Econometrica Supplementary Material

SUPPLEMENT TO "THE MACRO IMPACT OF SHORT-TERMISM"

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APPENDIX 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 data set on U.S.-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 U.S. firms measured in U.S. 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 CEOs and CFOs only. The Execucomp data are natively linked to the Compustat `gvkey` firm IDs and feature a unique executive ID `execid`.

Patenting Data. I use the U.S. public firm patenting data set constructed by Kogan, Papanikolaou, Seru, and Stoffman (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`.

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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

$$2\frac{X_{jt}-X_{jt-1}}{|X_{jt}|+|X_{jt-1}|}, \tag{19}$$

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

$$\frac{\texttt{capxv}}{\texttt{ppent}}_{jt}-\frac{\texttt{capxv}}{\texttt{ppent}}_{jt-1}. \tag{20}$$

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

$$fe^h_{jt}=street_{jt}-consensus^h_{jt}, \tag{21}$$

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

$$2\frac{fe^h_{jt}}{|street_{jt}|+|consensus^h_{jt}|} \tag{22}$$

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, Papanikolaou, Seru, and Stoffman (2017) patenting data, I compute the change in subsequent innovation outcomes X for firm j after year t at a given horizon

TABLE B.I

DESCRIPTIVE STATISTICS.

Variable	Mean	Median	Std. Dev.
Assets	9734.286	1855.781	34,666.13
Sales	7285.809	1564.981	21,475.93
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	15,095.6	2746.612	44,931.13

Note: Assets, sales, intangibles/SG&A, R&D, pro forma earnings, and market value are in millions of dollars. Employment is in thousands. The data are drawn from a 1990–2018 panel of Compustat financial statements merged to IBES earnings forecasts and realizations spanning 1685 firms with a total of 10,664 firm-year observations.

h as

$$X_{jt+h} - X_{jt}, \tag{23}$$

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.II verifies that my results are not dependent upon this choice.

TABLE B.II

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 C: 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	3646	3646	3646	3646

Note: Estimates are mean predicted differences for the outcome in p.p. for firms just meeting to just missing forecasts. 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.

B.3. *Descriptive Statistics*

The merged Compustat-IBES data set 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 1500 firms and just under 11,000 observations. Descriptive statistics for this sample are available in Table B.I.

APPENDIX 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 (8) is replaced by (15). Second, the intermediate goods state vector, which is $(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t)$ in nonstationary form and $(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt})$ in stationary normalized form, is augmented in both cases with the i.i.d. 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 (8) is replaced by (16). Second, R&D capital S_{kt} accumulates according to (17). Third, the intermediate goods state vector, which is $(M_{kt}, z_{kt}, \varepsilon_{kt}, Q_t)$ in nonstationary form and $(\frac{M_{kt}}{Q_t}, z_{kt}, \varepsilon_{kt})$ 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 $p_{\text{private}} \in [0, 1]$ of private firms, the technologies and structures for final goods firms, public intermediate goods firms, analysts, and households remain unchanged from the baseline equilibrium. However, the private firms choose R&D policies W_{kt}^p solving the Bellman equation

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

policies inducing a stationary distribution F^p satisfying

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

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

APPENDIX D: SOLUTION, ESTIMATION, AND 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 (10) can be written

$$-(1-\phi_e)w - \phi_a a^2 - \theta_\pi \mathbb{P}_\nu(\pi < \pi^f) + \frac{1+g}{R}\mathbb{E}(\pi_m(z')m'|z). \tag{24}$$

Analyst forecasts of profits can be written

$$\pi^f(m,z) = \pi^m(z)m - w^f(m,z) + a^f(m,z), \tag{25}$$

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

$$w^f(m,z) = \mathbb{E}_F(w(m,z,\varepsilon)|m,z), \tag{26}$$

$$a^f(m,z) = \mathbb{E}_F(a(m,z,\varepsilon)|m,z). \tag{27}$$

Firm value can be written

$$v(m,z,\varepsilon) = \left\{\pi_m(z)m - p_w w + \frac{1+g}{R}\mathbb{E}[v(m',z',\varepsilon')|z]\right\}. \tag{28}$$

Note that given target growth $\hat{g}$, condition (3) 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.

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 (25).
      ii. Compute implied manager R&D policies $w(m,z,\varepsilon)$ and $a(m,z,\varepsilon)$ by optimizing (24) given $\pi^f(m,z)$.
      iii. Compute the stationary distribution $F(m,z,\varepsilon)$ implied by manager policies via (18) as well as firm value via (28).
      iv. Check whether the forecast functions are consistent with policies according to (26) and (27). 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 (13).
   (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

$$g = \int m\,dF(m,z,\varepsilon). \tag{29}$$

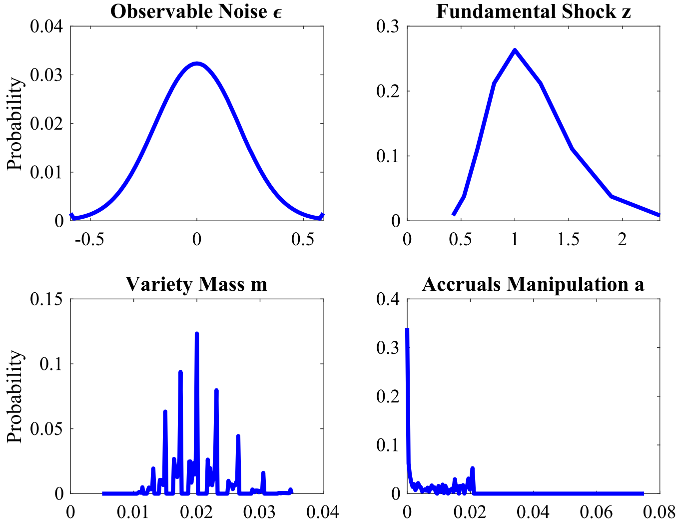

FIGURE D.1.—Model marginal ergodic distributions. *Note*: Each panel in the figure plots the marginal ergodic distribution of a state variable at the baseline estimated parameters from Panel A of Table 3.

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 (3).
   (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 (25).
   (b) Compute implied manager R&D policies $w(m, z, \varepsilon)$ and $a(m, z, \varepsilon)$ by optimizing (24) given $\pi^f(m, z)$.
   (c) Compute the stationary distribution $F(m, z, \varepsilon)$ implied by manager policies via (18) as well as firm value via (28).
   (d) Check whether the forecast functions are consistent with policies according to (26) and (27). 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 (29).
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

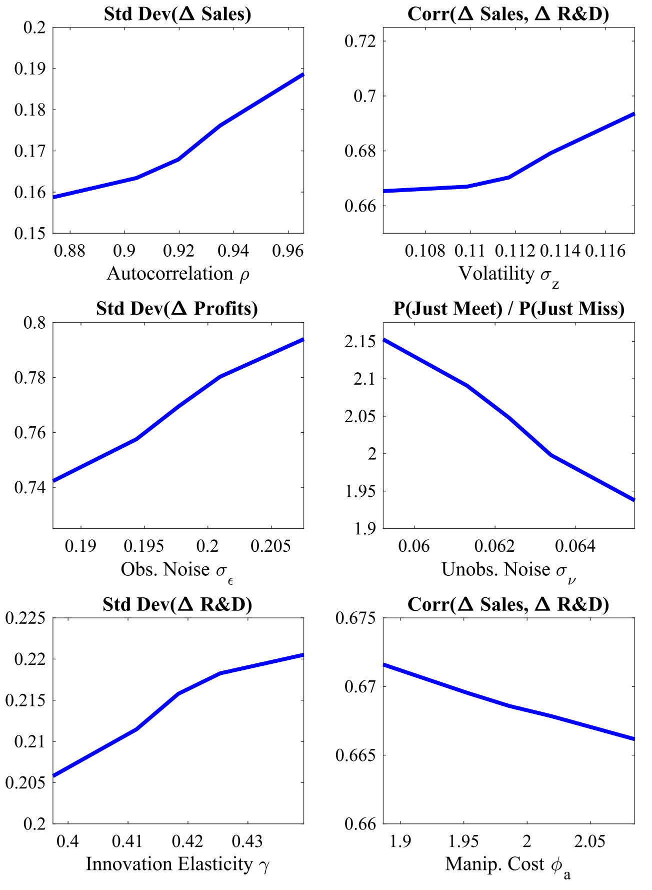

FIGURE D.2.—Identifying the remaining parameters. *Note*: The figure plots selected smoothed simulated target moments as a function of various parameters, varying each in isolation above and below its baseline estimate in Panel A of Table 3.

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 (14) with the robust global stochastic particle swarm optimization. I simulate a panel of 5000 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

$$\sqrt{N}\big(m(X) - m(\theta)\big) \to_d N(0, \Sigma). \tag{30}$$

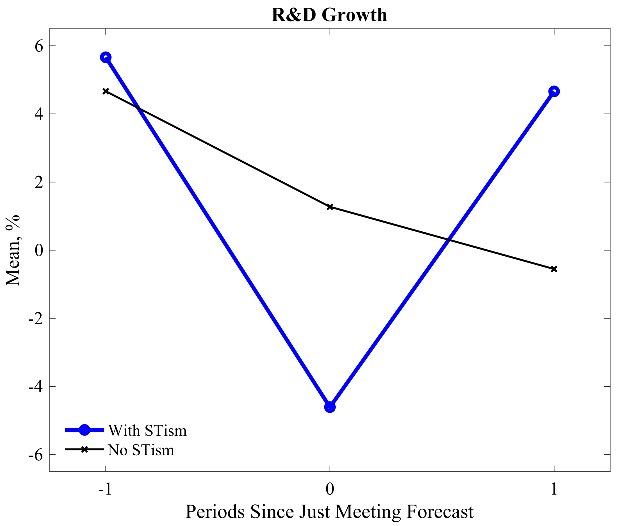

FIGURE D.3.—R&D growth dynamics. *Note*: The figure plots the simulated average path of R&D growth in the periods before and after just meeting an earnings target. The lightweight black line with x symbols is the counterfactual model with no short-term incentives and $\theta_\pi = 0$. The heavier blue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

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

$$\sqrt{N}(\hat{\theta} - \theta) \to_d N(0, \Omega), \quad \Omega = \left(1 + \frac{1}{S}\right)\left(\frac{\partial m(\theta)}{\partial \theta}' \Sigma^{-1} \frac{\partial m(\theta)}{\partial \theta}\right)^{-1}. \tag{31}$$

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 con-

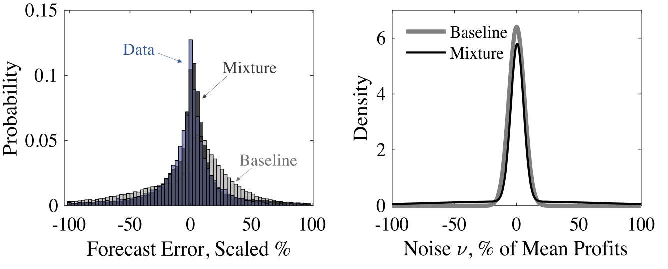

FIGURE D.4.—Mixture versus normal distributions for profit noise. *Note*: The left panel plots histograms of forecast errors in scaled percentage form, that is, $100\frac{\Pi - \Pi^f}{\frac{|\Pi| + |\Pi^f|}{2}}$, where Π is realized profits and Π^f is forecast profits. Blue "Data" is from a 2003–2018 Compustat-IBES sample of 4703 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.I. 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.

ventional raw covariances. For reference, Figure D.2 reports comparative statics for various model parameters.

D.3. *Supplemental Tables and Figures*

TABLE D.I

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.

Note: 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 2510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5000 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.II

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.

Note: Results for an extended framework including i.i.d. 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 2510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5000 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.III

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.

Note: 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 2510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5000 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.IV

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

Note: 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.V

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.

Note: 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.VI

MODEL RESULTS WITH DIFFERENT MACRO GROWTH RATES.

Panel A: Estimated Parameters	GDP/person $g = 1.90\%$ Est. (SE)	TFP $g = 1.24\%$ 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.

Note: Results in the GDP/person column target aggregate growth of 1.90%, equal to mean U.S. per capita GDP growth in 1960–2020. The TFP column targets aggregate growth of 1.24%, equal to mean U.S. 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 2510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5000 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.VII

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.

Note: Results based on estimation using an expanded data set 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 3834 firms for 27,989 firm-years. Model moments use a 25-year simulated panel of 5000 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.VIII

MODEL RESULTS, HIGH R&D VERSUS 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.

Note: 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 1647 firms for 9740 firm-years. The low R&D data moments use a 2003–2018 Compustat-IBES panel of 863 firms for 6835 firm-years. Model moments use a 25-year simulated panel of 5000 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.IX

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.

Note: 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 4521 firms for 31,756 firm-years. Model moments use a 25-year simulated panel of 5000 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.X

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.

Note: 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 2510 firms for 16,575 firm-years. Model moments use a 25-year simulated panel of 5000 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.XI

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.

Note: 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 U.S. R&D conducted by listed firms (79.6% in 2003–2018 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.

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