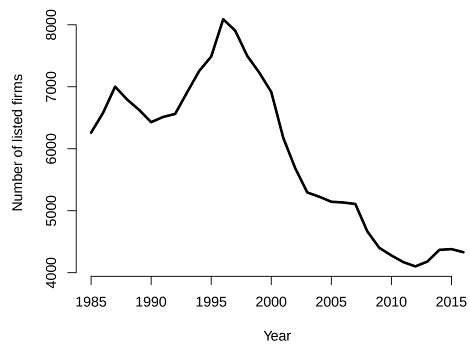
Online appendix for “Disclosure Regulation, Intangible Capital, and the Disappearance of Public Firms”

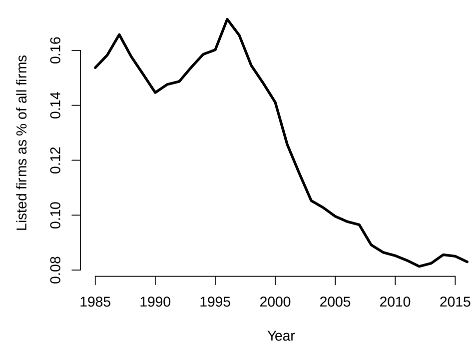
Contents

A Data and measurement

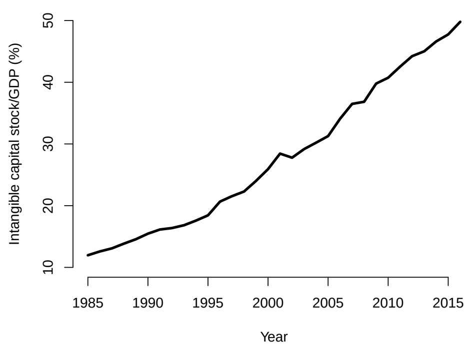
Figure A.1: Time series of aggregate variables.



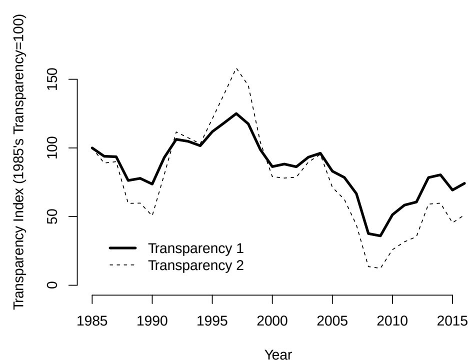
(a) Number of listed firms



(b) Listed firms as share of all firms



(c) Intangible/GDP



(d) Inverse forecast error

Notes: This figure plots the time series of the number (panel A.1a) and share (panel A.1b) of listed firms, intangible capital (panel A.1c), and the inverse forecast error (panel A.1d) in the U.S. The data is from Compustat, I/B/E/S, and the World Development Indicators.

In this section, we explain how we measure the intangible capital stock of public firm. We use firm level data on public U.S. firms from Compustat covering the period from 1985 to 2016 to measure firm-level intangible capital stock. Our baseline measure of *internally* generated intangible capital is the sum of two components: (i) estimated knowledge capital, calculated using research and development expenditure (XRD); and (ii) estimated organizational capital, calculated using selling, general, and administrative expenses (XSGA). The measure is constructed using the perpetual inventory method, which aggregates net investment flows over the life of the firm:

$$\begin{aligned}
\text{[Knowledge capital]}: \quad & k_{i,t}^{G} = (1-\delta_G)\, k_{i,t-1}^{G} + R\&D_{it}, \\
\text{[Organizational capital]}: \quad & k_{i,t}^{O} = (1-\delta_O)\, k_{i,t-1}^{O} + \gamma_O SG\&A_{it},
\end{aligned}$$

where $R\&D$ is research and development expenditure expenditure; $SG\&A$ is selling, general, and administrative expenses. All the intangible flow variables are deflated by the price of intellectual property products from National Income and Product Accounts data (NIPA Table 1.1.9, line 12). δ_G and δ_O are the depreciation rates.[1] γ_O is the fraction of selling,general, and administrative ($SG\&A$) expenditure that adds to the intangible capital stock. We assume $\gamma_O = 0.20$ following Falato et al. (2022). All the empirical results are robust over other reasonable choices of this parameter level.

Then, we calculate the net change in the *acquired* amount of intangibles from changes in the book values of intangibles after the amortization, using Compustat variables INTAN and AM. We obtain the acquired intangible stock $k_{i,t}^{B}$, applying the perpetual inventory method to the deflated net change in the intangibles.

Our final measure of firm-level intangible capital stock $k_{i,t}^{I}$ is obtained by combining the internally generated intangible stocks and the acquired intangibles stocks:

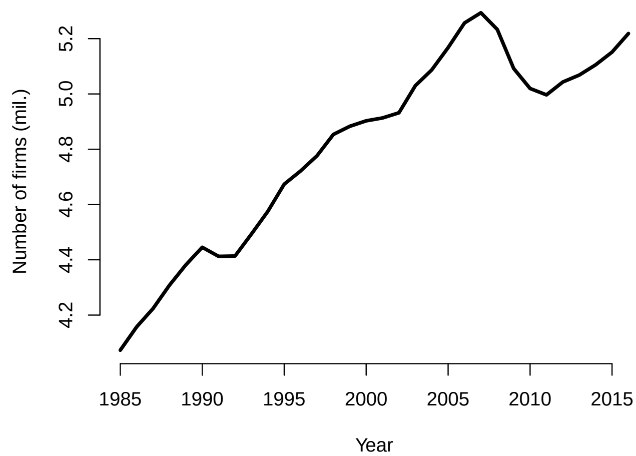
$$k_{i,t}^{I} = k_{i,t}^{G} + k_{i,t}^{O} + k_{i,t}^{B}$$

[1] We use $\delta_G = \delta_O = 0.15$, which is around the levels estimated in the literature (Corrado, Hulten, and Sichel, 2009).

B Industry-level analysis and additional figures

Figure B.2 plots the time series of the total number of firms in the united states. In contrast to the declining trend of the number of listed firms, the total number of firms has been steadily rising.

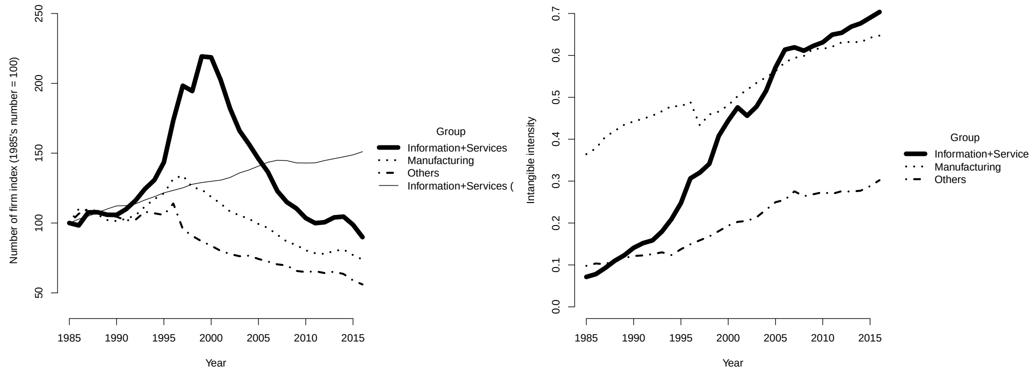
Figure B.2: Number of all firms



Notes: This figure plots the time series of the number of all firms using the Business Dynamics Statistics (BDS) data from the U.S. Census Bureau.

Panel B.3a shows the trend in the number of listed firms for the Information and Services sector, excluding trade and transportation, Manufacturing, and other sectors (Trade and transportation, Agriculture and Mining, Construction). All sectors show an initial increase and then a decline after the mid-nineties, and the decline is much more pronounced in the information and service sector. We also plot the normalized number of all non-listed firms in the information and service sector: as can be seen, only listed firms are affected by the large decline during the entire period of 2000 and 2010 (well after the dot-com bubble), while the overall number is only slightly affected by the 2001 and 2008 recessions. Panel B.3b shows the *intangible intensity*, defined as the ratio of intangible asset to total intangible and tangible asset values,

Figure B.3: Number of listed firms and intangible intensity by industry.



(a) Number of listed firms

(b) Intangibles intensity

Notes: This figure shows the trend in the number of listed firms and intangible capital intensity in the U.S. Intangible intensity is defined as the ratio of intangible asset to total intangible and tangible asset values. The groups are defined as Information and Services, excluding trade and transportation, Manufacturing,and other sectors (Trade and transportation, Agriculture and Mining, Construction). Data comes from Compustat.

for the same industries. Manufacturing had historically a higher intangible intensity, which has been taken over in the early 2000s by the service sector.

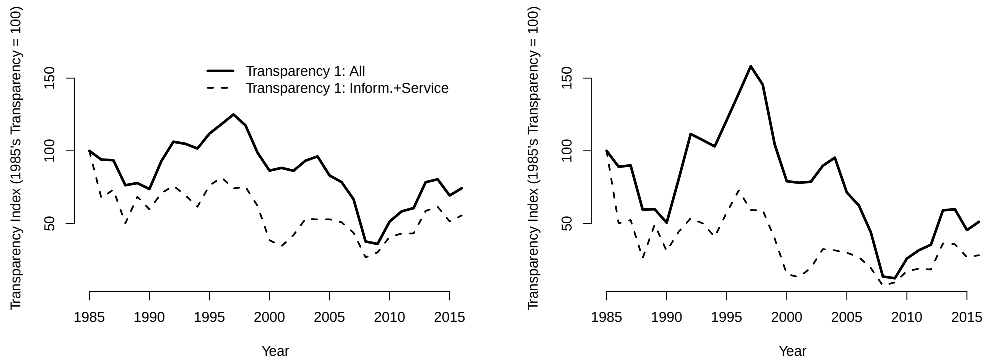
Finally, Figure B.4 shows our transparency measures for the information and service sector, compared to all other sectors. The information and service sector has a lower transparency over the entire period, and both time series of transparency for all sectors have also declined over time.

Two main take-aways can be taken by the analysis of industry trends: the information and services sector has seen the largest increase in its intangible intensity, and at the same time the largest decline in the number of listed firms and in transparency.

We show the trends for more disaggregated industries in figures B.5 and B.6. Specifically, we report the trends for (a) natural resources and mining, (b) construction, (c) manufacturing, trade, (d) transportation, and utilities, (e) information, (f) professional and business services, (g) education and health services, and (h) leisure and hospitality industries.

Finally, we also report the trends in intangible capital using internally generated

Figure B.4: Time series of transparency for information and service industries.



(a) Transparency 1 (b) Transparency 2

Notes: This figure shows the trend in in transparency for information and service industries compared to all other industries. Information and Services excludes trade and transportation. Data comes from Compustat and I/B/E/S. See Appendix for details on measurement.

R&D only (Figure B.7), so that the numbers on intangible intensity can be compared to the ones available in the Bureau of Economic Analysis (BEA), and the time series of the transparency measures for all firms and for only survivors (Figure B.8). Here, the survivor is ex-post conditioned by the firms of which observations are available at the end of the sample period.

Figure B.5: Trends in the number of public firms by industry

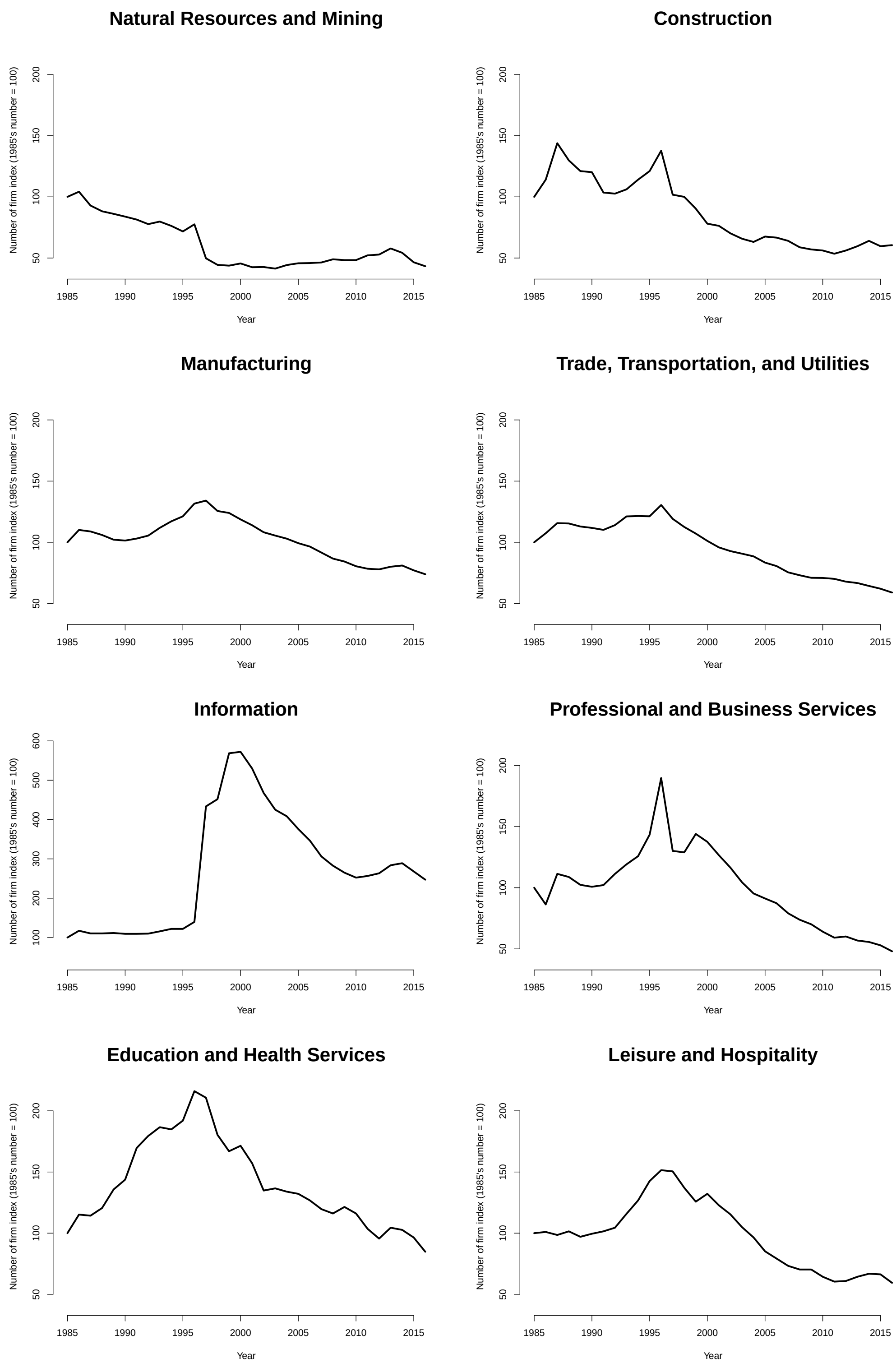


Figure B.6: Trends in intangible intensity by industry

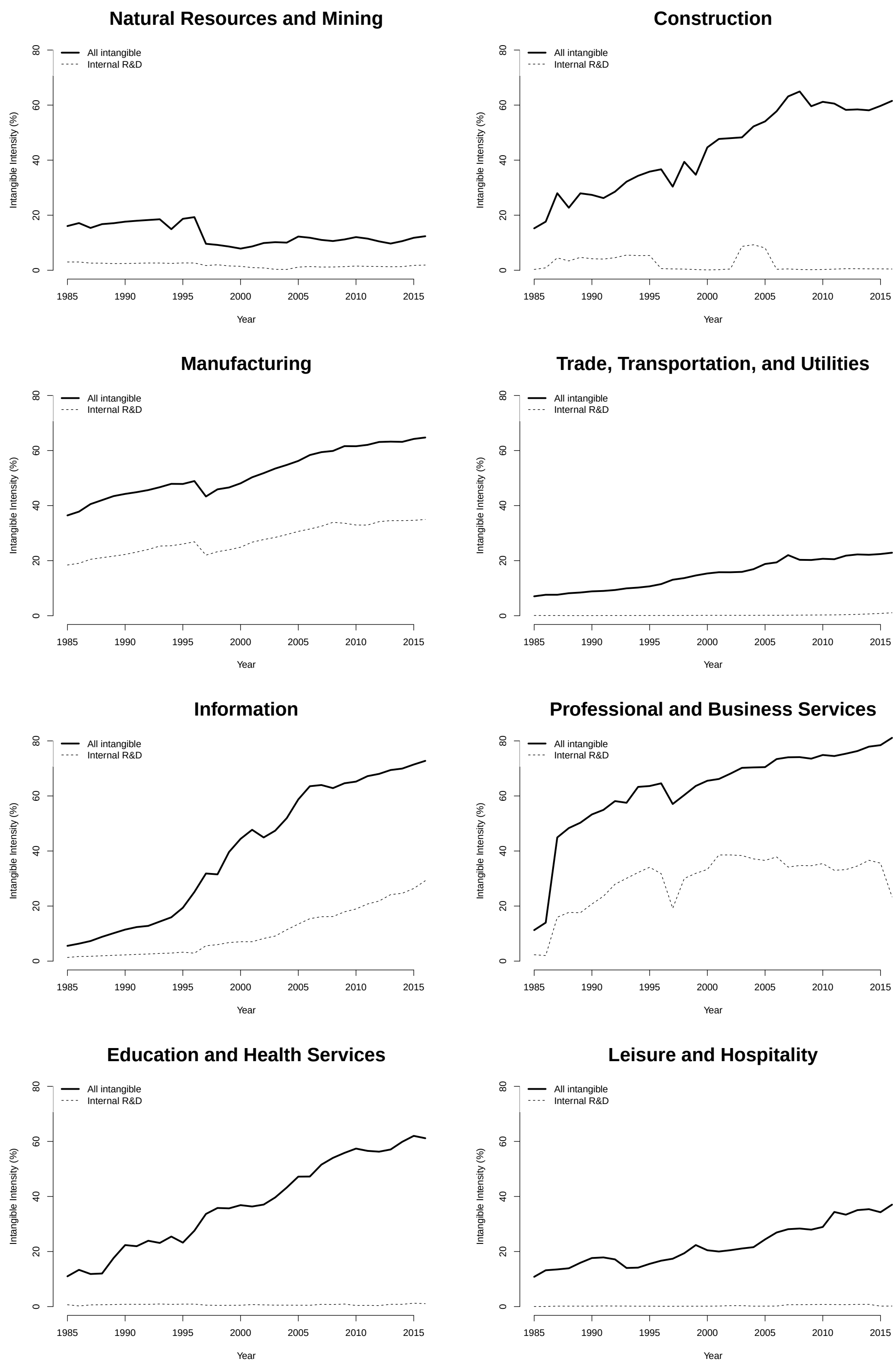
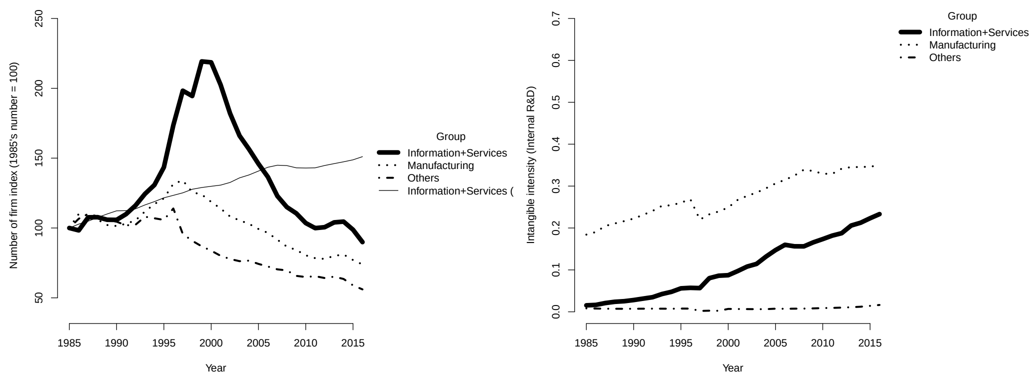


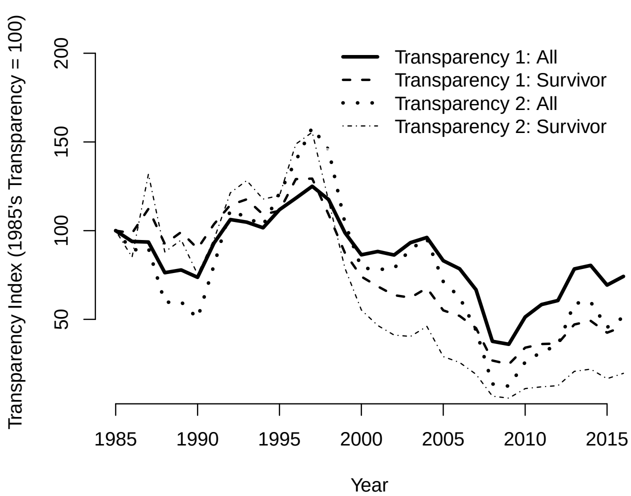
Figure B.7: Number of listed firms and intangible intensity by industry (internal R&D only).



(a) Number of listed firms (b) Intangibles intensity

Notes: This figure shows the trend in the number of listed firms and intangible capital intensity in the U.S. Intangible intensity is defined as the ratio of intangible asset, excluding acquired intangible and organizational capital, to total intangible (again excluding acquired intangible and organizational capital) and tangible asset values.The groups are defined as Information and Services, excluding trade and transportation, Manufacturing,and other sectors (Trade and transportation, Agriculture and Mining, Construction). Data comes from Compustat. See Section 2.1 for details on measurement.

Figure B.8: Time series of transparency: all firms vs. survivors



Notes: This figure shows the trend in in transparency for all firms vs. survivors. Data comes from Compustat and I/B/E/S. See Section 2.1 for details on measurement.

C Empirical cross-section analysis: Full table

Table C.1: Regression of transparency proxies on intangibles

	Transparency 1		Transparency 2	
	(1)	(2)	(3)	(4)
Intangible	-.7197	-.4886	-.3624	-.2405
	(.039)	(.0653)	(.0198)	(.033)
Sales	-.3703	-.3347	-.1898	-.1605
	(.0192)	(.0378)	(.0098)	(.0191)
Current Assets	-1.293	-.1028	-.672	-.0765
	(.0774)	(.1109)	(.0394)	(.0574)
Leverage	-3.323	-2.082	-1.606	-1.002
	(.085)	(.1024)	(.0427)	(.0512)
B/M	-2.049	-1.442	-1.009	-.7095
	(.0587)	(.0493)	(.0295)	(.0251)
log(Employment)	.4691	.0362	.2377	.0368
	(.0083)	(.025)	(.0042)	(.0129)
Age	-.0039	-.3347	-.0019	-.1762
	(7.3e-04)	(.1379)	(3.8e-04)	(.0708)
#Analysts	.0219	.0197	.0243	.0222
	(.0031)	(.0027)	(.0016)	(.0015)
sd Past Sales Growth	-1.368	-.404	-.6697	-.2086
	(.0609)	(.0518)	(.0307)	(.0267)
Year FE	✓	✓	✓	✓
Industry FE	✓		✓	
Year x Industry FE	✓		✓	
Firm FE		✓		✓
Adj. R^2	0.314	0.645	0.306	0.629
Observations	72239	71556	70423	69735

Notes: This table reports the estimates of the coefficients from the following regression using our baseline sample, which includes all firms in Compustat from 1985 to 2016 for which information on earnings forecasts is available:

$$\log y_{i,t} = \alpha_t + FEs + \beta \times \text{Intangible capital over total assets}_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t}$$

where $y_{i,t}$ is either the inverse of variance of earning surprises when more than one analyst forecast is present, or the inverse median absolute value of earning surprises. α_t are year fixed effects and FEs include either industry or firm fixed effects. $X_{i,t}$ represents firm controls. Standard errors are heteroskedasticity-robust.

D Standard & Poor's Transparency and Disclosure

The S&P Transparency and Disclosure index is constructed from a checklist of 98 individual items identified as relevant for assessing firms' transparency, using information drawn from annual reports, Form 10-K filings, and proxy statements. The items are grouped into three broad categories: (i) *ownership structure and investor rights*, (ii) *financial transparency and information disclosure*, and (iii) *board and management structure and process*. Each item is coded on a largely binary basis (1 if the information is disclosed, 0 otherwise). The overall score reflects the ratio of disclosed attributes to the total of 98, and separate scores are calculated for each of the three subcategories. A full description of the methodology, along with the list of the 98 disclosure items, is provided in Appendix 2 and 3 in Patel and Dallas (2002).

For our analysis, the *financial transparency and information disclosure* category is the most relevant. Examples of items in this category include: "Is there a discussion of corporate strategy?", "[does the company] Report details of the products or services produced/provided?", "Does the company disclose its plans for investment in the coming years?", and so on. In contrast, the ownership structure and investor rights and the board and management structure scores are mostly related to governance transparency (examples: "Does the company disclose the voting rights for each class of shares?", "Are specifics of directors' salaries disclosed (numbers)?" and so on).

S&P calculated individual scores for S&P 500 constituents in both June and September 2002, excluding firms for which the S&P had incomplete information (a total of 460 companies). These scores are reported in Appendix 4 of Patel and Dallas (2002). We scrape the table and merge the scores with our dataset using company names, manually verifying all matches to avoid erroneous merges. After the merge, we obtain 328 firms that are matched and have nonmissing information on intangible capital and all covariates.

We then estimate a regression specification as similar as possible as the one in Section 4:

$$\mathrm{y}_i = \alpha + FEs + \beta \times \text{Intangible over total assets}_i + \gamma \times X_i + \varepsilon_i \tag{1}$$

where y_i is either the overall transparency score or each of the three subcategories score. FEs include industry fixed effects. X_i contains standard firm controls, including book-to-market ratio, sales, liquid capital (cash, inventory, and receivables), leverage (total debt over total asset), employment in logs, standard deviation of sales growth in the past three years, and age (measured since IPO). Intangible, sales, and liquid capital are scaled by total assets.

Table D.2 reports the coefficient estimates. We can see there is a negative correlation between intangible capital and the S&P transparency measure, controlling for firm characteristics. The negative association is driven by the financial transparency and information disclosure measure only, consistent with our hypothesis.

Table D.2: Regression of S&P Transparency and Disclosure index on intangibles

	(1) Composite ranking Final	(2) Financial and Transparency	(3) Ownership	(4) Management
Intangible	-0.162	-0.517***	0.166	0.135
	(0.102)	(0.125)	(0.209)	(0.114)
Sales	-0.007	-0.032	0.042	0.057
	(0.047)	(0.056)	(0.093)	(0.051)
Current Assets	-0.429**	-0.778***	-0.505	-0.029
	(0.171)	(0.250)	(0.343)	(0.197)
Leverage	-0.604	0.666	-1.067	-0.956**
	(0.370)	(0.541)	(0.725)	(0.392)
B/M	0.063	-0.040	0.085	0.069
	(0.072)	(0.093)	(0.148)	(0.079)
log(Employment)	0.001	0.012	-0.027	0.008
	(0.025)	(0.033)	(0.052)	(0.026)
Age	0.005***	0.007***	-0.001	0.006***
	(0.002)	(0.003)	(0.003)	(0.002)
sd Past Sales Growth	-0.095	-0.091	0.326	-0.097
	(0.196)	(0.231)	(0.319)	(0.191)
Observations	328	328	328	328

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the estimates of the coefficients from the following regression

$$\mathrm{y}_i = \alpha + FEs + \beta \times \text{Intangible over total assets}_i + \gamma \times X_i + \varepsilon_i$$

where y_i is either the overall S&P transparency score or each of the three subcategories score. FEs include industry fixed effects. X_i represents firm controls. Standard errors are heteroskedasticity-robust.

E Welfare measure derivation

Here, we derive the welfare measure in the main text. The representative investor's utility can be monotonically transformed into the following mean-variance form:

$$
\begin{aligned}
&Objective_{welfare} = \int x(\widetilde{q})\frac{\pi(\widetilde{q})}{p(\widetilde{q})}d\widetilde{q} + x^N\frac{\pi^N}{P^N} - \frac{\Lambda}{2}\int x(\widetilde{q})^2\frac{1}{\xi+\psi(\overline{q}+q)}d\widetilde{q} - \frac{\Lambda}{2}(x^N)^2\frac{1}{\xi} \\
&= \int \mathcal{M}(\widetilde{q})\pi(\widetilde{q})d\widetilde{q} + \nu_N M^N\pi^N - \frac{\Lambda}{2}\int \frac{x(\widetilde{q})P(q)\mathcal{M}(q)}{\xi+\psi(\overline{q}+q)}d\widetilde{q} - \frac{\Lambda}{2}\frac{x^N\nu_N P^N M_N}{\xi} \\
&= \int \mathcal{M}(\widetilde{q})\pi(\widetilde{q})d\widetilde{q} + \nu_N M^N\pi^N - \frac{\Lambda}{2}\int \frac{\frac{\pi(q)/P(q)}{\Lambda/(\xi+\psi(\overline{q}+q))}P(q)\mathcal{M}(q)}{\xi+\psi(\overline{q}+q)}d\widetilde{q} - \frac{\Lambda}{2}\frac{\frac{\pi^N/P^N}{\Lambda/\xi}\nu_N P^N M_N}{\xi} \\
&= \int \mathcal{M}(\widetilde{q})\pi(\widetilde{q})d\widetilde{q} + \nu_N M^N\pi^N - \frac{1}{2}\int \pi(\widetilde{q})\mathcal{M}(\widetilde{q})d\widetilde{q} - \frac{1}{2}\nu_N\pi^N M_N. \\
&= \frac{1}{2}\int \mathcal{M}(\widetilde{q})\pi(\widetilde{q})d\widetilde{q} + \frac{\nu_N}{2}M^N\pi^N. \qquad (2)
\end{aligned}
$$

Therefore, the welfare measure is equivalent to the expected sum of profit in equilibrium.

F Proofs

F.1 Proof for Proposition 1.

Proposition 1 (Funding supply)**.**

The household's optimal funding supplies for listed firms with transparency q, $x^*(q)$, and for non-listed firms, x^{N*}, are as follows:

$$x^*(q) = \frac{\pi(q)/P(q)}{\Lambda/(\xi + \psi(\overline{q}+q))}, \quad x^{N*} = \frac{\pi^N/P^N}{\Lambda/\xi}. \tag{3}$$

Proof.

From the $i.i.d$ assumption of the stock return uncertainty, the consumption (income) satisfies

$$C \sim N\left(\int x(\widetilde{q})\overline{r}(\widetilde{q})d\widetilde{q} + x^N\overline{r}^N, \int x(\widetilde{q})^2 \frac{1}{\xi + \psi(\overline{q}+q)} d\widetilde{q} + (x^N)^2 \frac{1}{\xi}\right). \tag{4}$$

Then the investors' expected utility maximization problem is translated into the following form:[2]

$$\max_{\int x(\widetilde{q})d\widetilde{q} + x^N = a} \quad - e^{-\Lambda\left(\int x(\widetilde{q})\frac{\pi(\widetilde{q})}{P(\widetilde{q})}d\widetilde{q} + x^N\frac{\pi^N}{P^N} - \frac{\Lambda}{2}\int x(\widetilde{q})^2\frac{1}{\xi+\psi(\overline{q}+q)}d\widetilde{q} - \frac{\Lambda}{2}(x^N)^2\frac{1}{\xi}\right)}. \tag{6}$$

After a strictly-increasing (log) transformation, the problem reduces down to

$$\max_{\int x(\widetilde{q})d\widetilde{q} + x^N = a} \quad \int x(\widetilde{q})\frac{\pi(\widetilde{q})}{P(\widetilde{q})}d\widetilde{q} + x^N\frac{\pi^N}{P^N} - \frac{\Lambda}{2}\int x(\widetilde{q})^2\frac{1}{\xi+\psi(\overline{q}+q)}d\widetilde{q} - \frac{\Lambda}{2}(x^N)^2\frac{1}{\xi}. \tag{7}$$

The first-order condition with respect to $x(q)$ yields

[2] The derivation of the mean-variance portfolio objective function is as follows: consider a random variable, $y \sim N(\mu_y, \sigma_y^2)$. Then,

$$\mathbb{E}(-e^{-\Lambda y}) = -\mathbb{E}(e^{-\Lambda y}) = -e^{-\Lambda(\mu_y - \frac{\Lambda}{2}\sigma_y^2)}. \tag{5}$$

The last equation is immediate from the moment generating function of the normal distribution.

$$\frac{\pi(q)}{P(q)} - \Lambda x^*(q)\frac{1}{\xi + \psi(\overline{q} + q)} - \mu = 0, \tag{8}$$

where μ is the Lagrange multiplier of the wealth constraint. From this equation, we can derive the following supply curve of funding for the listed market:

$$x^*(q) = \frac{\pi(q)/P(q) - \mu}{\Lambda/(\xi + \psi(\overline{q} + q))}, \tag{9}$$

where $x^*(q)$ is the funding supply in a dollar amount for firms with the transparency level q. So, the household is willing to invest $\frac{\pi(q)/P(q)-\mu}{\Lambda\frac{1}{\xi+\psi(\overline{q}+q)}}$ in the firms with transparency level q. As we assume the representative household has a large enough wealth a, $\mu = 0$.

Similarly, from the first-order condition with respect to x^N, the funding supply curve for non-listed firms is characterized as follows:

$$x^{N*} = \frac{\pi^N/P^N}{\Lambda/\xi}. \tag{10}$$

■

F.2 Proof for Proposition 2.

Proposition 2. *(Intangibles and the transparency)*
The input demand of intangible capital k_I is as follows:

$$k_I(q, \mathcal{M}; \overline{q}) = \left(\left(\frac{\alpha(\Phi^{ex})^\gamma}{r}\right)^{\frac{1}{1-\alpha-\theta}}\left(\frac{r\theta}{p\alpha}\right)^{\frac{1-\alpha}{1-\alpha-\theta}}\right)(1-\overline{q}-q)^{\frac{\theta}{1-\alpha-\theta}}. \tag{11}$$

Proof.
From the first-order optimality condition,

$$[k_T]: \quad \alpha k_T^{\alpha-1}(k_I(1-\overline{q}-q))^\theta(\Phi^{ex})^\gamma = r \tag{12}$$

$$[k_I]: \quad \theta k_T^{\alpha}(k_I(1-\overline{q}-q))^{\theta-1}(\Phi^{ex})^\gamma(1-\overline{q}-q) = p \tag{13}$$

From the first-order conditions with respect to k_T and k_I, we obtain

$$\frac{r}{p} = \left(\frac{\alpha}{\theta}\right)\frac{k_I}{k_T}. \tag{14}$$

Substituting this relation into the first-order condition with respect to k_T, we get

$$r = \alpha\left(\frac{\alpha p}{\theta r}\right)^{\alpha-1}(k_I)^{\alpha+\theta-1}(1-\overline{q}-q)^{\theta}(\Phi^{ex})^{\gamma}. \tag{15}$$

Thus,

$$k_I = \left(\left(\frac{\alpha(\Phi^{ex})^{\gamma}}{r}\right)^{\frac{1}{1-\alpha-\theta}}\left(\frac{r\theta}{p\alpha}\right)^{\frac{1-\alpha}{1-\alpha-\theta}}\right)(1-\overline{q}-q)^{\frac{\theta}{1-\alpha-\theta}} = A(1-\overline{q}-q)^{\frac{\theta}{1-\alpha-\theta}}, \tag{16}$$

where $A := \left(\left(\frac{\alpha(\Phi^{ex})^{\gamma}}{r}\right)^{\frac{1}{1-\alpha-\theta}}\left(\frac{r\theta}{p\alpha}\right)^{\frac{1-\alpha}{1-\alpha-\theta}}\right)$. As $\alpha+\theta<1$, the proposition is immediate from the last equation. ■

F.3 An alternative proof for Proposition 3.

Proposition 3. *(Transparency distribution)*
The unnormalized probability density function $\mathcal{M}$ of transparency q has the following analytic form:

$$\mathcal{M}(q) = (\xi+\psi(\overline{q}+q))\,(1-\overline{q}-q)^{\frac{\theta}{1-\alpha-\theta}}\,\frac{1}{\phi^N} \tag{17}$$

where $\phi^N = \frac{\xi}{\nu_N M_N}$.

Proof.

We derive the following equations using the first-order condition with respect to q:[3]

$$\frac{\phi^{L'}(q)}{\phi^{L}(q)} = \frac{\theta k_T^{\alpha}(k_I(1-\overline{q}-q))^{\theta-1}(\Phi^{ex})^{\gamma}k_I}{k_T^{\alpha}(k_I(1-\overline{q}-q))^{\theta}(\Phi^{ex})^{\gamma} - rk_T - pk_I} \tag{18}$$

$$= \frac{\theta k_T^{\alpha}(k_I(1-\overline{q}-q))^{\theta-1}(\Phi^{ex})^{\gamma}k_I}{(1-\alpha-\theta)k_T^{\alpha}(k_I(1-\overline{q}-q))^{\theta}(\Phi^{ex})^{\gamma}} \tag{19}$$

$$= \frac{\theta}{1-\alpha-\theta}\left(\frac{1}{1-\overline{q}-q}\right). \tag{20}$$

From $\frac{\partial}{\partial q}log(\phi^L(q)) = \frac{\phi^{L'}(q)}{\phi^L(q)}$, the solution of the first-order differential equation is as follows:

$$\phi^L(q) = (1-\overline{q}-q)^n\,\widetilde{C}, \tag{21}$$

for some $n \in \mathbb{R}$ and some $\widetilde{C} \in \mathbb{R}$. From the indifference condition in the equilibrium, $\pi(q)\phi^L(q)$ does not depend on q.

$$\pi(q)\phi^L(q) = \left((1-\alpha-\theta)\left(\frac{\alpha p}{\theta r}\right)^{\alpha} A^{\alpha+\theta}(1-\overline{q}-q)^{\frac{\theta}{1-\alpha-\theta}}\Phi^{\gamma}\right)(1-\overline{q}-q)^n\,\widetilde{C}. \tag{22}$$

where $A := \left(\left(\frac{\alpha(\Phi^{ex})^{\gamma}}{r}\right)^{\frac{1}{1-\alpha-\theta}}\left(\frac{r\theta}{p\alpha}\right)^{\frac{1-\alpha}{1-\alpha-\theta}}\right)$.

Therefore,

$$n = -\frac{\theta}{1-\alpha-\theta}. \tag{23}$$

This leads to $\phi^L(q) = (1-\overline{q}-q)^{-\frac{\theta}{1-\alpha-\theta}}\,\widetilde{C}$.

[3]Here the proof is based on the first-order conditions that are simultaneously obtained for k_T, k_I, and q for the brevity of notations. The optimal allocations stay unaffected in this problem even if the solution is solved sequentially (interim problem first (k_T and k_I), and then q).

Then, the distribution of listed firms is as follows:

$$\mathcal{M}(q) = (\xi + \psi(\overline{q} + q))/\phi^L(q) \tag{24}$$
$$= (\xi + \psi(\overline{q} + q))\,(1 - \overline{q} - q)^{\frac{\theta}{1-\alpha-\theta}}\,\frac{1}{\widetilde{C}}. \tag{25}$$

From the indifference condition between listed and non-listed,

$$\phi^N = \frac{\pi(q)\phi^L(q)}{\pi^N} \tag{26}$$
$$= \frac{\left((1-\alpha-\theta)\left(\frac{\alpha p}{\theta r}\right)^{\alpha} A^{\alpha+\theta}(1-\overline{q}-q)^{\frac{\theta}{1-\alpha-\theta}}\Phi^{\gamma}\right)(1-\overline{q}-q)^{-\frac{\theta}{1-\alpha-\theta}}\,\widetilde{C}}{\left((1-\alpha-\theta)\left(\frac{\alpha p}{\theta r}\right)^{\alpha} A^{\alpha+\theta}\Phi^{\gamma}\right)} \tag{27}$$
$$= \widetilde{C}. \tag{28}$$

Therefore, $\mathcal{M}(q) = (\xi + \psi(\overline{q} + q))\,(1 - \overline{q} - q)^{\frac{\theta}{1-\alpha-\theta}}\,\frac{1}{\phi^N}$.

In the equilibrium, $\phi^N (= \widetilde{C})$ is determined at the level where the following equation holds:

$$\int_0^{1-\overline{q}} \mathcal{M}(q)dq = 1 - M_N.$$

■

F.4 Proof for Corollary 3.

Corollary 3. *(Truncated Beta distribution)*

The gross transparency, $y := q + \overline{q}$, is a shifted and scaled transformation of a random variable Y that follows a truncated Beta$(B+1, 2)$ distribution:

$$q + \overline{q} = 1 - (1 + \xi/\psi) \times Y \tag{29}$$

where $Y \sim$ Beta$(B+1, 2)$ on $[0, \frac{1-\overline{q}}{1+\xi/\psi}]$, and $B := \theta/(1-\alpha-\theta)$.

Proof.

We define $M_Y(y)$ as the probability density function of the random variable $Y =$

$\frac{1-q-\overline{q}}{1+\xi/\psi}$. Note that $q+\overline{q} = 1-(1+\xi/\psi)Y$. Then,

$$M_Y(y) \propto (1-y)y^B \quad \text{for} \quad y \in \left[0, \frac{1-\overline{q}}{1+\xi/\psi}\right]. \tag{30}$$

Also, $\int_0^{\frac{1-\overline{q}}{1+\xi/\psi}} M_Y(y)dy = 1 - M_N$. ■

F.5 Proof for Proposition 4

Proposition 4 (Non-listed firms' measure)**.**

In equilibrium, the measure of non-listed firms M_N is as follows:

$$M_N = \frac{1}{1+\psi\frac{\nu_N}{\xi}(1+\frac{\xi}{\psi})^{B+2}\mathcal{B}(B+1,2)F\left(\frac{1-\overline{q}}{1+\xi/\psi}; B+1,2\right)} \tag{31}$$

where $\mathcal{B}$ is the beta function, and F is the cumulative distribution function of beta distribution.[4]

Proof. We have the following closed-form solution for M_N:

$$M_N = \frac{1}{1+\psi\frac{\nu_N}{\xi}\int_0^{1-\overline{q}}(\frac{\xi}{\psi}+(\overline{q}+q))(1-\overline{q}-q)^B dq}. \tag{33}$$

Using Corollary 1, we can integrate out the $M(q)$ in the right-hand side of the equation in the following steps, using $y = \frac{1-q-\overline{q}}{1+\xi/\psi} \in [0, \frac{1-\overline{q}}{1+\xi/\psi}]$:

$$M_N = \frac{1}{1+\psi\frac{\nu_N}{\xi}(1+\frac{\xi}{\psi})^{B+2}\int_0^{\frac{1-\overline{q}}{1+\xi/\psi}}(1-y)(y)^B dy}. \tag{34}$$

[4] The beta function is defined as follows:

$$\mathcal{B}(a,b) := \frac{\Gamma(a)\Gamma(b)}{\Gamma(a+b)} = \frac{(a-1)!(b-1)!}{(a+b-1)!} = \int_0^1 x^{a-1}(1-x)^{b-1}dx. \tag{32}$$

$$M_N = \frac{1/\mathcal{B}(B+1,2)}{1/\mathcal{B}(B+1,2) + \psi \frac{\nu_N}{\xi}(1+\frac{\xi}{\psi})^{B+2}\mathcal{B}(B+1,2)\int_0^{\frac{1-\overline{q}}{1+\xi/\psi}} y^B(1-y)dy}. \tag{35}$$

We integrate the denominator using the cumulative distribution function of beta distribution, F:

$$M_N = \frac{1/\mathcal{B}(B+1,2)}{1/\mathcal{B}(B+1,2) + \psi \frac{\nu_N}{\xi}(1+\frac{\xi}{\psi})^{B+2} F\left(\frac{1-\overline{q}}{1+\xi/\psi}; B+1, 2\right)}. \tag{36}$$

By multiplying $\mathcal{B}(B+1,2)$ on the numerator and the denominator, we obtain the following analytic form:

$$M_N = \frac{1}{1 + \psi \frac{\nu_N}{\xi}(1+\frac{\xi}{\psi})^{B+2}\mathcal{B}(B+1,2) F\left(\frac{1-\overline{q}}{1+\xi/\psi}; B+1, 2\right)}. \tag{37}$$

■

F.6 Proof for Proposition 5.

Proposition 5 (Drivers of listing decisions)**.**
For $\overline{q} \in (0,1)$ and $\theta, \psi, \nu_N, \xi > 0$, the equilibrium measure of non-listed firms M_N strictly

(i) increases in $\overline{q}$ (mandated transparency),

(ii) increases in θ (intangible share),

(iii) decreases in ψ (transparency's information content),

(iv) decreases in ν_N (private market friction),

(v) increases in ξ (baseline information level).

Proof.
See Appendix H. ■

Proof.

See Appendix G. ■

Proof.

i) We have

$$M_N = \frac{1}{1 + \psi \frac{\nu_N}{\xi}(1+\frac{\xi}{\psi})^{B+2}\mathcal{B}(B+1,2)F\left(\frac{1-\overline{q}}{1+\xi/\psi}; B+1, 2\right)}. \tag{38}$$

F decreases in $\overline{q}$, and M_N decreases in F. Thus, M_N increases in $\overline{q}$.

For the other results, we write M_N in the following form:

$$M_N = \frac{1}{1 + \psi \frac{\nu_N}{\xi}\int_0^{1-\overline{q}}(\frac{\xi}{\psi} + (\overline{q}+q))(1-\overline{q}-q)^B dq.} \tag{39}$$

ii) Taking the partial derivative with respect to θ, we get

$$\frac{\partial M_N}{\partial \theta} = \underbrace{-(M_N)^2}_{<0}\left(\underbrace{\psi \frac{\nu_N}{\xi}\int_0^{1-\overline{q}}(\frac{\xi}{\psi} + (\overline{q}+q))(1-\overline{q}-q)^B \overbrace{\frac{\partial B}{\partial \theta}}^{>0}\overbrace{log(1-q-\overline{q})}^{<0}\, dq}_{<0}\right) \tag{40}$$

$$> 0. \tag{41}$$

iii) Taking the partial derivative with respect to ψ, we get

$$\frac{\partial M_N}{\partial \psi} = \underbrace{-(M_N)^2}_{<0}\left(\underbrace{\frac{\nu_N}{\xi}\int_0^{1-\overline{q}}(\overline{q}+q)(1-\overline{q}-q)^B dq}_{>0}\right) \tag{42}$$

$$< 0. \tag{43}$$

iv) Taking the partial derivative with respect to ν_N, we get

$$\frac{\partial M_N}{\partial \nu_N} = \underbrace{-(M_N)^2}_{<0} \left(\underbrace{\frac{\psi}{\xi} \int_0^{1-\overline{q}} (\frac{\xi}{\psi} + (\overline{q} + q))(1 - \overline{q} - q)^B dq}_{>0} \right) \tag{44}$$

$$< 0. \tag{45}$$

v) Taking the partial derivative with respect to ξ, we get

$$\frac{\partial M_N}{\partial \xi} = \underbrace{-(M_N)^2}_{<0} \left(\underbrace{\psi \nu_N \int_0^{1-\overline{q}} (\overline{q} + q) \overbrace{\left(-\frac{1}{\xi^2}\right)}^{<0} (1 - \overline{q} - q)^B dq}_{<0} \right) \tag{46}$$

$$> 0. \tag{47}$$

■

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