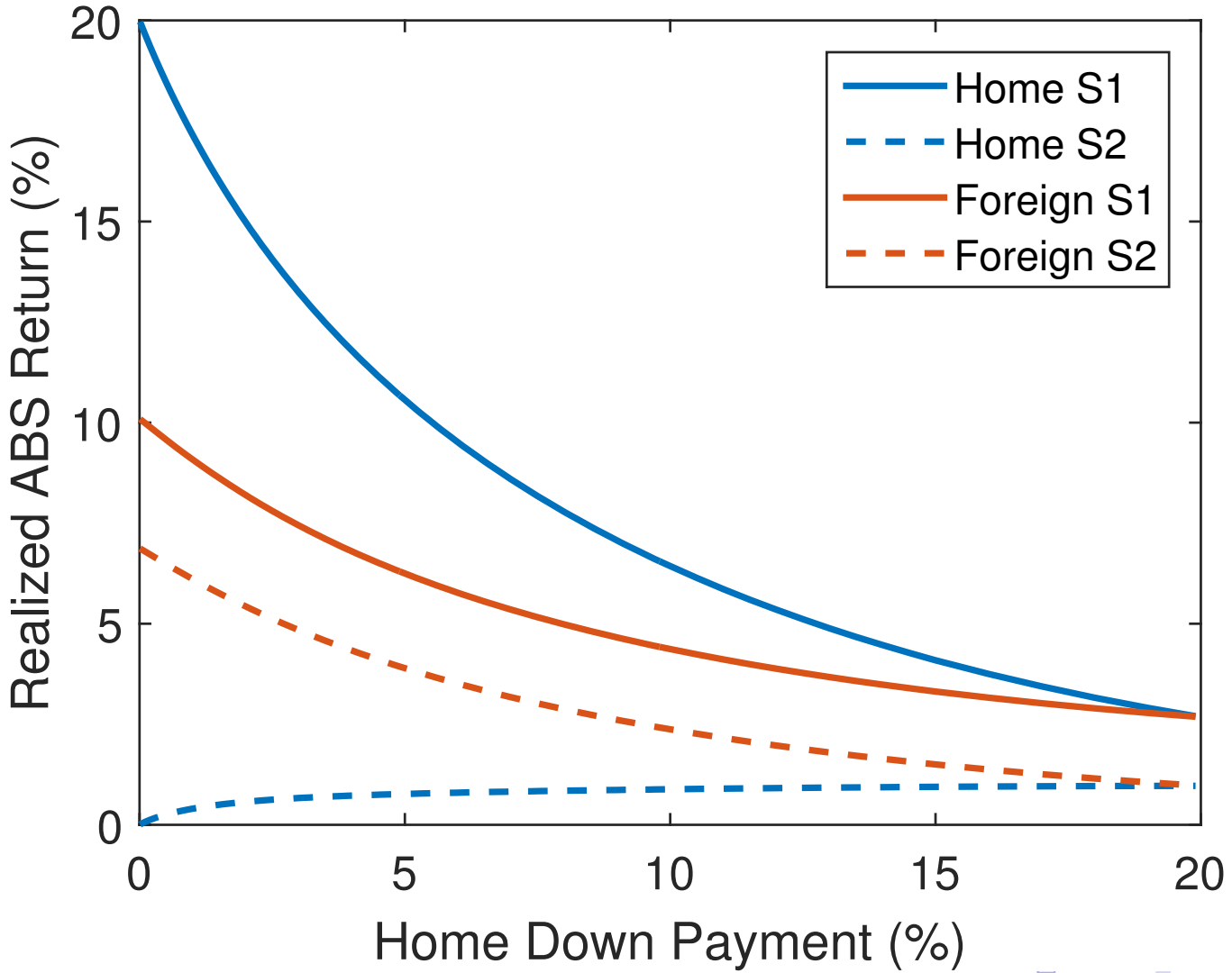
Equilibrium with Financial Integration

First-moment Shocks: ABS Holdings



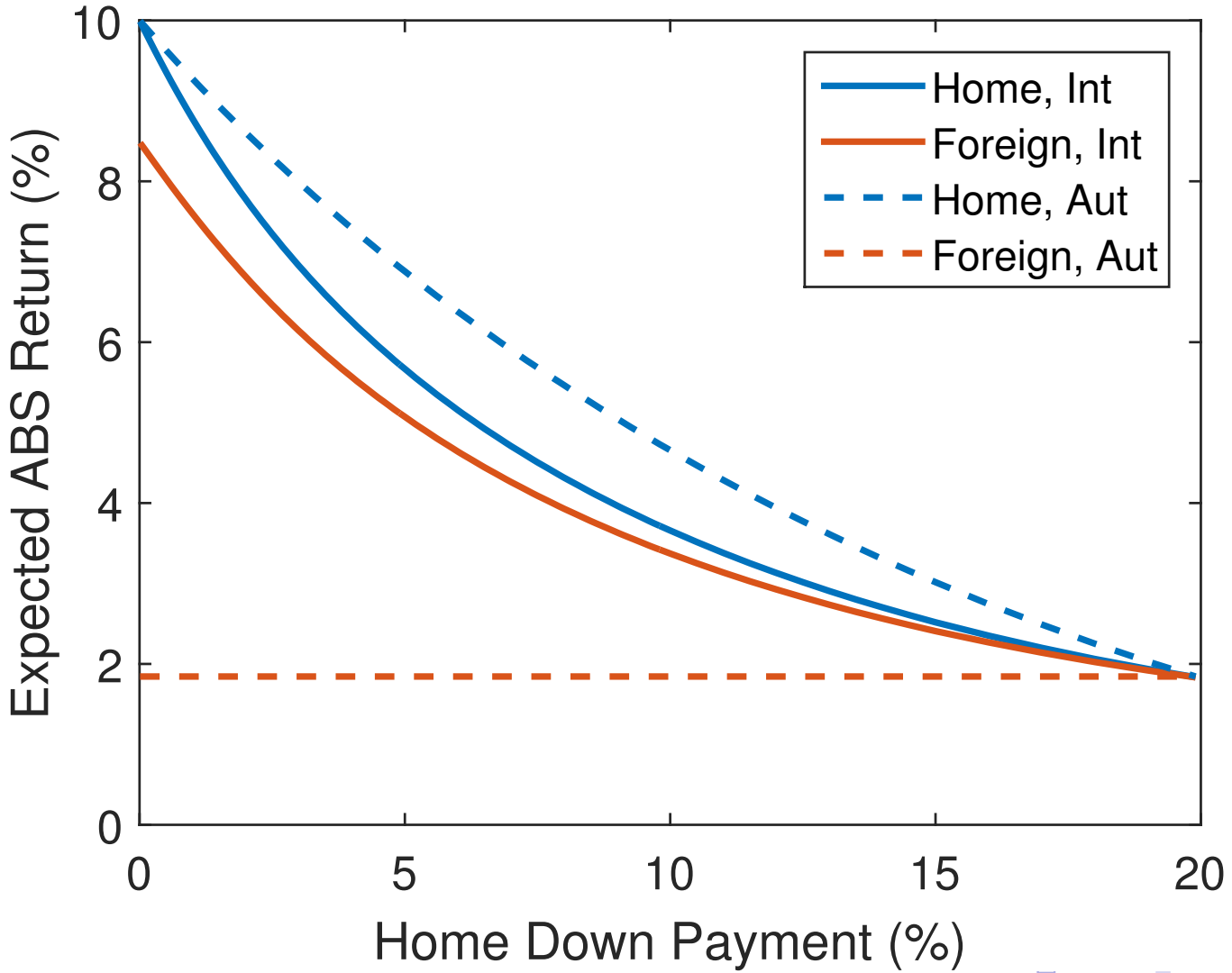
Equilibrium with Financial Integration

First-moment Shocks: Realized ABS Returns



Equilibrium with Financial Integration

First-moment Shocks: Expected ABS Returns



ABS Flows with First-Moment Shocks

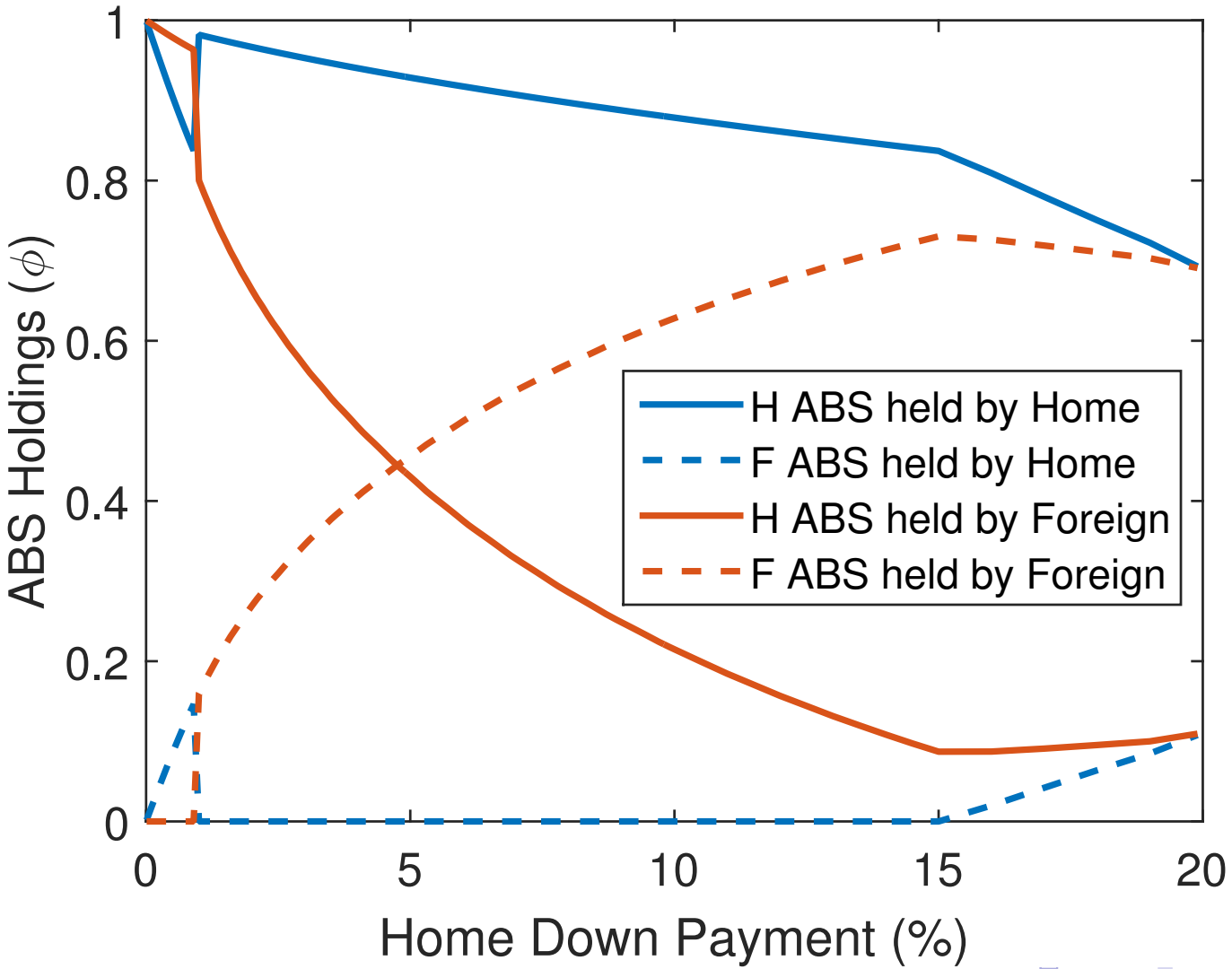
- With aggregate risk Home and Foreign ABS are not identical
  - Home ABS is riskier than Foreign (lower collateral rate)
  - Foreign investors typically hold ABS from both countries (except when they would like to short Foreign ABS)
  - Home investors hold Foreign ABS even though Foreign capital net flows into Home (gross flows)
- Foreign demand is for "safe enough" assets—safer than idiosyncratic investments—not for "safer" assets

Numerical Example: Second-Moment Shocks

- States equiprobable, $p_1 = p_2 = 0.5$
  - $\mu_1 = \mu_2 = 10\%$
  - $\sigma_1 = 10\%$, $\sigma_2 = 30\%$
- Implications for gross flows entirely different
- With second-moment shocks gross flows collapse (no change in net flows)
- Results are robust to size of second-moment shock

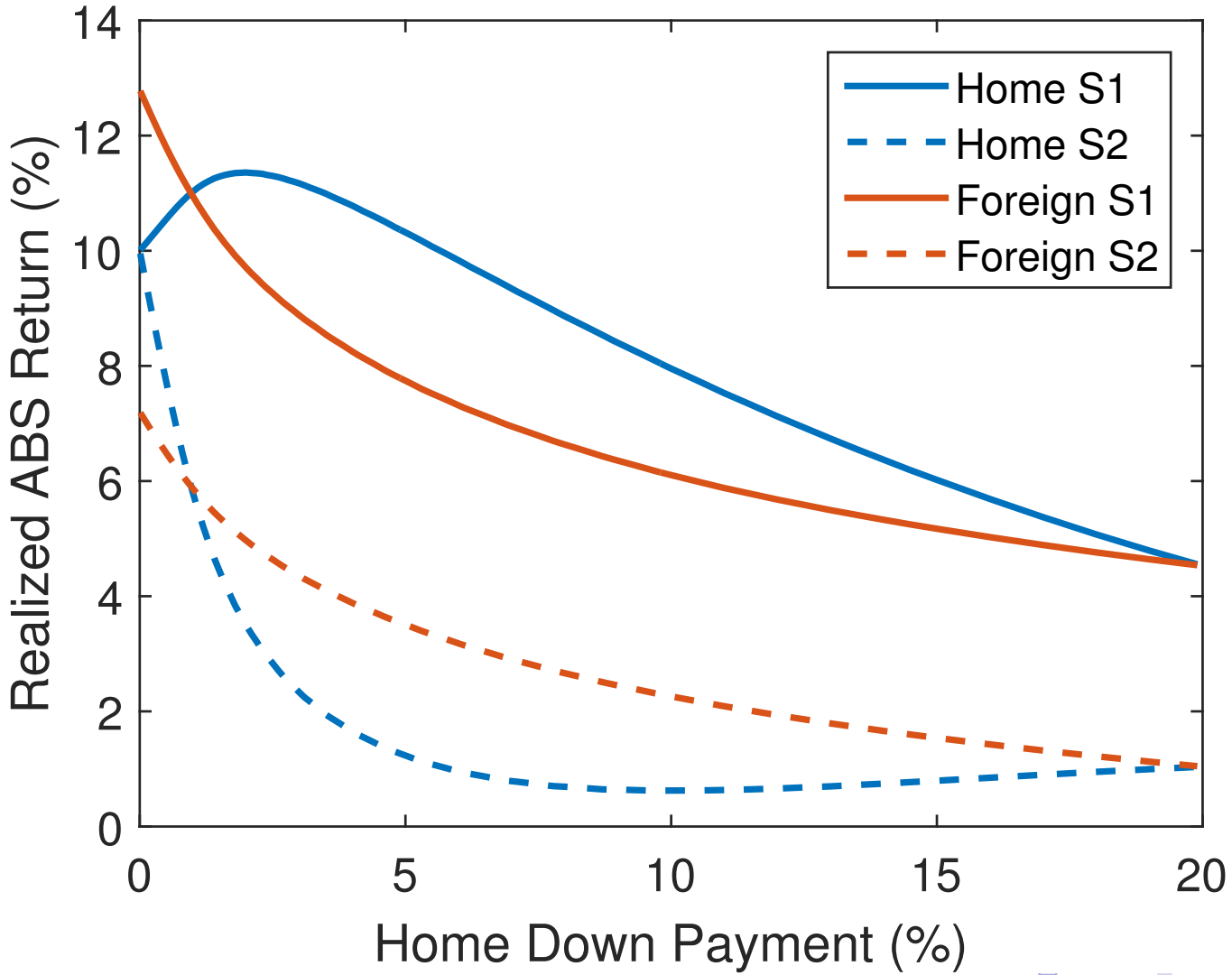
Equilibrium with Financial Integration

Second-moment Shocks: ABS Holdings



Equilibrium with Financial Integration

Second-moment Shocks: Realized ABS Returns



Tranching

- We also consider effects of tranching (splitting ABS into state-contingent payoffs)—meaningful when non-negativity constraint binds
- Tranching yields complete markets for aggregate states $\Longrightarrow$ indeterminate portfolios
- Any degree of home-bias would cause gross flows to be zero
- Very small effects on welfare

Model

- Infinite horizon: $t = 0, 1, \ldots$; productivity A_t^i i.i.d. across agents and time
- To separate portfolio choice (relative risk aversion, RRA) from saving (elasticity of intertemporal substitution, EIS), assume Epstein-Zin preferences:

$$U_t = \left((1-\beta) C_t^{1-1/\varepsilon} + \beta \, \mathrm{E}[U_{t+1}^{1-\gamma}]^{\frac{1-1/\varepsilon}{1-\gamma}} \right)^{\frac{1}{1-1/\varepsilon}}$$

  where γ: RRA, ε: EIS
- Optimal portfolio problem: $\rho = \max \mathrm{E}[R^i(\pi)^{1-\gamma}]^{\frac{1}{1-\gamma}}$, where $R^i(\pi)$: agent i's return on wealth with portfolio π
- Remaining consumption problem is standard (calculus): solution is $C_t = (1 - \beta^\varepsilon \rho^{1-\varepsilon}) W_t$

Stationary Distribution

- If agents are infinitely lived, stationary distribution does not exist because shocks permanent
  $\Longrightarrow$ Assume agents go bankrupt at probability δ each period
- If newborn agents inherit capital, then one country will dominate in the long run because growth rates differ
  $\Longrightarrow$ Assume agents are born with fixed capital and start private businesses, and capital of bankrupted agents wiped out

Stationary Distribution

- Evolution of individual wealth: $W_{i,t+1} = \beta^{\varepsilon}\rho^{1-\varepsilon}R^{i}_{t+1}(\pi)W_{it}$
- Gibrat's law, hence by Toda (JET, 2014), stationary distribution is (approximately) double Pareto
- Power law exponents $-\alpha_1, \alpha_2$ are solutions to

$$\frac{\sigma^2}{2}\zeta^2 - \mu\zeta - \delta = 0,$$

where

$$\mu = \log(\beta^{\varepsilon}\rho^{1-\varepsilon}) + \mathrm{E}[\log R^{i}(\pi)],$$
$$\sigma^2 = \mathrm{Var}[\log R^{i}(\pi)]$$

- Steady state aggregate wealth: $W = \frac{\delta}{1-(1-\delta)\beta^{\varepsilon}\rho^{1-\varepsilon}\,\mathrm{E}[R^{i}(\pi)]}W_0$

Equilibrium and Properties

Proposition

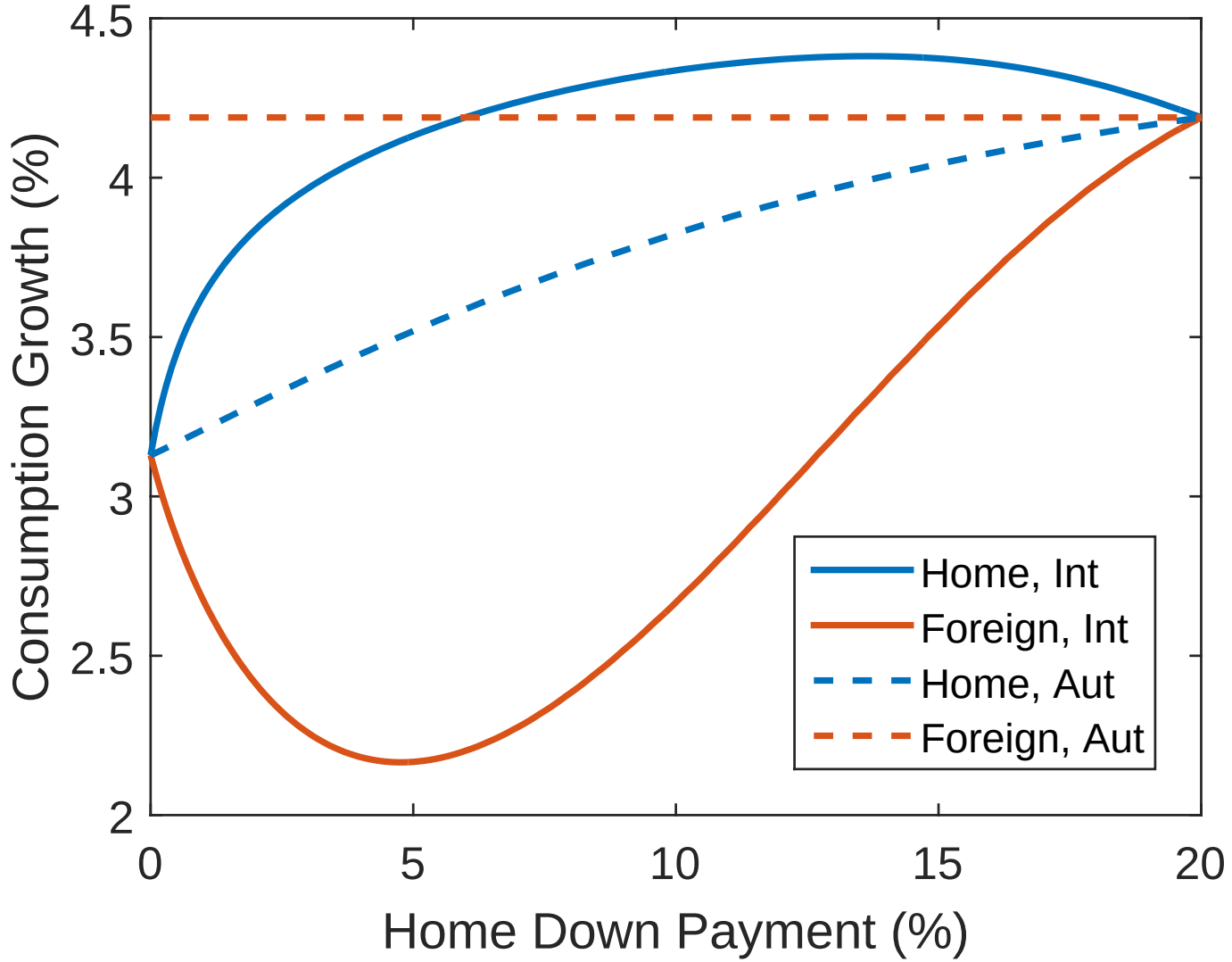
Suppose that $\varepsilon \leq 1$. If a country faces a higher risk-free rate after financial integration, then the growth rate of individual wealth goes down and the steady state capital stock becomes lower than autarky.

- Foreign will typically experience a slower economic growth

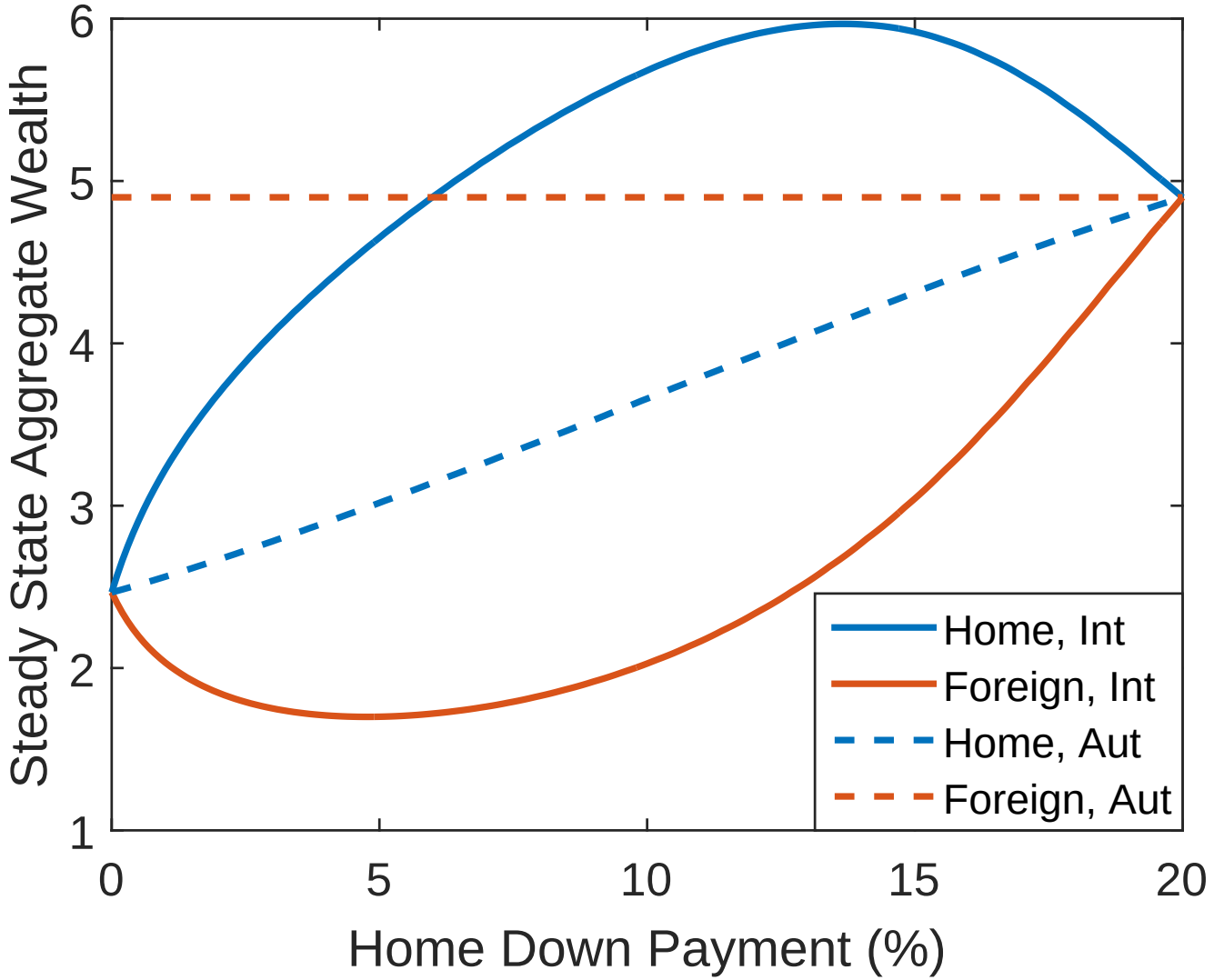
Numerical Example: Growth and Inequality

- No aggregate risk, same parameters as before
- We set $\varepsilon = 0.7$, $\beta = 0.95$, and $\delta = 0.05$
  (average lifetime of private business $1/0.05 = 20$ years)

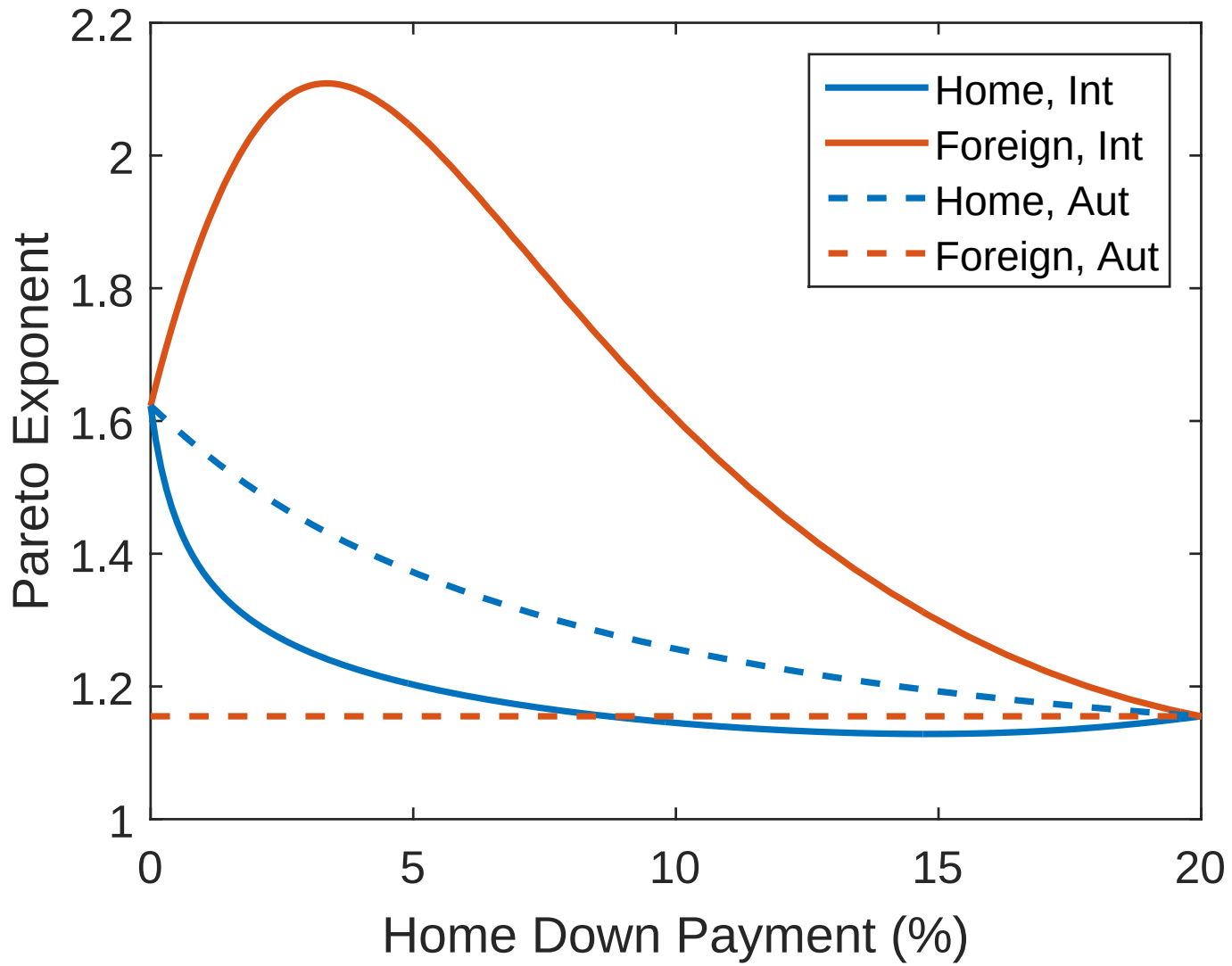
Wealth Growth of Surviving Agents



Steady State Aggregate Wealth



Power Law Exponents



Conclusion

- Different collateral requirements across countries lead to net international capital flows from high-margin to low-margin country
- Supply of safe assets and degree of risk sharing endogenously depend on financial integration and size of financial flows
- Foreign demand for "safe-enough" assets—Home doesn't produce safer assets
- Gross flows depend on nature of aggregate shocks
- Financial integration has asymmetric effects on welfare, benefiting high-margin country