

Rising Intangibles and Fading Listed

Sara Casella Hanbaek Lee Sergio Villalvazo

Department of Economics
University of Pennsylvania

December 2, 2020

Introduction

Model

Equilibrium

Conclusion

Introduction

Background

- ▶ The number of listed firms has been decreasing from 1996.
- ▶ The observed intangible capital in the corporate balance sheet has been increasing from 1970's, and has accelerated from the mid 1990's.
- ▶ The disclosed information in the financial reporting has become less transparent.
- ▶ U.S. SEC requires stricter transparency for the financial reporting.

Research Questions

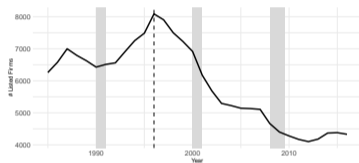
- ▶ Why does the number of listed firms decrease? And why do the listed firms become less transparent?
- ▶ What are the macroeconomic effects of these trends?
- ▶ What are the optimal policies to minimize the side effect?

This paper

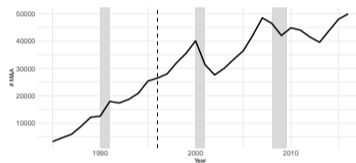
- ▶ We introduce a model that explains **increasing intangible capital** leads to decreasing the number of listed firms, and decreasing average transparency in the financial reporting
- ▶ Based on the model, we analyze **the macroeconomic effect** of decreasing listed firms, and decreasing average transparency in the financial reporting.
- ▶ **SEC regulation affects the aggregate outcome** through firm's decision on the transparency and exit/entry of the stock exchange.
- ▶ Directed search in the financial market is used to get the **closed form characterization** of the firm distribution which is an infinite-dimensional object.

Motivating Empirical Fact

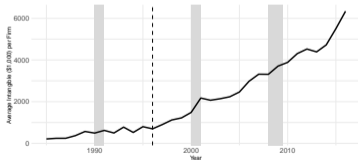
- ▶ **Transparency** is proxied by the inverse of **the earnings surprise**: the earnings surprise is the absolute difference between earnings forecast and actual quarterly earning normalized by the stock price. ▶ Earnings Surprise



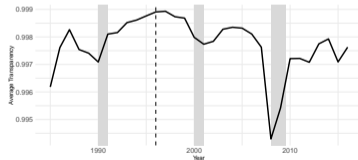
(a) Number of listed Firms



(b) Total number of mergers



(c) Average intangible



(d) Average transparency

Introduction

Model

Equilibrium

Conclusion

Basics

Basics and Assumptions

- ▶ A continuum of measure one of homogenous firms.
- ▶ Discrete time and infinite horizon.
- ▶ Both tangible and **intangible capital** are required for the production.
- ▶ Once a firm's intangible is disclosed, the disclosed portion of the intangible is **perfectly shared** by the other firms.
- ▶ Fixed aggregate labor supply and demand at 1
- ▶ Intangible capital perfectly amortizes (depreciates) every period.
- ▶ Capital is held by household, and firms solve static problem.
- ▶ Within each period, there are **subperiods** (morning/evening), where firms decide whether to go listed or delisted in the morning and operate to earn profit in the evening.
- ▶ A firm can operate **only if** the firm is **financed** for each period.

Technology

Production

- ▶ Both tangible and intangible capital are required for the production.

$$zk_T^\alpha (k_I(1 - \bar{q} - q) + \Phi^{\text{ex}})^\theta$$

where \bar{q} is the exogenous minimum level of intangible disclosure imposed by SEC; $q \in [0, 1 - \bar{q})$ is the transparency level a firm chooses; and Φ^{ex} is the **shared intangible capital** that comes from the other firms' disclosure. Using each unit of tangible (k_T), and intangible capital (k_I) incurs rental cost r and R&D cost p .

Shared intangible capital

- ▶ A firm i 's disclosure of intangible at the transparency level of q_i contributes additively to the **shared intangible capital**. Therefore, the shared intangible is aggregated in the following way:

$$\Phi^{\text{ex}} = \int_0^1 k_{I,i}(\bar{q} + q_i) di$$

Financial Market I

Financial Market for Listed Firms

- ▶ A listed firm that chooses the transparency level q receives funding for the firm operation with a **probability of** $\phi^F(q)$ which is defined as follows:

$$\phi^L(q) := q^\chi \mathcal{M}(q)^{-\nu}, \quad q \in [0, 1 - \bar{q}^*)$$

where $1 - \bar{q}^*$ is the endogenous upper bound of the transparency level q ; $\mathcal{M}(q)$ is the measure of firms choosing the transparency level q that is **endogenously determined in the equilibrium**; χ is the investor's preference parameter; and ν is the congestion effect parameter.

- ▶ Higher transparency q increases a firm's shared portion of intangible capital → **lower profit**
- ▶ Higher transparency q is assumed to be preferred by the investors → **higher chances of being financed**
- ▶ For each q , there exists a **congestion effect** among the firms with the same level of the transparency → dispersion of q .

Financial Market II

Financial Market for Delisted Firms (OTC market)

- ▶ A delisted firm receives funding for the firm operation with a probability of ϕ^D which is defined as follows:

$$\phi^D = \xi M_D^{-\nu}, \quad \text{s.t.} \quad \int_0^{1-\bar{q}^*} \mathcal{M}(q) dq + M_D = 1$$

where ξ is the OTC market condition parameter.

- ▶ **The same congestion effect** is assumed in the OTC market as in the financial market for the listed firms.
- ▶ Total measure of listed firms and delisted firms sum to one
→ the measure of delisted firms is endogenously determined.

Firm's problem

Given the measures of listed and delisted firms (\mathcal{M}, M_D) ,

- ▶ Entry decision: $V(\mathcal{M}, M_D) = \max\{J_1(\mathcal{M}), J_0(M_D)\}$
- ▶ Listed firm's problem:

$$J_1(M) = \max_{q, k_T, k_I} (zk_T^\alpha(k_I(1 - \bar{q} - q) + \Phi^{\text{ex}})^\theta - rk_T - pk_I) \phi^L(q)$$

$$\text{s.t. } \phi^L(q) = q^\chi \mathcal{M}(q)^{-\nu}, \quad q \in [0, 1 - \bar{q}^*]$$

- ▶ Delisted firm's problem:

$$J_0(M_D) = \max_{k_T, k_I} (zk_T^\alpha(k_I + \Phi^{\text{ex}})^\theta - rk_T - pk_I) \phi^D$$

$$\text{s.t. } \phi^D = \xi M_D^{-\nu}$$

where the shared intangible capital comes from $\Phi^{\text{ex}} = \int_0^1 k_{I,i}(\bar{q} + q_i) di$

Introduction

Model

Equilibrium

Conclusion

Equilibrium

Definition 1

A collection of functions $(k_T, k_I, q, \mathcal{M}, M_D, r, \bar{q}^*, \Phi^{\text{ex}})$ is an equilibrium if

1. $(k_T(q, \mathcal{M}), k_I(q, \mathcal{M}), q(\mathcal{M}))$ solves the listed firm's problem for all $q \in [0, 1 - \bar{q}^*]$.
2. The measure of listed firms choosing a transparency level q coincides with $\mathcal{M}(q)$ for all $q \in [0, 1 - \bar{q}^*]$.
3. The measure of delisted firms coincides with M_D that satisfies

$$\int_0^{1-\bar{q}^*} \mathcal{M}(q) dq + M_D = 1$$

4. Price of tangible capital r clears tangible market: $K_T = \int_0^1 k_{T,i} di$
5. Endogenous upper bound $1 - \bar{q}^*$ satisfies $k_I(1 - \bar{q}^*, \mathcal{M}) = 0$, and $k_I(q, \mathcal{M}) < 0$ for $\forall q > 1 - \bar{q}^*$.
6. Aggregate shared knowledge satisfies $\Phi^{\text{ex}} = \int_0^1 (\bar{q} + q_i) k_{I,i} di$.

Equilibrium Characterization I

- ▶ FOC of the firm's problem gives an **ordinary differential equation (ODE)** with respect to q of which solution characterizes the distribution of firms $\mathcal{M}(q)$.
→ Closed-form equilibrium characterization.

$$- \left(A(1 - \bar{q} - q)^{B+1} - \Phi^{\text{ex}} \right) \phi^L(q) + \left(\frac{A}{B} (1 - \bar{q} - q)^{B+2} + (1 - \bar{q} - q)\Phi^{\text{ex}} \right) \phi'^L(q) = 0$$

where $A = \left(\frac{z\alpha}{r} \right)^{\frac{1}{1-\alpha-\theta}} \left(\frac{\theta r}{\alpha p} \right)^{\frac{1-\alpha}{1-\alpha-\theta}}$, $B = \frac{\theta}{1-\alpha-\theta}$, and $\phi^L(q) = q^\chi \mathcal{M}(q)^{-\nu}$.

Solving the ODE above,

$$\phi^L(q) = (-C) * \frac{1 - \bar{q} - q}{A(1 - \bar{q} - q)^{B+1} + B\Phi^{\text{ex}}}$$

$$\mathcal{M}(q) = \left(\frac{q^\chi (A(1 - \bar{q} - q)^{B+1} + B\Phi^{\text{ex}})}{(-C) * (1 - \bar{q} - q)} \right)^{\frac{1}{\nu}}$$

- ▶ The constant $(-C)$ is determined from the following condition:

$$\int_0^{1-\bar{q}^*} \mathcal{M}(q) dq = 1 - M_D$$

Equilibrium Characterization II

- ▶ All the firms (listed with q / delisted) are ex-ante indifferent, and there arises smooth dispersion of listed firms due to the smooth congestion effect.
- ▶ The indifference rule between listed firms and delisted firms needs to hold as follows:

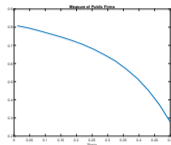
$$J_0(\phi^D) = J_1(\phi^L)$$

$$\Leftrightarrow \frac{z(1 - \alpha - \theta) \left(\frac{z\alpha}{r}\right)^{\frac{\alpha+\theta}{1-\alpha-\theta}} \left(\frac{\theta r}{\alpha p}\right)^{\frac{\theta}{1-\alpha-\theta}}}{(zk_T(q)^\alpha(k_I(q)(1 - \bar{q} - q) + \Phi^{ex})^\theta - rk_T(q) - pk_I(q))} = \frac{\phi^L(q)}{\phi^D}$$

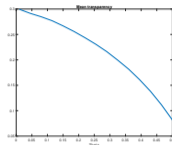
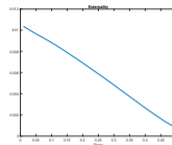
(for $\forall q \in [0, \bar{q}^*]$)

- ▶ The measure of delisted firms, M_D is obtained.

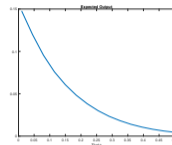
Comparative Statics for Equilibrium Allocations I



(a) # Listed

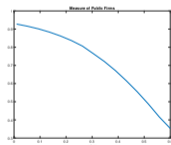
(b) Ave. q 

(c) Externality

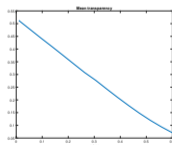
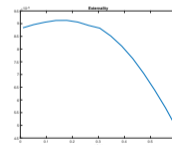


(d) Output

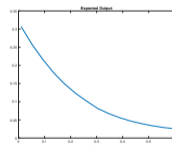
Figure: Comparative statics of the intangible share θ



(a) # Listed

(b) Ave. q 

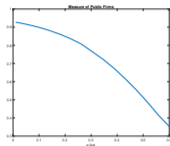
(c) Externality



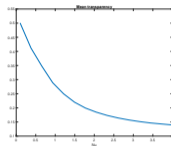
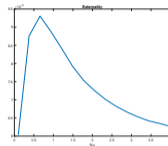
(d) Output

Figure: Comparative statics of the SEC regulation \bar{q}

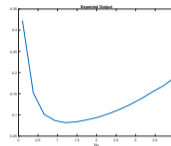
Comparative Statics for Equilibrium Allocations II



(a) # Listed

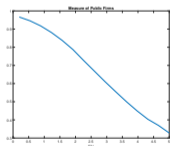
(b) Ave. q 

(c) Externality

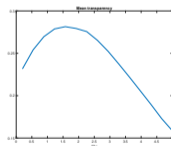
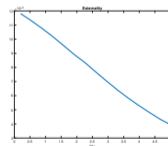


(d) Output

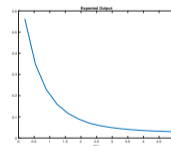
Figure: Comparative statics of the congestion parameter ν



(a) # Listed

(b) Ave. q 

(c) Externality



(d) Output

Figure: Comparative statics of the transparency preference χ

Introduction

Model

Equilibrium

Conclusion

Conclusion

- ▶ Less firms are listed, and listed firms are less transparent.
- ▶ **Stricter SEC regulation accelerates** decrease in the number of listed firms and makes firms less transparent.
- ▶ These lead to decrease in the total output through **less financing opportunity and less spill over** in the intangible capital.
- ▶ Under the same regulation, **shift to the intangible-intensive technology reduces aggregate output.**

Future Plan

- ▶ To consider a household who makes an intertemporal decision of saving: the closed form characterization of the firm distribution makes it much easier to embed the problem into the conventional RBC framework.
- ▶ To calibrate (estimate) the parameters to fit to the data.
- ▶ To strengthen the firm-level evidence.

Thank you!

Measure of Transparency

- ▶ Transparency is proxied by earnings surprise following Gu and Hackbarth (2018).
- ▶ Earnings surprise is defined as follows:

$$\text{earnings surprise}_{it} := \frac{|\text{earnings forecast}_{it} - \text{actual earnings}_{it}|}{p_{it}}$$

- ▶ Earnings forecast data is from I/B/E/S forecast data.
- ▶ All the details used for matching the timing of forecast and the actual announcement date are following Dellavigna and Pollet (2009).

▶ Back