The Macro Impact of Short-Termism*

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Abstract

R&D investment reduces current profits, so short-term pressure to hit profit targets may distort R&D. In the data, firms just meeting Wall Street forecasts have lower R&D growth and subsequent innovation, while managers just missing receive lower pay. But short-termist distortions might not quantitatively matter if aggregation or equilibrium dampen their impact. So I build and estimate a quantitative endogenous growth model in which short-termism arises naturally as discipline on conflicted managers and boosts firm value by about 1%. But short-termism reduces R&D, and the social return to R&D is higher than the private return due to standard channels including knowledge spillovers and imperfect competition. So at the macro level, short-termist distortions slow growth by 5 basis points yearly and lower social welfare by about 1%.

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JEL Codes: E20, G30, O40

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Managers of the largest firms in the US economy face relentless scrutiny of their short-term profits. The managing director of McKinsey & Company recently summarized the situation, writing "the mania over quarterly earnings [profits] consumes extraordinary amounts of senior executive time and attention." Commentators have long suspected that short-termist profit pressures lead managers to sacrifice investment, innovation, or even financial stability.[1] In this paper I quantitatively study the impact of short-term profit pressures or "short-termism" for firms and the economy.

Each fiscal period, public firms must disclose their profits. Small armies of analysts forecast profits, and the financial press widely reports consensus forecasts for a given firm. During earnings season when profits are revealed, firm performance is routinely compared to these short-term targets. Around 90% of recently surveyed US managers report pressure to meet short-term profit targets (Graham et al., 2005), and the pattern of firm profits in the data supports this notion. Figure 1 plots the distribution of forecast errors, realized profits minus consensus analyst forecasts, for a large panel of US public firms in recent decades.[2] Two facts stand out. First, firm profits bunch just above forecasts or at zero in the error distribution.[3] Second, relatively few firm-years display narrow misses. Figure 1 suggests some form of systematic pressure to meet profit targets.

In the face of short-term profit pressure, long-term investments like research and development (R&D) provide a choice target for manipulation, since they equal around 60% of profits for a typical firm.[4] While R&D's benefits may appear much later or fail to materialize altogether, the costs are borne today through lower profits. Some firms must therefore choose between R&D cuts or meeting targets. Almost half of surveyed US executives report a preference to reject a positive NPV project over missing their analyst target (Graham et al., 2005).

Drawing on a dataset of millions of analyst forecasts, combined with long-term

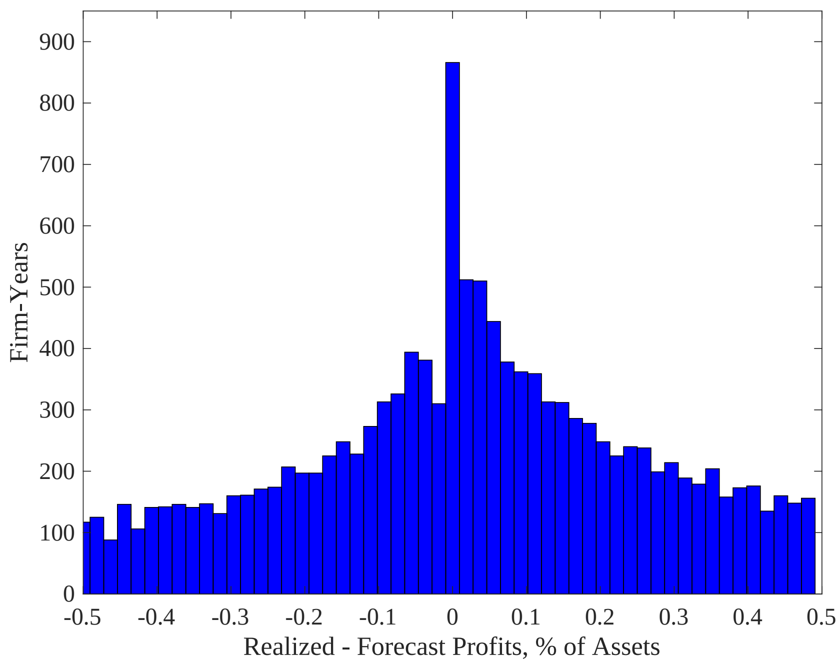
[1]See, for example, Stein (1989), Haldane and Davies (2011), Schwenkler et al. (2019), Budish et al. (2015), Rahmandad et al. (2014), Gigler et al. (2014), Kanodia and Sapra (2015), Markoff (1990), Mayer (2012), Michie (2001), Almeida (2019), Gutiérrez and Philippon (2017), or Gutiérrez and Philippon (2018). The quote is from Barton (2011).

[2]Section 1 and Appendix B provide more information on the data.

[3]Figure 1's pattern is neither novel nor fragile. Marinovic et al. (2012) and Hong and Kacperczyk (2010) overview analyst forecasts, while Derrien and Kecskés (2013) and He and Tian (2013) link the level of analyst coverage to innovation at firms. Burgstahler and Chuk (2017) emphasizes that the discontinuity is robust. See Garicano et al. (2016), Gourio and Roys (2014), Chetty et al. (2011), Daly et al. (2012), and Allen and Dechow (2013) for similar bunching in other contexts.

[4]This is the mean ratio of R&D to profits in my Section 1 dataset.

Figure 1: Profit Forecast Error Distribution



Notes: The forecast error histogram above is drawn from a 2003-18 sample of 4,703 US public firms for a total of 30,090 firm-year observations. 98% of the sample lies within the bounds above, ±0.5%, and 3% of the sample lies within the bin at or just above zero forecast errors. Realized profits are pro forma fiscal year earnings, forecast profits are median analyst forecasts at a 4-quarter horizon, and forecast errors (realized minus forecast profits) are expressed as a percentage of firm assets. Profit variables are from IBES, and firm assets are from Compustat.

investment, innovation, executive compensation, and stock returns, I build on an empirical literature in finance and accounting by comparing US public firms just meeting and just missing targets (Baber et al., 1991; Roychowdhury, 2006; Gunny, 2010; Almeida et al., 2016, 2021, 2022). Firms just meeting have lower R&D growth and subsequent patenting, consistent with opportunistic cuts. Moving to other measures, CEOs just missing receive lower total compensation and then depart their firms more often. Conditional upon even a narrow miss, their firms exhibit lower stock returns. Managers appear justified in fears of missing profit targets.

Motivated by such evidence, this paper pursues two questions. First, why does short-term pressure exist? Instead of insulating managers, firm owners and boards appear to implicitly tolerate or explicitly impose short-term pressure. I argue that, at the micro level, short-termism disciplines managers and boosts firm value. Second, I ask whether short-term pressures matter quantitatively, since aggregation or equilibrium might reduce their quantitative relevance. My answer is yes. Short-term discipline on managers reduces R&D. But the social return to R&D is higher than the private return, due to standard channels including both positive knowledge spillovers in innovation and less than full appropriation of surplus by imperfectly competitive firms (Jones and Williams, 2000). As a result, short-termism causes meaningfully lower US growth and welfare at the macro level.

I start with a toy model describing micro-level short-termism. R&D creates long-term benefits for firms. But managers get private benefits from R&D. These benefits, akin to empire building or prestige motives because R&D increases the scale of the firm under the manager's control, push managers towards overinvestment from the firm's perspective. Broadly related tendencies towards overinvestment in some form, whether through activities such as capital accumulation or external mergers and acquisitions, are a traditional object of study in corporate finance (Jensen, 1986; Nikolov and Whited, 2014; Glover and Levine, 2017). In response to this agency conflict, firm boards optimally choose costs for managers missing short-term profit targets.[5] In equilibrium, such short-termism fully undoes incentive conflicts and lowers R&D to its value-maximizing level. So discontinuous short-termism is optimal for firms as a form of cost discipline. This result proves true even though profit targets come from rational analyst forecasts and even though profits contain non-fundamental noise.

The toy model lacks features needed to confront microdata and provide quantitative macro insights. So I extend the toy model into a general equilibrium structure with heterogeneous firms. Firm R&D yields innovation of new goods varieties and positive innovation externalities in the endogenous growth tradition (Romer, 1990; Aghion and Howitt, 1992; Grossman and Helpman, 1991). Heterogeneous firms face persistent, fundamental shocks and non-fundamental profit noise. Analysts observe firm fundamentals, understand manager incentives, and rationally forecast profits. Managers with private benefits from R&D also possess private information about current profit noise while making decisions about R&D and non-fundamental account-

[5] The study of agency or governance conflicts in models of innovation and growth is an expanding area of study, with multiple important contributions in recent years (Iacopetta et al., 2019; Iacopetta and Peretto, 2021; Celik and Tian, 2021).

ing or "accruals" manipulation of profits. Firm boards solve a constrained problem, choosing short-termist incentives to maximize firm value. Short-term incentives lower R&D levels and generate misallocation through opportunistic cuts. In general equilibrium, a stationary distribution of firms generates aggregate balanced growth and influences a representative household's welfare.

I structurally estimate the model with the simulated method of moments (SMM). The parameters govern not only familiar objects like the persistence and volatility of firm shocks or the R&D elasticity of innovation but also manager preferences governing the extent of agency conflicts and the resulting short-termism. I target moments computed in my microdata. The covariance of sales, profits, R&D, and forecast error series helps identify parameters governing fundamentals, while the extent of bunching at the zero forecast error threshold helps identify the degree of short-termism and hence manager conflicts. I estimate meaningful firm heterogeneity through a combination of persistent fundamentals and profit noise, R&D elasticities in line with conventional estimates, and manager conflicts leading optimally to moderate short-termism in manager compensation.

Counterfactuals comparing the estimated economy to one with no short-term incentives reveal micro and macro impacts. At the micro level, short-termism boosts mean R&D costs by 2.4% since R&D raises the likelihood of missing targets. The extra discipline boosts firm value by over 1%, a substantial motive for firms to either explicitly impose or implicitly allow short-termism. At the macro level, distorted R&D creates negative innovation externalities not internalized by firms. A US economy without short-termism would feature around 5 basis points more growth each year – raising output by about 0.25% over each five-year period – and an increase of more than 1% of consumption-equivalent welfare. For some comparison, recent quantitative estimates place the welfare costs of business cycles at around 0.1-1.8%, the static gains from trade around 2.0-2.5% or more, and the welfare costs of inflation near 1%, figures in the same order of magnitude as the costs of short-termism.

Unpacking the zero forecast error threshold in the model yields two further insights. First, bunching and threshold effects increase with manager private information.[6] Although bunching is absent without short-termism, providing a tell-tale

[6]The term "bunching" refers to a disproportionate mass of firms just above rather than just below profit targets, and the term "threshold effects" refers to differences in outcomes such as R&D investment between firms just meeting and just failing to meet profit targets. Both of these patterns are local to the zero forecast error threshold.

detection mechanism, bunching also reflects higher manager ability to evade targets. So the quantitative impact of short-termism doesn't necessarily increase with observed distortions at forecast error thresholds. Quantitative counterfactual analysis in my model consistent with the global behavior of firms offers substantial information beyond that contained in my local reduced form estimates of short-term distortions for firms. Second, short-termism generates endogenous selection at the zero forecast error threshold. Firms with higher fundamentals can better afford opportunistic cuts and are therefore overrepresented among firms just meeting targets. A model extending mine with more substantial information frictions might therefore rationalize discontinuous stock market reactions to meeting short-term targets. My structure is therefore consistent with the idea that some short-term profit pressure arises in practice from capital markets and information frictions, a long-espoused theoretical view (Stein, 1989; Bebchuk and Stole, 1993).

In a range of robustness checks, I first investigate changes to the innovation function allowing for either long-lived R&D capital or unobserved heterogeneity in R&D project quality. I then conduct multiple exercises such as varying each model parameter, re-estimating with different time windows, subsamples, or alternative variable definitions, and even allowing for a fraction of R&D to be conducted by private firms without incentive conflicts. Although the exact quantitative magnitudes vary, my checks reveal qualitatively similar impacts from short-termism.

Overall, my analysis suggests that the benefits of liquid capital markets, transparent reporting, and disciplined managers aren't free. Closely associated short-termist behavior creates a nontrivial drag on growth and welfare.

Section 1 analyzes short-term targets in the data. Section 2 analyzes a toy short-termism model. Section 3 introduces my quantitative model. Section 4 estimates the impact of short-termism. Section 5 provides further discussion and robustness checks. Section 6 concludes. Appendix A contains details on the baseline quantitative model. Online appendices contain details on the data (Appendix B), extended models (Appendix C), and the estimation and quantitative analysis (Appendix D).

1 Data

I draw on two main data sources. First, I exploit millions of profit forecasts at the firm-analyst-fiscal year level from the Institutional Broker's Estimate System (IBES) database. Realized values of firm "Street" profits accompany analyst forecasts in IBES.[7] I also use Compustat data from annual US public firm income statements. Linking the IBES and Compustat datasets results in a panel of around 11,000 firm-fiscal year observations with consensus analyst forecasts, Street realizations, and various firm financials. Around 1,500 firms from 1990-2018 are available in the combined panel. My sample primarily consists of larger firms, which together conduct about 51% of US R&D expenditures in 2018. I also, where possible, link to Execucomp executive pay and career data, Center for Research in Security Prices (CRSP) stock return data, and USPTO patenting outcomes from Kogan et al. (2017). Appendix B provides further detailed information on my data, variable definitions, and sample construction, with descriptive statistics in Table B.1.

My forecast error measure for a given firm-year is the realized value of Street profits minus median analyst forecasts from the start of the same fiscal year, scaled by firm assets. This measure, plotted in Figure 1, guarantees comparability with existing empirical work and reflects the need to normalize by some measure of scale.[8] Profit bunching just above forecasts suggests that firms near targets may engage in some behavior(s) to avoid small misses. If so, firms just meeting short-term targets may differ on observables from firms just missing. Motivated by this logic, I compare firms that just meet and just miss, applying a standard regression discontinuity estimator in Table 1 to various outcomes of interest by estimating a local linear regression

$$X_{jt} = \alpha + \beta fe_{jt} + \gamma fe_{jt}\mathbb{I}(fe_{jt} \geq 0) + \delta\mathbb{I}(fe_{jt} \geq 0) + \varepsilon_{jt}. \qquad (1)$$

Here, X_{jt} is some outcome of interest for firm j in year t, and fe_{jt} is the associated forecast error. The estimate of interest, $\hat{\delta}$, represents the local difference in the conditional mean of X between firms just meeting relative to firms just missing short-term analyst forecasts. Note that I first demean outcomes by firm then year, controlling for both permanent heterogeneity across firms as well as business-cycle effects.

Panel A examines firm investment. Column (1) reveals that R&D growth is 4.4% lower for firms just meeting targets. An alternative intangible investment measure (selling, general, and administrative expenditures, or SG&A) includes advertising

[7]Street earnings, over which firms possess more discretion, are more widely followed than the GAAP profit measures reported in Compustat (Bradshaw and Sloan, 2002).

[8]Bunching in forecast error distributions such as that in Figure 1 relies on neither the precise forecast horizon nor the scaling measure (Burgstahler and Eames, 2006).

Table 1: Outcomes at the Zero Forecast Error Threshold

	(1)	(2)	(3)
Panel A: Investment Growth	R&D	SG&A	Capital
Mean Chg. at 0 Threshold (p.p.)	-4.44***	-3.51***	-2.00
	(1.55)	(1.01)	(1.53)
Standardized (%)	-17.5	-23.9	-4.6
Fixed Effects	Firm, Year	Firm, Year	Firm, Year
Observations	10,664	10,664	10,664
Panel B: Subsequent Innovation Growth	Raw Patenting	Market-Valued Patenting	Cite-Weighted Patenting
Mean Chg. at 0 Threshold (p.p.)	-23.0***	-5.61*	-1.15*
	(7.16)	(3.36)	(0.605)
Standardized (%)	-32.1	-13.1	-15.5
Fixed Effects	Firm, Year	Firm, Year	Firm, Year
Observations	3,646	3,646	3,646
Panel C: CEO's, Returns	CEO Pay	CEO Turnover	Stock Returns
Mean Chg. at 0 Threshold (p.p.)	3.63**	-3.63***	4.44**
	(1.67)	(1.27)	(1.81)
Standardized (%)	6.2	-11.0	-
Fixed Effects	Firm, Year, Executive	Firm, Year, Executive	Market Adjusted
Observations	24,448	24,448	50,579

Notes: Estimates are mean predicted differences for the outcome in p.p. for firms just meeting to just missing forecasts. Standardized values scale estimates by the outcome's residualized standard deviation and multiply by 100. *,**,*** denote 10, 5, 1% significance. Standard errors are clustered by firm. Local linear regression discontinuities estimated with a triangular kernel and optimal Calonico and Farrell (2020) bandwidth. Running variable is forecast errors, pro forma profits minus median analyst forecasts relative to firm assets from a four-quarter horizon (Panels A and B) or one-quarter horizon (Panel C). Investment measures are in growth rates. R&D is research and development. SG&A is selling, general, and administrative expenses. Capital expenditure is spending on plants, property, and equipment. Patenting is patents issued by the firm in the subsequent four years, with measures in growth rates or differences. Raw patenting is the inverse hyperbolic sine of patents. Market-valued patenting is patents' market value to assets. Citation-weighted patenting is patents' citation weights to firm assets. CEO pay is log total compensation for CEO's and CFO's. CEO turnover is an indicator for CEO or CFO turnover in the following year. Returns are standardized cumulative market-adjusted stock returns in a 10-day window to the earnings announcement.

and various other nonproduction expenses.[9] Column (2) reports that SG&A growth is 3.5% lower for firms just meeting targets. The R&D and SG&A discontinuities are moderately large, each reflecting a drop relative to one standard deviation of around 20%. By contrast, in column (3) growth in tangible investment does not precisely vary across the threshold. An accounting digression is useful. Tangible investment in column (3), creating straightforward assets, is not immediately subtracted from profits but instead gradually expensed as depreciation. Under US Generally Accepted Accounting Principles (GAAP), firms immediately subtract R&D (and SG&A) in columns (1)-(2) from profits (FASB, 1974). So R&D or SG&A cuts mechanically boost short-term profits, while cuts to capital expenditures have less impact.

How might firms cut R&D practically? Compustat doesn't break down R&D, but NSF business surveys do. About 40% of 2008 internal US R&D budgets were materials, specialized equipment, or facilities, with the rest spent on staff.[10] By cutting supplies or reducing facilities costs a firm can quickly cut large portions of R&D, hampering its innovation, while staff cuts can yield even more cost reductions. But even if real cuts to research inputs are possible, one might worry that Panel A's R&D results reflect creative accounting. This sort of manipulation is constrained by the fact that R&D budgets outlined above primarily reflect nonproduction expenses, difficult to reclassify in a way that avoids subtraction from current profits. Still, Panel B turns to external measures of innovation - not directly subject to profit pressure - based on patenting. Patent grant lags are heterogeneous and sometimes lengthy. So I consider patenting over the next four years, but Appendix Table B.2 verifies that the exact horizon isn't crucial. In column (1), new patent growth is 23% lower for firms just meeting targets. But patent counts, though transparent, do not incorporate quality information. Column (2) reports that growth in the value of patents, measured using stock market event studies, is lower by 5.6% of assets for firms just meeting targets. Column (3) reveals that citation-weighted patenting growth relative to firm assets is 1.2% lower for firms just meeting targets. The declines in patenting outcomes just above targets are meaningful, reflecting drops relative to one standard deviation ranging from about 15-30%.

Panel C examines manager outcomes and firm stock returns, both perhaps linked

[9] Work highlighting this intangible investment measure includes Eisfeldt and Papanikolaou (2014), Peters and Taylor (2017), and Gourio and Rudanko (2014).

[10] See Table 6 of the 2008 Business R&D and Innovation survey, entitled "Domestic R&D paid for and performed by the company, by type of cost, industry, and company size: 2008."

to the short-term incentives of firm decisionmakers. Columns (1) and (2) use data on outcomes for CEOs and CFOs at the executive-firm-fiscal year level. Column (1) reveals that managers' total mean compensation is 3.6% higher when just meeting targets. In column (2), their likelihood of turnover or departure from the firm in the following year is 3.6 percentage points lower, relative to a mean of 12.3 percentage points. Column (3) examines standardized cumulative abnormal stock returns in a 10-day window to the firm's financial statement, with a moderately large increase of 4.4 percent for firms just meeting targets.

Three comments are useful. First, Table 1 doesn't present causal evidence. Discontinuities are not "the effect of meeting a profit target" but instead serve as an endogenous detection mechanism. Second, although I present results in one location with a standard discontinuity estimator, findings of anomalous outcomes for firms around profit targets are not entirely novel. An accounting literature documents "earnings manipulation" including apparent R&D cuts around targets.[11] Discontinuous manager pay and stock returns also link to an empirical literature.[12] Third, disaggregated reduced-form facts do not immediately map to aggregate conclusions. Such facts represent local, relative variation which could mechanically average out at the aggregate level, does not rationalize short-term incentives, and does not provide general equilibrium counterfactual analysis of an economy without short-term incentives. I now turn to building a model filling these gaps.

2 Short-Termism as Optimal Cost Discipline

A toy model shows that apparent short-termism can arise through optimal cost discipline on managers with agency conflicts. Consider a single firm for two periods, t (today) and $t+1$ (tomorrow). The firm profits from products with mass M_t today and M_{t+1} tomorrow. R&D investment W_t innovates new products M_{t+1} through

$$M_{t+1}(W_t) = \bar{\xi} W_t^{\gamma}, \tag{2}$$

[11] See Baber et al. (1991), Roychowdhury (2006), or Gunny (2010) for seminal contributions to this empirical strategy.

[12] See MacKinlay (1997), McNichols (1989), Bartov et al. (2002), Kasznik and McNichols (2002), Liu et al. (2009), Matsunaga and Park (2001), Edmans et al. (2017), Asch (1990), Eisfeldt and Kuhnen (2013), Larkin (2014), Murphy (1999), Murphy (2001), Oyer (1998), Jenter and Lewellen (2020), Bhojraj et al. (2009), or Jenter and Kanaan (2015).

where $\bar{\xi} > 0$ and $0 < \gamma < 1$. The firm takes as given cash flows $\bar{\pi} > 0$ per product, the real interest rate $R > 1$, and the mass M_t today. Firm value $V(W_t)$ is

$$V(W_t) = \bar{\pi} M_t - W_t + \frac{1}{R} \bar{\pi} M_{t+1}(W_t). \quad (3)$$

Today's profits are cash flows plus accounting noise

$$\Pi_t = \bar{\pi} M_t - W_t + \nu_t, \quad \nu_t \sim N(0, \sigma_\nu^2). \quad (4)$$

Noise ν_t, with CDF F_ν and PDF f_ν, is unobservable when R&D W_t is chosen. Outside analysts observe the product mass M_t and make a profit forecast

$$\Pi_t^f = \bar{\pi} M_t - W_t^f \quad (5)$$

linked one-for-one with an R&D forecast W_t^f.

A risk-neutral manager chooses R&D. Their board-determined compensation is a fraction $\theta_d > 0$ of firm value net of a short-termist clawback $\theta_\pi \geq 0$ when profits fall below the forecast Π_t^f. The manager receives a private benefit $\phi_e > 0$ from R&D, representing research prestige or empire building. The manager's objective, without loss of generality normalizing $\theta_d = 1$, is

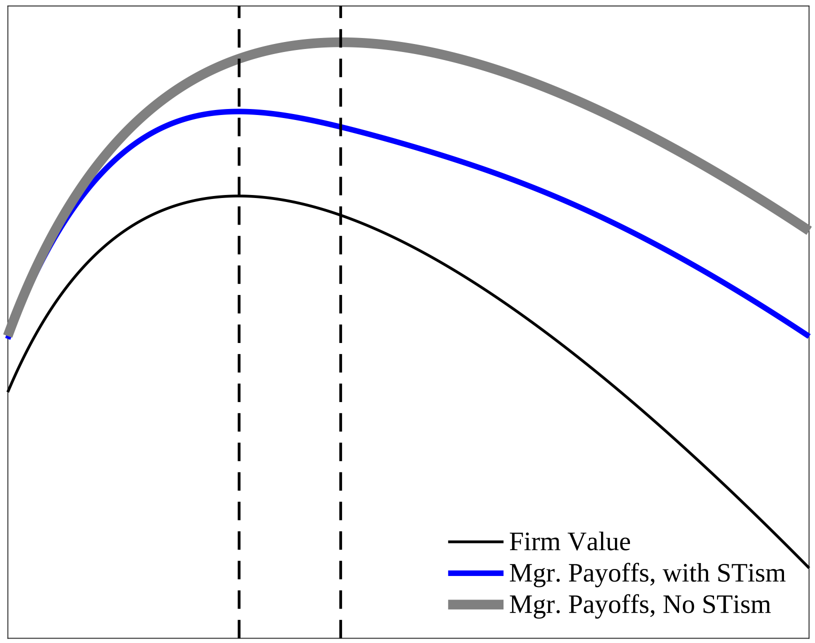
$$V_m(W_t|\theta_\pi, W_t^f) = \bar{\pi} M_t - W_t + \frac{1}{R} \bar{\pi} M_{t+1}(W_t) - \theta_\pi \mathbb{P}(\Pi_t < \Pi_t^f) + \phi_e W_t. \quad (6)$$

The probability of missing a short-term profit target $\mathbb{P}(\Pi_t < \Pi_t^f) = \mathbb{P}(\bar{\pi} M_t - W_t + \nu_t < \bar{\pi} M_t - W_t^f) = F_\nu(W_t - W_t^f)$ increases in R&D W_t.

Consider an equilibrium with rational forecasts and optimal compensation defined as a triple $(W_t^*(\theta_\pi), W_t^f(\theta_\pi), \theta_\pi^*)$. $W_t^*(\theta_\pi)$ is a schedule of manager R&D choices, $W_t^f(\theta_\pi)$ is a schedule of analyst R&D forecasts, and θ_π^* is optimal board-chosen short-term incentives. Equilibrium requires that i) manager R&D optimizes their payoffs with $W_t^*(\theta_\pi) = \arg\max_{W_t} V_m(W_t|\theta_\pi, W_t^f(\theta_\pi)) \ \forall \ \theta_\pi$, ii) analysts forecast rationally with $W_t^f(\theta_\pi) = W_t^*(\theta_\pi) \ \forall \ \theta_\pi$, and iii) board-chosen compensation maximizes firm value with $\theta_\pi^* = \arg\max_{\theta_\pi} V(W_t^*(\theta_\pi))$.

For an illustrative parameterization, Figure 2 plots firm value $V(W_t)$ in the light black line, manager equilibrium payoffs with optimal short-termism $V_m(W_t|\theta_\pi^*, W_t^f)$ in the medium blue line, and counterfactual manager payoffs with no short-termism

Figure 2: Manager versus Firm Incentives



Notes: The figure plots firm versus manager incentives in the toy model. The horizontal axis is R&D expenditures. The thin black line is firm value. The medium-weight blue line is manager payoffs with short-term incentives θ_π^* chosen optimally by the firm. The heavy gray line is manager payoffs with no short-term incentives $\theta_\pi = 0$. The left dashed vertical line indicates optimal R&D choices for firm value and for the manager with optimal incentives. The right dashed vertical line indicates the optimal R&D choice for a manager with no short-term incentives.

$V_m(W_t|\theta_\pi = 0)$ in the thick gray line as functions of R&D W_t. The left dotted vertical line locates value-maximizing R&D satisfying the optimality condition

$$1 = \frac{1}{R}\bar{\pi}\bar{\xi}\gamma W_t^{\gamma-1}. \tag{7}$$

The marginal cost of R&D on the left of (7) equals the discounted marginal profits from R&D on the right. A manager's optimal R&D choice satisfies

$$1 - \phi_e + \theta_\pi f_\nu(W_t - W_t^f) = \frac{1}{R}\bar{\pi}\bar{\xi}\gamma W_t^{\gamma-1}. \tag{8}$$

Manager private benefits ϕ_e lower the net marginal R&D cost on the left of (8).

So with no short-term incentives $\theta_\pi = 0$, the right dotted vertical line in Figure 2 indicates that R&D exceeds the value-maximizing level. But short-term incentives θ_π offset this force, since at the margin R&D raises the probability of missing the profit target. In equilibrium with optimal short-termism $\theta_\pi^* > 0$ and rational forecasts, the manager's R&D choice matches the value-maximizing choice. The value-maximizing and manager R&D optimality conditions (7) and (8) fully coincide in equilibrium when

$$\theta_\pi^* f_\nu(0) = \phi_e. \tag{9}$$

Optimally, therefore, short-term incentives θ_π^* vary proportionally with the agency conflict's size ϕ_e, exactly offsetting manager's private benefits from R&D and imposing cost discipline through a profit target that fully recovers value maximization. Note that the restriction to discontinuous short-term incentives does not impose a binding constraint on the board's contract structure in this toy model, since full value maximization can be achieved through the resulting decline in the level of R&D.[13]

So short-termist profit targets can optimally preserve firm value, placing cost discipline on managers who privately prefer to invest more in R&D. Firm boards can use widely available analyst forecasts as a convenient tool for this discipline, either explicitly through compensation as modelled above or implicitly by declining to shield managers from external pressures. But the toy model is incomplete in two dimensions. First, in endogenous growth models, the social returns to R&D are often higher than the private returns. For example, more R&D today and more ideas reduce future innovation costs, a positive externality absent in the toy model. Second, the toy model lacks some quantitatively realistic features which will be needed to confront my firm microdata such as persistent heterogeneity, private manager information, and accounting-based tools for profit manipulation. I now present a general equilibrium endogenous growth model with these features.

[13]Two technical comments are in order. First, firm value $V(W_t)$ neglects manager compensation without loss of generality after allowing for a fixed component of compensation ensuring mean zero manager pay without impact on risk-neutral manager choices. Second, a well behaved equilibrium requires sufficiently small manager private R&D benefits ϕ_e and sufficiently high profit noise σ_ν. In this case, R&D W_t^* varies weakly with forecasts W_t^f. The result is single crossing with existence and uniqueness of R&D choices coinciding with forecasts for a given θ_π. The concavity of firm value in R&D, inherited by the board objective, then delivers a unique optimal level of θ_π^*. Both comments also apply to my full quantitative model as well. In practice, equilibrium existence failure is straightforward to numerically detect through cycling in manager R&D choices and analyst forecasts, and I discard such parameterizations in my quantitative work.

Table 2: Model Summary

Panel A: Aggregates	
Household preferences	$\sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\eta}}{1-\eta}$
Final goods production	$Y_t = L_t^{1-\alpha} \int_0^{Q_t} z_{jt}^{1-\alpha} x_{jt}^{\alpha} dj$
Variety growth	$Q_{t+1} = M_{t+1} + Q_t$
Panel B: Firms	
Variety innovation	$M_{kt+1} = \bar{\xi} W_{kt}^{\gamma} Q_t^{1-\gamma}$
Persistent demand	$\log z_{kt+1} = \rho \log z_{kt} + \zeta_{kt+1},\ \zeta_{kt+1} \sim N(0, \sigma_z^2)$
Profit noise	$\varepsilon_{kt} \sim N(0, \sigma_\varepsilon^2)$ (obs.), $\nu_{kt} \sim N(0, \sigma_\nu^2)$ (unobs.)
Profits definition	$\Pi_{kt} = M_{kt}\pi_{Mkt} - W_{kt} + \nu_{kt}Q_t + \varepsilon_{kt}Q_t + A_{kt}$
Payouts	$D_{kt} = \pi_{Mkt}M_{kt} - W_{kt}$
Firm value	$V_{kt} = \left[D_{kt} + \frac{1}{R_{t+1}}\mathbb{E}_{kt}V_{kt+1}\right]$
Stationary distribution	$F\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}\right)$
Panel C: Managers	
Compensation	$D_{kt}^M = \theta_d \left(-W_{kt} + \frac{1}{R_{t+1}}\mathbb{E}_t\left(\pi_{Mkt+1}M_{kt+1}\right)\right) - \theta_\pi \mathbb{I}\left(\Pi_{kt} < \Pi_{kt}^f\right)$
Flow in RN preferences	$D_{kt}^M + \phi_e W_{kt} - \phi_a \left(\frac{A_{kt}}{Q_t}\right)^2 Q_t$
Panel D: Analysts	
Rational forecasts	$\Pi_{kt}^f = \mathbb{E}\left[\Pi_{kt} \mid z_{kt}, M_{kt}, Q_t\right]$
Panel E: Boards	
RN over firm value	$\int v\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}\right) dF\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}\right),\ v(\cdot)Q_t = V(\cdot)$

Notes: Each panel in the table presents a list of key definitions and expressions within the model relating to a particular level of aggregation or economic agent.

3 Quantitative Model of Short-Termism

Time t is discrete with no macro uncertainty. A household, a final goods sector, heterogeneous intermediate goods firms run by managers under board discipline, and forecasting analysts all optimize in general equilibrium. The economy expands with a variety measure in the endogenous growth tradition of Romer (1990). For reference, Table 2 provides a summary of key model definitions and equations, each later fleshed out in further detail.

3.1 Household

A representative household at time t owns final goods firms, intermediate goods firms, and land, solving the consumption-savings problem

$$\max_{\{B_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\eta}}{1-\eta} \quad \text{s.t.} \tag{10}$$

$$C_t + B_{t+1} = B_t R_t + P_t^L L_t + D_t^{Final} + D_t^{Int} \quad \forall t \geq 0. \tag{11}$$

Preferences satisfy $0 < \beta < 1$ and $\eta > 0$. Savings B_{t+1} in period t in a one-period bond yield real interest rate R_{t+1}. Land is in exogenous fixed unit supply $L_t = 1$ with price P_t^L. D_t^{Final} and D_t^{Int} are payouts of the final and intermediate goods sectors. Household optimal savings satisfy

$$\frac{1}{C_t^{\eta}} = \beta R_{t+1} \frac{1}{C_{t+1}^{\eta}}, \tag{12}$$

linking a constant rate R to the macro growth rate g under balanced growth.

3.2 Final Goods

A competitive final goods sector statically maximizes profits, solving

$$\max_{\{x_{jt}\}_j, L_t} L_t^{1-\alpha} \int_0^{Q_t} z_{jt}^{1-\alpha} x_{jt}^{\alpha} dj - P_t^L L_t - \int_0^{Q_t} p_{jt} x_{jt} dj. \tag{13}$$

The first term is numeraire gross output Y_t with a constant returns technology combining land L_t in share $0 < 1-\alpha < 1$ under price P_t^L with an expanding continuum of varieties $j \in [0, Q_t]$ of intermediate goods used in quantity x_{jt} with price p_{jt}. An exogenous demand shock z_{jt} described below shifts the marginal product of and hence demand for each good j. Final demand for intermediate j, substituting $L_t = 1$, is

$$x_{jt} = z_{jt} \left(\frac{\alpha}{p_{jt}} \right)^{\frac{1}{1-\alpha}}. \tag{14}$$

Constant returns yield zero equilibrium payouts from the final goods sector.

3.3 Intermediate Goods

A unit mass of firms $k \in [0, 1]$ innovates and produces new intermediate varieties for sale to the final goods sector. Innovation of a new variety entitles a firm to one-period monopoly patent protection.[14]

Static Monopoly Firm k arrives in t with a mass of previously innovated products M_{kt} under monopoly patent protection. All goods j in this portfolio are subject to the same firm-level persistent exogenous demand shock z following

$$\log z_{kt+1} = \rho \log z_{kt} + \zeta_{kt+1}, \quad \zeta_{kt+1} \sim N(0, \sigma_z^2), \tag{15}$$

where $0 < \rho < 1$ and $\sigma_z > 0$. Firms face identical marginal production costs $\psi > 0$. Firm k solves the good j static monopoly pricing problem

$$\max_{p_{jt}} p_{jt} x_{jt}(p_{jt}, z_{kt}) - \psi x_{jt}(p_{jt}, z_{kt}). \tag{16}$$

Given isoelastic demand in (14), optimal prices follow a constant-markup rule $p_M = \frac{\psi}{\alpha}$. Optimal monopoly profits per variety are proportional to a firm's demand shock

$$\pi_{Mkt} = p_M x(p_M, z_{kt}) - \psi x(p_M, z_{kt}) = (1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}} \psi^{-\frac{\alpha}{1-\alpha}} z_{kt}, \tag{17}$$

and total monopoly production profits for firm k are $M_{kt}\pi_{Mkt}$. A competitive fringe with common demand shock $z = 1$ produces all off-patent varieties with pricing at marginal cost $p_C = \psi$ resulting in zero profits for such goods.

Dynamic Innovation Firm k's R&D investment W_{kt} yields innovation of new varieties next period with mass

$$M_{kt+1} = \bar{\xi} W_{kt}^{\gamma} Q_t^{1-\gamma}, \tag{18}$$

where R&D productivity and the R&D elasticity of innovation satisfy $\bar{\xi} > 0$ and $0 < \gamma < 1$. The current aggregate variety mass Q_t, boosting innovation through a

[14] The one-period monopoly protection used here is clearly a simplification, although versions of the model with longer-lived monopoly protection bear substantial similarity to a version of the model with long-lived R&D capital analyzed below in Section 5.2.

positive externality in (18), evolves with the collective R&D investments of firms via

$$Q_{t+1} = M_{t+1} + Q_t, \tag{19}$$

where $M_{t+1} = \int_k M_{kt+1} dk$ is the total newly innovated mass at $t+1$.

Firm Profits Firm k's profits are production profits net of R&D costs adjusted for accounting noise and manipulation:

$$\Pi_{kt} = M_{kt}\pi_{Mkt} - W_{kt} + \nu_{kt} Q_t + \varepsilon_{kt} Q_t + A_{kt}. \tag{20}$$

Above, $\varepsilon_{kt} \sim_{iid} N(0, \sigma_\varepsilon^2)$ is noise observable to the firm when decisions are made, $\nu_{kt} \sim_{iid} N(0, \sigma_\nu^2)$ is noise unobservable to the firm when decisions are made, and A_{kt} is accounting or accruals manipulation.[15]

Manager A risk-neutral manager at each firm decides R&D W_{kt} and manipulation A_{kt}. Board-determined compensation includes an equity share θ_d of firm payouts, without loss of generality normalized to 1, and $\theta_\pi \geq 0$ units clawed back if profits Π_{kt} fall below an analyst profit forecast Π_{kt}^f. The manager receives private benefits $\phi_e > 0$ from R&D while bearing a quadratic private cost of accounting manipulation scaling with $\phi_a > 0$. The time-t manager decision solves

$$\max_{W_{kt}, A_{kt}} -W_{kt} + \frac{1}{R_{t+1}} \mathbb{E}_t \left(\pi_{Mkt+1} M_{kt+1}\right) - \theta_\pi \mathbb{P}\left(\Pi_{kt} < \Pi_{kt}^f\right) + \phi_e W_{kt} - \phi_a \left(\frac{A_{kt}}{Q_t}\right)^2 Q_t. \tag{21}$$

The first three terms are mean equity and short-term compensation. The remaining terms are private payoffs.[16]

[15] A rich literature on accruals manipulation in accounting emphasizes that real outcomes such as R&D are not the only tools available to managers for profit manipulation and that substitution between accruals manipulation and other distortions may matter quantitatively (Cohen et al., 2008). To economize on state variables, I model A_{kt} as a static choice, although richer dynamic models of accounting manipulation exist (Zakolyukina, 2018; Terry et al., 2021).

[16] Formally, I assume the compensation contract's flow payoffs at the end of t are $\theta_d \left(-W_{kt} + \frac{1}{R_{t+1}} \mathbb{E}_t \left(\pi_{Mkt+1} M_{kt+1}\right)\right) - \theta_\pi \mathbb{I}\left(\Pi_{kt} < \Pi_{kt}^f\right)$, normalizing $\theta_d = 1$ in (21). When $\theta_\pi = \phi_e = \phi_a = 0$, manager policies maximize firm value at equilibrium interest rates. Since under this timing manager time-t policies affect only time-t payoffs, the problem is formally static but fully nests value maximization without specification of manager preferences beyond risk-neutrality.

Analysts A mass of risk-neutral analysts receives private payoffs from accurately predicting profits. Analysts observe a firm's demand shock z_{kt} and variety mass M_{kt}. The analysts do not observe either component of profit noise ε_{kt} nor ν_{kt}. Analyst payoffs decline in mean squared prediction error. Their rational forecasts are

$$\Pi_{kt}^{f} = \arg\min_{\Pi^f} \mathbb{E}\left[\left(\Pi_{kt} - \Pi^f\right)^2 | z_{kt}, M_{kt}, Q_t\right] = \mathbb{E}\left[\Pi_{kt} | z_{kt}, M_{kt}, Q_t\right]. \tag{22}$$

Board of Directors Given manager R&D policies, themselves dependent on short-term incentives θ_π, firm value is the expected discounted value of payouts satisfying

$$V(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t) = \left[\pi_{Mkt} M_{kt} - W_{kt} + \frac{1}{R_{t+1}} \mathbb{E}\left(V(M_{kt+1}, z_{kt+1}, \varepsilon_{kt+1}, Q_{t+1}) | z_{kt}\right)\right]. \tag{23}$$

Under balanced growth, by exploiting homogeneity, firm value V can be written in stationary form $V(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t) = Q_t v\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}\right)$. Let $F\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}\right)$ be the unconditional firm stationary distribution from a given choice of θ_π. The board of directors of each firm commits to an optimal contracted level of short-term incentives θ_π^* to maximize the unconditional mean of firm value, solving

$$\max_{\theta_\pi} \int v\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt} | \theta_\pi\right) dF\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt} | \theta_\pi\right). \tag{24}$$

Recall that Section 2's toy model analysis revealed that this sort of discontinuous short-term incentive θ_π linked to analyst forecasts can be fully optimal for boards and induce value-maximization by managers. The extended quantitative model, however, includes features such as manager private information about noise – information exploited through R&D manipulation near analyst profit targets – which imply that the discontinuous incentives considered here are not necessarily fully optimal. The boards optimization problem is therefore a constrained contracting choice, albeit under constraints motivated naturally by both simpler theory in Section 2 and empirical evidence in Section 1. With no agency conflict the manager's equity share alone induces value maximization with optimal short-term compensation $\theta_\pi^* = 0$. With manager private R&D benefits $\phi_e > 0$, boards may impose short-termist incentives $\theta_\pi^* > 0$ to optimally constrain R&D.

3.4 Equilibrium and Solution

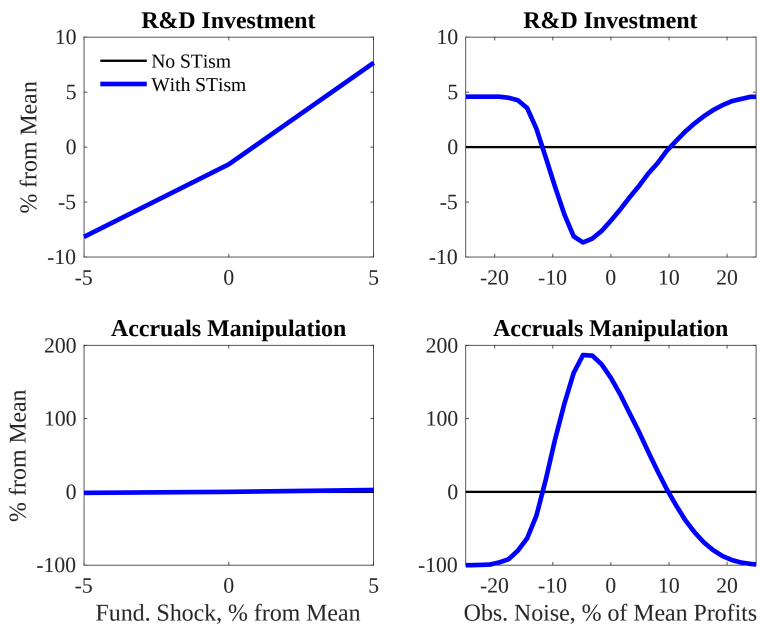
Appendix A defines and characterizes stationary general equilibrium with balanced growth. Equilibrium involves prices and quantities for intermediate goods, final goods, and land, aggregate growth and interest rates, manager R&D and manipulation policies, analyst profit forecasts, a stationary distribution of intermediate firms, short-term compensation contracts, and aggregate quantities such that i) final goods demand for intermediates and land solves (13), ii) intermediate goods monopoly prices solve (16), iii) manager policies solve (21), iv) analyst forecasts solve (22), v) short-term incentives solve (24), vi) the stationary distribution is consistent with manager policies and exogenous shocks, vii) the interest rate satisfies (12), viii) the growth rate is consistent with manager R&D policies and the stationary distribution, and ix) markets clear while aggregate quantities, growing at a common rate, satisfy a resource constraint. Appendix A verifies that balanced growth is compatible with the model, yielding a growth rate for all macro quantities equal to the growth rate g of varieties Q_t. Appendix D describes my numerical solution algorithm exploiting a computationally intensive "outer loop, inner loop" approach. Below, I sometimes drop firm and time notation in the model where obvious from context.

3.5 Manager Policies

Figure 3 plots mean manager R&D (top row) and manipulation (bottom row) policies as fundamental shocks z (left column) and noise shocks ε (right column) vary under my baseline parameter estimates with short-termism (thick blue lines) and a counterfactual with no short-termism and $\theta_\pi = 0$ (thin black lines).[17] Higher persistent fundamentals z cause R&D increases with and without short-termism (top left). The two R&D policies are not identical, but their profiles overlap in deviations from their respective means. Fundamentals z, observable to forecasting analysts, have less direct impact on managers' ability to meet targets. So mean manipulation policies are flat across z (bottom left). By contrast, profit noise ε is observable to managers but not analysts. Without short-termism, managers optimally ignore noise (right column). With short-termism, managers with small absolute noise understand that profits are

[17] Figure 3 innocuously omits M and ν. First, the variety mass M, observable to analysts and incorporated into forecasts, does not impact manager payoffs or policies in equilibrium. Second, the component ν of profit noise, unobservable to the manager ex-ante, doesn't influence policies directly.

Figure 3: Manager Policies



Notes: In all panels, the lightweight black line is manager policy with no short-term incentives $\theta_\pi = 0$, and the heavier blue line is manager policy chosen with optimal incentives θ^*_π. The top row plots manager R&D policy, and the bottom row plots manager accruals manipulation policy. The left column reports mean policies for a given value of the fundamental shock z, expressed in percentage deviation from mean. The right column reports mean policies for a given value of the observable noise shock ε, expressed in percent of mean production profits. All policies are expressed as deviations from mean in the associated parameterization of the model. The policies are smoothed and computed from the baseline parameter estimates from Panel A of Table 3.

near targets and therefore face higher incentives to opportunistically cut R&D (top right) and boost manipulation (bottom right) to reduce the likelihood of missing.

So, in summary, short-termism influences R&D in two ways. First, R&D exhibits excess sensitivity to noise, causing volatility and misallocation in a manner akin to financial frictions.[18] This excess sensitivity manifests itself through the opportunistic dips in manager R&D policies for small values of noise in the top right panel of Figure 3. Second, short-termism raises the ongoing possibility of a profit miss, increasing mean R&D costs while depressing mean R&D levels. More explicitly, a manager's overall marginal cost of R&D W_{kt} from differentiation of their payoffs in (21) is given

[18] See two important contributions studying R&D volatility in Barlevy (2004) and Barlevy (2007).

by

$$1 - \phi_e + \theta_\pi \frac{\partial}{\partial W_{kt}} \mathbb{P}\left(\Pi_{kt} < \Pi^f_{kt}\right).$$

This marginal R&D cost expression is made up of the physical cost of R&D, one, net of private benefits ϕ_e and augmented – when there is short-termism with $\theta_\pi > 0$ – by the expected marginal loss of compensation from a higher likelihood of missing the analyst profit target. When averaged across the cross-section of managers this final term results in a higher mean cost of R&D causing a lower average level of R&D, a shift in mean costs which I quantify in my counterfactual analysis below.

4 Quantifying Short-Termism's Impact

This section structurally estimates the model and computes the quantitative impact of short-termism at the micro and macro levels.

4.1 Structurally Estimating the Model

I solve the model annually, externally calibrating parameters for household risk aversion ($\eta = 2$ with CRRA preferences), household patience (β delivers a real return of $R = 6\%$), the land share (α chosen to deliver a 20% markup), and marginal production costs (ψ normalizes mean production profits to 1).[19]

Simulated Method of Moments I then structurally estimate 7 remaining parameters listed in Table 3's s Panel A via SMM. These parameters govern the innovation and profitability processes and manager's private payoffs. Table 3's Panel B lists the 12 targeted moments computed in the Compustat-IBES micro data from Section 1. I target the covariance matrix of sales, profits, R&D, and forecast errors. The model lacks a natural normalizer such as tangible capital. So I use sales, profits, and R&D in growth rates, a natural choice in a growth model, together with percentage forecast errors scaling raw forecast errors by the average magnitude of forecasts and profit

[19]Note that the precise identity of the fixed factor L_t, e.g., land versus labor, does not qualitatively matter in the context of this model's environment which lacks features such as population growth. However, the convention of referring to the factor as "land" rather than labor allows for the perhaps more palatable use of moderate implied markups of 20% (recall that $1/\alpha$ is the gross markup, where $1-\alpha$ is the land share) rather than those which might otherwise be mechanically linked to the labor share (e.g., note that a labor share of $1 - \alpha = 2/3$ would imply a 200% markup).

Table 3: Baseline Model Results

Panel A: Estimated Parameters	Symbol	Estimate	(Std. Error)
R&D elasticity of innovation	γ	0.4184	(0.0292)
Profitability persistence	ρ	0.9197	(0.0258)
Profitability volatility	σ_z	0.1117	(0.0065)
Observable profit noise	σ_ε	0.1977	(0.0362)
Unobservable profit noise	σ_ν	0.0623	(0.0045)
Manager private R&D benefits	ϕ_e	0.0915	(0.0074)
Manager private accruals cost	ϕ_a	1.9857	(0.9410)
Panel B: Moments	Data	(Std. Error)	Model
Std. deviation of sales growth	0.4249	(0.0102)	0.1675
Correlation of sales growth, profit growth	0.2616	(0.0098)	0.5326
Correlation of sales growth, R&D growth	0.1745	(0.0123)	0.6673
Correlation of sales growth, forecast error	0.1282	(0.0085)	0.2575
Std. deviation of profit growth	0.8490	(0.0101)	0.7722
Correlation of profit growth, R&D growth	-0.0364	(0.0093)	-0.0085
Correlation of profit growth, forecast error	0.5486	(0.0102)	0.6719
Std. deviation of R&D growth	0.3092	(0.0052)	0.2151
Correlation of R&D growth, forecast error	-0.0246	(0.0093)	-0.0649
Std. deviation of forecast error	0.6637	(0.0099)	0.5639
Prob. of meeting forecast	0.5473	(0.0041)	0.5721
Prob. of just meeting to prob. of just missing	1.7852	(0.0516)	2.0166
Panel C: Quantitative Impacts			
Mean R&D cost increase from short-term pressure			2.4363 %
Mean value loss without short-term pressure			1.2525 %
Welfare gain without short-term pressure			1.1473 %
Growth gain without short-term pressure			4.7 b.p.

Notes: Panel A's SMM parameter estimates use efficient moment weighting. Panel B's data moments use a 2003-2018 Compustat-IBES panel of 2,510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5,000 firms. Moment units are proportional (0.01 = 1%). Standard errors are firm clustered. Panel C's mean increase in R&D costs is the estimated percentage rise in marginal investment costs due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to the baseline 2%. Units in Panel C are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

levels.[20] I also target the probability of meeting forecasts, together with the ratio of the likelihoods that a firm just meets a profit forecast versus just misses. Here, "just" refers to a window of ±10%. Accounting regulations changed meaningfully with 2002's Sarbanes-Oxley (SOX) Act. My baseline estimation therefore uses only the 2003-18 post-SOX period with about 17,000 firm-years of data on around 2,500 firms. I pair my empirical panel with a simulated panel, computing identically defined moments within each. The estimated parameter vector $\hat{\theta}$ solves the SMM problem

$$\min_{\theta}(m(X) - m(\theta))'W(m(x) - m(\theta)), \tag{25}$$

where $m(X)$ is the data moment vector and $m(\theta)$ is the simulated model moment vector. I use the asymptotically efficient weighting matrix W, cluster standard errors by firm with the asymptotic formulas in Hansen and Lee (2019), and employ a global stochastic optimization routine for (25).

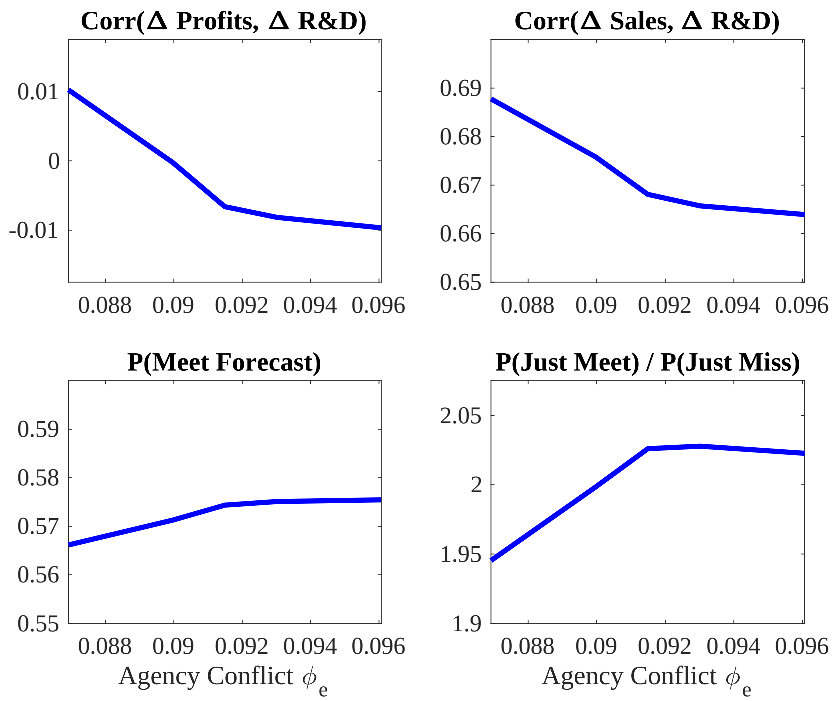
The macro growth rate is not a target moment, since my overidentified estimation might not match the targets perfectly. I instead normalize to exactly match the growth rate. Mechanically, within problem (25) for given parameters θ, I iteratively compute the R&D productivity level $\bar{\xi}(\theta)$ delivering a desired macro growth rate in general equilibrium. As a baseline I match the round, conventional value of 2% for real US per capita GDP growth, exploring alternatives below. Note that only the estimated model must match the target growth rate. The growth rate varies freely during counterfactual exercises. Appendix D provides further details on my estimation and computational approach.

Identification Identification depends on the mapping from parameters to moments. The degree of short-termism in compensation increases in the manager's agency conflict ϕ_e. Figure 4 plots selected simulated moments varying ϕ_e around my baseline estimate. With higher ϕ_e and hence more short-termism causing R&D cuts to boost profits, the correlation between profit and R&D growth declines (top left). Since higher short-termism raises the marginal cost of R&D, growth in investment opportunities and the firm's sales is less correlated with R&D growth (top right).

[20]More precisely, for sales, profits, and R&D, I compute growth rates $2\frac{X_{jt}-X_{jt-1}}{|X_{jt}|+|X_{jt-1}|}$ for firm j in year t. Percentage forecast errors are $2\frac{\Pi_{jt}-\Pi^f_{jt}}{|\Pi_{jt}|+|\Pi^f_{jt}|}$. Both measures follow formulas introduced by Davis and Haltiwanger (1992) and are conveniently bounded between -2 and 2.

With more short-term incentives, managers meet their short-term profit targets more often (bottom left). Bunching around the profit target also increases in short-termism (bottom right). So the estimated manager agency conflict $\hat{\phi}_e$, and hence the extent of short-termism, depends upon both R&D and forecast error patterns.

Figure 4: Identifying the Agency Conflict ϕ_e



Notes: The figure plots selected simulated smoothed target moments on the agency conflict parameter ϕ_e, varying the value above and below the baseline estimate in Panel A of Table 3.

Identifying the remaining parameters is straightforward. Appendix Figure D.2 plots selected comparative statics. Sales growth volatility increases in fundamental persistence ρ which generates more dispersion in investment opportunities, realized innovation, and hence sales growth (top left). When fundamental volatility σ_z increases, R&D and sales growth correlate more strongly due to larger fundamental shifts (top right). Profit growth volatility mechanically increases in observable profit noise σ_ε (middle left). Forecast error bunching declines in unobservable profit noise σ_ν, since managers can't as narrowly control realized profits (middle right). A higher R&D elasticity of innovation γ drives more sensitivity of R&D to fundamentals and hence higher R&D growth volatility (bottom left). Higher accounting manipulation costs ϕ_a drive firms to manipulate profits with R&D instead, leading to lower sensitivity of R&D growth to sales growth (bottom right).

Baseline Estimates Table 3's Panel A reports baseline estimates and standard errors. Each parameter is precisely estimated. The R&D elasticity of innovation $\hat{\gamma} \approx 0.4$ is similar to those estimated in Blundell et al. (2002) or Terry et al. (2021). High fundamental persistence $\hat{\rho} \approx 0.9$ and moderate conditional volatility $\hat{\sigma}_z \approx 10\%$ compare closely to the estimates in Gourio and Rudanko (2014) and Hennessy and Whited (2007), both of which are also based on dynamic firm models and Compustat data. At around $\frac{\hat{\sigma}_{\varepsilon}^2}{\hat{\sigma}_{\varepsilon}^2 + \hat{\sigma}_{\nu}^2} \approx 0.9$, the high estimated fraction of profit noise observed by managers suggests substantial information asymmetries. Due to their private benefit, managers perceive marginal R&D costs $\hat{\phi}_e \approx 9\%$ lower than the fundamental R&D cost, one. In response, board-chosen short-term incentives are moderately large at $\theta_{\pi}^{*} \approx 1.3\%$, so missing a profit target is as costly for managers as a one-time loss of 1.3% of mean production profits. Finally, manipulation costs of $\hat{\phi}_a \approx 2$ are moderate, implying that boosting reported profits by 10% relative to mean is as privately costly to managers as a one-time loss of around 1% of mean production profits.

Model Fit Table 3's Panel B reports data moments, standard errors, and simulated moments. Constrained by the overidentified, nonlinear estimation, the model fits well overall. First, the model matches all moments' signs, including the difficult-to-match coexistence of slightly negative correlations between the R&D and profit/forecast error series – generated by opportunistic R&D cuts – with the overall positive correlation of R&D and sales growth from fundamentals. Second, in the simulation I assume that noise shocks flow through production profits and are hence measured in both sales and profit growth. As a result, although the model's sales growth volatility still isn't quite as high as in the data, its cross-correlations are realistically meaningful.[21] Third, because of short-termism the model reasonably matches the volatility of forecast errors together with distortions near the zero threshold.

[21] A robustness check below verifies that this noise measurement convention is not crucial.

4.2 The Impact of Short-Termism

Table 3's Panel C reports the quantitative impact of short-termism at the micro (first two entries) and macro (last two entries) levels. I compare various outcomes in my baseline estimated model with short-termist incentives to meet profit targets ($\theta_\pi^* > 0$) to a counterfactual no short-termism economy without short-termist incentives (constraining $\theta_\pi = 0$).[22] The first quantity of interest, about 2.5 percent, is the mean increase in managers' marginal R&D cost from short-termist incentives. This value, $\theta_\pi^* \int \frac{\partial}{\partial W_{kt}} \mathbb{P}\left(\Pi_{kt} < \Pi_{kt}^f\right) dF\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}\right)$, can be compared to the fundamental R&D cost, one. Recall that manager private R&D benefits, $\hat{\phi}_e \approx 9\%$, are larger. So boards only partially reverse overinvestment tendencies, an optimal choice since short-termism also causes damaging opportunistic R&D cuts.[23] But compared to a world with unconstrained managers short-termism substantially increases R&D costs. The second quantity reveals that in a no short-termism counterfactual with $\theta_\pi = 0$ firms lose around 1.25% of mean value. The mean (median) firm in my data loses around \$189 (\$34) million, a significant but not overwhelming sum compared to an estimated 3% loss from CEO turnover frictions (Taylor, 2010) or 6% loss from manager cash incentive conflicts (Nikolov and Whited, 2014). The loss also compares closely to a short-termism effect of around 1.5% of value estimated by Celik and Tian (2021) in an exercise inspired by an earlier version of my paper.

The final two macro quantities reveal that growth increases by 4.7 basis points and that social welfare increases by a consumption-equivalent 1.1% per year with no short-termism. Firms don't internalize the positive externalities from R&D on future innovation embedded in (18), nor do they fully appropriate the surplus created by their new varieties due to markups. So rational short-termist manager discipline prevents increased macro growth and welfare. The magnitudes are quantitatively meaningful but not excessive. Growing at the faster rate produces about 0.25% extra output after five years. Short-termism's 1.1% welfare implications are somewhat smaller or comparable to the estimated costs of business cycles at around 2% (Krusell

[22]Note that in this no short-termism counterfactual I maintain the presence of estimated empire building agency frictions with $\phi_e > 0$. An alternative strategy for counterfactual analysis in this context, considering a case of full manager value maximization with no short-term incentives and no agency conflict, would instead commingle the impact of short-term incentives themselves with the impact of underlying agency conflicts and therefore obscure the effect of short-termism.

[23]Recall that in the toy model, absent manager private information creating forecast error bunching, the board can more tightly control managers and fully reverses agency conflicts.

Table 4: Summary of Robustness Checks and Extensions

	R&D Cost Increase, %	Mean Value Loss, %	Welfare Gain, %	Growth Gain, b.p.
Baseline estimates	2.4363	1.2525	1.1473	4.7
Gaussian mixture noise	10.422	1.4623	1.1955	4.9
Project quality shocks	2.5012	0.6030	0.5525	2.3
Long-lived R&D capital	0.8741	1.3822	1.1901	4.9
Matching R&D to profits ratio	2.3230	1.0055	0.9338	3.8
Matching GDP per capita growth	2.0036	0.8700	0.7757	3.3
Matching TFP growth	2.0416	0.4378	0.3684	1.8
Longer estimation window	1.4973	0.7268	0.6604	2.7
High R&D intensity sample	4.8841	1.7146	1.4658	6.0
Low R&D intensity sample	1.7764	0.5741	0.4977	2.1
SG&A investment measure	0.7671	0.5333	0.5022	2.0
Noise in profits only	1.0463	0.7170	0.6633	2.6
Allowing for unlisted firms	2.4729	1.0683	0.9405	3.9

Notes: Key results from various model robustness checks and extensions summarized in Section 5. The increase in R&D costs is the mean estimated percentage rise in marginal investment costs due to short-term pressure $\theta_\pi^* > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to the baseline 2%. Units are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

et al., 2009), trade gains at 2.5% or higher (Melitz and Redding, 2015; Costinot and Rodríguez-Clare, 2015), inflation costs at around 1% (Lucas, 2000), or costs from irrational investors at about 5% (Hassan and Mertens, 2016).

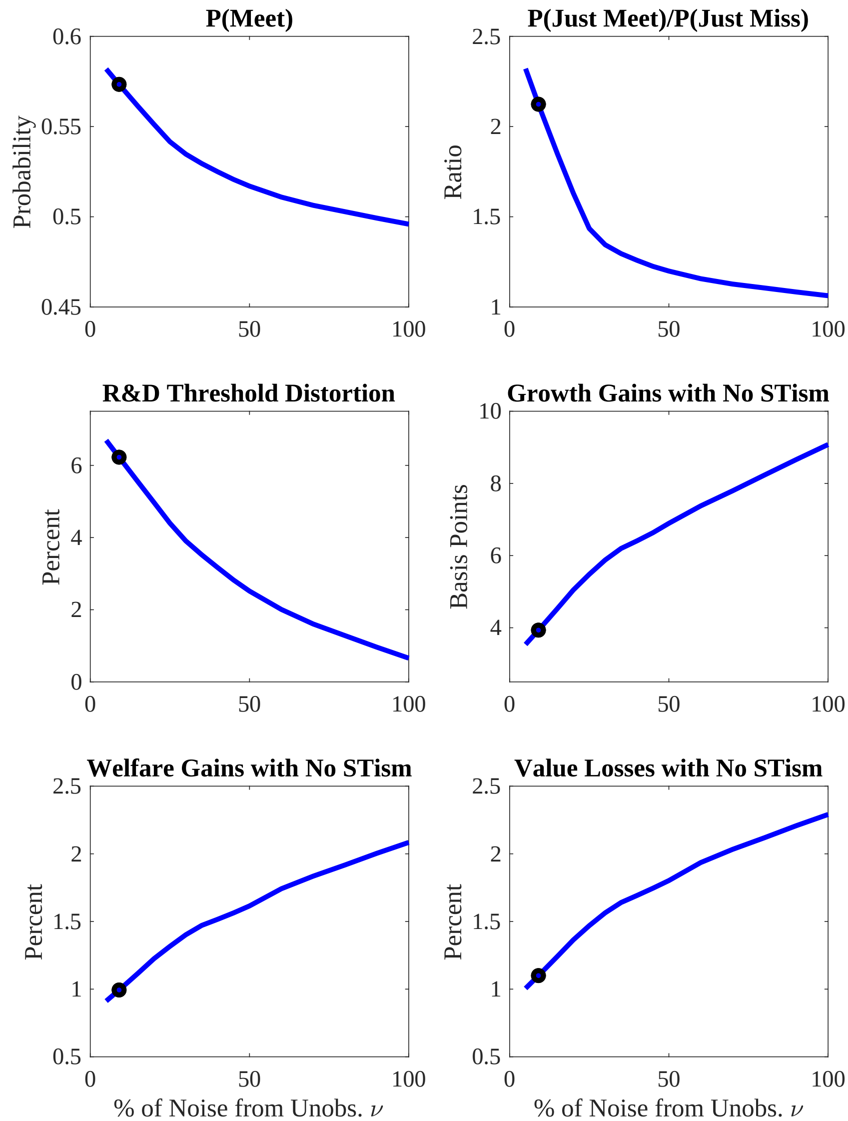
5 Discussion, Extensions, and Robustness

This section presents further discussion, model extensions, and robustness checks. For reference, Table 4 presents a quantitative summary of key counterfactual results computed in each of the relevant model extensions or robustness checks, with further details and discussion in both the main text and various online appendices.

5.1 The Forecast Error Distribution

Three analyses shed light on the quantitative role of the forecast error distribution.

Figure 5: Unobservable Noise, the Threshold, and Macro Impacts



Notes: Horizontal axes vary unobservable noise σ_ν^2 with total noise variance $\sigma_\nu^2 + \sigma_\varepsilon^2$ and other parameters held constant at baseline estimates from Panel A of Table 3. The circles mark the baseline estimates. Model outcomes are smoothed. The top row reports simulated target moments. The middle left panel reports the mean absolute drop in R&D growth just above the zero forecast error threshold, i.e., $|\mathbb{E}(\Delta \text{ R\&D Growth} \mid \text{Just Meet}) - \mathbb{E}(\Delta\text{R\&D Growth})|$. The middle right and bottom panels report the increase in aggregate growth, the consumption equivalent welfare gain, and the mean value losses in a counterfactual with no short-term incentives $\theta_\pi = 0$.

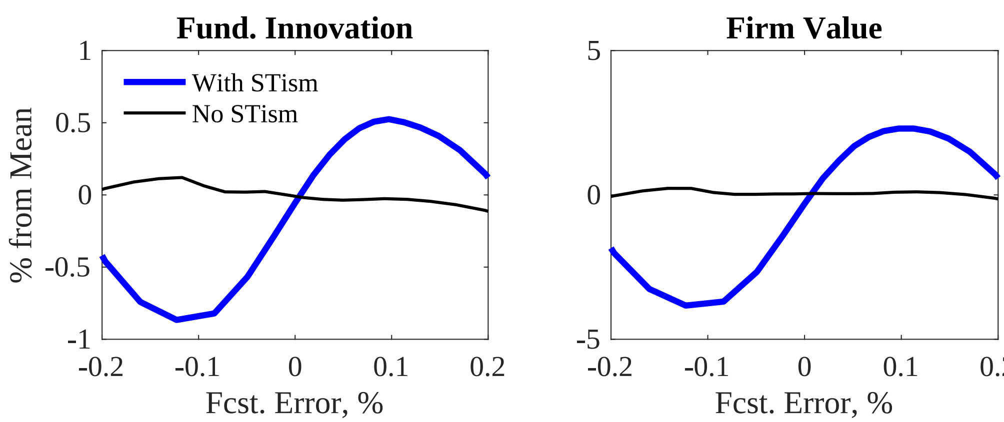
Unobservable Noise and the Zero Forecast Error Threshold Starting from Table 3's baseline (circle dot), Figure 5 varies the degree of noise unobservable (ν) versus observable (ε) to managers while fixing total noise $\sigma_\nu^2 + \sigma_\varepsilon^2$. With less information managers can't as precisely manipulate profits near targets. So the likelihood of meeting targets (top left), and the size of bunching (top right) decline. R&D growth is always lower for firms just meeting targets, but as managers become less precise the magnitude of the R&D threshold distortion declines (middle left). One might suspect, since threshold effects decline with more unobservable noise, that short-termism's overall impact declines. This intuition is incorrect. Less-informed managers are more cautious, leading to more uniform R&D distortions reducing the sharpness of identifiable threshold effects. But more uniform cuts lead to larger impacts on aggregate growth (middle right), welfare (bottom left), and mean firm value (bottom right). Two implications are immediate. First, although threshold effects serve as a detection mechanism, short-termism's quantitative impact doesn't increase directly with the size of the observed reduced-form distortions. Appropriate interpretation of these reduced-form facts requires a quantitative model and counterfactuals rather than back of the envelope aggregation.[24] Second, since the model lacks a natural normalizer such as tangible assets which would allow for direct comparability, I do not directly target Section 1's empirical R&D growth discontinuities. Figure 5 reveals that this choice is conservative, since my baseline estimates lie to the far left of the graph with smaller impacts of short-termism.

Selection at the Zero Forecast Error Threshold Figure 6 plots the conditional mean of various outcomes as a function of forecast errors for the baseline estimates with short-termism (heavy blue lines) and the no short-termism counterfactual (thin black lines). With short-termism, firms just meeting targets are better. Their innovation or shock ζ in the fundamental z process (15) is higher (left panel), as is their level of z (unplotted). This pattern arises, even though z is observable to forecasters, because firms with higher fundamentals have larger baseline R&D budgets. Manipulating R&D is proportionately easier, so such firms are overrepresented among

[24]Intuitively, simple aggregation of the reduced-form estimates does not capture the overall impact of short-termism because short-termist incentives reduce the mean R&D level in the model for firms both above and below profit targets, since unobservable profit noise will cause some firms with R&D cuts to still lie ex-post below their targets. This common or mean effect is differenced out in the inherently relative reduced-form differences captured between firms just meeting and missing.

those just meeting targets. The endogenous selection force, absent without short-termism, has two important implications. First, selection clarifies the finding of R&D distortions for firms just meeting targets. Intuitively, such firms should experience persistently worse outcomes, but that intuition is incomplete. Since such firms are also better on average, opportunistic R&D cuts and innovation declines don't persist (see Appendix Figure D.3's dynamic plots). Their revenues and profits are also persistently higher. So a large macro impact of short-termism doesn't require persistently poor outcomes for firms just meeting targets. Second, selection can help rationalize higher stock returns for firms just meeting targets, seen empirically in Table 1. The right panel of Figure 6 reveals that under short-termism firms just meeting targets have higher market value. Some care is required here. In the current model, outsiders observe fundamentals z, so higher market value is already priced into markets and absent from returns. But recall that not just the level of z but also the innovations in z in the left panel are higher for firms just meeting targets. So a model with extended information frictions or learning might easily generate information revelation and hence stock return reactions.

Figure 6: Selection Local to the Threshold



Notes: Both panels plot the simulated conditional mean of the indicated outcome across bins of the given percent forecast error on the horizontal axis. The lightweight black line is the counterfactual model without short-term incentives $\theta_\pi = 0$, and the heavier blue line is the baseline estimated model with short-term incentives at the parameters in Panel A of Table 3. The top left is the innovation in the AR(1) fundamental shock process z. The top right is firm value v.

Flexibly Matching the Forecast Error Distribution My baseline targets the shape of the forecast error distribution near zero rather than the distribution's global shape. As a robustness check, I estimate a model with a more flexible Gaussian mixture distribution of unobserved noise ν targeting the weight on nine intervals in the forecast error data. Table 4 reports the quantitative impacts of short-termism in this case, while Appendix Table D.1 reports further results and Appendix Figure D.4 plots the implied forecast error and noise distributions. The extension fits the full forecast error distribution better, but the quantitative impact of short-termism is similar to baseline.

5.2 Does the Model's R&D Structure Inflate Magnitudes?

I estimate two extensions of the model with alternative innovation functions.

Project Quality Shocks One might worry that R&D payoffs vary due to heterogeneity in underlying project quality about which managers possess more information than outsiders. If so, opportunistic R&D cuts might disproportionately be borne by low-quality projects, dampening short-termism's impact. So in Appendix C I generalize the innovation function (18) to

$$M_{kt+1} = \xi_{kt}\bar{\xi}W_{kt}^{\gamma}Q_t^{1-\gamma}, \tag{26}$$

where $\log \xi_{kt} \sim_{iid} N\left(-\frac{\sigma_\xi^2}{2}, \sigma_\xi^2\right)$ are iid unit mean lognormal shocks to R&D project quality observed only by the manager of firm k at time t. Appendix Table D.2 reports new estimates, model fit, and counterfactual magnitudes for this model extension, with counterfactual magnitudes summarized in Table 4. I estimate a meaningful degree of heterogeneity in project quality, with a log standard deviation of $\hat{\sigma}_\xi \approx 5\%$. The quantitative impacts of short-termism are dampened somewhat from the baseline but remain significant with over half a percentage point of lost consumption-equivalent welfare. Short-termism remains potent for two reasons. First, the baseline persistent shock z already creates heterogeneity in R&D payoffs. Second, the selection highlighted above applies here. Firms with higher project quality ξ have higher baseline R&D riper for manipulation. So high-quality projects, not low-quality projects, bear much of the brunt of opportunistic R&D cuts.

Accumulated R&D Capital Growth models typically link innovation to R&D flows as in my baseline (18). But in other models R&D flows into an accumulated capital stock with depreciation and diminishing returns (McGrattan and Prescott, 2014; Peters and Taylor, 2017; McGrattan, 2020). One might worry that, omitting a role for R&D capital, my model inflates the impact of opportunistic cuts to R&D flows. So in Appendix C I generalize the innovation function (18) to

$$M_{kt+1} = \bar{\xi} S_{kt}^{\gamma} Q_t^{1-\gamma}, \tag{27}$$

where the R&D stock S_{kt} evolves over time according to

$$S_{kt} = (1 - \delta) S_{kt-1} + W_{kt}. \tag{28}$$

This model nests my baseline when R&D depreciation is $\delta = 1$. But work estimating R&D capital depreciation suggests lower rates at around $\delta = 0.35$ (Li and Hall, 2016). Appendix Table D.3 reports multiple results. The first column duplicates my baseline R&D flow model estimates and target empirical moments. The second column reports moments for a model imposing $\delta = 0.35$ but otherwise fixing my baseline parameters. This version of the R&D capital model fits poorly due to excessively volatile R&D flows. So the third column reports results for a re-estimated R&D capital model with $\delta = 0.35$. R&D capital generates endogenous persistence, so I estimate lower persistence and volatility of z. The marginal benefit of R&D is also higher with long-lived capital, i.e., the user cost declines. The re-estimated model requires a higher agency conflict ϕ_e to generate large enough short-term incentives to counteract this force and match observed profit bunching. On net, counterfactuals reveal short-termism impacts similar in size to baseline, as summarized in the counterfactual results in Table 4.

5.3 Other Robustness Checks

This subsection provides a range of additional quantitative robustness checks.

Varying Parameters Appendix Table D.4 varies the value of each parameter one standard error in both directions from Table 3's estimate. There is some moderate variation in the impact of short-termism at the micro or macro levels, but my qualitative conclusions remain unchanged.[25]

Matching the R&D to Profits Ratio The size of R&D versus profits matters for the degree of R&D-based profit manipulation in the model. I don't target the empirical ratio, 59%, but the value in my baseline, 67%, is reasonably similar. Nevertheless, Appendix Table D.5 reports model results after slightly lowering the R&D elasticity of innovation γ to exactly match the empirical R&D to profits ratio. The quantitative impacts of short-termism, also summarized in Table 4, are only dampened slightly from baseline.

Matching Different Macro Growth Rates I normalize R&D productivity to match the round macro growth rate of $g = 2\%$ in my baseline. The model lacks population growth, so the closest data equivalent is arguably the quite similar US per capita GDP growth rate averaging 1.9% per year. But one might instead target US aggregate TFP growth, more aggressively stripping out observable sources of growth with a value of 1.24% per year.[26] Appendix Table D.6 reports results for two re-estimated models targeting these observed growth rates for GDP per capita (first column) and TFP (second column), with a summary of counterfactual magnitudes presented in Table 4. Unsurprisingly, the model estimated with GDP per capita growth rates yields results quite similar in magnitude to baseline. Also unsurprisingly, since the growth rate and hence the quantitative importance of R&D decline drastically when targeting TFP growth, the model in this case reveals somewhat smaller quantitative impacts of short-termism in absolute terms.

Estimating on a Longer Time Window My baseline relies on a 2003-2018 time window after the 2002 SOX legislation tightened US accounting standards. Appendix Table D.7 reports detailed results from estimating the model using data in a longer 1990-2018 window, with counterfactual magnitudes summarized in Table 4. Short-termism's impact is slightly weaker including the earlier period, consistent with an accounting literature suggesting that profit manipulation with tools like R&D is more common in the current post-SOX period (Cohen et al., 2008).

[25] In Table D.4 I also report a set of two robustness checks in which I increase and decrease the curvature of the private accounting cost function away from my baseline quadratic specification in (21), again finding little qualitative difference in the impact of short-termism.

[26] The per capita GDP figure comes from the NIPA accounts over 1960-2020, and the TFP growth figure comes from John Fernald's baseline TFP growth series over the 1947-2021 period.

Estimating on High- and Low-R&D Intensity Samples R&D should be mechanically more useful for profit manipulation for firms with large baseline R&D budgets. Appendix Table D.8 reports detailed results for models estimated on two samples of firms: those with above and below median R&D-to-sales ratios. Table 4 presents a summary of key counterfactual impacts in this case. In the high-R&D sample, profit growth and forecast errors vary negatively with R&D growth, and forecast error distortions are larger. Naturally, the high-R&D estimates imply larger impacts of short-termism than baseline and vice-versa for the low-R&D sample.

An Alternative Measure of Intangible Investment Appendix Table D.9 reports detailed estimates, model fit, and counterfactual magnitudes replacing R&D spending with SG&A spending, an alternative intangible investment proxy. Table 4 presents a summary of key counterfactual impacts in this case. The impacts of short-termism remain qualitatively similar to baseline.

Noise in Profits Only In my baseline, profit noise flows from production sources and appears in measured sales and profits. Appendix Table D.10 reports detailed estimates, model fit, and counterfactuals assuming that noise only appears in profits. Table 4 presents a summary of key counterfactual impacts in this case. This model fits more poorly, with not enough correlation between sales growth and forecast errors. Nevertheless, the impact of short-termism is qualitatively similar.

Allowing for Unlisted Firms without Short-Termism My baseline results might be overstated if short-term incentives are weaker for privately held companies (Asker et al., 2015; Bernstein, 2015). This line of reasoning is easy to exaggerate, omitting forces such as internal benchmarks or implied IPO distortions. And since US private firm financials are confidential, quantitative analysis is difficult. Nevertheless, Appendix C extends the model with an exogenous fraction $p_{private}$ of fully value maximizing private firms. When $p_{private} = 0$ this model nests my baseline, and when $p_{private} = 1$ short-termism is absent. Appendix Table D.11 sets $p_{private}$ in two ways, presenting detailed results. Over my sample period, publicly listed firms conducted an average of 79% of total US private R&D spending.[27] In the first column, I set

[27]The 79% value is the mean ratio of total Compustat R&D spending to total US private R&D spending in the NIPA accounts across the years 2003-2018.

$p_{private}$ to match this fraction. Since individual private companies do more R&D than short-termist public companies, $p_{private} \approx 7\%$ is smaller than their R&D share $100 - 79 \approx 20\%$. In this case, the impacts from short-termism are only slightly muted relative to baseline, a result summarized in Table 4. The second column of Table D.11 naively sets $p_{private} \approx 20\%$, equating the fraction of private firms with their R&D share. This crude approach results in an implausibly high R&D spending share for unlisted firms but arguably serves as an upper bound on their impact. The impact of short-termism is smaller but remains meaningful.

6 Conclusion

I argue that short-termist incentives arise naturally as discipline placed on managers. However, my results highlight a potential distinction between the micro and macro impacts of short-termism. For firms, short-termism can improve value by restricting R&D expenditures by managers. But at the aggregate level, short-termism can lower growth and welfare because the social returns to R&D are higher than the private returns. My calculations therefore support some long-voiced concerns about short-termism.

In light of my findings, some discussion of policy implications seems natural. First, and most obviously, the mean increase in the marginal cost of R&D – and the associated decline in the level of R&D – due to short-termism in my model pushes R&D further down and away from a socially optimal level, a shift which likely increases the size of the R&D subsidy which would be required to align firm and social objectives. In this sense, my analysis reinforces traditional arguments in the endogenous growth literature about the potential welfare gains from subsidies to R&D (Jones and Williams, 2000). Second, since the expensing of R&D in profits as defined by US GAAP leads to a strong tradeoff between short-term profits and long-term investment, my results suggest potential gains from designing accounting standards and manager compensation structures with specific attention to their implications for innovation and growth. Almeida (2019) offers a wide survey of the lively academic debate in finance and accounting about potential changes to both manager compensation and accounting concepts in light of evidence on short-termism. For example, capitalization rather than expensing of R&D or the introduction of manager incentives based on longer horizons are oft-proposed changes. However, I emphasize that such changes

(i) may be either difficult to implement from a political economy perspective or simply because of inertia, and (ii) may involve unintended consequences such as changes in the overall informativeness of accounting statements and therefore the average cost of capital for firms. A full analysis of optimal policy in this context therefore lies beyond the scope of this paper.

I also emphasize that, despite the title, the paper studies only one category, profit pressures on public firm managers, of a broader set of short-termism mechanisms. A partial list includes behavioral forces such as reference dependence (Kőszegi and Rabin, 2006), short manager career horizons (Narayanan, 1985), inflexible heuristics for hurdle rates or payback horizons (Poterba and Summers, 1995), or dividend-smoothing pressures (Lintner, 1956; Wu, 2018). Existing work explores these topics, but most remain promising for further quantitative analysis at either the micro or macro levels.

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A Baseline Model

This appendix offers theoretical details for the baseline model.

A.1 Equilibrium

A stationary general equilibrium on a balanced growth path is a collection of

1. intermediate goods prices p_{jt},
2. intermediate goods quantities x_{jt},
3. land prices P_t^L,
4. land quantities L_t,
5. real interest rates R_{t+1},
6. growth rates g_{t+1},
7. aggregate savings B_{t+1},
8. aggregate consumption C_t,
9. aggregate intermediate goods production costs X_t,
10. aggregate R&D investment W_t,
11. aggregate intermediate goods firm payouts D_t^{Int},
12. aggregate final goods firm payouts D_t^{Final},
13. aggregate gross output Y_t,
14. aggregate variety masses Q_t,
15. a schedule of intermediate goods firm value functions $V(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t|\theta_\pi) = Q_t v\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}|\theta_\pi\right)$,
16. a schedule of intermediate goods firm manager policies for R&D $W_{kt}(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t|\theta_\pi)$
17. a schedule of intermediate goods firm manager policies for accounting manipulation $A_{kt}(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t|\theta_\pi)$,

18. a schedule of analyst forecasts for intermediate goods firm profits $\Pi^f_{kt}(M_{kt}, z_{kt}, Q_t|\theta_\pi)$,
19. a schedule of stationary distributions of normalized intermediate goods firm states $F\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}|\theta_\pi\right)$, and
20. a realized short-term incentive level θ^*_π for intermediate goods firm managers,

such that

1. final goods firms optimize their land demand with L_t solving (13) given P^L_t and p_{jt},
2. final goods firms optimize their intermediate goods demand with x_{jt} solving (13) given P^L_t and p_{jt},
3. aggregate gross output Y_t satisfies the production technology in (13),
4. aggregate final goods payouts D^{Final}_t are equal to the objective in the static profit maximization problem (13),
5. taking as given final goods demand (14), monopoly prices p_{jt} for newly innovated intermediate goods $j \in (Q_{t-1}, Q_t]$ solve the profit maximization problem (16),
6. competitive prices p_{jt} for off-patent intermediate goods varieties $j \in [0, Q_{t-1}]$ are set to marginal cost ψ,
7. for all candidate short-term incentives θ_π, and taking as given analyst forecasts Π^f_{kt}, intermediate goods firm manager R&D policies W_{kt} solve their optimization problem (21),
8. for all candidate short-term incentives θ_π, and taking as given analyst forecasts Π^f_{kt}, intermediate goods firm manager accounting manipulation policies A_{kt} solve their optimization problem (21),
9. for all candidate short-term incentives θ_π, and taking as given intermediate goods firm manager policies W_{kt} and A_{kt}, analyst forecasts $\Pi^f_{kt}(M_{kt}, z_{kt}, Q_t|\theta_\pi)$ rationally satisfy their mean squared error minimization problem (22),
10. for all candidate short-term incentives θ_π, and taking as given intermediate goods firm manager policies W_{kt} and A_{kt}, intermediate goods firms value functions $V(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t|\theta_\pi)$ satisfy the Bellman equation (23),

11. for all candidate policies of short-term incentives θ_π, the stationary distribution $F\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}|\theta_\pi\right)$ is consistent with manager policies and exogenous shocks according to

$$F\left(m, z_{kt}, \varepsilon_{kt}|\theta_\pi\right) = \int \mathbb{I}\left(\frac{M_{kt}}{Q_t} \leq m\right) F(z_{kt}|z_{kt-1})F(\varepsilon_{kt})dF\left(\frac{M_{kt-1}}{Q_{t-1}}, z_{kt-1}, \varepsilon_{kt-1}|\theta_\pi\right) \tag{29}$$

where $F(z_{kt}|z_{kt-1})$ is the exogenous transition distribution for z_{kt} implied by (15), $F(\varepsilon_{kt})$ is the exogenous distribution for $\varepsilon_{kt} \sim N(0, \sigma_\varepsilon^2)$, and M_{kt} is the new variety mass innovated by the manager R&D policy W_{kt-1} together with the innovation function (18),

12. realized short-term incentives θ_π^* are chosen by firm boards optimally under commitment, taking as given induced manager policies W_{kt}, A_{kt}, stationary distributions F, value functions v, and analyst forecasts Π_{kt}^f, in order to maximize mean firm value according to (24),

13. payouts from the intermediate goods sector D_t^{Int} satisfy

$$D_t^{Int} = \int_0^1 D_{kt}dk,$$

where D_{kt} is the flow payout for intermediate goods firm k in equation (23),

14. land markets clear with $L_t = 1$,

15. aggregate intermediate goods consumption of gross output X_t satisfies

$$X_t = \int_0^{Q_t} \psi x_{jt}dj,$$

16. aggregate R&D investment expenditure W_t satisfies

$$W_t = \int_0^1 W_{kt}dk,$$

17. aggregate consumption C_t satisfies the resource constraint

$$Y_t = C_t + X_t + W_t,$$

18. aggregate varieties Q_t evolve according to (19),

19. the growth rate of varieties is constant, satisfies

$$g_{t+1} = g = \frac{Q_{t+1} - Q_t}{Q_t},$$

and is equal to the growth rate of all macro aggregates, and

20. real interest rates $R_{t+1} = R$ are constant and satisfy the household savings optimality condition (12).

Without loss of generality, manager compensation doesn't enter firm value functions v nor the resource constraint. A fixed component of manager compensation doesn't affect risk-neutral manager policies but normalizes the expected discounted value of manager compensation to zero. Similarly, a lump-sum transfer from risk-neutral managers to households doesn't affect manager policies but sets aggregate manager consumption to zero each period. These choices reduce notation and avoid conflation of the mechanical impact of short-termism with impacts induced by manager policy changes.

A.2 Balanced Growth

This subsection shows that balanced growth at a common rate g is compatible with the model. I will use the conventions $m = \frac{M_{kt}}{Q_t}$, $z = z_{kt}$, $\varepsilon = \varepsilon_{kt}$, $\nu = \nu_{kt}$ to denote stationary variables dropping firm and time subscripts and, in the case of the variety mass m and similar variables, normalizing by Q_t. Now, recall that the final goods market clearing condition is given by

$$Y_t = C_t + X_t + W_t.$$

Assume that the growth rate of aggregate varieties Q_t is constant. Let the growth rate of any aggregate Z be written g_Z. Output consumed in the production of intermediate varieties X_t satisfies

$$X_t = \int_{Q_{t-1}}^{Q_t} \psi x_{jt} dj + \psi \int_0^{Q_{t-1}} x_{jt} dj = M_t \int \psi x_m(z) dF(m, z, \varepsilon) + Q_{t-1} \psi x_c$$

$$= g_Q Q_t \int \psi x_m(z) dF(m,z,\varepsilon) + \frac{1}{1+g_Q} Q_t \psi x_c \propto Q_t,$$

where x_m is the monopoly quantity produced and x_c is the competitive amount produced. Aggregate R&D W_t satisfies

$$W_t = \int_0^1 W_{kt} dk = \int_0^1 w_{kt} Q_t dk = Q_t \int w(m,z,\varepsilon) dF(m,z,\varepsilon) \propto Q_t.$$

Total output Y_t satisfies

$$Y_t = L_t^{1-\alpha} \int_0^{Q_t} z_{jt}^{1-\alpha} x_{jt}^{\alpha} dj = M_t \int z^{1-\alpha} x_m(z)^{\alpha} dF(m,z,\varepsilon) + Q_{t-1} x_c^{\alpha}$$

$$= g_Q Q_t \int z^{1-\alpha} x_m(z)^{\alpha} dF(m,z,\varepsilon) + \frac{1}{1+g_Q} Q_t x_c^{\alpha} \propto Q_t.$$

By the final goods clearing condition plus the proportionality relationships derived above, we have that $g_Y = g_X = g_W = g_C = g_Q = g$, i.e., on a balanced growth path all the aggregates will grow at the same rate g.

Appendices for Online Publication Only

B Data

This section provides more detail on my data.

B.1 Data Sources

I use data from four main sources.

Compustat/CRSP I organize a Compustat panel dataset on US-headquartered primary issues by firm ID `gvkey` and fiscal year `fyear`. I measure total assets `at`, tangible capital or plants, property, and equipment `ppent`, R&D `xrd`, SG&A `xsga`, tangible capital expenditures `capxv`, and revenues `sale`. Using the CRSP linking ID `permno` to associate with the Compustat sample, I extract realized daily stock returns `ret` and the value-weighted market return `vwret`.

IBES I extract Street earnings per share (EPS) profit realizations for a given fiscal year for a given IBES firm ID `ticker` from the IBES Actuals file by restricting to annual-periodicity outcomes with EPS measures for US firms measured in US dollars. From the IBES Detail History file I extract individual analyst EPS forecasts for the current fiscal year, measuring the individual forecast announcement date `anndats` and the announcement date for actual data or realizations `anndats_act`. I extract the historical stock-split adjustment factor `adj` from the IBES Adjustment Factor table. I link both the IBES analyst forecasts and realized profit data to the Compustat/CRSP data for a given firm-fiscal year using the WRDS CRSP/IBES linking table associating CRSP `permno` with IBES `ticker`.

Execucomp I extract total compensation `tdc2` at the executive-firm-fiscal year frequency from Execucomp, restricting to a sample of CEO's and CFO's only. The Execucomp data is natively linked to the Compustat `gvkey` firm ID's and features a unique executive ID `execid`.

Patenting Data I use the US public firm patenting dataset constructed by Kogan et al. (2017) in the firm-year file `firm_innovation_v2.zip`. This file links to CRSP ID's `permno` and provides raw patent counts `Npats`, market value weighted patenting scaled by firm assets `tsm`, and citation weighted patenting scaled by firm assets `tcw`.

B.2 Variable Definitions and Transformations

With Compustat data, I compute the growth rate of R&D, SG&A, and sales for firm j in fiscal year t via

$$2\frac{X_{jt} - X_{jt-1}}{|X_{jt}| + |X_{jt-1}|}, \tag{30}$$

Table B.1: Descriptive Statistics

Variable	Mean	Median	Std. Dev.
Assets	9734.286	1855.781	34666.13
Sales	7285.809	1564.981	21475.93
Employment	19.94756	5.934	41.75922
Intangibles	1439.832	357.9595	3744.312
R&D	333.1302	55.7895	1068.972
Street profit realizations	675.1928	96.0941	2404.02
Market value	15095.6	2746.612	44931.13

Notes: Assets, sales, intangibles/SG&A, R&D, pro forma earnings, and market value are in millions of dollars. Employment is in thousands. The data is drawn from a 1990-2018 panel of Compustat financial statements merged to IBES earnings forecasts and realizations spanning 1,685 firms with a total of 10,664 firm-year observations.

which is a robust growth rate formula for some outcome X from Davis and Haltiwanger (1992) often used in firm dynamics empirical work and bounded in $[-2, 2]$. I also compute the growth in tangible capital investment as

$$\frac{\texttt{capxv}}{\texttt{ppent}}_{jt} - \frac{\texttt{capxv}}{\texttt{ppent}}_{jt-1}. \tag{31}$$

The R&D, SG&A, sales growth, and investment growth series are variously used in Table 1 and my SMM estimation exercises.

With the IBES data, I first convert realized Street profits and individual analyst forecasts to a common historical basis using the IBES historical stock-split adjustment series `adj` and then convert to raw dollar values using Compustat primary `cshpri` or diluted `cshfd` share counts as appropriate. For individual analyst forecasts, I define the forecast horizon as the difference between the actual data release date and the forecast announcement date. My consensus forecast measure is the median of analyst dollar earnings forecasts for a given firm-fiscal year combination at either the one-quarter (0 to 100 day) or four-quarter (270 to 370 day) horizons. All forecast error results in the paper rely on the four-quarter horizon except for one-quarter horizons used in discontinuity calculations for executive compensation and stock return outcomes in Panel C of Table 1. Raw forecast errors fe^h_{jt} for a given horizon h for firm j in fiscal year t are

$$fe^h_{jt} = street_{jt} - consensus^h_{jt}, \tag{32}$$

where *street* is the dollar value of realized IBES Street earnings and $consensus^h$ is my consensus forecast measure at horizon h. I variously scale fe^h_{jt} by Compustat firm assets `at` in Table 1 and Figure 1 or by using the percentage scaled measure

$$2\frac{fe^h_{jt}}{|street_{jt}| + |consensus^h_{jt}|} \tag{33}$$

Table B.2: Innovation Horizons at the Zero Forecast Error Threshold

	(1)	(2)	(3)	(4)
Horizon:	1 Year	2 Year	3 Year	4 Year
Panel A: Subsequent Raw Patenting Growth				
Mean Chg. at	-8.78**	-10.8**	-6.94	-23.0***
0 Threshold (p.p.)	(3.74)	(5.02)	(6.17)	(7.16)
Panel B: Subsequent Market-Valued Patenting Growth				
Mean Chg. at	-4.34**	-6.57***	-4.90*	-5.61*
0 Threshold (p.p.)	(1.79)	(2.32)	(2.63)	(3.36)
Panel B: Subsequent Cite-Weighted Patenting Growth				
Mean Chg. at	-0.35	-0.81*	-0.86*	-1.15*
0 Threshold (p.p.)	(0.36)	(0.49)	(0.49)	(0.61)
Fixed Effects	Firm, Year	Firm, Year	Firm, Year	Firm, Year
Observations	3,646	3,646	3,646	3,646

Notes: Estimates are mean predicted differences for the outcome in p.p. for firms just meeting to just missing forecasts. *,**,*** denote 10, 5, 1% significance. Standard errors are clustered by firm. Local linear regression discontinuities estimated with a triangular kernel and optimal Calonico and Farrell (2020) bandwidth. Running variable is forecast errors, pro forma profits minus median analyst forecasts relative to firm assets from a four-quarter horizon. Innovation outcomes are growth rates or differences for patents granted in the year(s) after the firm's earnings release, with horizon varying from 1 to 4 years across columns (1)-(4). Raw patenting is the inverse hyperbolic sine of patents. Market-valued patenting is patents' market value to assets. Citation-weighted patenting is patents' citation weights to firm assets.

in my SMM estimation exercises.

With CRSP data, I first compute market-adjusted or abnormal realized returns as the residuals of a firm-by-firm regression of log daily return realizations on the log of the value-weighted market return on the same day. My abnormal returns measure in Table 1's Panel C is the standardized cumulative market-adjusted return in a 10-day window to the IBES earnings realization release date `anndats_act`.

With Execucomp data, I compute the log of total realized manager compensation for a given firm-fiscal year combination. I compute the turnover indicator as 1 if the manager's firm ID changes or is missing in the following fiscal year and 0 otherwise. Both variables are used in Table 1's Panel C.

With the Kogan et al. (2017) patenting data, I compute the change in subsequent innovation outcomes X for firm j after year t at a given horizon h as

$$X_{jt+h} - X_{jt}, \tag{34}$$

where X is the inverse hyperbolic sine of the patent counts `Npats`, the asset-scaled market value of firm patenting `tsm`, or the asset-scaled citation-weighted firm patenting measure `tcw` at a horizon h from 1 to 4 years. My baseline analysis in Panel B of Table 1 uses the $h = 4$ year horizon, but Table B.2 verifies that my results are not dependent upon this choice.

B.3 Descriptive Statistics

The merged Compustat-IBES dataset in cleaned form results in a sample of primarily large firms, with the longest time window used in my analysis spanning 1990-2018 for just over 1,500 firms and just under 11,000 observations. Descriptive statistics for this sample are available in Table B.1.

C Model Extensions

This appendix offers theoretical details on various extended versions of the model expanding upon the baseline structure in Appendix A.

C.1 R&D Shocks Model

The introduction of R&D project quality shocks ξ_{kt}, observed by the manager but not outside analysts, requires two changes to the baseline equilibrium. First, the innovation function (18) is replaced by (26). Second, the intermediate goods state vector, which is $(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t)$ in nonstationary form and $\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}\right)$ in stationary normalized form, is augmented in both cases with the iid project quality shock ξ_{kt}. The model is otherwise identical.

C.2 R&D Capital Model

The introduction of accumulated R&D capital to the model requires three changes to the baseline equilibrium. First, the innovation function (18) is replaced by (27). Second, R&D capital S_{kt} accumulates according to (28). Third, the intermediate goods state vector, which is $(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t)$ in nonstationary form and $\left(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt}\right)$ in stationary normalized form, is augmented with the lagged R&D capital stock S_{kt-1} in the nonstationary case and $\frac{S_{kt-1}}{Q_t}$ in normalized form. The model is otherwise identical.

C.3 Model with Private Firms

In the model with an exogenous fraction $p_{private} \in [0,1]$ of private firms, the technologies and structures for final goods firms, public intermediates goods firms, analysts, and households remain unchanged from the baseline equilibrium. However, the private firms choose R&D policies W^p_{kt} solving the Bellman equation

$$V^p(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t) = \max_{W_{kt}} \left[\begin{array}{c} \pi_{Mkt} M_{kt} - W_{kt} + \\ \frac{1}{R_{t+1}} \mathbb{E}\left(V^p(M_{kt+1}, z_{kt+1}, \varepsilon_{kt+1}, Q_{t+1}) | z_{kt}\right) \end{array} \right],$$

policies inducing a stationary distribution F^p satisfying

$$F^p\left(m, z_{kt}, \varepsilon_{kt}\right) = \int \mathbb{I}\left(\frac{M_{kt}}{Q_t} \leq m\right) F(z_{kt}|z_{kt-1}) F(\varepsilon_{kt}) dF^p\left(\frac{M_{kt-1}}{Q_{t-1}}, z_{kt-1}, \varepsilon_{kt-1}\right).$$

All macro aggregates must be computed aggregating both over the public firm stationary distribution F, with weight $1-p_{private}$, and the private firm stationary distribution F^p, with weight $p_{private}$. The model is otherwise unchanged.

D Solution, Estimation, & Robustness

This appendix outlines my numerical solution algorithm, the SMM estimation approach, and provides various robustness check results and supplemental figures.

D.1 Model Solution

Writing the model in stationary form, I drop firm and time subscripts. Lowercase variables refer to nonstationary variables scaled by Q or to natively stationary variables. Manager payoffs (21) can be written

$$-(1-\phi_e)w - \phi_a a^2 - \theta_\pi \mathbb{P}_\nu(\pi < \pi^f) + \frac{1+g}{R} \mathbb{E}\left(\pi_m(z')m'|z\right). \quad (35)$$

Analyst forecasts of profits can be written

$$\pi^f(m,z) = \pi^m(z)m - w^f(m,z) + a^f(m,z) \quad (36)$$

where R&D and accruals expectations over the stationary distribution F are

$$w^f(m,z) = \mathbb{E}_F\left(w(m,z,\varepsilon)|m,z\right) \tag{37}$$

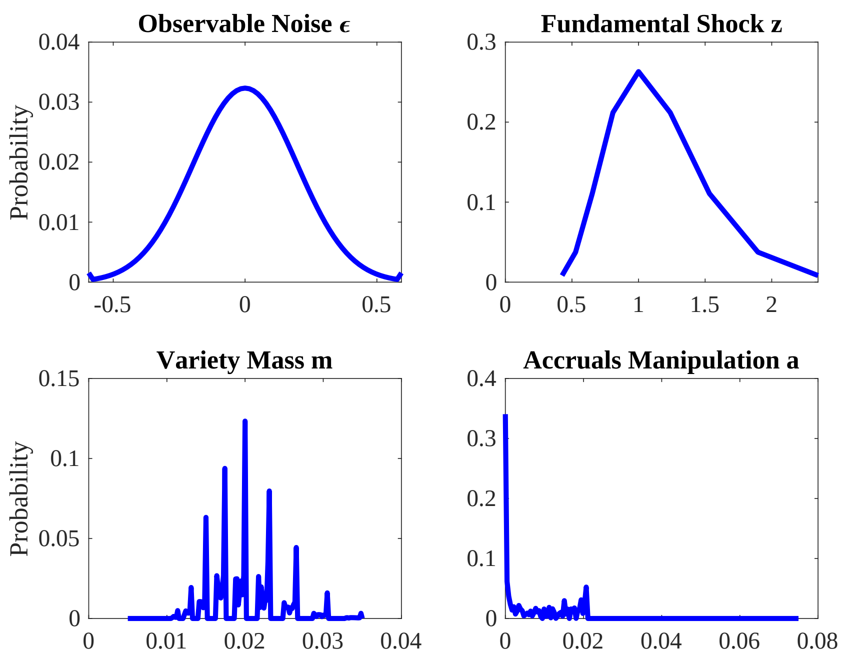
$$a^f(m,z) = \mathbb{E}_F\left(a(m,z,\varepsilon)|m,z\right). \tag{38}$$

Firm value can be written

$$v(m,z,\varepsilon) = \left\{\pi_m(z)m - p_w w + \frac{1+g}{R}\mathbb{E}\left[v(m',z',\varepsilon')|z\right]\right\}. \tag{39}$$

Note that given target growth $\hat{g}$, condition (12) implies $R = \hat{R} = \frac{1}{\beta}(1+\hat{g})^{\eta}$. During model estimation, in which consistency with the target growth rate is required, I employ the following algorithm.

Figure D.1: Model Marginal Ergodic Distributions



Notes: Each panel in the figure plots the marginal ergodic distribution of a state variable at the baseline estimated parameters from Panel A of Table 3.

Numerical solution algorithm during estimation

1. (Outer Loop) Guess R&D productivity $\bar{\xi}$.
   (a) (Middle Loop) Guess short-term incentives θ_π.

i. (Inner Loop) Guess R&D and accruals forecast functions $w^f(m,z)$, $a^f(m,z)$, implying profit forecasts $\pi^f(m,z)$ via (36).

ii. Compute implied manager R&D policies $w(m,z,\varepsilon)$ and $a(m,z,\varepsilon)$ by optimizing (35) given $\pi^f(m,z)$.

iii. Compute the stationary distribution $F(m,z,\varepsilon)$ implied by manager policies via (29) as well as firm value via (39).

iv. Check whether the forecast functions are consistent with policies according to (37) and (38). If so, the policies w and a, forecasts π^f, value v, and stationary distribution F implied by θ_π are computed. If not, update the guess for forecasts and return to (1(a)i).

(b) Compute the implied mean firm value objective of boards given θ_π via (24).

(c) If the board objective is optimized, realized short-term incentives θ_π^* are computed. If not, update the guess for θ_π and return to (1a).

2. Compute the implied growth rate $g(\bar{\xi})$ via

$$g = \int m dF(m,z,\varepsilon). \tag{40}$$

3. If $g(\bar{\xi}) = \hat{g}$, then R&D productivity consistent with target growth is computed and the model is solved. If not, update the guess for $\bar{\xi}$ and return to (1).

During counterfactuals, the model estimation step is complete and $\bar{\xi}$ is in hand. Similarly, the value of short-term incentives θ_π is assumed for a given counterfactual experiment. So the loops over $\bar{\xi}$ and θ_π above are not required. But a loop over the implied growth rate g, and the associated real interest rate R, neither of which is fixed by the target $\hat{g}$ as above, must now be employed. I use the following algorithm.

Numerical solution algorithm during counterfactuals

1. (Outer Loop) Guess the growth rate g and compute the associated real interest rate R from (12).

   (a) (Inner Loop) Guess R&D and accruals forecast functions $w^f(m,z)$, $a^f(m,z)$, implying profit forecasts $\pi^f(m,z)$ via (36).

   (b) Compute implied manager R&D policies $w(m,z,\varepsilon)$ and $a(m,z,\varepsilon)$ by optimizing (35) given $\pi^f(m,z)$.

   (c) Compute the stationary distribution $F(m,z,\varepsilon)$ implied by manager policies via (29) as well as firm value via (39).

   (d) Check whether the forecast functions are consistent with policies according to (37) and (38). If so, the policies w and a, forecasts π^f, value v, and stationary distribution F are computed. If not, update the guess for forecasts and return to (1a).

2. Compute the implied growth rate via (40).

3. If guessed and implied growth rates are equal, the model is solved. If not, update the guess for g and return to (1).

When solving the model, I use bisection for loops on $\bar{\xi}$ or g, Brent's method for optimization of θ_π, discretization for optimization of manager policies a and w, dampened fixed point iteration for updates of analyst forecasts π^f, and fixed point iteration for calculation of firm value v and the stationary distribution F. I implement the solution using heavily parallelized Fortran. Depending on grid density, the model is solvable in around a minute on a 2017 iMac Pro with an 18-core 2.3 GHz processor. At my baseline estimates from Table 3, for reference, the marginal ergodic distributions of model variables are plotted in Figure D.1.

D.2 SMM Estimation

My SMM estimation routine computes the parameter estimates $\hat{\theta}$ from (25) with the robust global stochastic particle swarm optimization. I simulate a panel of 5,000 firms for 25 years each, discarding an initial 25 year burn-in period. Target moments $m(X)$ are means or differentiable functions of means. So I compute the covariance of the underlying means, clustering by firm as in Hansen and Lee (2019) and then estimate the covariance matrix Σ of $m(X)$ via the Delta method. Here, as the number of observations $N \to \infty$, we have

$$\sqrt{N}(m(X) - m(\theta)) \to_d N(0, \Sigma). \tag{41}$$

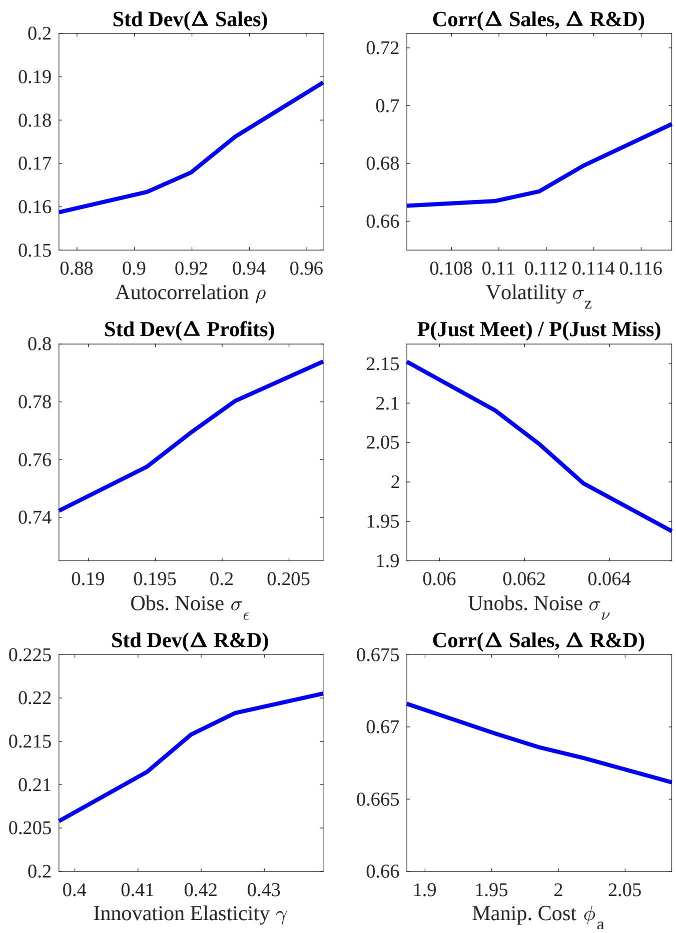
In the estimation I employ the optimal weighting matrix $W = \Sigma^{-1}$, so

$$\sqrt{N}(\hat{\theta} - \theta) \to_d N(0, \Omega), \qquad \Omega = \left(1 + \frac{1}{S}\right) \left(\frac{\partial m(\theta)'}{\partial \theta} \Sigma^{-1} \frac{\partial m(\theta)}{\partial \theta}\right)^{-1}. \tag{42}$$

S is the ratio of simulated to empirical sample size. $\frac{\partial m(\theta)}{\partial \theta}$ is the moment Jacobian, computable with numerical differentiation. For ease of reference I report the target covariance moments as standard deviations and correlations, with standard errors computed straightforwardly via the Delta method, while the underlying estimation uses more conventional raw covariances. For reference, Figure D.2 reports comparative statics for various model parameters.

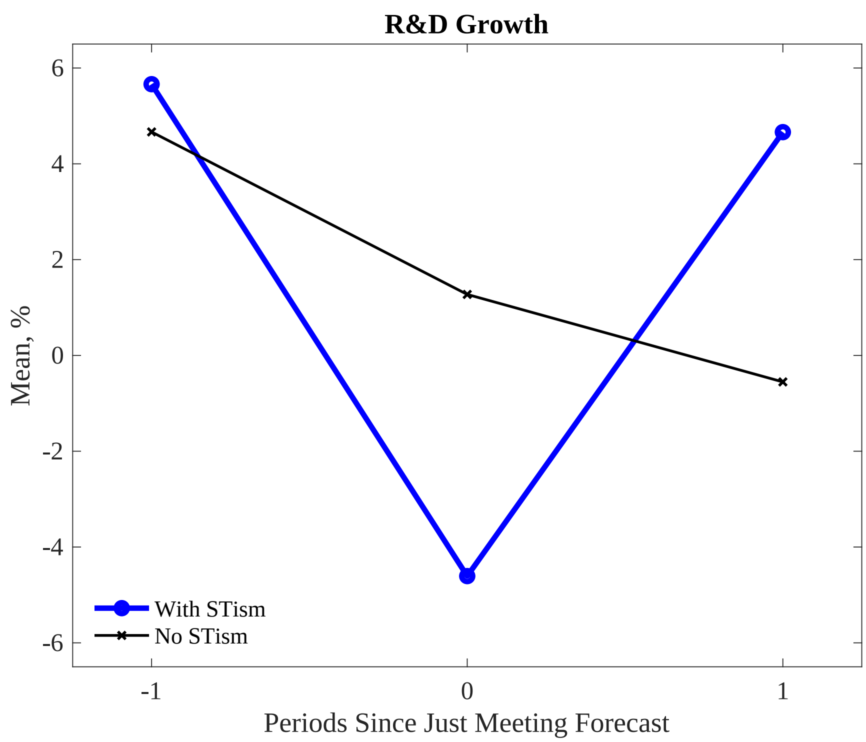
D.3 Supplemental Tables and Figures

Figure D.2: Identifying the Remaining Parameters



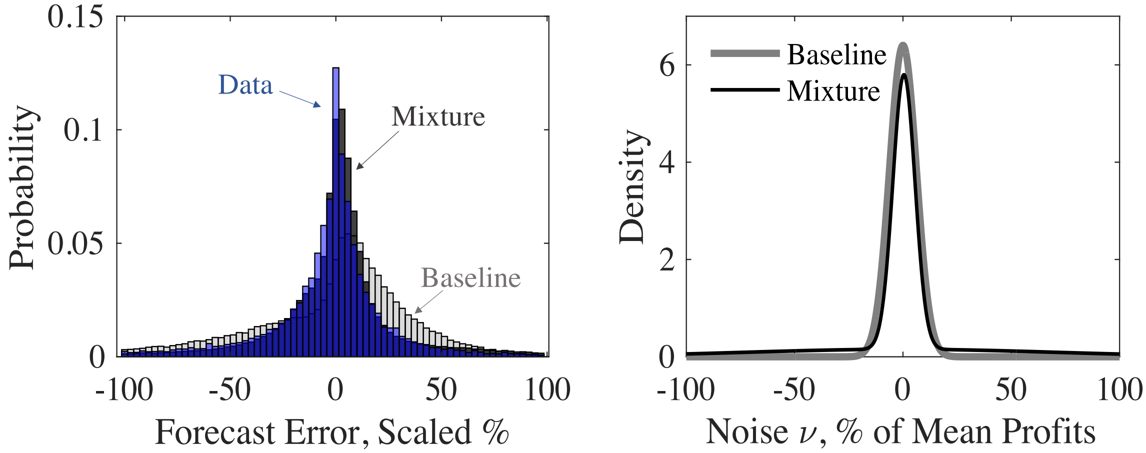
Notes: The figure plots selected smoothed simulated target moments as a function of various parameters, varying each in isolation above and below its baseline estimate in Panel A of Table 3.

Figure D.3: R&D Growth Dynamics



Notes: The figure plots the simulated average path of R&D growth in the periods before and after just meeting an earnings target. The lightweight black line with x symbols is the counterfactual model with no short-term incentives and $\theta_\pi = 0$. The heavier blue line with circles is the baseline estimated model with short-termism using parameters from Panel of Table 3.

Figure D.4: Mixture versus Normal Distributions for Profit Noise



Notes: The left panel plots histograms of forecast errors in scaled percentage form, i.e., $100\frac{\Pi-\Pi^f}{\frac{|\Pi|+|\Pi^f|}{2}}$ where Π is realized profits and Π^f is forecast profits. Blue "Data" is from a 2003-18 Compustat-IBES sample of 4,703 firms for 30,088 firm-years, with pro forma earnings for realizations and four-quarter median analyst forecasts. Dark gray "Mixture" is from the estimated model with mixture noise in Table D.1. Light gray "Baseline" is from the baseline estimated model with normal noise in Table 3. The right panel plots the densities of unobservable profit noise ν from the Mixture (lightweight black line) and Baseline (heavier gray line) models.

Table D.1: Model Results Estimating with Gaussian Mixture Noise

Panel A: Estimated Parameters	Symbol	Estimate	(Std. Error)
R&D elasticity of innovation	γ	0.1980	(0.0183)
Manager private R&D benefits	ϕ_e	0.1718	(0.0094)
Manager private accruals cost	ϕ_a	2.2362	(0.3597)
Profitability persistence	ρ	0.9386	(0.0068)
Profitability volatility	σ_z	0.1284	(0.0044)
Observable profit noise	σ_ε	0.0785	(0.0046)
Unob. profit noise, mixture 1 weight	$p_{1,\nu}$	0.7258	(0.0122)
Unob. profit noise, mixture 1 mean	$\mu_{1,\nu}$	0.0045	(0.0012)
Unob. profit noise, mixture 1 volatility	$\sigma_{1,\nu}$	0.0513	(0.0017)
Unob. profit noise, mixture 2 volatility	$\sigma_{2,\nu}$	0.7119	(0.0336)
Panel B: Moments	Data	(Std. Error)	Model
Std. deviation of sales growth	0.4249	(0.0102)	0.2001
Correlation of sales growth, profit growth	0.2616	(0.0098)	0.6775
Correlation of sales growth, R&D growth	0.1745	(0.0123)	0.5717
Correlation of sales growth, forecast error	0.1282	(0.0085)	0.3922
Std. deviation of profit growth	0.8490	(0.0101)	0.7444
Correlation of profit growth, R&D growth	-0.0364	(0.0093)	0.0765
Correlation of profit growth, forecast error	0.5486	(0.0102)	0.6870
Std. deviation of R&D growth	0.3092	(0.0052)	0.2120
Correlation of R&D growth, forecast error	-0.0246	(0.0093)	-0.0385
Std. deviation of forecast error	0.6637	(0.0099)	0.5323
Prob. of forecast error < -50%	0.1332	(0.0041)	0.1005
Prob. of forecast error < -25%	0.2060	(0.0049)	0.1629
Prob. of forecast error < -10%	0.3091	(0.0056)	0.2708
Prob. of forecast error < -5%	0.3673	(0.0055)	0.3227
Prob. of forecast error < 0	0.4527	(0.0051)	0.4208
Prob. of forecast error < 5%	0.6099	(0.0049)	0.5971
Prob. of forecast error < 10%	0.7089	(0.0049)	0.7347
Prob. of forecast error < 25%	0.8457	(0.0039)	0.8834
Prob. of forecast error < 50%	0.9179	(0.0029)	0.9408
Panel C: Quantitative Impacts			
Mean R&D cost increase from short-term pressure			10.422 %
Mean value loss without short-term pressure			1.4623 %
Welfare gain without short-term pressure			1.1955 %
Growth gain without short-term pressure			4.9 b.p.

Notes: Results for a version of the model allowing for a Gaussian mixture specification of unobservable noise. Panel A's SMM parameter estimates use efficient moment weighting. Panel B's data moments use a 2003-2018 Compustat-IBES panel of 2,510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5,000 firms. Moment units are proportional (0.01 = 1%). Standard errors are firm clustered. Units in Panel C are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

Table D.2: Model Results with Project Quality Shocks

Panel A: Estimated Parameters	Symbol	Estimate	(Std. Error)
R&D elasticity of innovation	γ	0.3812	(0.0235)
Profitability persistence	ρ	0.9051	(0.0116)
Profitability volatility	σ_z	0.1224	(0.0078)
Observable profit noise	σ_ε	0.1938	(0.0086)
Unobservable profit noise	σ_ν	0.0605	(0.0033)
Manager private R&D benefits	ϕ_e	0.0856	(0.0152)
Manager private accruals cost	ϕ_a	1.2459	(0.5888)
Project quality volatility	σ_ξ	0.0503	(0.0025)
Panel B: Moments	**Data**	**(Std. Error)**	**Model**
Std. deviation of sales growth	0.4249	(0.0102)	0.2046
Correlation of sales growth, profit growth	0.2616	(0.0098)	0.6066
Correlation of sales growth, R&D growth	0.1745	(0.0123)	0.3136
Correlation of sales growth, forecast error	0.1282	(0.0085)	0.2388
Std. deviation of profit growth	0.8490	(0.0101)	0.7705
Correlation of profit growth, R&D growth	-0.0364	(0.0093)	-0.1082
Correlation of profit growth, forecast error	0.5486	(0.0102)	0.6503
Std. deviation of R&D growth	0.3092	(0.0052)	0.2343
Correlation of R&D growth, forecast error	-0.0246	(0.0093)	-0.1036
Std. deviation of forecast error	0.6637	(0.0099)	0.5455
Prob. of meeting forecast	0.5473	(0.0041)	0.5724
Prob. of just meeting to prob. of just missing	1.7852	(0.0516)	2.0915
Panel C: Quantitative Impacts			
Mean R&D cost increase from short-term pressure			2.5012 %
Mean value loss without short-term pressure			0.6030 %
Welfare gain without short-term pressure			0.5525 %
Growth gain without short-term pressure			2.3 b.p.

Notes: Results for an extended framework including iid shocks ξ to project quality. Panel A's SMM parameter estimates use efficient moment weighting. Panel B's data moments use a 2003-2018 Compustat-IBES panel of 2,510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5,000 firms. Moment units are proportional ($0.01 = 1\%$). Standard errors are firm clustered. Panel C's mean increase in R&D costs is the estimated percentage rise in marginal investment costs due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to the baseline 2%. Units in Panel C are in percent ($0.1 = 0.1\%$) or basis points (1 b.p. $= 0.0001$) as indicated.

Table D.3: Model Results with R&D Capital

Panel A: Parameters	Estimated Flow Model $\delta = 1.00$	Flow Estimates Imposing $\delta = 0.35$	Estimated Cap. Model $\delta = 0.35$
R&D elasticity of innovation, γ	0.4184	0.4184	0.4950 (0.0144)
Profitability persistence, ρ	0.9197	0.9197	0.4864 (0.1144)
Profitability volatility, σ_z	0.1117	0.1117	0.0269 (0.0091)
Observable profit noise, σ_ε	0.1977	0.1977	0.1107 (0.0500)
Unobservable profit noise, σ_ν	0.0623	0.0623	0.2035 (0.0243)
Manager private R&D benefits, ϕ_e	0.0915	0.0915	0.6607 (0.0035)
Manager private accruals cost, ϕ_a	1.9857	1.9857	4.2709 (2.4263)
Panel B: Moments	**Data (SE)**	**Model**	**Model**
Std. dev. sales growth	0.4249 (0.0102)	0.1411	0.1675
Corr. sales growth, profit growth	0.2616 (0.0098)	0.5903	0.5326
Corr. sales growth, R&D growth	0.1745 (0.0123)	0.2182	0.6673
Corr. sales growth, forecast error	0.1282 (0.0085)	0.3152	0.2575
Std. dev. profit growth	0.8490 (0.0101)	0.5942	0.7722
Corr. profit growth, R&D growth	-0.0364 (0.0093)	-0.1154	-0.0085
Corr. profit growth, forecast error	0.5486 (0.0102)	0.6562	0.6719
Std. dev. R&D growth	0.3092 (0.0052)	0.6666	0.2151
Corr. R&D growth, forecast error	-0.0246 (0.0093)	-0.014	-0.0649
Std. deviation of forecast error	0.6637 (0.0099)	0.4341	0.5639
Prob. meeting forecast	0.5473 (0.0041)	0.5024	0.5721
Prob. just meeting to just missing	1.7852 (0.0516)	1.1055	2.0166
Panel C: Quantitative Impacts			
Mean R&D cost increase			0.8741 %
Mean value loss			1.3822 %
Welfare gain			1.1901 %
Growth gain			4.9 b.p.

Notes: Results for an extended model allowing for R&D capital, not flow, to enter the innovation function. The first two columns report results either from some version of the baseline R&D flow model or the data. The final column reports results from the re-estimated R&D capital model. Where relevant, the depreciation rate for R&D capital is set to $\delta = 0.35$ following the estimates in Li and Hall (2016). Panel A's SMM parameter estimates use efficient moment weighting. Panel B's data moments use a 2003-2018 Compustat-IBES panel of 2,510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5,000 firms. Moment units are proportional (0.01 = 1%). Standard errors are firm clustered. Panel C's mean increase in R&D costs is the estimated percentage rise in marginal investment costs due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to baseline. Units in Panel C are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

Table D.4: Quantitative Impacts, Parameter Robustness

Parameter Experiment	R&D Cost Increase, %	Mean Value Loss, %	Welfare Gain, %	Growth Gain, b.p.
Baseline estimates	2.4363	1.2525	1.1473	4.7
High R&D elasticity, γ	2.4662	1.0484	0.9139	3.8
Low R&D elasticity, γ	2.2554	0.7070	0.6047	2.4
High profitability persistence, ρ	2.4953	0.7586	0.6582	2.6
Low profitability persistence, ρ	2.3234	0.9036	0.7939	3.3
High profitability volatility, σ_z	2.2748	0.8141	0.7134	2.9
Low profitability volatility, σ_z	2.3287	1.0834	0.9850	3.9
High observable profit noise, σ_ε	2.1081	0.6985	0.6048	2.5
Low observable profit noise, σ_ε	2.8656	1.2695	1.1449	4.7
High unobservable profit noise, σ_ν	2.3898	1.2585	1.1475	4.7
Low unobservable profit noise, σ_ν	2.4610	1.2476	1.1476	4.7
High manager private R&D benefits, ϕ_e	2.8604	0.8883	0.7652	3.3
Low manager private R&D benefits, ϕ_e	2.0911	0.8423	0.7690	3.3
High manager private accruals cost, ϕ_a	2.4891	1.2512	1.1471	4.7
Low manager private accruals cost, ϕ_a	2.5547	1.2542	1.1467	4.7
High accruals cost curvature, 2.5	2.4421	0.8481	0.7096	3.8
Low accruals cost curvature, 1.5	2.4025	0.8439	0.7100	3.8

Notes: Results from individually changing each estimated parameter in Table 3 Panel A higher or lower by one standard error or from changing the curvature of the accruals cost function from quadratic to higher or lower values. The increase in R&D costs is the mean estimated percentage rise in marginal investment costs due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to the baseline 2%. Units are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

Table D.5: Quantitative Impacts, Matching the R&D Profit Share

Mean R&D cost increase from short-term pressure	2.3230 %
Mean value loss without short-term pressure	1.0055 %
Welfare gain without short-term pressure	0.9338 %
Growth gain without short-term pressure	3.8 b.p.

Notes: Results for a parameterization of the model choosing $\gamma = 0.375$ to match the mean R&D to profit share in the Compustat data but otherwise identical to baseline. The mean increase in R&D costs is the estimated percentage rise in marginal investment costs at listed firms due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to a baseline value of 2%. Units are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

Table D.6: Model Results with Different Macro Growth Rates

	GDP/person $g = 1.90\%$	TFP $g = 1.24\%$	
Panel A: Estimated Parameters	Est. (SE)	Est. (SE)	
R&D elasticity of innovation, γ	0.4403 (0.0335)	0.4277 (0.0235)	
Profitability persistence, ρ	0.9096 (0.0109)	0.9135 (0.0068)	
Profitability volatility, σ_z	0.1168 (0.0047)	0.1195 (0.0040)	
Observable profit noise, σ_ε	0.1919 (0.0195)	0.1973 (0.0128)	
Unobservable profit noise, σ_ν	0.0601 (0.0088)	0.0639 (0.0109)	
Manager private R&D benefits, ϕ_e	0.0851 (0.0121)	0.0897 (0.0117)	
Manager private accruals cost, ϕ_a	2.1544 (0.3835)	1.2513 (0.4665)	
Panel B: Moments	Model	Model	Data (SE)
Std. dev. sales growth	0.1810	0.1825	0.4249 (0.0102)
Corr. sales growth, profit growth	0.5159	0.5221	0.2616 (0.0098)
Corr. sales growth, R&D growth	0.6849	0.7044	0.1745 (0.0123)
Corr. sales growth, forecast error	0.2391	0.2481	0.1282 (0.0085)
Std. dev. profit growth	0.7975	0.7953	0.8490 (0.0101)
Corr. profit growth, R&D growth	0.0001	0.0205	-0.0364 (0.0093)
Corr. profit growth, forecast error	0.6654	0.6660	0.5486 (0.0102)
Std. dev. R&D growth	0.2319	0.2305	0.3092 (0.0052)
Corr. R&D growth, forecast error	-0.0567	-0.0498	-0.0246 (0.0093)
Std. deviation of forecast error	0.5836	0.5848	0.6637 (0.0099)
Prob. meeting forecast	0.5665	0.5645	0.5473 (0.0041)
Prob. just meeting to just missing	1.9882	1.9283	1.7852 (0.0516)
Panel C: Quantitative Impacts			
Mean R&D cost increase	2.0036 %	2.0416 %	
Mean value loss	0.8700 %	0.4378 %	
Welfare gain	0.7757 %	0.3684 %	
Growth gain	3.3 b.p.	1.8 b.p.	

Notes: Results in the GDP/person column target aggregate growth of 1.90%, equal to mean US per capita GDP growth in 1960-2020. The TFP column targets aggregate growth of 1.24%, equal to mean US TFP growth in 1947-2021 according to John Fernald's TFP series. Panel A's SMM parameter estimates use efficient moment weighting. Panel B's data moments use a 2003-2018 Compustat-IBES panel of 2,510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5,000 firms. Moment units are proportional (0.01 = 1%). Standard errors are firm clustered. Panel C's mean increase in R&D costs is the estimated percentage rise in marginal investment costs due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to baseline. Units in Panel C are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

Table D.7: Model Results Estimating with Pre- and Post-SOX Data

Panel A: Estimated Parameters	Symbol	Estimate	(Std. Error)
R&D elasticity of innovation	γ	0.4800	(0.0203)
Profitability persistence	ρ	0.7628	(0.0723)
Profitability volatility	σ_z	0.1381	(0.0061)
Observable profit noise	σ_ε	0.1914	(0.0114)
Unobservable profit noise	σ_ν	0.0726	(0.0244)
Manager private R&D benefits	ϕ_e	0.0689	(0.0118)
Manager private accruals cost	ϕ_a	5.2653	(1.1784)
Panel B: Moments	**Data**	**(Std. Error)**	**Model**
Std. deviation of sales growth	0.4054	(0.0074)	0.1871
Correlation of sales growth, profit growth	0.2678	(0.0077)	0.4883
Correlation of sales growth, R&D growth	0.2421	(0.0097)	0.7280
Correlation of sales growth, forecast error	0.1631	(0.0067)	0.2037
Std. deviation of profit growth	0.8924	(0.0084)	0.7957
Correlation of profit growth, R&D growth	-0.0141	(0.0074)	0.0241
Correlation of profit growth, forecast error	0.5893	(0.0073)	0.6700
Std. deviation of R&D growth	0.3407	(0.0043)	0.2279
Correlation of R&D growth, forecast error	0.0043	(0.0072)	-0.0493
Std. deviation of forecast error	0.6952	(0.0077)	0.5707
Prob. of meeting forecast	0.4901	(0.0038)	0.5341
Prob. of just meeting to prob. of just missing	1.6645	(0.0374)	1.3515
Panel C: Quantitative Impacts			
Mean R&D cost increase from short-term pressure			1.4973 %
Mean value loss without short-term pressure			0.7268 %
Welfare gain without short-term pressure			0.6604 %
Growth gain without short-term pressure			2.7 b.p.

Notes: Results based on estimation using an expanded dataset spanning pre- and post-SOX periods. Panel A's SMM parameter estimates use efficient moment weighting. Panel B's data moments use a 1990-2018 Compustat-IBES panel of 3,834 firms for 27,989 firm-years. Model moments use a 25-year simulated panel of 5,000 firms. Moment units are proportional (0.01 = 1%). Standard errors are firm clustered. Panel C's mean increase in R&D costs is the estimated percentage rise in marginal investment costs due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to the baseline 2%. Units in Panel C are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

Table D.8: Model Results, High R&D vs Low R&D Samples

Panel A: Estimated Parameters	High R&D Est. (SE)	Low R&D Est. (SE)
R&D elasticity, γ	0.3526 (0.0542)	0.4584 (0.0510)
Profitability persistence, ρ	0.9300 (0.0166)	0.5858 (0.0651)
Profitability volatility, σ_z	0.1314 (0.0062)	0.1140 (0.0056)
Observable profit noise, σ_ε	0.2476 (0.0354)	0.1720 (0.0205)
Unobservable profit noise, σ_ν	0.0783 (0.0038)	0.0502 (0.0047)
Manager private R&D benefits, ϕ_e	0.1369 (0.0162)	0.0828 (0.0121)
Manager private accruals cost, ϕ_a	1.9247 (0.6476)	2.0329 (0.7642)
Panel B: Moments	Data (SE) Model	Data (SE) Model
Std. dev. sales growth	0.5287 (0.0134) 0.1959	0.1925 (0.0054) 0.1816
Corr. sales growth, profit growth	0.2486 (0.0115) 0.5788	0.3884 (0.0176) 0.2543
Corr. sales growth, R&D growth	0.1468 (0.0151) 0.5902	0.3413 (0.0220) 0.7316
Corr. sales growth, forecast error	0.1188 (0.0099) 0.2959	0.1848 (0.0180) 0.0035
Std. dev. profit growth	0.9237 (0.0123) 0.8604	0.7292 (0.0164) 0.7739
Corr. profit growth, R&D growth	-0.0886 (0.0111) -0.0451	0.0558 (0.0159) -0.0026
Corr. profit growth, forecast error	0.5152 (0.0127) 0.6658	0.6242 (0.0162) 0.6618
Std. dev. R&D growth	0.3108 (0.0061) 0.2539	0.3060 (0.0093) 0.2353
Corr. R&D growth, forecast error	-0.0569 (0.0112) -0.0954	0.0268 (0.0158) -0.0529
Std. dev. forecast error	0.7208 (0.0124) 0.6387	0.5699 (0.0158) 0.5494
Prob. meeting forecast	0.5637 (0.0053) 0.5986	0.5241 (0.0064) 0.5555
Prob. just meeting to just missing	1.8693 (0.0772) 2.4855	1.7108 (0.0688) 1.7820
Panel C: Quantitative Impacts		
Mean R&D cost increase	4.8841 %	1.7764 %
Mean value loss	1.7146 %	0.5741 %
Welfare gain	1.4658 %	0.4977 %
Growth gain	6.0 b.p.	2.1 b.p.

Notes: Results in the high (low) R&D columns are for a sample of firms which have above (below) median R&D to sales ratios. Panel A's SMM parameter estimates use efficient moment weighting for both samples. Panel B's high R&D data moments use a 2003-2018 Compustat-IBES panel of 1,647 firms for 9,740 firm-years. The low R&D data moments use a 2003-2018 Compustat-IBES panel of 863 firms for 6,835 firm-years. Model moments use a 25-year simulated panel of 5,000 firms. Moment units are proportional (0.01 = 1%). Standard errors are firm clustered. Panel C's mean increase in R&D costs is the estimated percentage rise in marginal investment costs due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to the baseline 2%. Units in Panel C are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

Table D.9: Model Results Estimating with SG&A Instead of R&D

Panel A: Estimated Parameters	Symbol	Estimate	(Std. Error)
SG&A elasticity of innovation	γ	0.4912	(0.0235)
Profitability persistence	ρ	0.5395	(0.0373)
Profitability volatility	σ_z	0.1333	(0.0031)
Observable profit noise	σ_ε	0.1979	(0.0241)
Unobservable profit noise	σ_ν	0.0422	(0.0304)
Manager private SG&A benefits	ϕ_e	0.0628	(0.0629)
Manager private accruals cost	ϕ_a	2.8133	(0.6912)
Panel B: Moments	**Data**	**(Std. Error)**	**Model**
Std. deviation of sales growth	0.4249	(0.0102)	0.1668
Correlation of sales growth, profit growth	0.2616	(0.0098)	0.5108
Correlation of sales growth, SG&A growth	0.1745	(0.0123)	0.7923
Correlation of sales growth, forecast error	0.1282	(0.0085)	0.2196
Std. deviation of profit growth	0.8490	(0.0101)	0.7486
Correlation of profit growth, SG&A growth	-0.0364	(0.0093)	0.1077
Correlation of profit growth, forecast error	0.5486	(0.0102)	0.6772
Std. deviation of SG&A growth	0.3092	(0.0052)	0.1681
Correlation of SG&A growth, forecast error	-0.0246	(0.0093)	-0.0279
Std. deviation of forecast error	0.6637	(0.0099)	0.5331
Prob. of meeting forecast	0.5473	(0.0041)	0.5436
Prob. of just meeting to prob. of just missing	1.7852	(0.0516)	1.6317
Panel C: Quantitative Impacts			
Mean SG&A cost increase from short-term pressure			0.7671 %
Mean value loss without short-term pressure			0.5333 %
Welfare gain without short-term pressure			0.5022 %
Growth gain without short-term pressure			2.0 b.p.

Notes: Results replacing R&D with SG&A as the empirical measure of innovation investment. Panel A's SMM parameter estimates use efficient moment weighting. Panel B's data moments use a 2003-2018 Compustat-IBES panel of 4,521 firms for 31,756 firm-years. Model moments use a 25-year simulated panel of 5,000 firms. Moment units are proportional (0.01 = 1%). Standard errors are firm clustered. Panel C's mean increase in SG&A costs is the estimated percentage rise in marginal investment costs due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to the baseline 2%. Units in Panel C are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

Table D.10: Model Results Estimating with Noise in Profits Only

Panel A: Estimated Parameters	Symbol	Estimate	(Std. Error)
R&D elasticity of innovation	γ	0.5060	(0.0219)
Profitability persistence	ρ	0.7618	(0.0443)
Profitability volatility	σ_z	0.1355	(0.0052)
Observable profit noise	σ_ε	0.1761	(0.0236)
Unobservable profit noise	σ_ν	0.0457	(0.0124)
Manager private R&D benefits	ϕ_e	0.0690	(0.0094)
Manager private accruals cost	ϕ_a	2.3370	(0.2800)
Panel B: Moments	**Data**	**(Std. Error)**	**Model**
Std. deviation of sales growth	0.4249	(0.0102)	0.1816
Correlation of sales growth, profit growth	0.2616	(0.0098)	0.2543
Correlation of sales growth, R&D growth	0.1745	(0.0123)	0.7316
Correlation of sales growth, forecast error	0.1282	(0.0085)	0.0035
Std. deviation of profit growth	0.8490	(0.0101)	0.7739
Correlation of profit growth, R&D growth	-0.0364	(0.0093)	-0.0026
Correlation of profit growth, forecast error	0.5486	(0.0102)	0.6618
Std. deviation of R&D growth	0.3092	(0.0052)	0.2353
Correlation of R&D growth, forecast error	-0.0246	(0.0093)	-0.0529
Std. deviation of forecast error	0.6637	(0.0099)	0.5494
Prob. of meeting forecast	0.5473	(0.0041)	0.5555
Prob. of just meeting to prob. of just missing	1.7852	(0.0516)	1.7820
Panel C: Quantitative Impacts			
Mean R&D cost increase from short-term pressure			1.0463 %
Mean value loss without short-term pressure			0.7170 %
Welfare gain without short-term pressure			0.6633 %
Growth gain without short-term pressure			2.6 b.p.

Notes: Results for a specification of the model with noise terms in profits only. Panel A's SMM parameter estimates use efficient moment weighting. Panel B's data moments use a 2003-2018 Compustat-IBES panel of 2,510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5,000 firms. Moment units are proportional (0.01 = 1%). Standard errors are firm clustered. Panel C's mean increase in R&D costs is the estimated percentage rise in marginal investment costs due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$). The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to the baseline 2%. Units in Panel C are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.

Table D.11: Quantitative Impacts, Allowing for Private Firms

	Match Listed R&D Share	Naive Fraction
Fraction of private firms without short-term pressure	6.8835 %	20.400 &
Mean R&D cost increase from short-term pressure	2.4729 %	2.6336 %
Mean value loss without short-term pressure	1.0683 %	0.6675 %
Welfare gain without short-term pressure	0.9405 %	0.5484 %
Growth gain without short-term pressure	3.9 b.p.	2.3 b.p.

Notes: Results for an extended model allowing for a portion of firms to be private and immune from short-term pressures or agency conflicts. The first column reports results when the fraction of private firms (6.9%) is chosen to match the mean observed share of US R&D conducted by listed firms (79.6% in 2003-18 according to BEA and Compustat data). The second column reports results when the fraction of private firms (20.4%) is naively set to the observed R&D share of private firms (100-79.6 = 20.4%). The mean increase in R&D costs is the estimated percentage rise in marginal investment costs at listed firms due to short-term pressure $\theta_\pi > 0$. The mean value loss is the counterfactual change from baseline in firm value after elimination of short-term pressure (setting $\theta_\pi = 0$), averaging over private and listed firms. The welfare gain is the counterfactual consumption-equivalent welfare gain. The growth gain is the counterfactual increase in aggregate growth, relative to a baseline value of 2%. Units are in percent (0.1 = 0.1%) or basis points (1 b.p. = 0.0001) as indicated.