Long-Term Finance and Investment with Frictional Asset Markets

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Why firms in emerging countries borrow short-term?

- **Fact:** Firms in emerging countries tend to borrow at shorter maturities
  - Long-term finance $\rightarrow$ investment at long horizons, high return projects...
  - ...but it is more costly $\rightarrow$ upward slopping credit spread yield curve

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- **Novel ingredient:** Corporate debt trade in decentralized asset markets
  - OTC market $\rightarrow$ costly to trade
  - Both in advanced and emerging economies
  - Frictions are more severe in emerging countries

Why firms in emerging countries borrow short-term?

- **Credit spreads**

$$\text{Credit spread} = \text{Default} + \text{Liquidity}$$

- **US: Liquidity component**
  - Between 65 and 130 basis points
  - Account to 15 to 50% of total credit spread

Source: Longstaff Mithal Neis '05, Krishnamurthy Vissing-Jorgensen '12, He Milbradt '14.

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- **Emerging economies: Trading frictions are more severe**
  - Hard to measure due to data limitations (need to control for default)
  - Empirical evidence based on credit spreads in the quantitative analysis

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- **Active policy debate:** How to stimulate access to long-term finance?

Main results

1. **Theory**
   - Credit spread yield curve

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- Measure liquidity spread yield curve in advanced and emerging economies
- Trading frictions explain 50% of maturity differences between US and ARG

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3. Policy implications

- Intervention: Government-Sponsored Intermediaries
- Effective to increase liquidity, maturity and welfare

Contribution to the literature

1. **Maturity choice**
   - Diamond (1991); Leland Toft (1996)
   - Contractual frictions between lenders and borrowers
   - **New:** Frictions within lenders in financial markets

2. **Finance & development**
   - Buera Kabobski Shin (2011); Moll (2014); Midrigan Xu (2014); Cole Greenwood Sanchez (2016)
   - Frictions between lenders and borrowers
   - **New:** Frictions within lenders & maturity

3. **Finance & trading frictions**
   - Duffie Gârleanu Pedersen (2005)
   - **Corporate bonds:** He Milbradt (2014); Chen Cui He Milbradt (2017)
   - **Primary & secondary markets:** Bruche Segura (2017); Arseneau Rappoport Vardoulakis (2017)
   - **Term premium:** Gürkaynak Wright (2012); Geromichalos Herrenbrueck Salyer (2016)
   - **New:** Liquidity-Maturity interactions, production & development

Environment

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- Continuous time, infinite horizon

Agents

- **Production sector:** Borrowers
- **Financial sector:** Lenders

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- Borrow from financial sector

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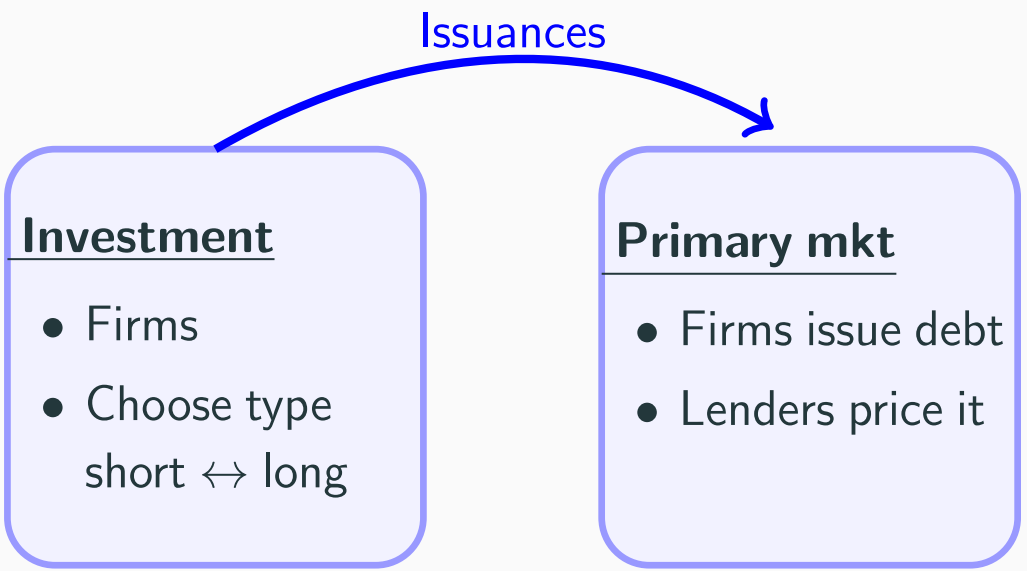
- **Primary market**
  - Borrowers issue bonds to lenders
- **Secondary market**
  - Shocks to private valuations generate motives for trade
  - Decentralized OTC secondary market, endogenous liquidity

Investment

- Firms
- Choose type
  short $\leftrightarrow$ long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Investment
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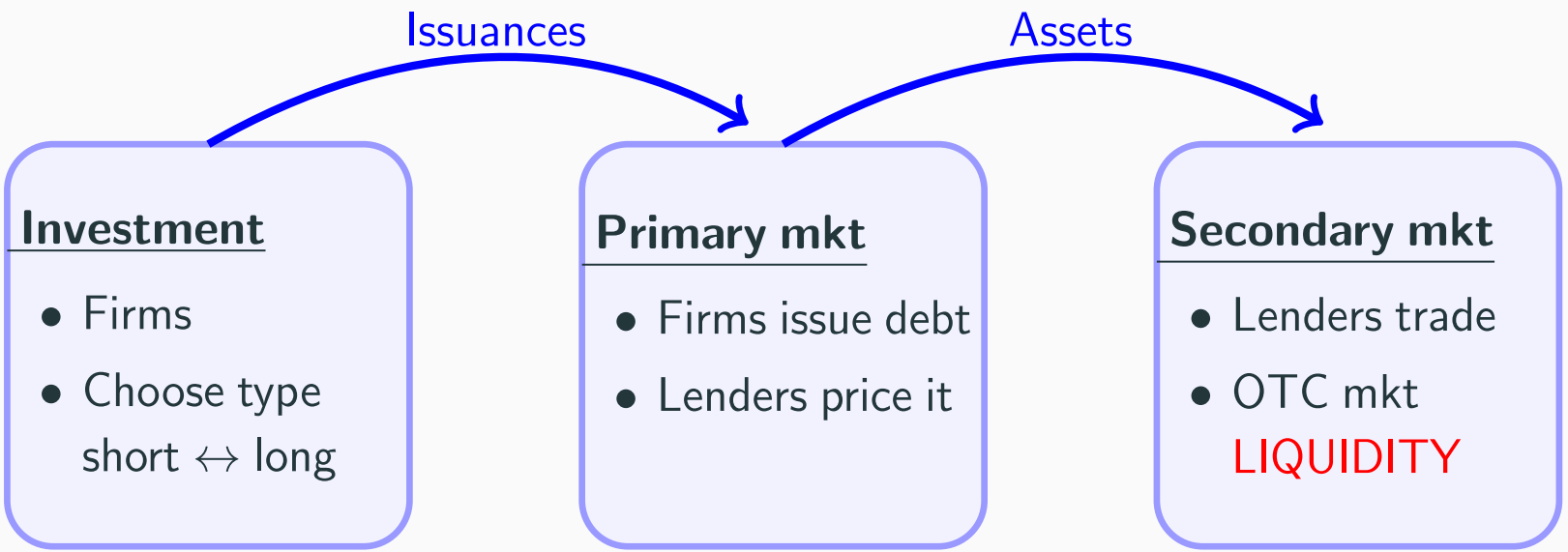
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• OTC mkt
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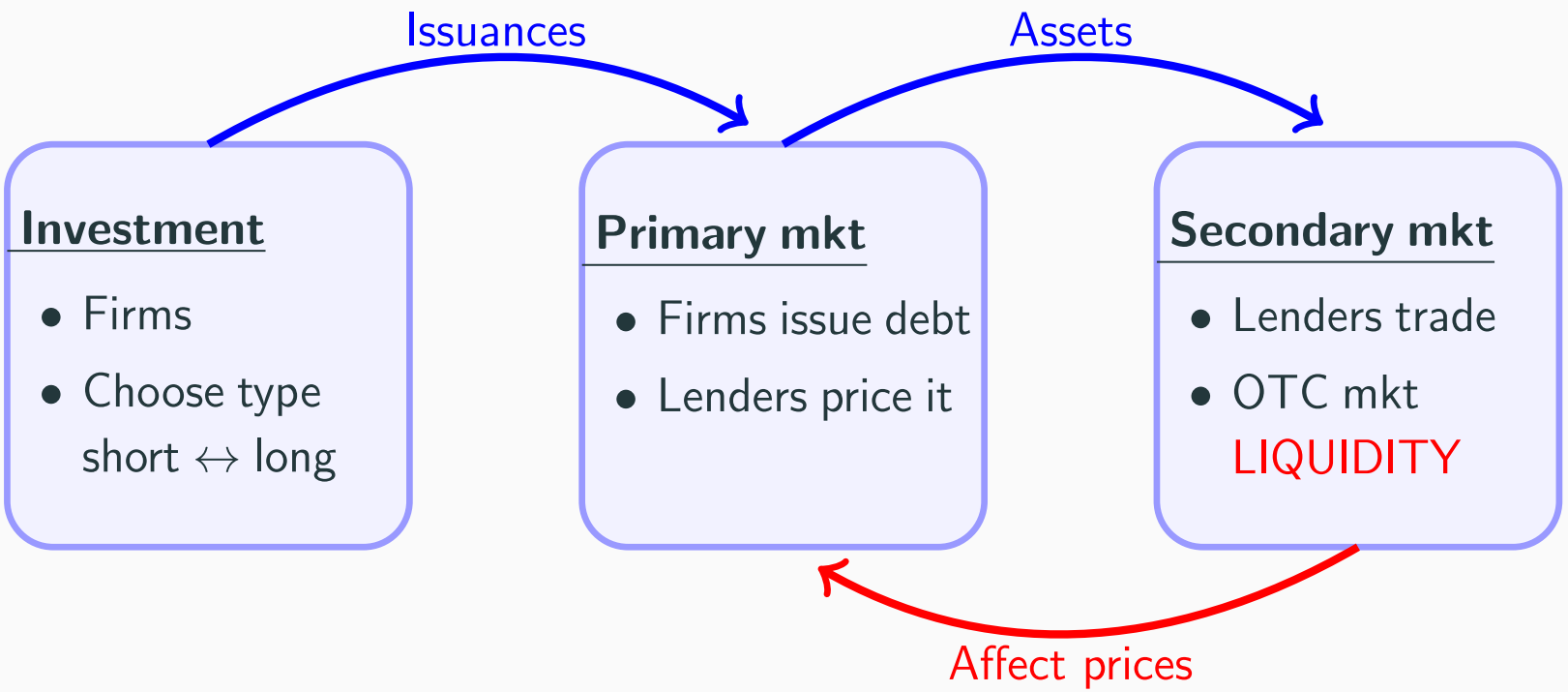
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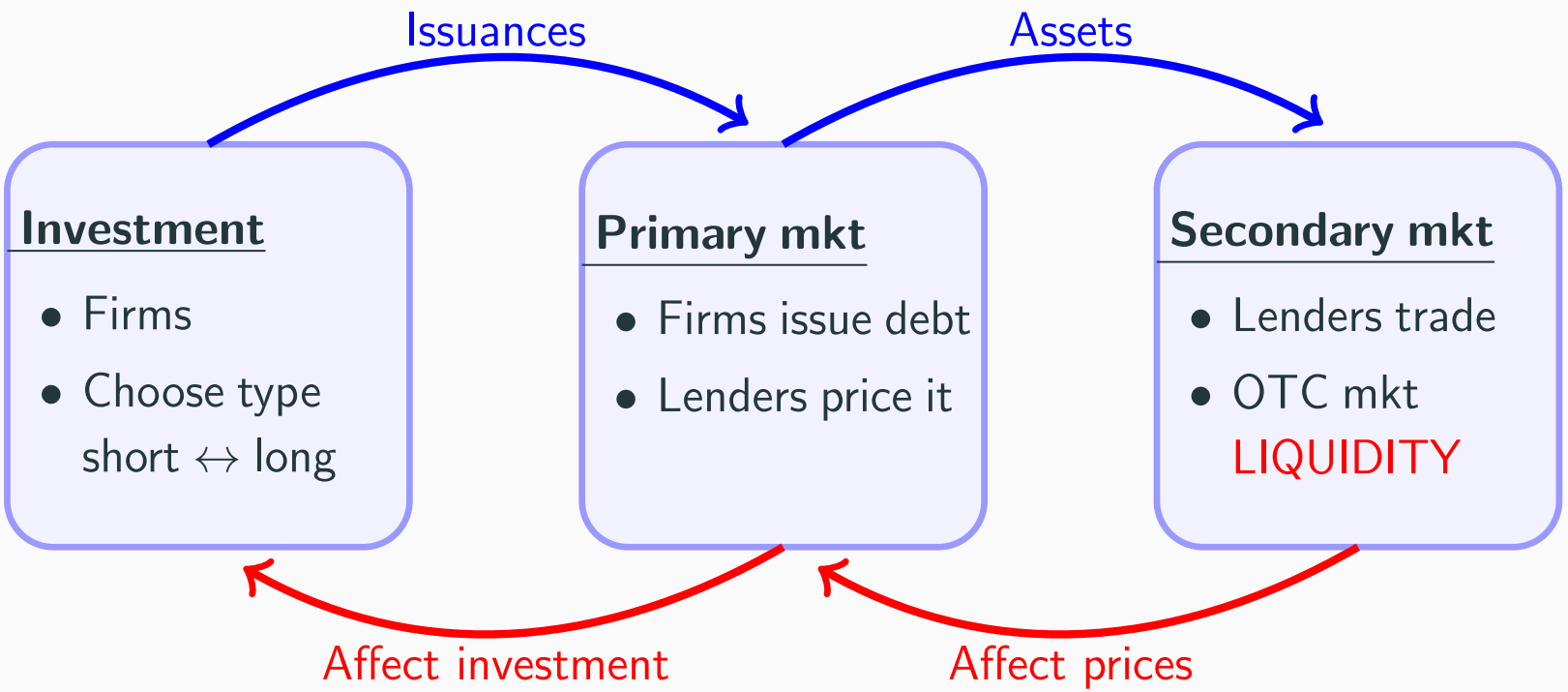
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Production sector

- **Projects**
  - Menu of back-loaded investment projects, indexed by maturity $\tau \geq 0$
  - Return at maturity $F(\tau) = A\tau$
  - Investment cost $I(\tau) = \kappa \frac{1-e^{-\rho\tau}}{\rho}$
  - Paper: Microfoundations for F and $I \rightarrow$ Guidance on quantitative analysis
  - Aggregate output: $Y \propto \tau$

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  - Interpretation: Rely on short-term debt is costly or risky
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$$\max_{\tau, B} e^{-\rho\tau} \left(F(\tau) - B\right)$$

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How does $P(\tau, \lambda)$ affect maturity choices?

Primary market

- **Free entry to primary market**
  - $P(\tau, \lambda)$: Price in primary market of bond with maturity τ for liquidity λ
  - Large mass of potential enters, no frictions
  - $D^H(\tau, \lambda)$ lenders' value of holding the asset
  - Free entry condition

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- *How does the friction in the secondary market affect valuations D^H?*

Secondary market

Securities

- Maturity at issuance τ, bonds with residual maturity $y \in [0, \tau]$
- Face value 1, analysis with default in the paper

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Agents

- With an asset
  - High valuation: With intensity η becomes low valuation (absorbing state)
  - Low valuation: Pay holding cost $h \rightarrow$ sellers in secondary market
  - Heterogeneous agents $\left[\mu^H(y;\lambda,\tau), \mu^L(y;\lambda,\tau)\right]$ for $y \leq \tau$

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Random matching

- Market tightness $\theta = \frac{\text{sellers}}{\text{buyers}}$
- $\lambda(\theta) = \theta^{\alpha-1}$ Intensity a seller finds a buyer
- $\beta(\theta) = \theta^{\alpha}$ Intensity a buyer finds a seller

} **Liquidity:** λ

- Nash bargaining: γ bargaining power of seller

Equilibrium

- Price schedules in primary and secondary markets $\left(P(y,\lambda), P^S(y,\lambda)\right)$, high and low valuations $\left(D^H(y,\lambda), D^L(y,\lambda)\right)$, distributions of agents in the financial sector $\left(\mu^L(y;\lambda,\tau), \mu^H(y;\lambda,\tau)\right)$, maturity τ, and liquidity λ such that:

1. **Production sector (borrowers)**
   - Choose maturity taking the price schedule $P(y,\lambda)$ as given

2. **Financial sector (lenders)**
   - Nash bargaining $\rightarrow P^S(y,\lambda)$
   - Free entry in primary markets $\rightarrow P(\tau,\lambda)$
   - Free entry in secondary market $\rightarrow \left\{\lambda, \mu^L(y;\lambda,\tau), \mu^H(y;\lambda,\tau)\right\}$

Valuations

- **High valuation**

$$\rho D^H(y;\lambda) = \eta\left(D^L(y;\lambda) - D^H(y;\lambda)\right) - \frac{\partial D^H(y;\lambda)}{\partial y}$$

- **Low valuation**

$$\rho D^L(y;\lambda) = -h + \lambda\gamma\left(D^H(y;\lambda) - D^L(y;\lambda)\right) - \frac{\partial D^L(y;\lambda)}{\partial y}$$

- **Maturity**

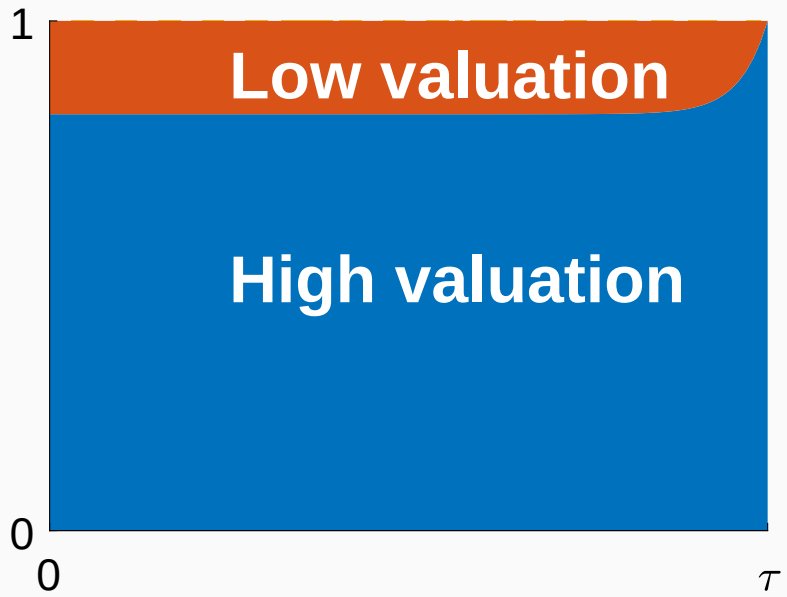
$$D^H(0,\lambda) = D^L(0,\lambda) = 1$$

- **High valuation**

$$\mu^H(y;\lambda,\tau) = \frac{\eta}{\eta+\lambda}\left(\frac{\lambda}{\eta} + e^{(\eta+\lambda)(y-\tau)}\right)$$

- **Low valuation**

$$\mu^L(y;\lambda,\tau) = \frac{\eta}{\eta+\lambda}\left(1 - e^{(\eta+\lambda)(y-\tau)}\right)$$



1. How does liquidity affect...
   - prices in primary market?
   - credit spreads?
   - maturity choices?

2. Equilibrium liquidity & maturity

How does liquidity affect prices?

- **Price in primary market**

$$P(\tau, \lambda) = \underbrace{e^{-\rho\tau}}_{\text{Expectation hypothesis}} - \underbrace{\mathcal{L}(\tau, \lambda)}_{\text{Illiquidity cost}}$$

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  - No secondary market: Intensity η pays h between shock and maturity
  - Secondary market: Intensity λ recovers γ of gains from trade

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$$\mathcal{L}(\tau,\lambda) = h \int_0^\tau e^{-\rho y} s^L(y)\,dy$$

  - $[s^H(y), s^L(y)]$: Adjusted probability of security y held by high/low valuation

$$\dot{s}^H = -\eta s^H + \lambda\gamma s^L \qquad s^H(0) = 1$$
$$\dot{s}^L = \eta s^H - \lambda\gamma s^L \qquad s^L(0) = 0$$

Illiquidity cost $\mathcal{L}(\tau, \lambda)$

1. Increasing in maturity: $\frac{\partial \mathcal{L}(\tau,\lambda)}{\partial \tau} \geq 0$

Liquidity & Asset prices

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2. Decreasing in liquidity: $\frac{\partial \mathcal{L}(\tau,\lambda)}{\partial \lambda} \leq 0$

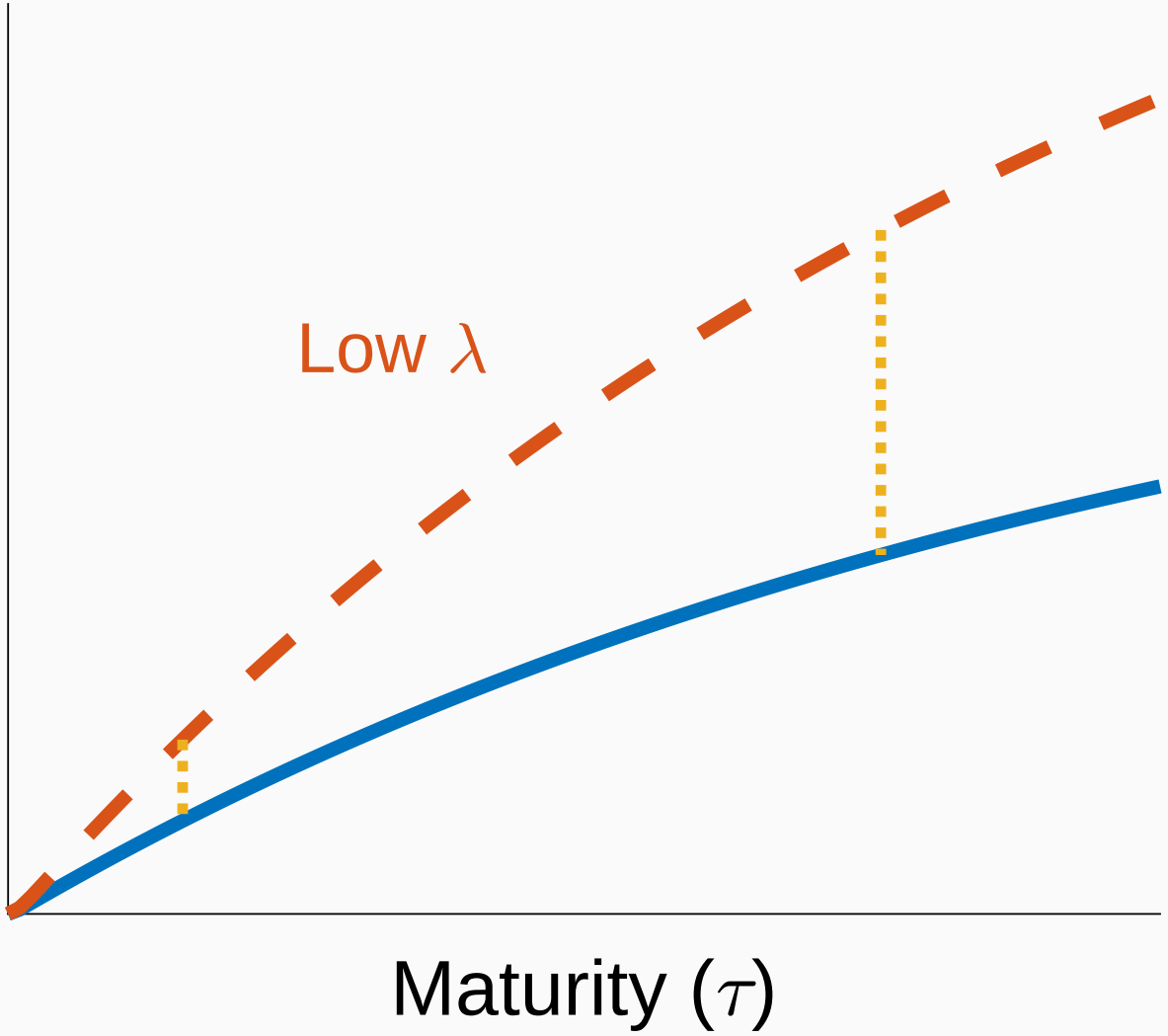
Liquidity & Asset prices

Illiquidity cost $\mathcal{L}(\tau, \lambda)$

1. Increasing in maturity: $\frac{\partial \mathcal{L}(\tau,\lambda)}{\partial \tau} \geq 0$
2. Decreasing in liquidity: $\frac{\partial \mathcal{L}(\tau,\lambda)}{\partial \lambda} \leq 0$
3. Liquidity is more important for long-term assets: $\frac{\partial^2 \mathcal{L}(\tau,\lambda)}{\partial \tau \lambda} \leq 0$

Key result for long-term finance

Illiquidity cost



Liquidity is more important for long-term assets

Credit spreads: Default & liquidity

- Introduce default
  - Poisson arrival rate $\delta \rightarrow$ default
  - Value zero after default

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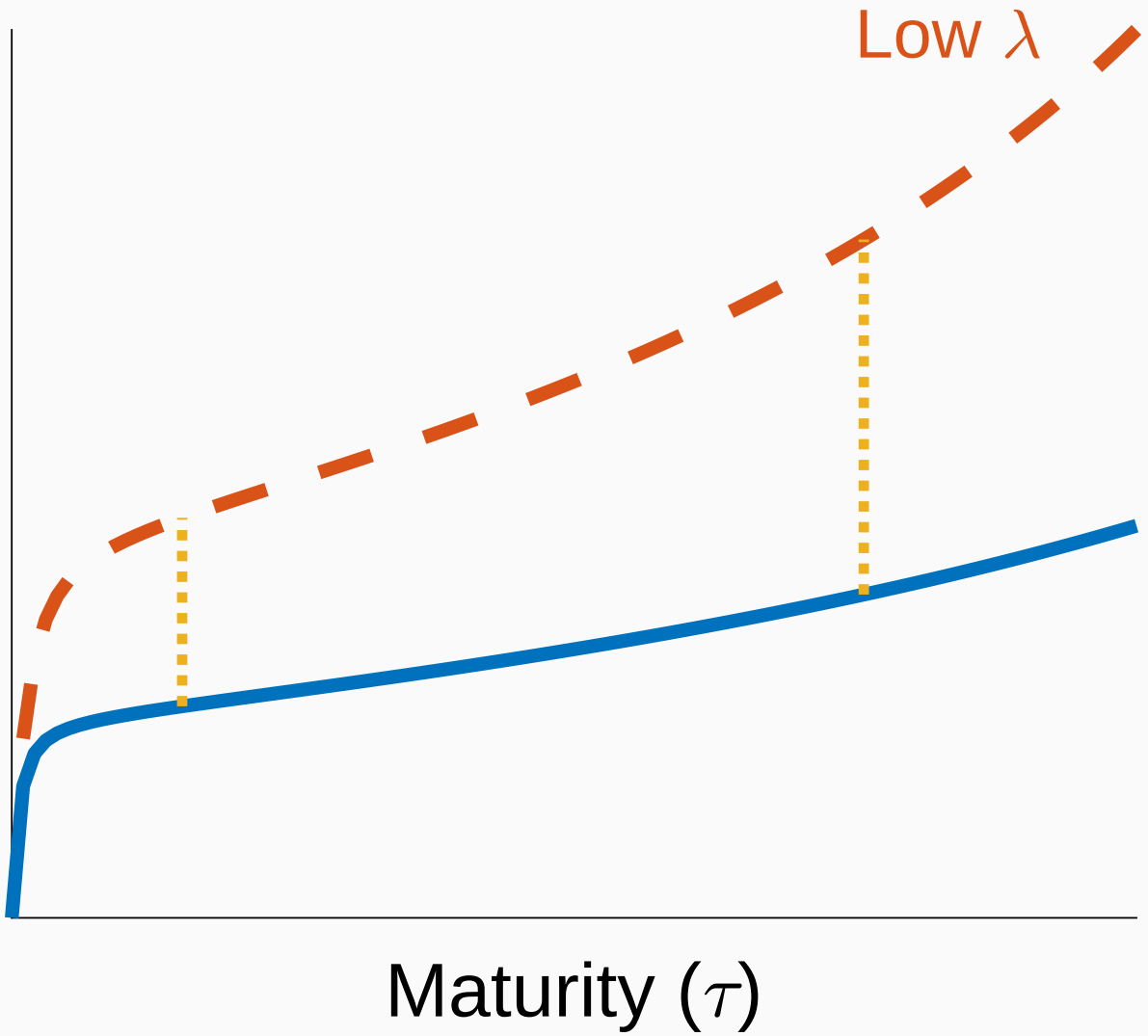
- Interest rate: $P(\tau, \lambda) = e^{-r(\tau,\lambda)\tau}$

$$r(\tau, \lambda) = \underbrace{\rho}_{\text{Risk-free rate}} + \underbrace{\delta}_{\text{Default spread}} + \underbrace{\text{cs}^{liq}(\tau, \lambda)}_{\text{Liquidity spread}}$$

$$\text{cs}^{liq}(\tau, \lambda) = \frac{-\log\left(1 - e^{(\rho+\delta)\tau}\mathcal{L}(\tau, \lambda)\right)}{\tau}$$

- Credit spread yield curve
  - Variations of credit spreads across maturities $\rightarrow$ liquidity spread

Credit spread yield curve



Liquidity & maturity choices

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$$\frac{\partial F(\tau)}{\partial \tau} = \rho F(\tau) + e^{r(\tau,\lambda)\tau} \frac{\partial I(\tau)}{\partial \tau} + \underbrace{e^{r(\tau,\lambda)\tau} I(\tau)\, \mathrm{cs}^{\mathrm{liq}}(\tau,\lambda)\left(1+\epsilon_{\mathrm{cs}^{\mathrm{liq}}}(\tau,\lambda)\right)}_{\text{Financial cost}}$$

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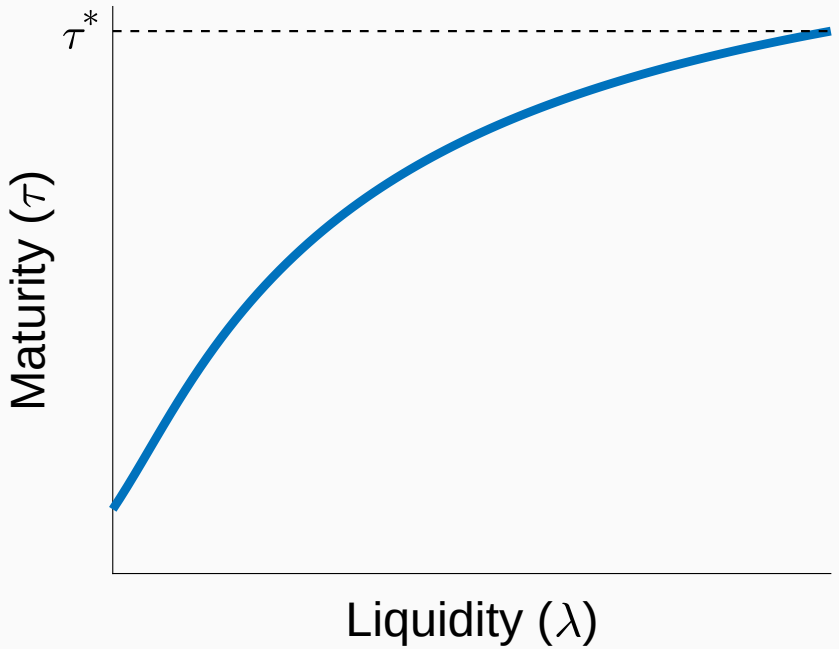
Maturity

Maturity is increasing in liquidity
$\frac{\partial \tau(\lambda)}{\partial \lambda} \geq 0$

$\uparrow \lambda \rightarrow$ Cheap long-term finance $\rightarrow \uparrow \tau$



What determines liquidity?

Equilibrium liquidity: How does maturity affect liquidity?

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- Free entry in secondary markets

$$c = \beta(1-\gamma)\int_0^\tau \frac{\mu^L(y)}{\int_0^\tau \mu^L(y)}\Big(D^H(y;\lambda) - D^L(y;\lambda)\Big)\,dy$$

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- Equilibrium: $\lambda(\tau) : \mathbb{R}_+ \mapsto [0, \overline{\lambda}]$. $\lambda(\tau)$ is increasing in maturity

  $\uparrow$ maturity $\rightarrow \uparrow$ gains from trade $\rightarrow \uparrow$ entry

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Equilibrium liquidity: How does maturity affect liquidity?

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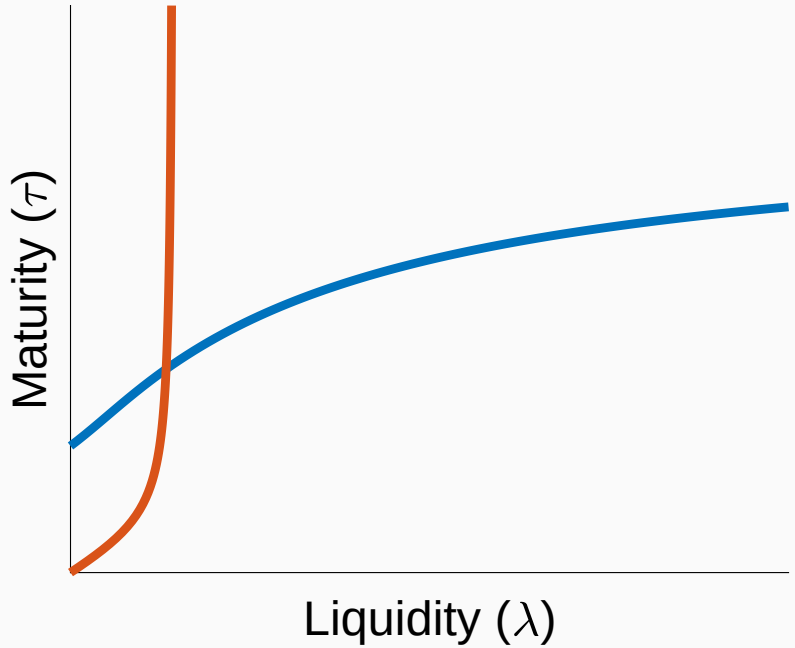

Financial development

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Interpretations

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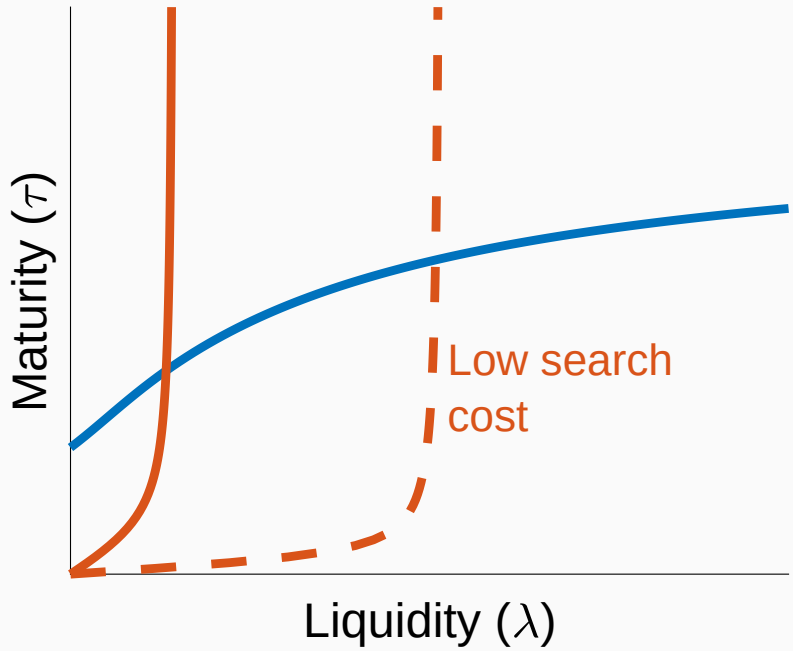
- **Model:** Low search cost c

Interpretations



Financial Development

Low search cost $c \rightarrow \uparrow \lambda \rightarrow$ flatten yield curve $\rightarrow \uparrow \tau$

Theory: Lower trading frictions improve long-term finance which induces firms to borrow and invest at longer horizons

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1. **Quantitative analysis**

   How important are trading frictions to understand maturity choices?

2. **Policy implications**

   How can we improve the liquidity of financial markets?

3. **Extensions**

   Rollover, secondary markets segmented by maturity, default

Quantitative analysis

Quantitative analysis

- Assess the importance of trading frictions to understand maturity choices
- Calibrate the model to evaluate policy interventions

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Strategy

1. **Empirical estimate:** non-default credit spread in US and Argentina
   - Exploit variation across maturities
2. **Calibrate:** for the US
   - Validate with additional data for the US
3. **Counterfactual analysis:**
   a. Discipline trading frictions with estimation for US and Argentina
   b. The model predicts 50% of maturity differences

Empirical analysis: Credit spread yield curve

- **Data** Data details
  - US and Argentina
  - Credit spreads of corporate debt issuances
  - Domestic market, local currency, 2017

- **Want:** Separate **default** and **liquidity** components of credit spreads

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- **Credit spreads**
  - $cs_{i,t,k}$: credit spread of firm i, day t, issuance k

$$cs_{i,t,k} = \gamma_i + \beta m_{i,t,k} + \epsilon_{i,t,k}$$

    - Firm fixed effect $\rightarrow$ default component
    - $\beta \rightarrow$ effect of maturity on credit spread

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- **Credit spread differential**
  - Difference in credit spreads conditional on issue of same firm, same day

$$\Delta cs_{i,t,k_1,k_2} = \beta \Delta m_{i,t,k_1,k_2} + \epsilon_{i,t,k_1,k_2}$$

    - Short maturity $\rightarrow$ default component
    - $\beta \rightarrow$ effect of Δ maturity on Δ credit spread

- Note: measure the slope of liquidity spread, not the level

Empirical analysis

	Firm fixed effect		Difference	
	US	Argentina	US	Argentina
Maturity	2.570***	29.68**	2.983***	41.42***
	(0.135)	(12.62)	(0.201)	(3.182)
R-squared	0.419	0.126	0.564	0.833
Observations	598	153	171	35
Number of firms	389	54	93	15

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Median maturities

	All	Matched	
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Regression details

Target moments

- **US:** $\overline{\Delta m} = 5$ years $\rightarrow \Delta cs = 15$ bps
- **Arg:** $\overline{\Delta m} = 1.5$ years $\rightarrow \Delta cs = 62$ bps

Calibration for the US

Parameter		Value	Target/source	Model	Data
Financial sector					
Intensity of liquidity shocks	η	0.58	Turnover rate	0.57	0.57
Search cost	c	0.0002	Increase liquidity	15	15
Holding cost	h	0.17	Expected time to sell	2.00	2.00
Production sector					
$F(\tau) = A\tau$	A	2.55	Maturity	8.08	8.08
$I(\tau) = \kappa\frac{1-e^{-\rho\tau}}{\rho}$	κ	1.00	Normalization		
Matching					
Share of sellers	α	0.50	Normalization		
Bargaininw power of sellers	γ	0.50	Normalization		
Others					
Discount factor	ρ	0.02	He Milbradt (2014)		
Default rate	δ	0.03	Moodys (2015)		

Validation: Level of liquidity spread yield curve

- **Target:** **Slope** of credit spread yield curve
- **Non-target:** its **level**

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- **Non-target:** its **level**
- **Measurement** Assets with same cash flow but different liquidity
  - Liquid asset: Treasuries
  - Illiquid asset: Corporate bonds (high quality market, rated above A)

  $\rightarrow$ Abstract from default

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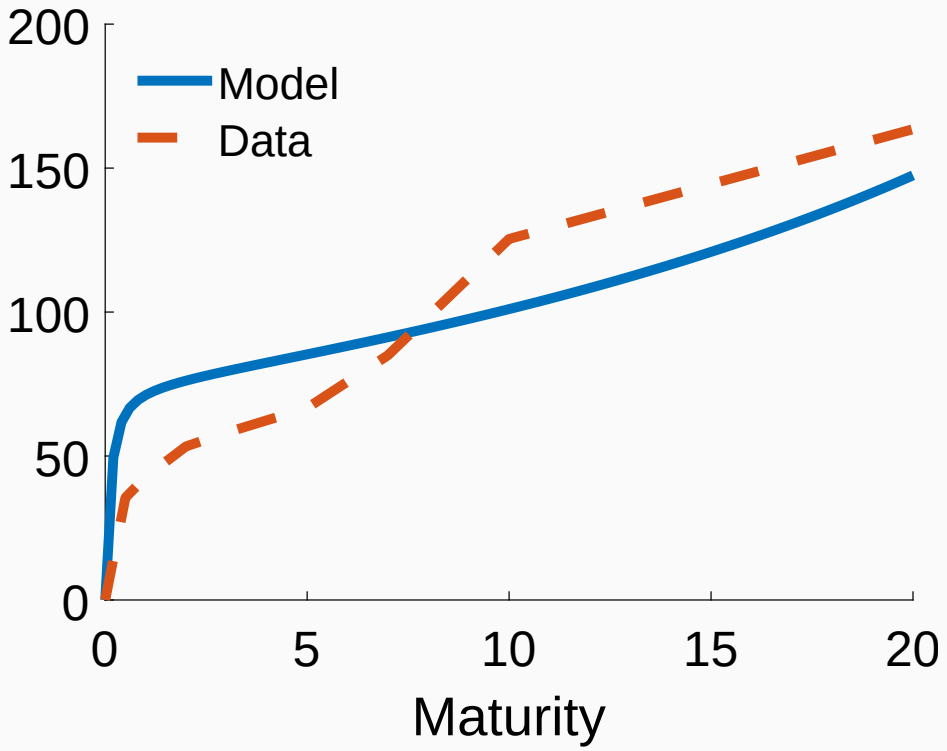

Additional evidence

Counterfactual: Assessing the effect of trading frictions

Counterfactual strategy

- Trading frictions $\rightarrow$ variations in search cost c
- $\Delta c \rightarrow$ match slope of liquidity spread yield curve in Argentina
  $cs^{liq}(3) - cs^{liq}(1.5) = 62$ bps
- Other parameters as in US
  What are the effects of bringing the trading frictions of Argentina to US?

Counterfactual: Assessing the effect of trading frictions

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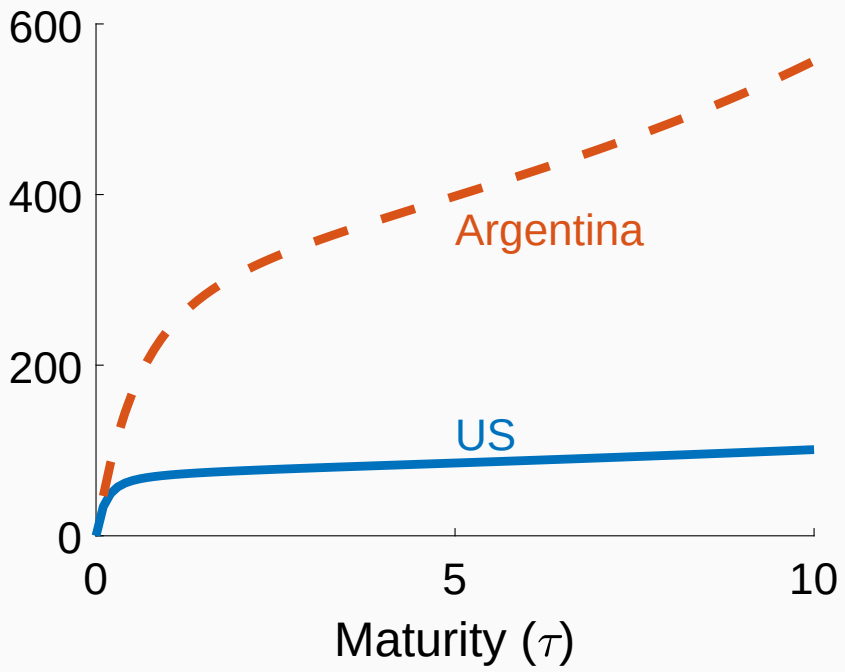

Counterfactual: Assessing the effect of trading frictions

	US		Argentina	
	Data	Model	Data	Model
Liquidity (bps)				
Slope liquidity	15	15		
Liquidity spread (τ)	125	95		
Maturity (years)	8.1	8.1		
Output	1.0	1.0		

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	Data	Model	Data	Model
Liquidity (bps)				
Slope liquidity	15	15	62	62
Liquidity spread (τ)	125	95		405
Maturity (years)	8.1	8.1	2.0	5.2
Output	1.0	1.0	0.4	0.7

- Trading frictions explain one-half of maturity and output differences
- Liquidity $\rightarrow$ Credit spreads $\rightarrow$ Investment & productivity $\rightarrow$ Output

Quantitative analysis

- Stylized model captures important features of corporate debt markets
- Trading frictions are quantitatively important for maturity choices

Robustness

- Alternative production technologies
  - Introduce labor demand
- Alternative measure of liquidity
  - Net interest margin
  - More countries
  - Counterfactual flat liquidity spread

Policy analysis

How can we improve the liquidity of financial markets?

Propose policy such that

1. Improve liquidity of secondary markets

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1. Improve liquidity of secondary markets
2. Lower bound on the effects of an intervention
    - Cannot eliminate search frictions or holding costs
    - Face same constraints as private agents
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   - Government-sponsored enterprises (GSEs)
   - Large-scale asset purchases (QEs)
   - Priority sector lending (India)

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Government-sponsored intermediaries (GSIs)

- Government institution to improve credit to corporate sector
- Act as intermediaries in secondary markets
- **Key:** Increase equilibrium liquidity by giving more gains from trade to private agents in bilateral meetings

GSIs: Instruments

Optimal policy

- Steady state welfare + equilibrium conditions + gov budget
  - Corporate sector: Positive profits
  - Free-entry to primary market: Zero profits
  - Free-entry to secondary market: Zero profits

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Policy instruments

Details

1. Size: Measure of government agents in the secondary market
2. Government **buy** price
   - Higher than in private meetings $\rightarrow$ Relax holding cost of low valuation
3. Government **sell** price
   - Lower than in private meetings $\rightarrow$ Stimulate entry to the secondary market
4. Finance GSI
   - Distortionary corporate taxes, budget balanced

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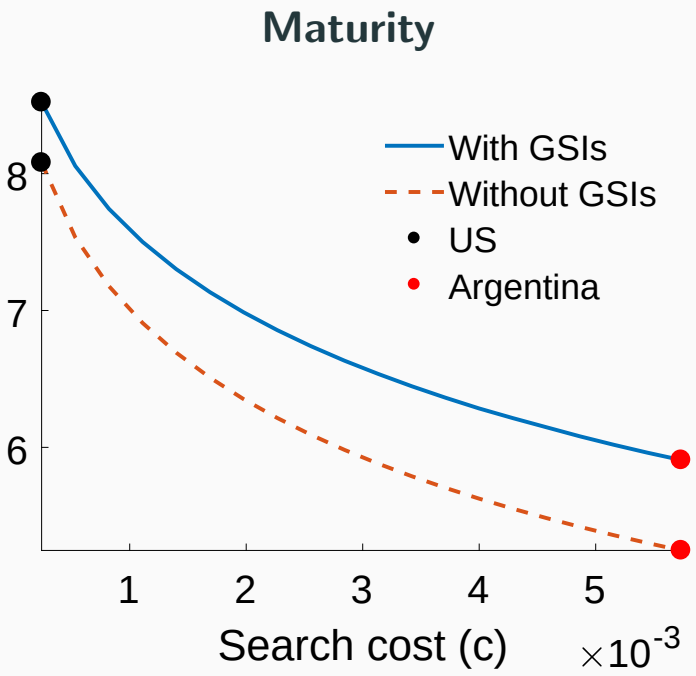
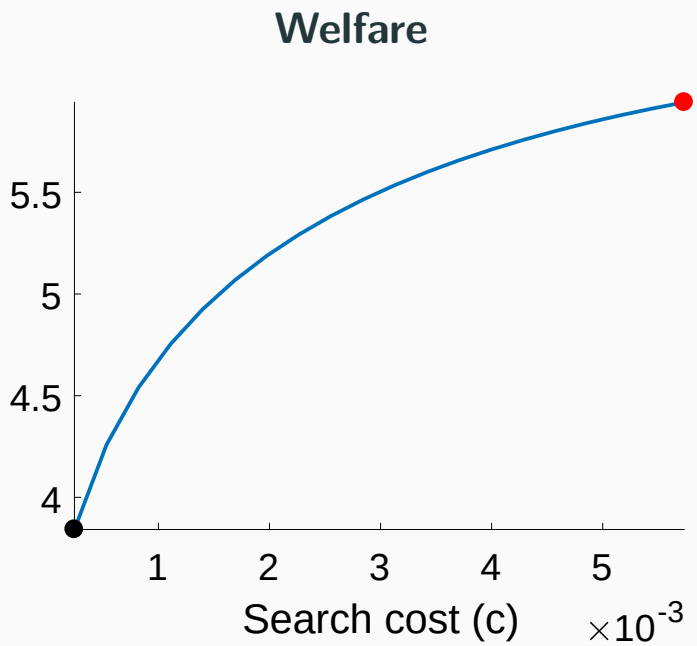
Mechanisms

- Direct: Private agents trade at better terms with government agents
- Equilibrium: Outcomes improve in private meetings

Effects of GSIs across countries

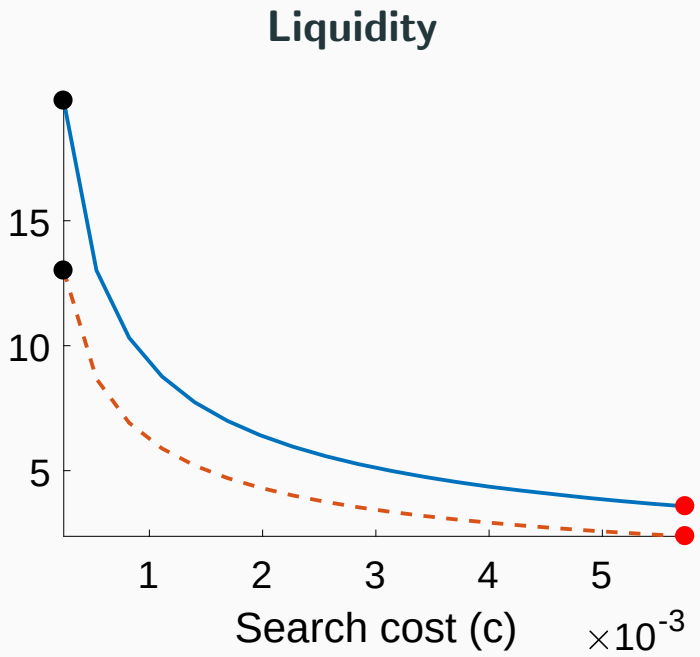


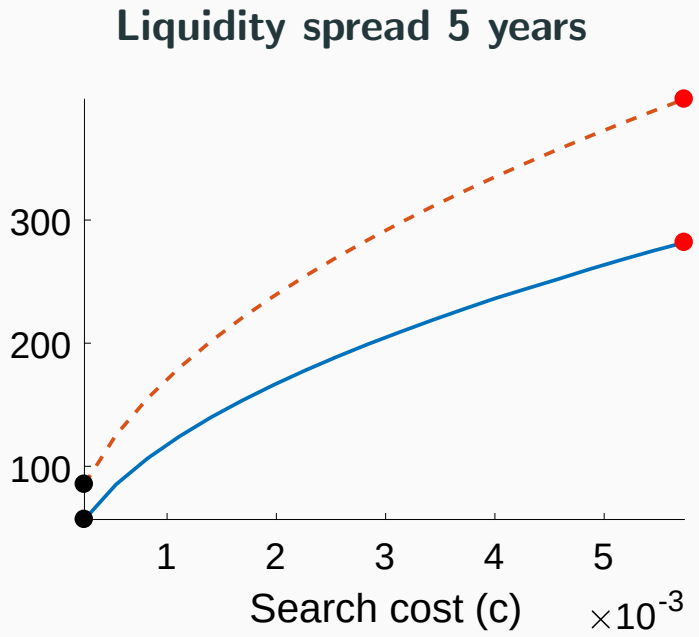


GSIs are more effective in markets with severe trading frictions

	US	Argentina
Maturity	5%	13%
Welfare	4%	6%

Effects of GSIs across countries





Important nonlinearities

- More efficient to improve liquidity in developed financial markets...
- ...but larger effects on credit spreads in markets with severe frictions

Robustness

Extensions & robustness

1. **Rollover short-term debt to finance long-term projects**
   More illiquid secondary market:
   - Shorter maturity and rollover more often
   - If issuances are costly, financial cost increases and firms invest shorter-term
   - Similar quantitative effect, independent of issuance cost

2. **Markets segmented by maturity**
   - Secondary market is effectively a market for long-term assets

3. **Default and maturity**
   - Liquidity spread increases with default, particularly at longer horizons

4. **Alternative measure of liquidity**
   - Net interest margin
   - Counterfactual flat liquidity spread

5. **Alternative production**
   - Production with productivity and labor

6. **Microfoundations for demand of long-term debt**
   - Hopenhayn model, quality ladder, time-to-build capital

Conclusions

1. **Theory:** Model of maturity choices with decentralized asset markets
    - Result: Economies with severe frictions $\rightarrow$ borrow at shorter maturities
    - Why? Ability to trade is more important for long-term finance

2. **Quantitative application:** Finance & development
    - Measure of liquidity spread for emerging economies
    - Model reconciles data on maturities, credit spreads and the real economy

3. **Policy analysis:** Government-sponsored Intermediaries
    - Effective to increase liquidity and improve long-term finance

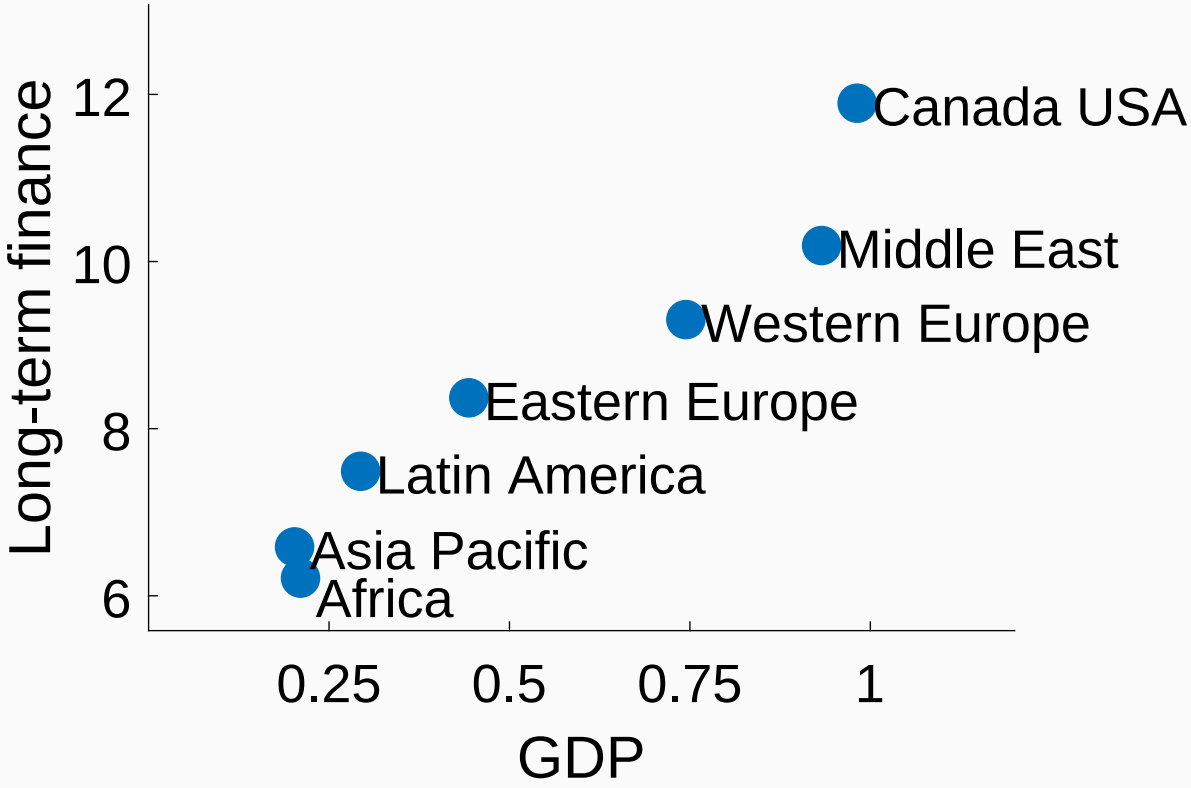
Appendices

Appendix

1. Empirical evidence
2. Production
3. Rollover
4. Default
5. Financial development
6. Quantitative analysis
7. Segmented markets
8. GSIs

Empirical evidence

Firms borrow at shorter maturities in developing countries



Maturity of corporate bonds at issuance in domestic markets.

Source: Cortina Didier and Schmukler (2017).

Maturity of different securities

- Firms borrow at shorter maturity in developing countries
  - **Firm's balance-sheet data:** Demirgüç-Kunt Maksimovic (1998), Fan Titman Twite (2012)
  - **Bonds issuances:** Cortina Didier and Schmukler (2017)
  - **Bank data:** World Bank (2015)

- Significant use of corporate bonds on non-financial sector

	% total debt	% GDP
Advanced	50	80
Emerging	23	28

Source: BIS.

Trading frictions are more severe in developing countries

In Developing countries: Lower turnover and higher Bid-Ask spreads

	Turnover relative to US	**Bid-Ask Spreads** bps above US
Corporate bonds in Asia		
Malaysia	65	
Japan	40	
India	25	
New Zealand	25	
Thailand	20	
Korea	5	
Sovereign bonds in Latin America		
Mexico	23	6
Argentina	9	29
Colombia	6	3
Brazil	4	4
Chile	4	5
Peru	2	14
Venezuela	2	74

Source: BIS. Bid-Ask Spread for US treasuries is 1.2 basis points

Back

Frictional asset markets in the US

- **Credit spreads have a large non-default component**
  - **Longstaff Mithal Neis 2005 JoF**
    - Non-default: Average **65 basis points**
    - Use CDS to identify non-default component
    - Conservative measure: Firms with CDS are more liquid, maturity below 5 years
  - **Krishnamurthy Vissing-Jorgensen 2012 JPE**
    - Convenience yield: **Liquidity (64%)** and safety (36%)
    - Convenience yield $\in$ [**50**, **200**] basis points
  - **He Milbradt 2014 Ecma**
    - Structural decomposition of credit spreads

	Investment grade	**Speculative grade**
Credit spread	100	350
Non-pure default	53	132

- **Important for investment, in particular at long horizons**
- **Less-developed financial markets $\rightarrow$ Larger liquidity component**

Back

Empirics: Credit spread yield curve

Credit spreads data

US

- Securities: FISD issuances in 2017
- Filter: local currency, domestic borrowers, fixed rate
- Credit spread on treasuries of same maturity

Argentina

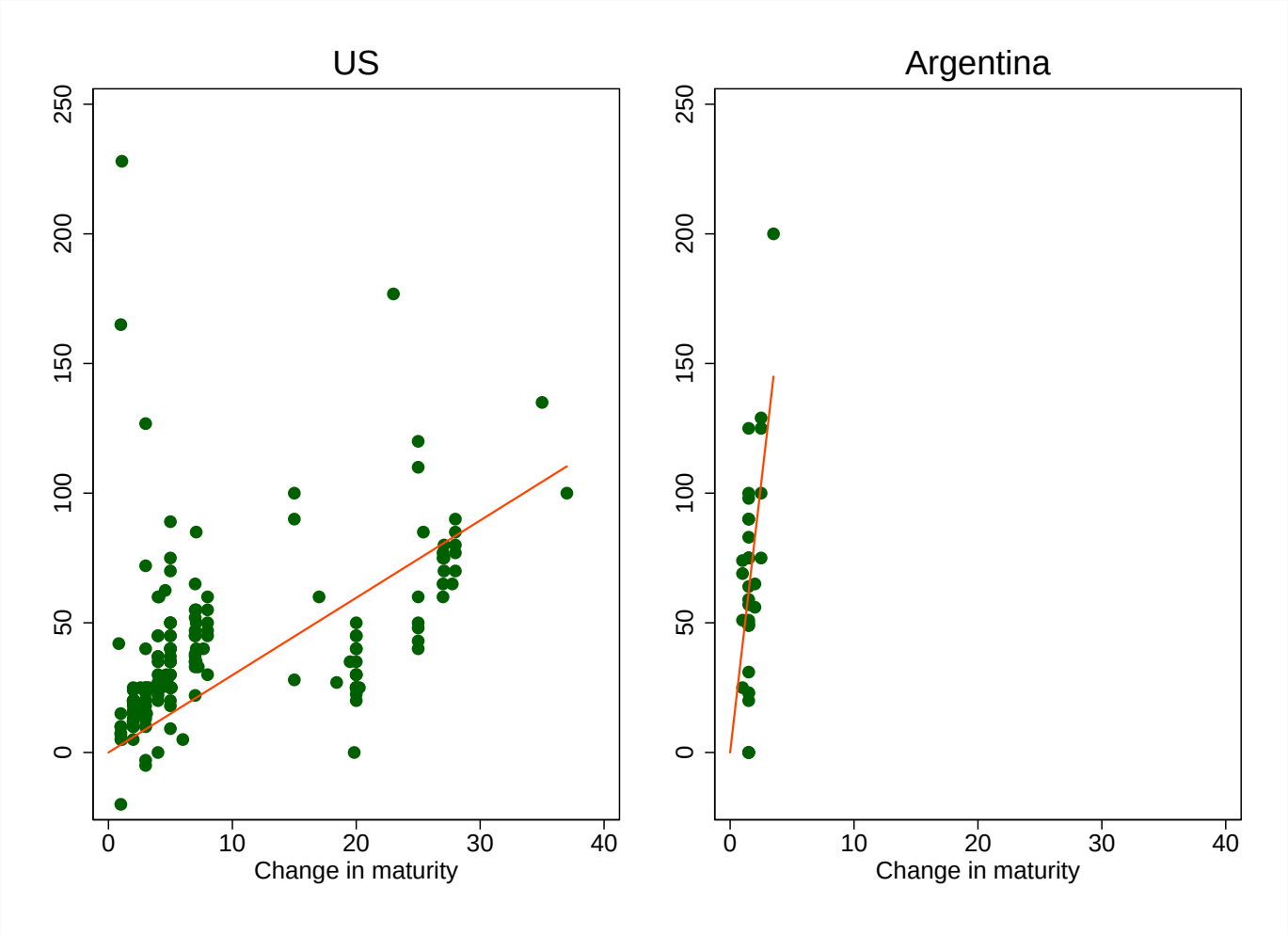
- Securities: Active bonds in August 2017 in the domestic market (MAE)
- Filter: local currency, 100% amortization, floating rate (Badlar + spread)
- Credit spread on badlar rate

Credit spreads data

	US	Argentina
Initial sample		
Issuances	598	153
Firms	389	54
Maturity		
Mean	10.3	2.6
Median	8.1	2.0
Coefficient of variation	0.8	0.5
Matched sample		
Observations	171	35
Firms	93	15
Maturity (median)	7.1	2.3
Maturity short (median)	3.1	1.5
Maturity difference (median)	5.0	1.5

Back

Credit spread differential



Back

Production

Production

- **Firm's life-cycle**
  - Investment phase
    - Invest in productivity for age $\leq \tau$
    - Productivity: $dz = \zeta dt$ so $z(\tau) = \zeta\tau$
    - Investment cost: κdt

$$I(\tau) = \kappa \frac{1 - e^{-\rho\tau}}{\rho}$$

  - Production phase
    - Produce for age $> \tau$
    - Technology $y = z$
    - Discount ρ, exit shock at Poisson rate δ
    - Project's return $F(\tau)$

$$F(\tau) = z(\tau) \int_0^\infty e^{-(\rho+\delta)t} dt = \tau \frac{\zeta}{\rho + \delta}$$

$$F(\tau) = A\tau$$

- **Aggregation**
  - Total output

$$Y(\tau) = \int z = \mu z(\tau)$$

$$Y(\tau) \propto \tau$$

Back

Rollover

Rollover short-term debt to finance long-term projects

Rollover

- Project maturity: τ
- Securities: Zero-coupon bonds of maturity y_j, J issuances
- Interest rate $r(y, \lambda) = \rho + \delta + cs^{liq}(y, \lambda)$
- Issuance cost Φ
- Firm's problem

$$\max_{\tau, J, \{y_i\}_{i=1}^{J}} e^{-(\rho+\delta)\tau} \left(F(\tau) - B(J)\right)$$

$$B(j) = e^{r(y_j, \lambda)y} \left(B(j-1) + \Phi + I(y_j)\right) \quad \text{for } j = 1, \ldots, J$$

$$B(0) = 0 \qquad \text{and} \qquad \sum_{j=1}^{J} y_j = \tau$$

Financial cost

Firm's problem

$$\max_{\tau} \quad e^{-\left(\rho+\lambda^{D}\right)\tau}\left(F\left(\tau\right)-\text{FIN}^{\text{COST}}\left(\tau,\lambda\right)\right)$$

$$\text{FIN}^{\text{COST}}\left(\tau,\lambda\right)=\min_{J,\left\{y_j\right\}_{j=1}^{J}}\sum_{i=1}^{J}\left(\Phi+l\left(y_i\right)\right)e^{\sum_{s=i}^{J}r(y_s)y_s}\quad\text{s.t.}\quad\sum_{j=1}^{J}y_j=\tau$$

Maturity trade-offs

- Fix cost of issuance $\Phi \rightarrow$ longer maturities and less issuances
- Illiquidity $cs^{liq}(y,\lambda) \rightarrow$ shorter maturities and more issuances

Rollover: Results

Liquidity generates similar effects on investment for different issuance costs

Secondary market	Issuances	Maturity		Interest rate
		Project	Bond	
		No rollover		
Centralized	1	9.6	9.6	5.0%
OTC	1	8.1	8.1	5.9%
Shut down	1	2.7 (+5.4)	2.7	15.4%
		Rollover with low issuance cost		
Centralized	15	12.0	0.8	5.0%
OTC	22	11.1	0.5	5.6%
Shut down	30	6.7 (+4.5)	0.2	6.1%
		Rollover with high issuance cost		
Centralized	3	11.2	3.7	5.0%
OTC	3	10.0	3.3	5.8%
Shut down	7	6.6 (+3.4)	0.9	9.1%

Back

Rollover & issuance cost

- How does the issuance cost affect the financial cost for a given project?

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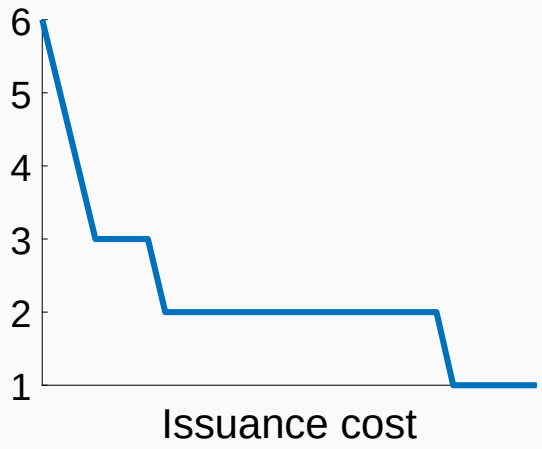
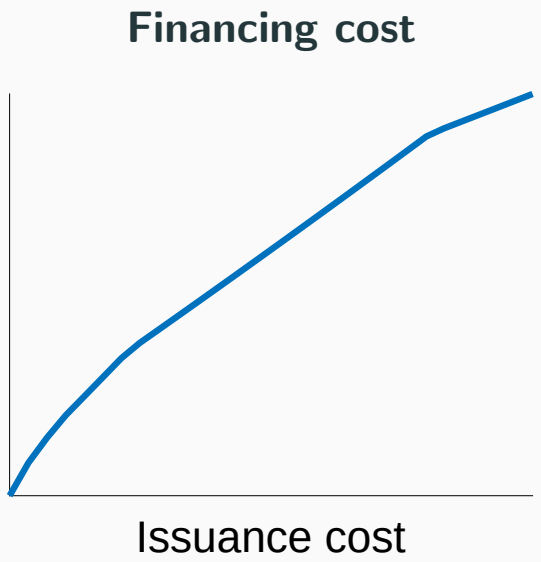


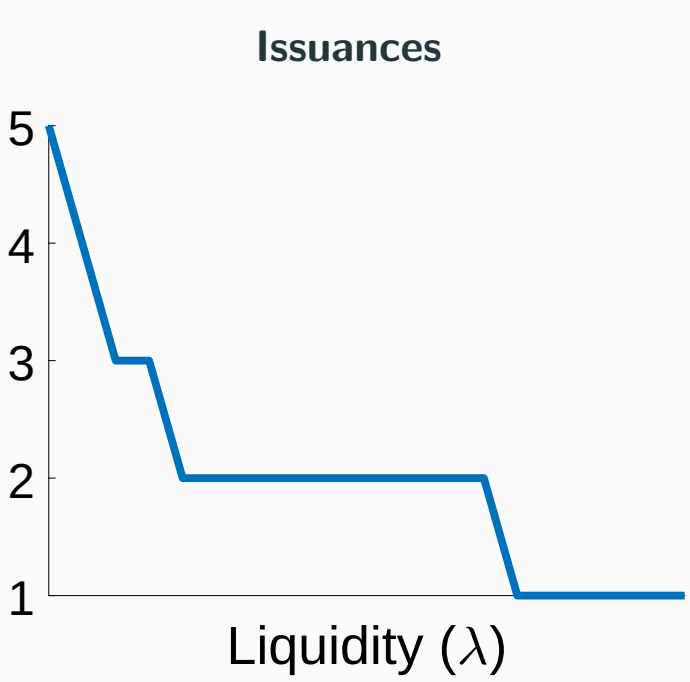


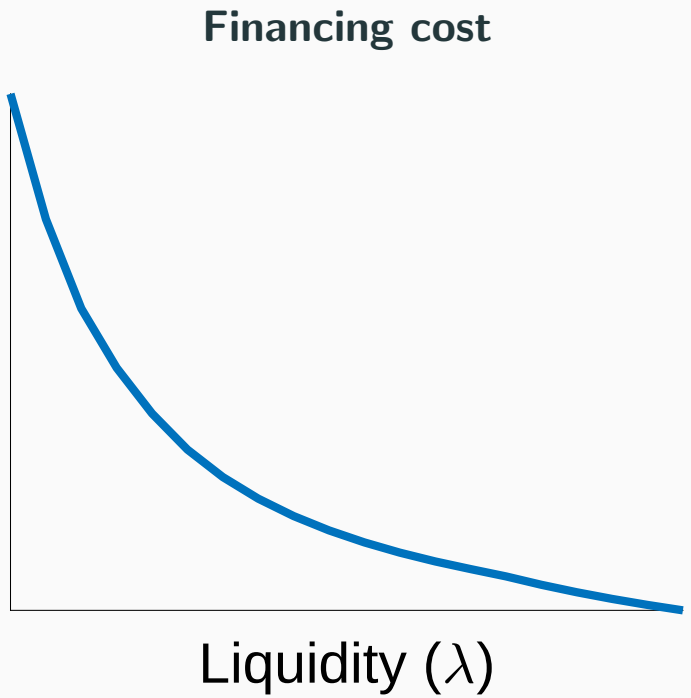
Higher Issuance cost

1. Less issuances, longer maturities
2. Higher financing cost

Rollover & liquidity

- How does liquidity affect the financial cost for a given project?





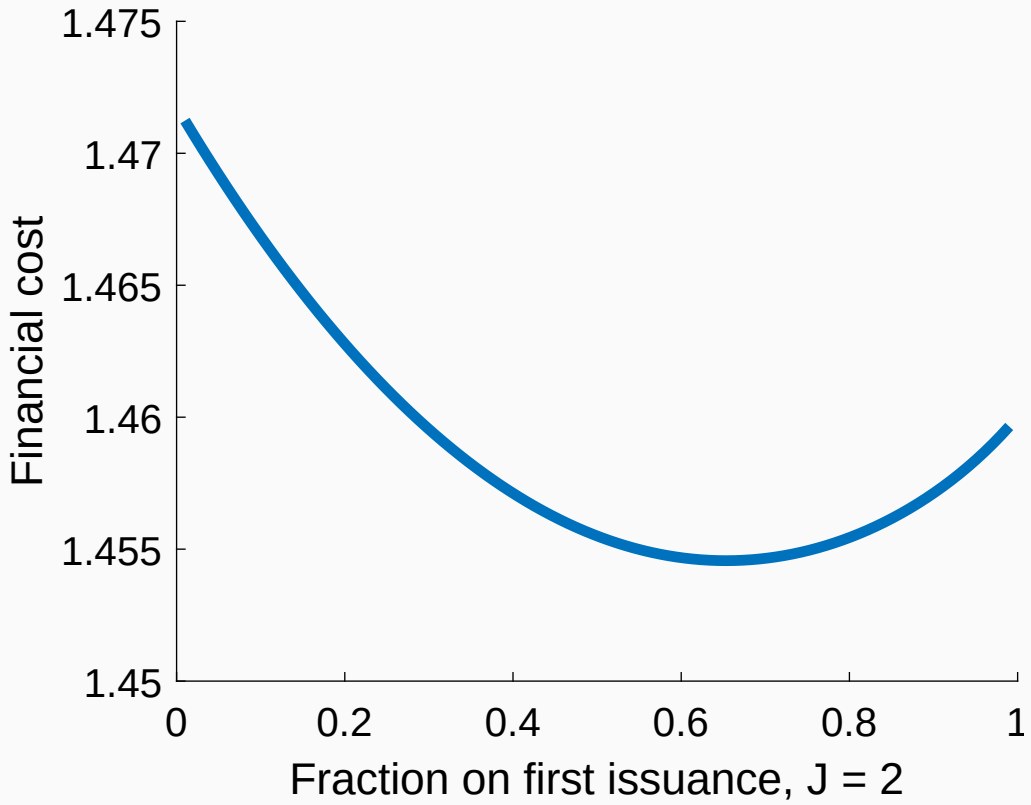
Higher liquidity

1. Less issuances
2. Lower financing cost

Maturity structure

Maturity trade-offs:

- Equalize maturities to pay the same liquidity spread
- Decreasing maturity structure to postpone future issuance costs



Back

Default

Default

- Default at Poisson rate δ
- Value of the project is zero after default
- Interest rate

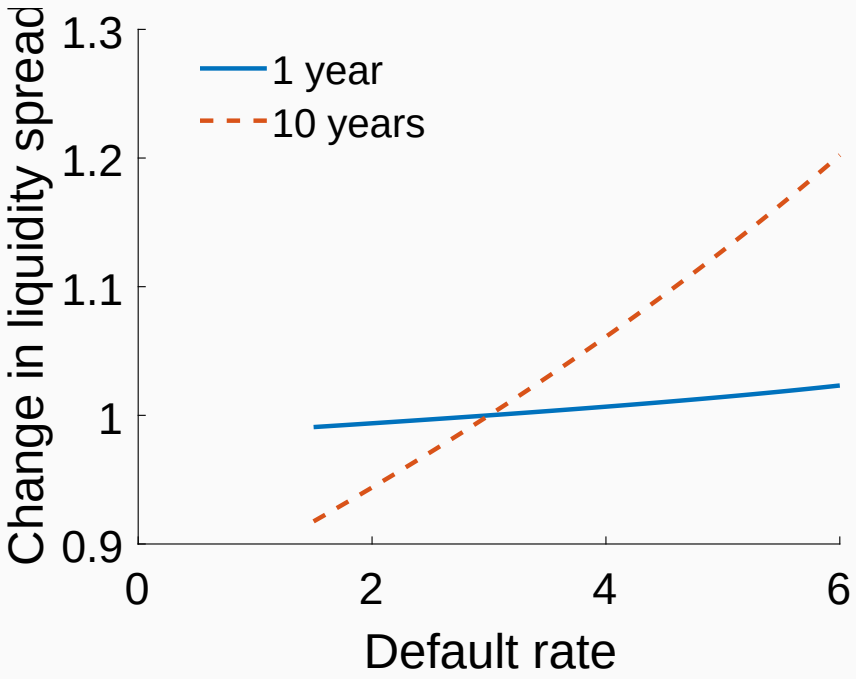
$$r(\tau, \lambda) = \rho + \mathsf{cs}^{def} + \mathsf{cs}^{liq}(\tau, \lambda)$$

$$\mathsf{cs}^{def} = \delta$$

$$\mathsf{cs}^{liq}(\tau, \lambda) = \frac{-\log\left(1 - e^{(\rho+\delta)\tau}\mathcal{L}(\tau, \lambda)\right)}{\tau}$$

Default & liquidity interactions

$$r(\tau,\lambda) = \underbrace{\rho}_{\text{Risk-free rate}} + \underbrace{\delta}_{\text{Default spread}} + \underbrace{\text{cs}^{liq}(\tau,\lambda,\delta)}_{\text{Liquidity spread}}$$



- The liquidity spread is increasing in the default rate
- The spread for 10 years increases 20% if default rate doubles
- The spread for 1 year increases 2% if default rate doubles

Default amplifies the liquidity spread, particularly for long-term assets

Back

What is financial development

Holding costs

What is the holding cost h?

- Discounting
- Financing costs
- Hedging reasons
- Tax disadvantage
- Lower personal use of the asset
- Balance sheet needs for regulatory requirements

Back

What is financial development?

- In the model:
  1. Decrease in search costs
  2. Increase in matching efficiency

- Interpretations:
  1. Technology to execute trades
     - **Clearing houses** such as Euroclear or Clearstream
     - Developing countries: Different institutions to liquidate securities and make payments
  2. Add securities such as **mutual funds** or ETF
     - Agents with more needs for trade $\rightarrow$ increase liquidity
  3. Private information rents reduce trade
     - Larger in developing countries due to weak **credit bureaus**
     - Bethune Sultanum Trachter 2017

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Quantitative analysis

High quality corporate bonds: Safe but illiquid assets

- **Default credit losses**

Rating	Average 1982-2014	Maximum 2008
Aaa	0.00%	0.00%
Aa	0.03%	0.48%
A	0.03%	0.37%

- **Default rates**

Rating	Average 1920-2014	Maximum 2008
Aaa	0.000%	0.00%
Aa	0.061%	0.724%
A	0.096%	0.547%

- Gilchrist Zakrajšek 2012: Credit spreads are increasing in maturity after controlling for firms' characteristics

Source: Moody 2015

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Empirical evidence: CDS and international issuances

Theory: An increase in liquidity flattens the credit spread yield curve and firms borrow at longer horizons

- **Credit default swaps:**
  - Bonds of firms with CDS trade in more liquid markets
  - Firms with CDS Increase maturity by 1.5 years relative to firms without
  - Saretto Tookes 2013

- **International issuances:**
  - Developing countries are less liquid than international financial centers
  - Firms from developing countries that issue in international markets increase maturity by 1.6 years, relative to previous issuances in domestic market
  - Cortina Didier Schmukler 2017

Empirical evidence: Real economy

Theory: When the yield curve flattens firms invest in longer-term, higher return projects

- **Real effects:**
  - When it becomes more expensive to borrow long-term, firms invest in shorter-term projects
  - If term spread increase by 1 standard deviation, duration of investment drops by 0.58 standard deviations
  - Dew-Becker 2012

- **Cross-sectional variation & business cycles:**
  - Maturity Extension Program (MEP): Exogenous shock that flattened the corporate yield curve
  - Firms with more dependence on long-term debt benefited relatively more after MEP: More long-term issuances, higher stock market returns, more investment, and larger employment growth
  - Foley-Fisher Ramcharan Yu 2016

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Alternative production functions

- Production with labor and productivity: $y = z^{1-\sigma} l^{\sigma}$
- Calibrate for $\sigma \in \{0.2, 0.5, 0.8\}$
- Counterfactual: Increase in liquidity spread as in Argentina

Labor share	0.2	0.5	0.8
Δ Liquidity spread (bps)	317	324	330
Δ Maturity (years)	-2.56	-2.26	-2.03
Δ Output (%)	-26	-23	-20

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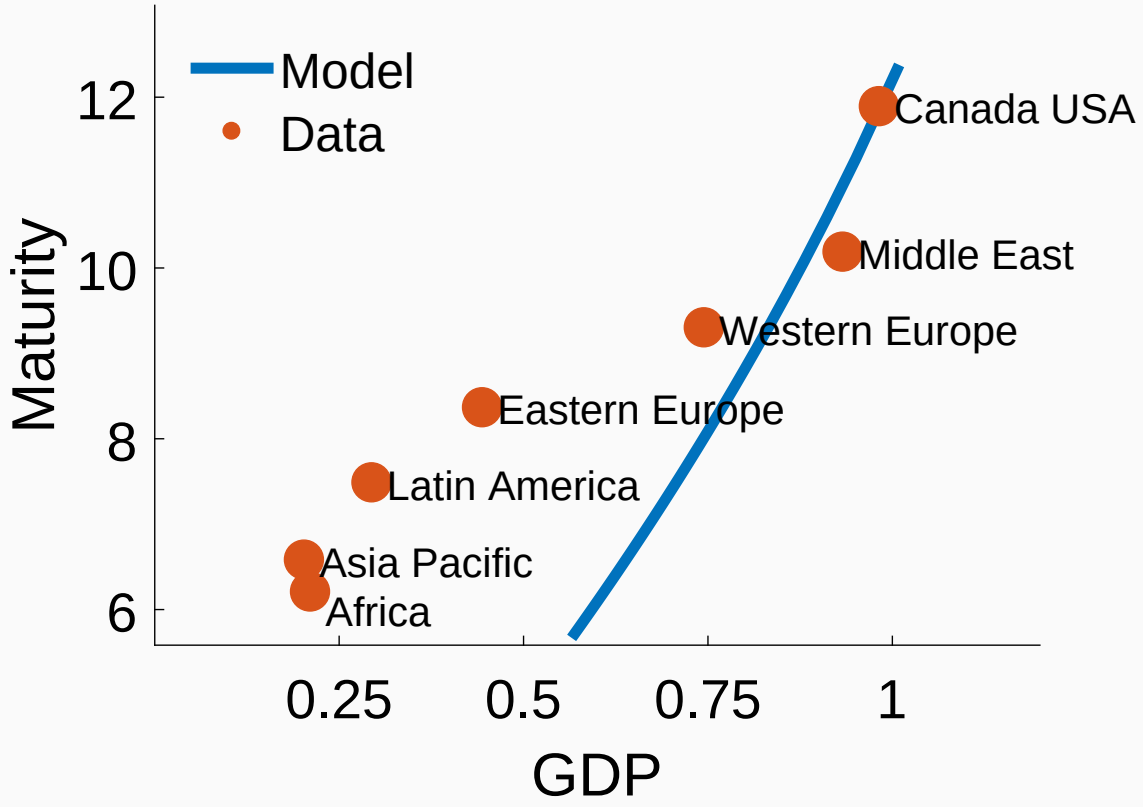
Bank net interest margin

- Credit spread → Bank net interest margin
  - Difference between the interest income and paid out to lenders
  - Use in the literature: Greenwood Sanchez Wang '13
  - Previously understood as intermediation/informational costs
  - This paper: Liquidity cost
  - Source: Bankscope
- Maturity → Issuance in domestic markets (Thomson Reuters SDC)
- Difference between advanced and developing economies

	Data	**Model**	
		Endogenous	Exogenous
Δ Liquidity spread (bps)	295	295	295
Δ Maturity (years)	-3.60	-3.29	-2.96
Δ Output (%)	-60	-19	-16

Financial Development: Model & Data



Trading frictions

- High explanatory power for developed countries
- Explains about half of the relationship for emerging countries

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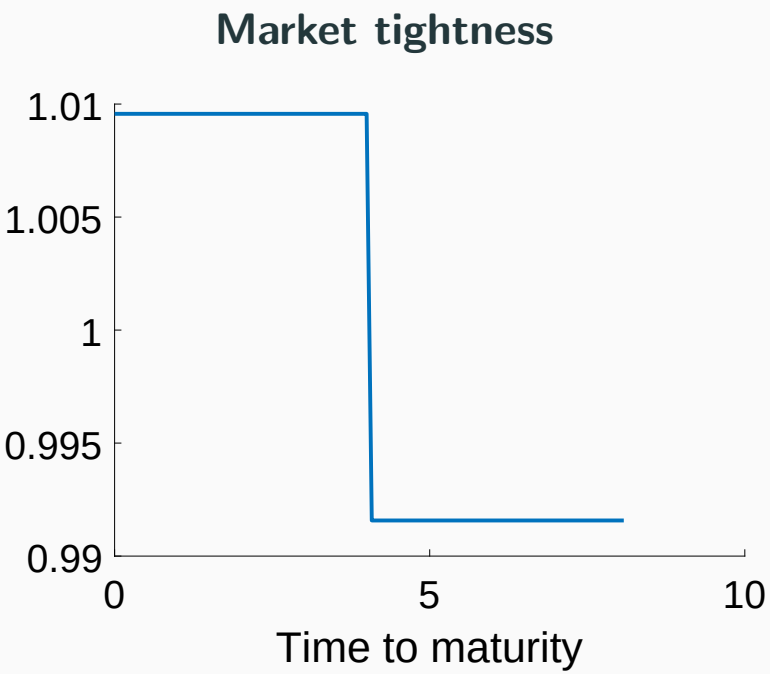
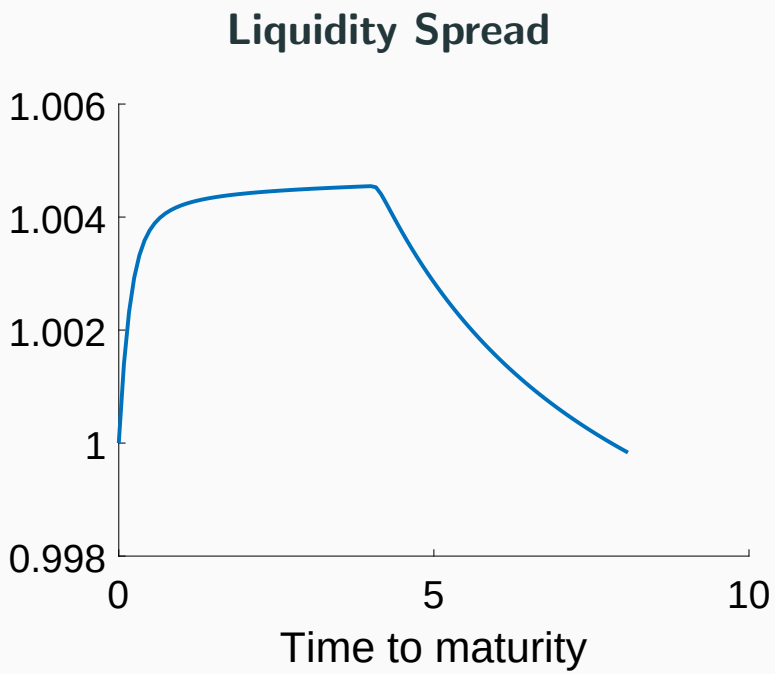
Segmented markets

Segmented markets

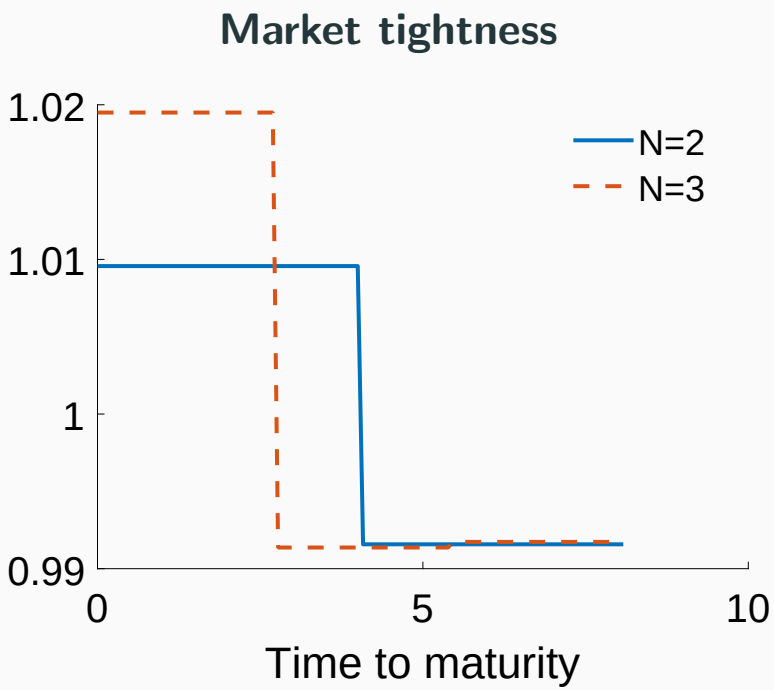
- **Benchmark:** One market for all assets of maturities $t \in [0, \tau]$
- **Concern:** Short-term assets with small gains from trade causes low entry of buyers
- **Segmented markets:** Markets segmented by maturity: Short term and long term assets (later N markets)
- **Results:**
  - Market for short-term: Increase the seller-to-buyer ratio
  - Market for long-term: Market tightness similar to $N = 1$
- **Conclusion:** With $N = 1$ the secondary market is effectively a market for long-term assets

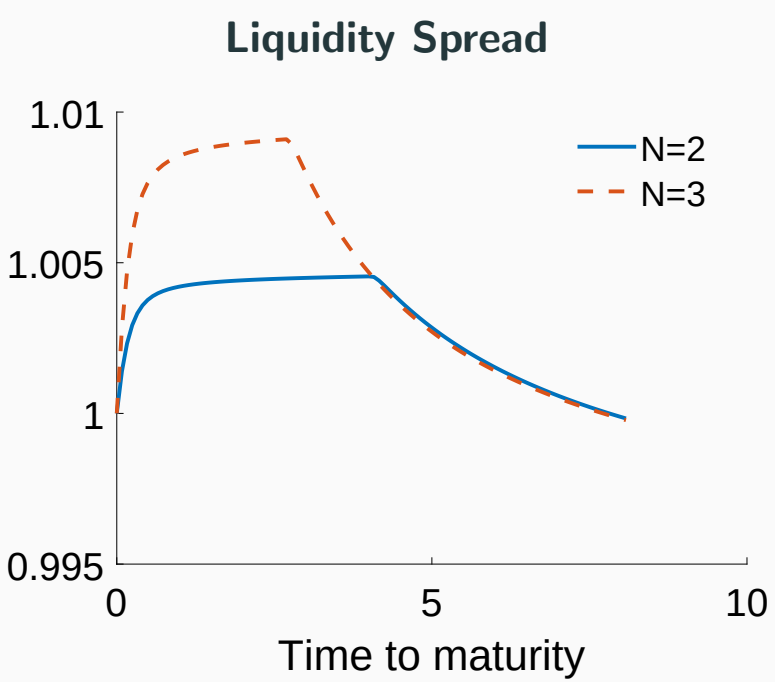
Relative to no segmentation: $N = 2$



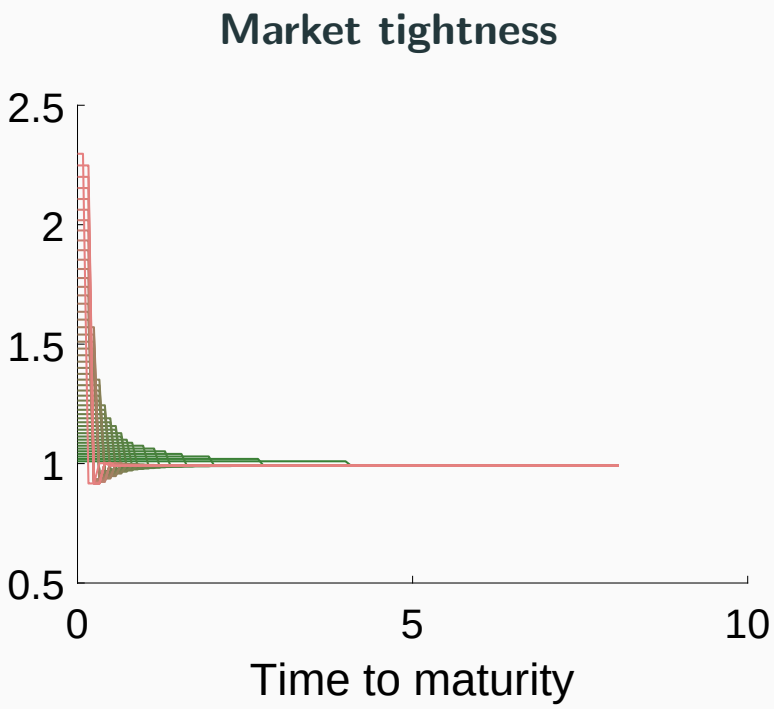


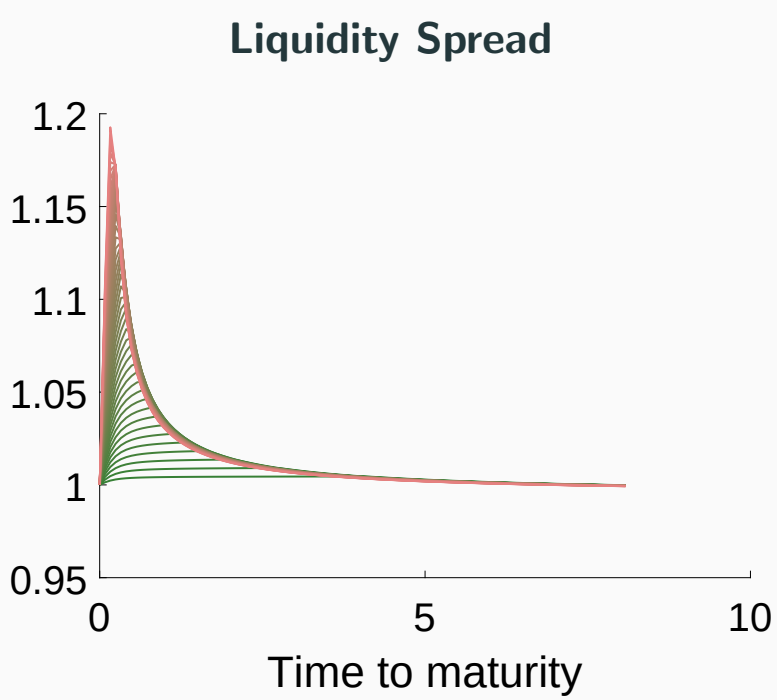
Relative to no segmentation: $N = 3$



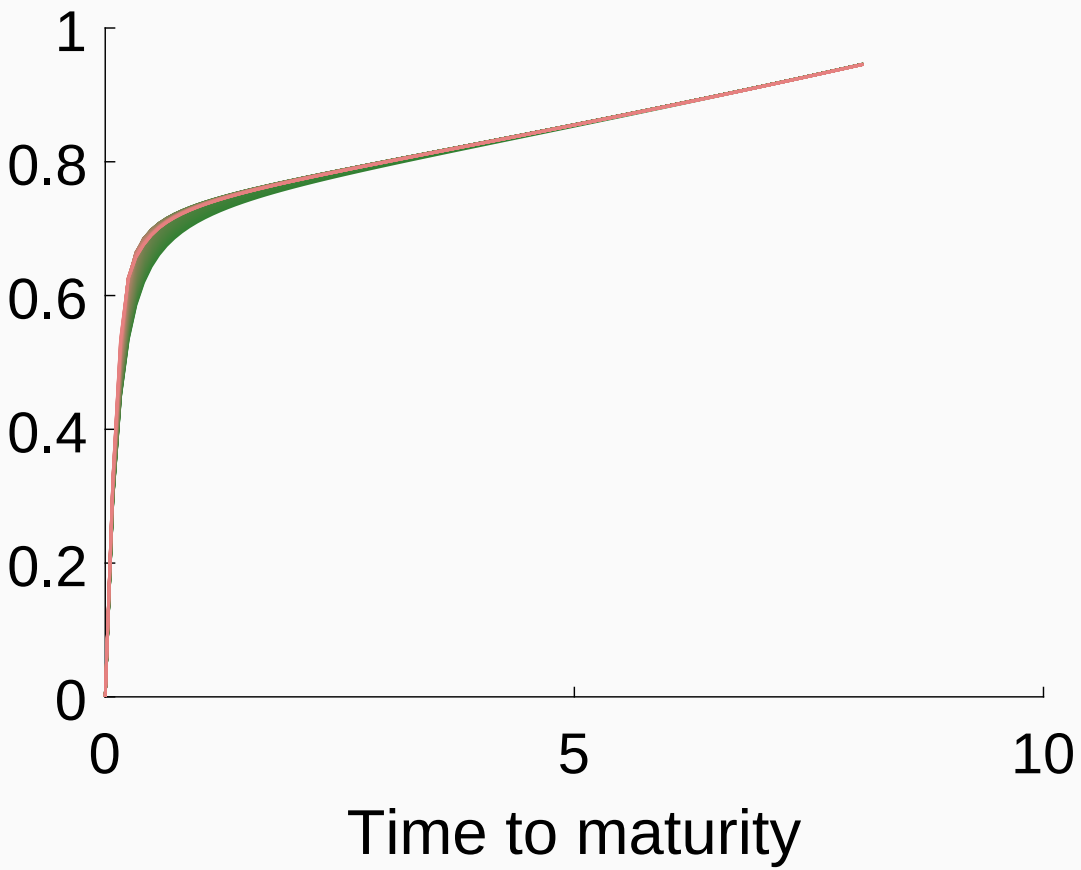


Relative to no segmentation: $N = 50$





Segmented markets: Liquidity spread for different degrees of segmentation



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GSIs

Financial sector: Life-cycle of corporate bonds

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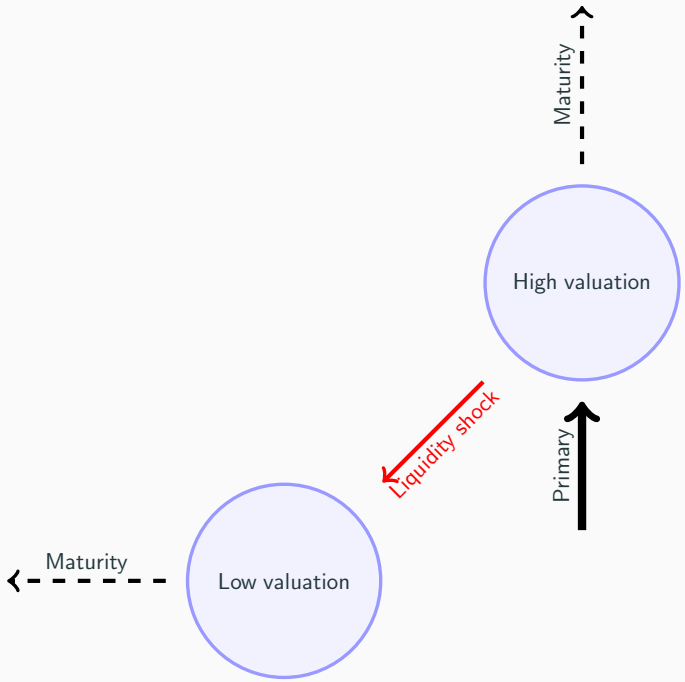

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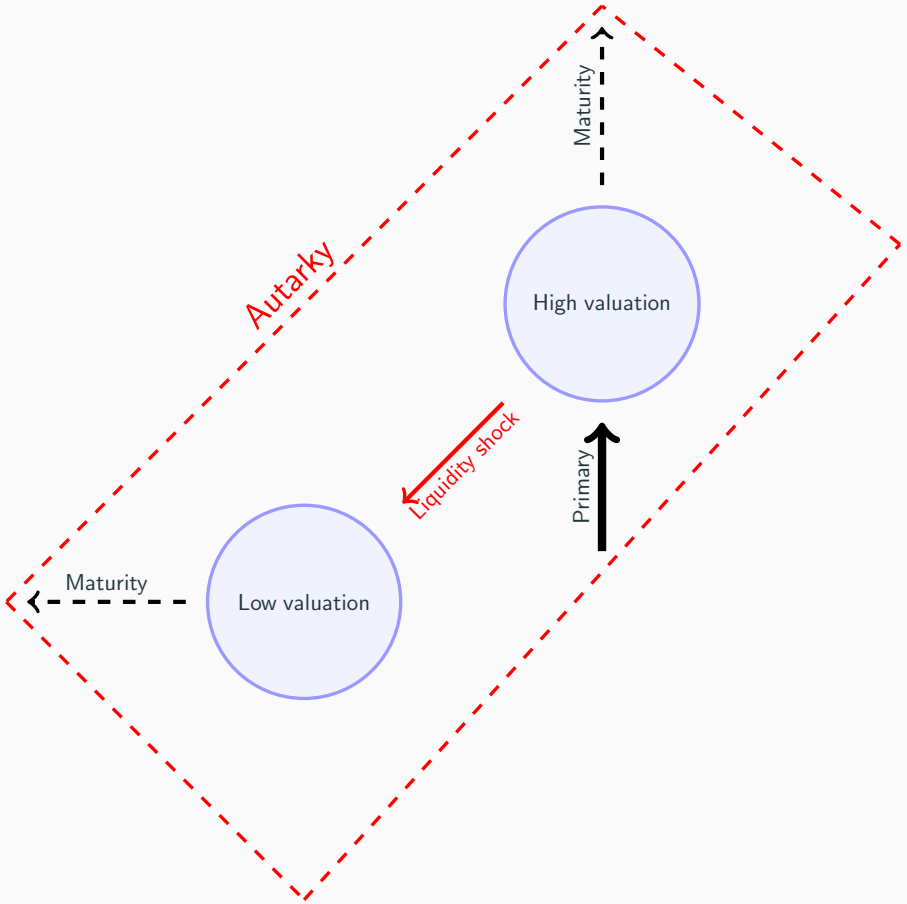

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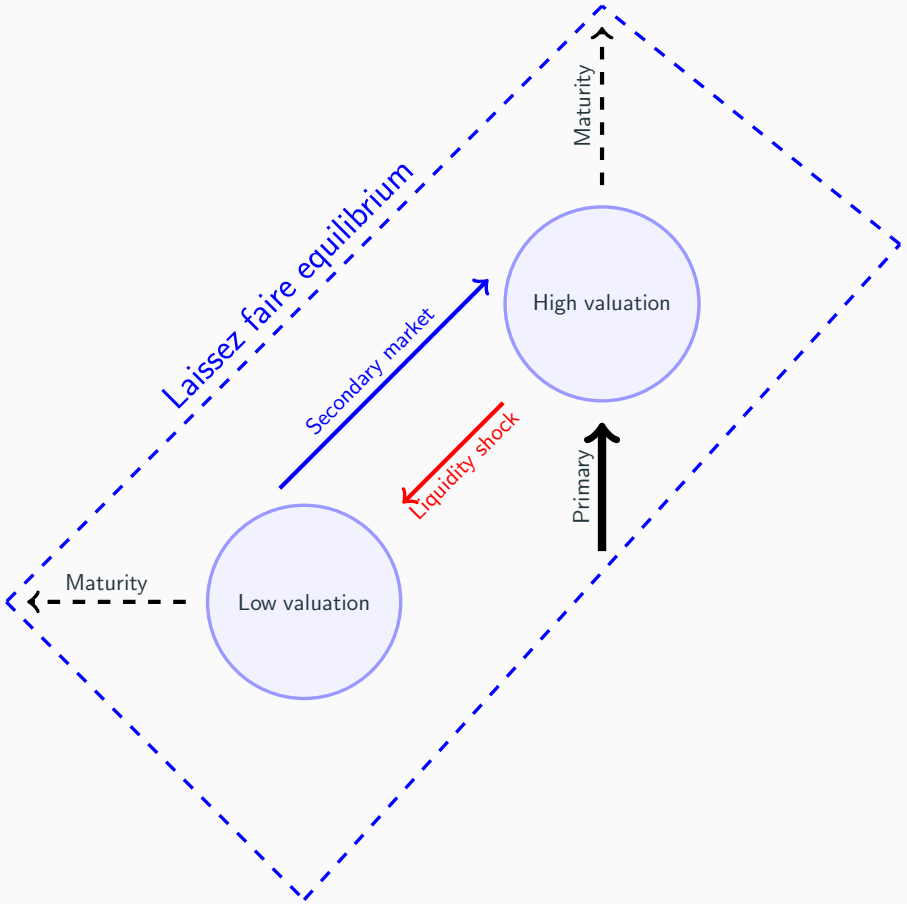
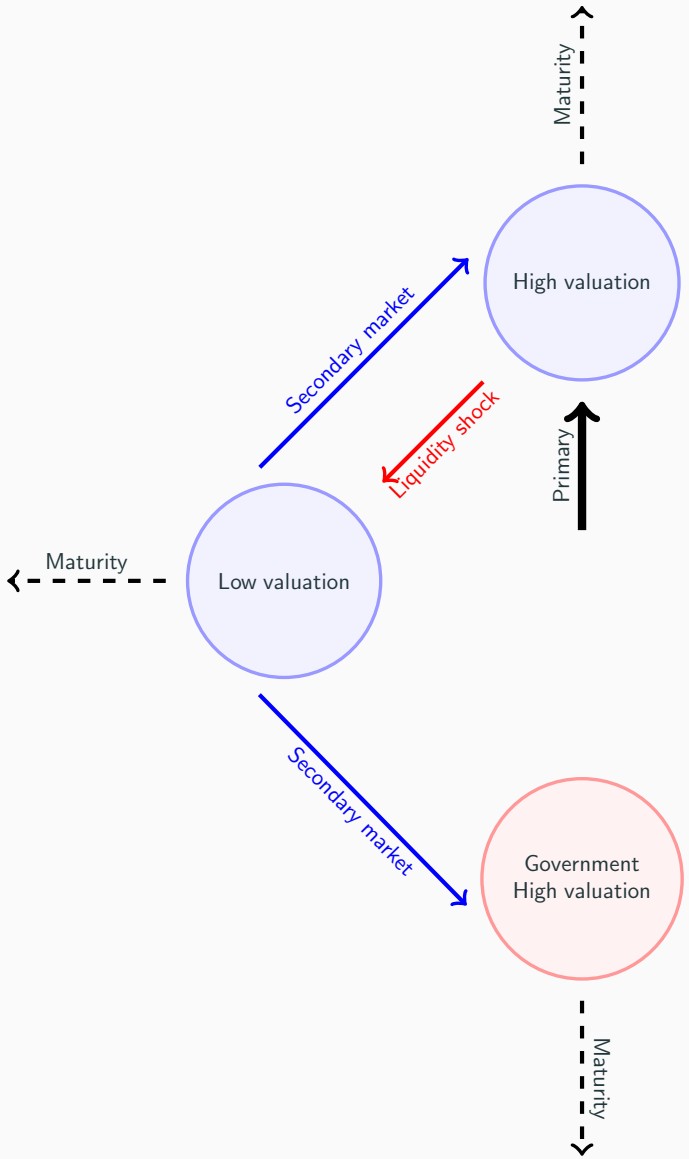


Financial sector: Life-cycle of corporate bonds



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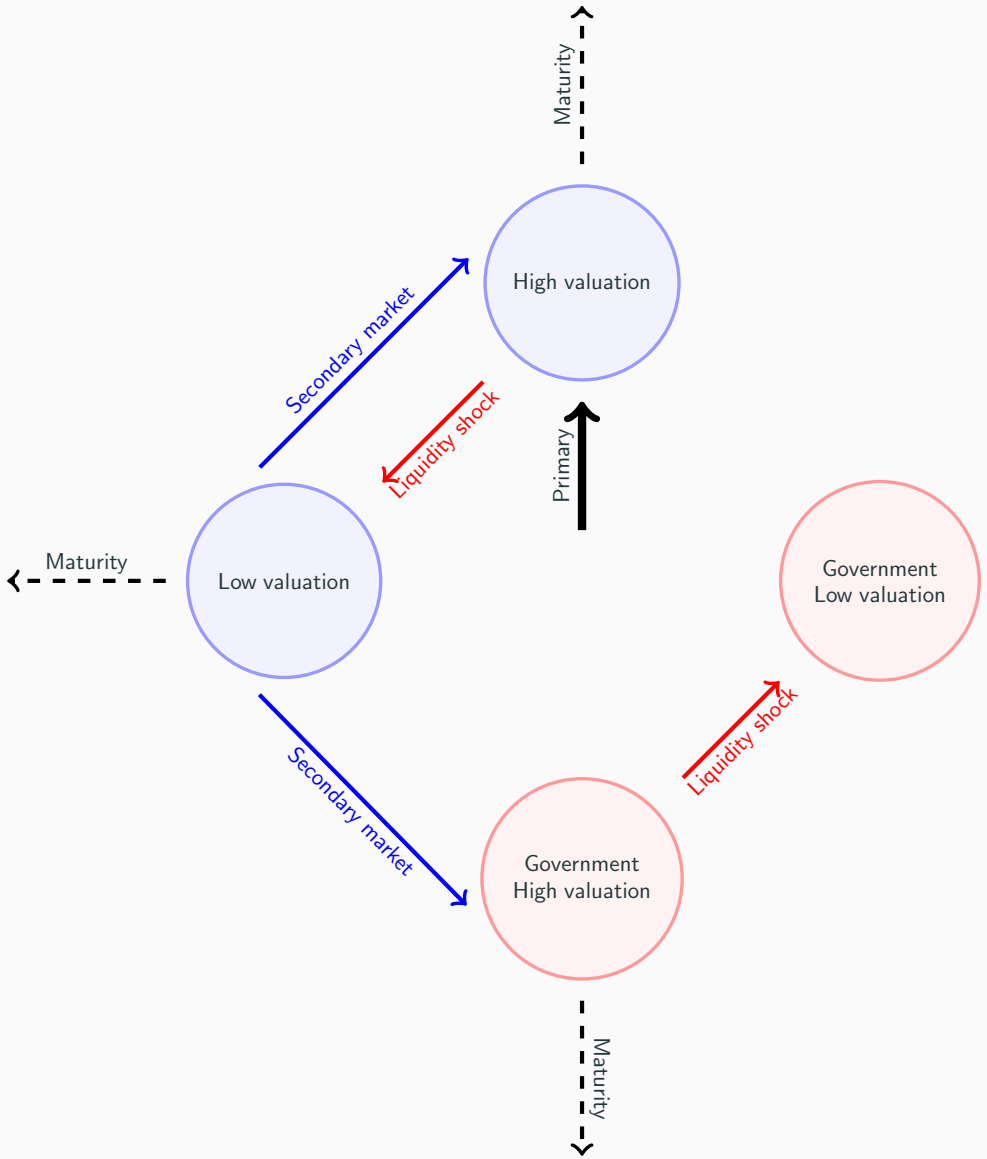

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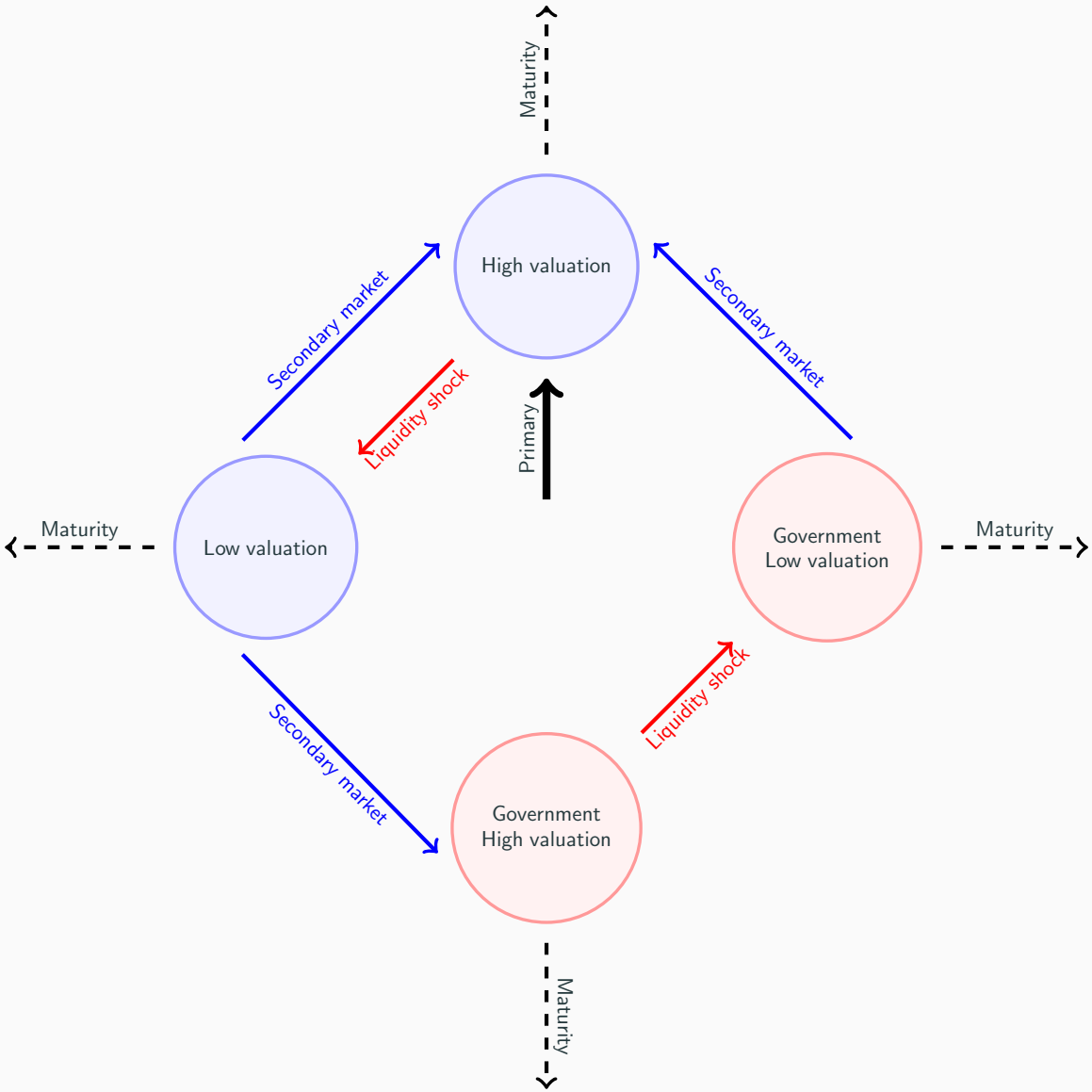
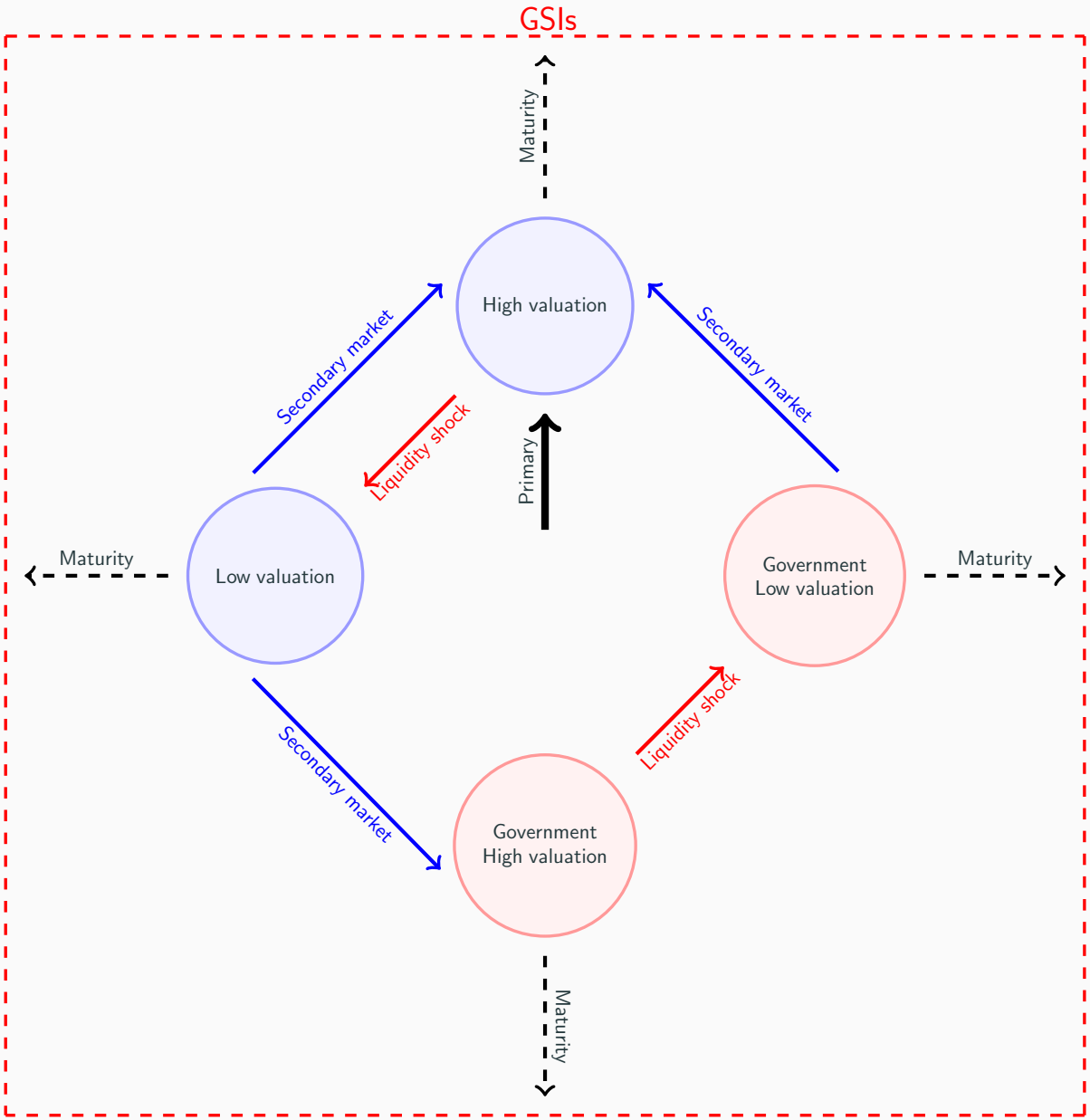


Financial sector: Life-cycle of corporate bonds



Policies

Policy instruments: Buying price, selling price, size of GSIs, tax rate

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1. Buy
    - Relax holding costs of low valuation agents
    - $P^{S,P-G}(y) = \gamma^{GB} D^H(y) + (1 - \gamma^{GB}) D^L(y)$
    - Policy instrument: γ^{GB}

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2. Sell
   - Stimulate private entry in secondary market
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3. Size of GSIs: Choose measure of government buyers $\mu^{B,G}$

4. Tax rate: Balanced budget

Government budget constraint

- Balanced budget:

$$\underbrace{x^c f(\tau)\mu^F}_{\text{Corporate taxes}} + \underbrace{\left[\mu^{G,H}(0) + \mu^{G,L}(0)\right]}_{\text{Maturity of holding securities}} + \underbrace{\lambda \int_0^\tau \mu^{L,G}(y) P^{S,G-P}(y) sy}_{\text{Sell securities}} =$$

$$\underbrace{\mu^{B,G} c}_{\text{Search costs}} + \underbrace{\mu^{B,G} \beta \int_0^\tau \frac{\mu^{L,P}(y)}{\mu^{L,P} + \mu^{L,G}} P^{S,P-G}(y) dy}_{\text{Buy securities}} + \underbrace{h \int_0^\tau \mu^{L,G}(y) dy}_{\text{holding costs}}$$

- Given policy $\mu^{B,G}, \gamma^{GB}, \gamma^{GS}$ tax rate x^c adjust to have a balanced budget

Optimal policy

- Welfare:
  - Lenders' sector is competitive: Free entry condition in primary and secondary markets
  - Borrowers have positive profits $\rightarrow$ measure of welfare

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- Government's problem:

$$\max_{x^c, \mu^{G,B}, \gamma^{S,GB}, \gamma^{S,GS}} e^{-\rho\tau} \left((1 - x^c) F(\tau) - I(\tau) e^{r(\tau)\tau} \right)$$

s.t. balanced budget & equilibrium $r(\tau)$

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- GSIs effects:
  - Direct: Higher taxes $\rightarrow$ lower welfare ....
  - Equilibrium: GSIs increase liquidity which reduces credit spreads $r(\tau)$
  - Next: Equilibrium effect dominates direct effect

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Robustness

	Liquidity	Spread 5 years	Maturity	Welfare gains	Output
Low trading frictions (US)					
No GSIs	13.00	85	8.08		
Benchmark policy	19.80	57	8.52	3.84	4.07
Gov. 10% more efficient	20.39	55	8.55	4.07	4.31
Gov. 50% more efficient	21.98	51	8.61	4.62	4.89
Gov. transactions	21.89	51	8.61	4.59	4.86
High trading frictions (Argentina)					
No GSIs	2.37	398	5.25		
Benchmark policy	3.57	282	5.91	5.94	10.38
Gov. 10% more efficient	3.63	278	5.94	6.51	10.87
Gov. 50% more efficient	3.81	267	6.04	8.32	12.40
Gov. transactions	4.09	250	6.23	12.93	15.23

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