# Corporate Finance with Asset Demand


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## Motivation

- Asset demand fluctuates dramatically over time across firms
- Asset demand affects asset prices, contrary to the "efficient markets"
  - Gabaix and Koijen (2022): \$1 inflow to capital markets ⇒ \$5 value increase

⇒ \$1 inflow to capital markets ⇒ How much do firms change their real investments?

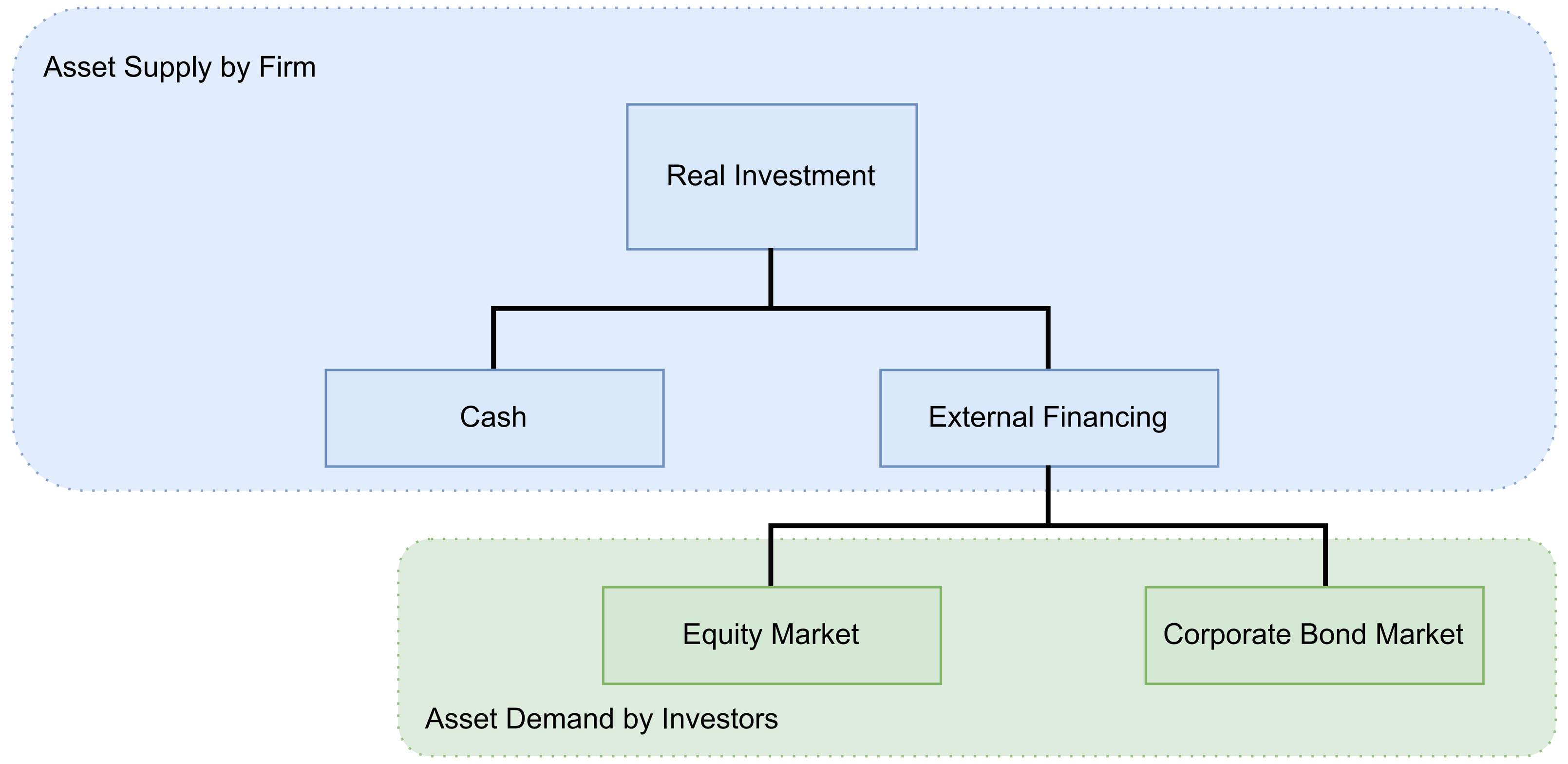
Assume \$1 inflow to the stock market and \$0 inflow to the corporate bond market:

- Demand for the equity of an average firm increases ⇒ the cost of equity decreases
  1. Leverage ratio↓: How much will the leverage be?
  2. Real investment↑: How much will the real investment be?
- Demand shocks differ between firms due to investor preferences ⇒ the cost of equity decreases differently across firms
  1. Leverage ratio↓ more for firms with larger demand shocks
  2. Real investment↑ more for firms with larger demand shocks

## Research Question

How much do firms change their leverage and real investment for the \$1 inflow to the equity and/or corporate bond markets?

## Model Overview




Assume \$1 inflow to the equity market:

1. The price of equity increases by \$5
2. Firm issues new equity or repay corporate bond due to relative cheaper equity
3. Firm accumulates cash due to cheaper external financing costs
4. Firm increases real investment due to lower marginal cost of financing

The model combines the dynamic investment model and the demand system asset price model.

- Supply side: dynamic investment model in Hennessy and Whited (2007)
- Demand side: demand system asset price model in Koijen and Yogo (2019)

## Model

Supply side:

- Bellman equation for the firm

$$V(K,C,z,\epsilon;a,\Gamma)=\max_{\{\Delta s,E,D,I,C'\}}\underbrace{(1-\tau_d)\,D}_{\text{Dividend at current period}}+\underbrace{\frac{1}{1+\Delta s}}_{\text{Equity dilution}}\mathbb{E}_{z,\epsilon,a}\left[\underbrace{m\,(a,a')}_{\text{SDF}}\underbrace{V\,(K',C',z',\epsilon';a',\Gamma')}_{\text{Value at next period}}\right]$$

- Current dividend of the firm

$$\underbrace{I_t+\kappa\frac{I_t^2}{K_t}}_{\text{Marginal cost of real investment}}=\underbrace{(1-\tau_c)\,a_t^{\zeta_n}z_{n,t}K_t^{\alpha}}_{\text{Production}}+\underbrace{\delta\tau_c K_t}_{\text{Tax depreciation allowances}}+\underbrace{C_t\left[1+r\,(1-\tau_c)\right]}_{\text{Current cash}}-\underbrace{Int_t(1-\tau_c)}_{\text{Interest payment}}-\underbrace{C_{t+1}}_{\text{Cash for next period}}+\underbrace{(F_t-\Psi(F_t)-\tilde{B}_t-D_t)}_{\text{External financing after costs}}$$

Demand side:

- Portfolio weights of equity investor $i$ on firm $n$'s equity

$$\frac{w_{i,t}(n)}{w_{i,t}(0)}=\exp\left[b_{i,t}+\beta_{0,i,t}me_t(n)+\beta_{1,i,t}x_t(n)\right]\cdot\epsilon_{i,t}(n)$$

⇒ Equilibrium equity price:

$$\underbrace{\boldsymbol{P_t}}_{\text{Equity price}}=\boldsymbol{P}(\underbrace{\boldsymbol{s_t}}_{\text{Shares outstanding}},\underbrace{\boldsymbol{A_t}}_{\text{AUM}},\underbrace{\boldsymbol{x_t}}_{\text{Firm's characteristics}},\boldsymbol{\beta_t},\boldsymbol{\epsilon_t})$$

- Portfolio weights of bond investor $i$ on firm $n$'s corporate bond

$$\frac{w_{i,t}(n)}{w_{i,t}(0)}=\exp\left[b_{i,t}+\beta_{0,i,t}y_t(n)+\beta_{1,i,t}x_t(n)\right]\cdot\epsilon_{i,t}(n)$$

⇒ Equilibrium bond yield:

$$\underbrace{\boldsymbol{Y_t}}_{\text{Bond price}}=\boldsymbol{Y}(\underbrace{\boldsymbol{d_t}}_{\text{Bond outstanding}},\underbrace{\boldsymbol{A_t}}_{\text{AUM}},\underbrace{\boldsymbol{x_t}}_{\text{Firm's characteristics}},\boldsymbol{\beta_t},\boldsymbol{\epsilon_t})$$

- Equity vs. corporate bond

$$\underbrace{F_t^E(n)}_{\text{Equity financing}}=\underbrace{F_t(n)}_{\text{Total external financing}}\times\frac{\exp[\widehat{Y_t^*(n)}]}{\exp[\widehat{Y_t^*(n)}]+\exp[\underbrace{Y_t^*(n)}_{\text{Equilibrium bond yield}}]}$$

where $\widehat{Y_t^*(n)}$ is the equivalent bond yield for equilibrium equity price $P_t^*(n)$ as in Chen et al. (2023).

Markov-perfect Nash Equilibrium (MPNE):

- For the above setting, assume
  1. $\exists i,\beta_{0,i,t}<1\forall n$ in equity demand
  2. $\exists j,\beta_{0,j,t}>0\forall n$ in corporate bond demand
  3. Firm-specific TFP $z_{n,t}$ is private information and the distribution $\log z_{n,t+1}\sim\mathcal{N}(\rho_z\log z_{n,t},\sigma_z^2)$ is common knowledge.

⇒ There exists a pure strategy $\sigma(n):(s,\epsilon(n))\to I(n)$ in equilibrium.

## Data

- Firm level data: Compustat
- Equity prices and holdings: CRSP and Factset Ownership v5
- Bond prices and holdings: WRDS Bond Return, Mergent, Datastream and eMAXX

- Sample: 1999Q1 – 2021Q4
- Only firms with equity and bond data
- Exclude financial firms

## Estimation

Supply side:

- Simulated Method of Moments
  1. Simulation
     - Create a grid of parameters
     - For each pair of parameter values, compute the competitive equilibrium
  2. Estimation
     - Find the parameter values that minimize the distance between the simulation moments and the data moments

Demand side:

- Instruments in equity demand estimation
  - Instrument for $me_t(n)$: $\widehat{me_t(n)}=\log[\sum_{j\neq i}A_{j,t}\frac{1_j(n)}{1+\sum_{m=1}^N 1_j(m)}]$
  - Instrument for $x_t(n)$: $\widehat{\varepsilon_t(n)}$

$$x_t(n)=\alpha_0+\alpha_1\times mb_t(n)+\alpha_2\times y_t(n)+\varepsilon_t(n)$$

- Instruments in bond demand estimation
  - Instrument for $y_t(n)$: $\widehat{y_t(n)}=\log[\sum_{k\neq j}A_{k,t}\frac{1_k(n)}{1+\sum_{m=1}^N 1_k(m)}]$
  - Instrument for $x_t(n)$: the same $\widehat{\varepsilon_t(n)}$

## Application (Work in progress)

How much is the impact of sustainable investing on firm's leverage and real investment?

1. Quantify the flows to ESG assets
   - Classify ESG stocks
     - Identify ESG equity mutual funds by their names
     - Calculate over-weighted stocks by these ESG mutual funds
     - ESG stocks are those over-weighted stocks
   - Calculate total institutional flows to ESG stocks
     - Compute the degree of following ESG mutual funds

$$w_{i,t}(n)=\theta_{i,t}^{ESG}w_t^{ESG}(n)+\sum_{s\in S}\theta_{i,t}^{s}w_t^{s}(n)+\eta_{i,t}(n)$$

     - Compute flow to ESG stocks by all institutions

$$F_{t+1}^{ESG}=\sum_i[\theta_{i,t}^{ESG}A_{i,t}-\theta_{i,t-1}^{ESG}A_{i,t-1}(1+R_{t+1}^{ESG})]$$

   - Similar calculation for flows to ESG bonds
2. Compute counterfactual
   - Compute the new equilibrium firm investment if $F_{t+1}^{ESG}$ is invested to general mutual fund portfolios
3. The impact is the difference between the counterfactual and the actual