Short-Term Shocks and Long-Term Investment

Itay Saporta-Eksten, Tel Aviv University
&
Stephen Terry, Boston University

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Investment Matters Because It Is...

...Very Large

US investment $\approx$ \$2.3 trillion in 2015, totalling $\approx$ 13% of US GDP, larger than the GDP of all but 6 other nations[1]

...Very Volatile

Around four times more volatile than US GDP over business cycle[2]

...Increasingly Intangible

R&D, software, & intangibles account for almost 30% of total US investment, and such categories may be crucial for long-term growth.[3]

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[1] BEA NIPA, total private nonres. invest., World Bank WDI GDP at mkt. x-rates

[2] Bloom, et al. 2014

[3] BEA NIPA, total intellectual property products in 2015

Investment is All About Tomorrow, Not Today

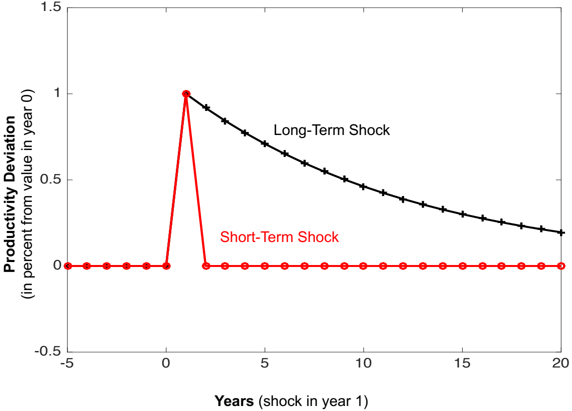
$$r + \delta = \mathbb{E}_t \left(\frac{\partial Y_{t+1}}{\partial K_{t+1}} \right)$$

A Strong Benchmark Result
Investment is determined by expectations of the future MPK alone

The Type of Shock Matters
Distinguishing between ST (transitory) and LT (persistent) shocks to firms is crucial, because ST shocks don't change the future MPK

Sensitivity Matters
Any sensitivity of forward-looking investment to ST shocks yields direct insight into the magnitude and type of investment frictions at firms

Different Shocks Imply Wildly Different Outlooks



Note: The paths above are the impulse response of profitability to a 1% shock emanating from multiple sources. The black line (+ symbols) represents a long-term shock. The red line (circle symbols) represents a short-term shock. Parameterizations are drawn from the best fit investment model with distortions introduced below.

What We Do in This Paper

Estimate a Flexible Process with ST & LT Firm Shocks
Two Shocks: profitability is the sum of ST and LT components
ST Shocks: a little under half of conditional firm risk

Unpack the Black Box
ST shocks correlated with taste shifts, weather, CEO turnover

Examine Sensitivity of Investment to ST Shocks
Context: directly tackles one key empirical endogeneity issue
Fact: tangible and intangible investment co-move with ST shocks

Lost Investment Efficiency from Misallocation
Sensitivity Matching: a model with reduced-form ST distortions
Destroyed Value: around half a percent, or $\approx$ $75 billion

Related Work

Investment Frictions

Veracierto (2002), Gomes (2001), Cooper & Haltiwanger (2006), Gourio & Rudanko (2014), Gourio & Kashyap (2007), Glover (2013), Caballero, Engel, & Haltiwanger (1995), Khan & Thomas (2003, 2008), Thomas (2002), Thomas (2002), Hennessy & Whited (2007), Eisfeldt & Rampini (2006), Nikolov & Whited (2013), Acemoglu, et al. (2013), Hall (2004), Strebulaev & Whited (2012), Stein (2003), Hsieh & Klenow (2009), Restuccia & Rogerson (2008), Yang (2014), Vincent & Kehrig (2016), Buera, Kaboski, & Shin (2011), Moll (2014), Midrigan & Xu (2014), Gourio (2008)

Intangible Investment

Griliches (1990), Blundell, Griffith, & Windmeijer (2002), Klette & Kortum (2004), McGrattan & Prescott (2005, 2010, 2014), Acemoglu & Cao (2010), Kortum & Lerner (2000), Brown, Fazzari, & Petersen (2009), Romer (1990), Aghion & Howitt (1992), Grossman & Helpman (1991), Terry (2016), Peters (2013), Peters & Taylor (2016), Barlevy (2007), Alp, Akcigit, & Peters (2016), Eisfeldt & Papanikolaou (2013, 2014)

Investment-Cash Flow Sensitivities

Hayashi (1982), Fazzari, et al. (1988), Moyen (2004), Gilchrist & Himmelberg (1995), Kaplan & Zingales (1997), Brown & Petersen (2009), Rauh (2006), Eberly, Rebelo, & Vincent (2008, 2012), Erickson & Whited (2006, 2012), Cummins, et al. (2006)

Consumption-Income Process & Sensitivities

Freidman (1957), MaCurdy (1982), Abowd & Card (1989), Meghir & Pistaferri (2004), Blundell, Pistaferri, & Preston (2008), Johnson, McClelland, Parker, & Souleles (2013, 2014), Hsieh (2003), Attanasio & Davis (1996), Nakata and Tonetti (2015)

Estimating Short-Term and Long-Term Shocks

Unpacking the Black Box of Firm Risk

Long-Term Investment and Short-Term Shocks

The Costs of Short-Term Sensitivity

A More Flexible Profitability Process

Overall Profitability

Level for firm j at time t is given by

$$\log z_{jt} = \varepsilon_{jt} + \nu_{jt}$$

LT Persistent Component

AR(1) assumption for persistent component

$$\varepsilon_{jt} = \rho\varepsilon_{jt-1} + \eta_{jt}, \quad \eta_{jt} \sim N(0, \sigma_\eta^2)$$

ST Transitory Component

Generalize to allow for short-term risk to also hit firm profits

$$\nu_{jt} \sim N(0, \sigma_\nu^2)$$

Interpreting Micro Shocks z_{jt}

Supply or Demand: process maps into reduced-form revenue function, demand or supply shifters allowed, "overall profitability" summary

Micro Only: our process is separable from permanent firm heterogeneity and macro shocks, which can be modelled separately

Bayesian Estimation of Firm Profitability Process

Follow posterior sampling procedure outlined in Nakata & Tonetti (2015)

Basic Approach

Start with a panel of observed firm profitability z_{jt}, $j = 1, ..., N$, $t = 1, ...T$, and then construct a series of draws from joint posterior distribution

$$f\left(\rho, \sigma_\eta^2, \sigma_\nu^2, \sigma_0^2, \{\varepsilon_{jt}\}_{j,t} | \{z_{jt}\}_{j,t}\right),$$

with additional nuisance cross-sectional variance σ_0^2 of ε_{j0}.

Steps and Assumptions

Conjugate Priors

Normal prior for ρ, inverse-Wishart for variances, choose uninformative parameters

MCMC or Gibbs Sampling

Draw iteratively from conditional posteriors for each component

Tractable Individual Blocks

Conditional posterior draws only require OLS estimation, variance calculations, application of Kalman filter and Carter-Kohn smoother given state-space structure

Our outcomes of interest are posterior draws for...

1) process parameters ρ, σ_η^2, and σ_ν^2 and 2) smoothed unobserved shocks $\{\varepsilon_{jt}, \nu_{jt}\}_{j,t}$

U.S. Firm-Level Profitability and Investment Panel

Compustat
Coverage: U.S. public firms, fiscal years 1990-2013, annual accounts
Structure: baseline panel including around 600 firms, 14,000 firm-years

Observe Multiple Outcomes
Sales: total revenue
Investment: capital expenditures on plants, property, and equipment
SG&A: selling, general, and administrative expenses
R&D: research and development expenditures
Advertising: marketing expenditures
Employment: total firm employment

Revenue TFP
Two-factor TFP estimates from Imrohoroglu & Tuzel (2013) for smaller panel within Compustat universe

Descriptive Statistics

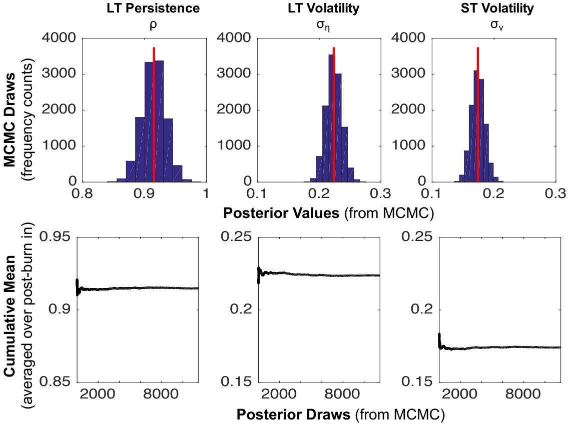
Firm Profitability Process

	Productivity	Sales
LT Persistence ρ	0.9152 (0.8777, 0.9506)	0.8810 (0.8735, 0.8883)
LT Volatility σ_η	0.2236 (0.1993, 0.2486)	0.2472 (0.2437, 0.2507)
ST Volatility σ_ν	0.1740 (0.1532, 0.1960)	0.0680 (0.0643, 0.0722)
Fixed Effects	Year, Ind.	Year, Firm
Years	2000-2013	1990-2013
Firms	50	597
Firm-Fiscal Yr. Obs.	700	14,328
ST Cond. Variance $\sigma_\nu^2/(\sigma_\eta^2+\sigma_\nu^2)$	38%	7%

Note: The table reports posterior median estimates (and 95% credible intervals) from the Nakata & Tonetti (2015) sampler. The middle column uses TFP estimated by Imrohoroglu & Tuzel (2013), and the right column uses log sales. The MCMC uses 15,000 draws with 3,500 burn-in draws. The bottom panel reports the ST variance share.

Comparison

Well Behaved MCMC Procedure for TFP Panel



Note: The top row plots posterior marginal histograms for each profitability process parameter, together with posterior medians in red. The bottom row plots the cumulative mean for progressive MCMC draws of each parameter. The total MCMC process is implemented with 15,000 draws and a 3,500-draw burn-in period.

Estimating Short-Term and Long-Term Shocks

Unpacking the Black Box of Firm Risk

Long-Term Investment and Short-Term Shocks

The Costs of Short-Term Sensitivity

What's Actually Happening?

Our estimation process delivers smoothed posterior draws of transitory shocks at the firm-year level $\{\hat{\nu}_{jt}\}_{j,t}$

News Stories & Annual Reports

Comparing them in small scale, anecdotal manner to annual reports, financial news stories reveals a ST role for:

Taste Fluctuations

E.g. Aussie snacks for Campbell's Soup, ChemLawn for Ecolab

Natural Disasters

E.g. energy price increase for Flexsteel after Hurricane Katrina in 2005

Reorganizations or Management Turnover

E.g. CEO turnovers and organizational restructuring for multiple firms

Next Steps: text mining of 10-K's and news for objective event classification, and formal first-stage analysis to align with out smoothed series

Campbell's Soup | Dynatronics Corp | Amgen | Ecolab, Inc. | Unisys Corp. | Regal Beloit Corp. | Flexsteel Industries

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A Long History of Investment Regressions

Many reduced-form empirical studies in corporate finance traditionally center around regressions of the form

$$\left(\frac{i}{k}\right)_{jt} = \beta_0 + \beta_1 Q_{jt} + \beta_2 \text{Cash Flow}_{jt} + \beta_3 \left(\frac{i}{k}\right)_{jt-1} + \gamma' \text{Controls}_{jt} + \epsilon_{jt}$$

Cash Flow Sensitivity
Some early papers (e.g. Fazzari, et al. 1988) interpreted $\beta_2 >> 0$ as evidence of financial frictions

Classic Endogeneity Issue
Cash flows may be correlated with unobserved shifts in the expected future marginal product of capital (e.g. Kaplan & Zingales 1997)

Our Approach
Attack this particular form of endogeneity directly by examining the ST components of shocks uncorrelated with future profitability

We Estimate Simple Sensitivity Regressions

$$IHS(X_{jt}) = f_j + g_t + \beta_X \hat{\nu}_{jt}^{sales} + \epsilon_{jt}$$

Dep. Var.	Cap. Inv.	R&D	SG&A	Advertising	Employment
ST Shock $\hat{\nu}_{jt}^{sales}$	10.92*** (0.56)	5.32*** (0.64)	6.82*** (0.34)	9.41*** (0.90)	6.84*** (0.41)
Fixed Effects	Firm, Yr.	Firm, Yr.	Firm, Yr.	Firm, Yr.	Firm, Yr.
Years	'90-'13	'90-'13	'90-'13	'90-'13	'90-'13
Firms	597	373	582	347	594
Firm-Fiscal Yr. Obs	13,928	7,644	13,049	4,509	14,016

Note: *,**,*** denote significance at the 10, 5, and 1% levels, respectively, with standard errors clustered by firm in parentheses. "IHS" is the inverse hyperbolic sine, $IHS(x) = ln(x + \sqrt{(}1 + x^2))$, defined over the reals and equal to $ln(2x)$ to a first order for positive x. The coefficients are therefore in elasticity units. The value $\hat{\nu}_{jt}$ is the smoothed posterior median transitory shock for firm j in fiscal year t from MCMC sampling using the Nakata & Tonetti (2015) estimator. Cap. Inv. refers to capital expenditures on plants, property, and equipment. R&D refers to expenditures on research and development. SG&A refers to selling, general, and administrative expenditures. Advertising refers to marketing expenditures. Employment refers to total employment in the firm. All values drawn from annual firm statements as reported in Compustat, and all regressions performed at the firm-fiscal year level.

Three Missing Elements So Far

At least three glaringly obvious challenges or questions remain for us at this point in our analysis:

1) So What?
We haven't yet introduced a means of mapping reduced-form sensitivities to underlying structural parameters or counterfactual experiments

2) Noisy ST Shock Estimates
Smoothed ST shock estimates are imperfect, so we might misclassify some LT shocks as ST even conditional upon perfectly observed profitability

3) Endogenous Profitability Proxies
Sales measures and TFPR may be endogenous to investment and R&D, so sensitivity may lead us to misclassify some ST shocks as LT shocks

Our Systematic Structural Solution for All 3 Issues
Build a firm investment model for counterfactuals and treat noisy, potentially endogenous sensitivity estimates as useful targets for our model

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The Costs of Short-Term Sensitivity

A More Heartfelt, Sensitive Model of Investment

Firm Profitability Process

Short-term and long-term components in underlying shock process

$$\log z = \varepsilon + \nu, \quad \varepsilon = \rho\varepsilon_{-1} + \eta$$

$$\eta \sim N(0, \sigma_\eta^2), \quad \nu \sim N(0, \sigma_\nu^2)$$

Firm Output, Capital Accumulation, and Adjustment Costs

DRTS in capital and org. capital, time-to-build, convex adjustment costs

$$y = zk^{\alpha_k} o^{\alpha_o}, \quad \alpha_k + \alpha_o < 1$$

$$k' = (1 - \delta_k)k + i, \quad o' = (1 - \delta_o)o + x$$

$$AC_k(k, i) = \phi_k \left(\frac{i}{k}\right)^2 k, \quad AC_o(o, x) = \phi_o \left(\frac{x}{o}\right)^2 o$$

Perceived Sensitivity Costs

τ_i, τ_x are nonpecuniary, impact value through manager policies

$$\nu \left(\tau_i \frac{i}{k} + \tau_x \frac{x}{o}\right)$$

Manager Problem vs. Firm Value

Manager Value

Solve this Bellman equation to obtain optimal policies i^*, x^*

$$V^M(\varepsilon, \nu, k, o) = \max_{i,x} \left\{ \begin{array}{c} y - p_i i - p_x x \\ -AC_k(k,i) - AC_o(o,x) \\ -\nu\left(\tau_i \frac{i}{k} + \tau_x \frac{x}{o}\right) \end{array} + \frac{1}{1+r} \mathbb{E} V^M(\varepsilon', \nu', k', o') \right\}$$

subject to ...

Firm Value

Solution to manager problem with distortions implies firm value

$$V(\varepsilon, \nu, k, o) = \left\{ \begin{array}{c} y^* - p_i i^* - p_x x^* \\ -AC_k(k,i^*) - AC_o(o,x^*) \end{array} + \frac{1}{1+r} \mathbb{E} V(\varepsilon', \nu', k', o') \right\}$$

subject to ....

Taking the Model to Data

9 Parameters to Pin Down

Parameters	Role	Parameters	Role
ρ, σ_η, σ_ν	Firm risk	ϕ_k, ϕ_o	Adjustment costs
τ_i, τ_x	Inv. sensitivity	α_k, α_o	Revenue elasticities

11 Target Moments

Moments	Explanation	Number
Cov(y, i, x)	Covariance of sales, investment, R&D	6 moments
$\hat{\rho}^{sales}$, $\hat{\sigma}_\eta^{sales}$, $\hat{\sigma}_\nu^{sales}$	LT/ST process estimates from sales	3 moments
$\hat{\beta}_i$, $\hat{\beta}_x$	Reduced-form investment sensitivities	2 moments

Our Procedure

1. Fix some parameters e.g. r, δ_k, and δ_n externally from SS
2. Determine remaining parameters through moment matching

Solving the Model

We solve the model using perturbation for moment-matching and a global solution for firm value counterfactuals and policy functions

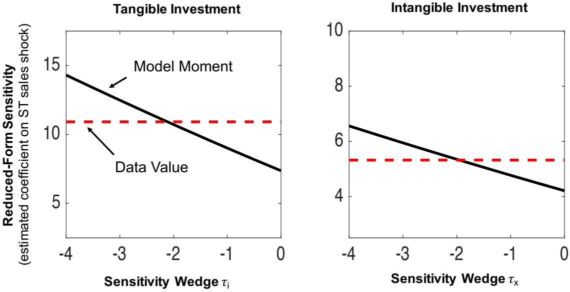
Linearization for Moment Matching, IRFs

- Linearized model around steady-state using smooth FOC's
- Simulated a panel of firms to compute moments
- Fast solution, simulation, moment calculation ($\approx$ 10 sec)
- Matched moments with stochastic global minimization algorithm

Global Solution for Firm Value Counterfactuals, Policy Functions

- Global model solution with discretized state space
- Policy iteration, parallelized algorithm
- Optimized execution but still slower of course ($\approx$ 2 minutes)
- Moments from global and perturbation solutions differ little

How Does Identification Work?



Joint Mapping, Simple Intuition

- Reduced-form sensitivities $\hat{\beta}_i$, $\hat{\beta}_x$ $\rightarrow$ sensitivity wedges τ_i, τ_x
- Sales process estimates $(\hat{\rho}, \hat{\sigma}_\eta, \hat{\sigma}_\nu)^{sales}$ $\rightarrow$ profitability process ρ, σ_η, σ_ν
- Investment covariances σ_i, σ_x, $\rho_{y,i}$, $\rho_{y,x}$ $\rightarrow$ adj. costs ϕ_k, ϕ_o
- Output volatility, covariances σ_y, $\rho_{y,i}$, $\rho_{y,x}$ $\rightarrow$ elasticities α_k, α_o

Model Fits Investment and Output Moments Well

Description	Data	Model
Est. LT persistence $\hat{\rho}^{sales}$	0.8810	0.9093
Est. LT volatility $\hat{\sigma}_{\eta}^{sales}$	0.2472	0.2170
Est. ST volatility $\hat{\sigma}_{\nu}^{sales}$	0.0680	0.0726
Est. Inv. sensitivity $\hat{\beta}_i$	10.920	12.480
Est. R&D sensitivity $\hat{\beta}_x$	5.3220	5.4453
Std. Deviation of Sales	0.5619	0.5493
Std. Deviation of Inv.	0.7660	0.7427
Std. Deviation of R&D	0.6393	0.4360
Corr(Sales, Inv.)	0.6342	0.6633
Corr(Sales, R&D)	0.5535	0.8858
Corr(Inv., R&D)	0.5055	0.8915

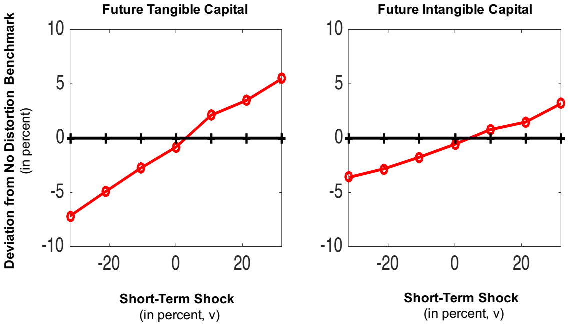
Note: The table above reports the value of each targeted moment drawn from Compustat data over 1990-2013 (middle column) and a panel of simulated firms of identical size in the best fit model (right column). The first three rows report the estimated sales process parameters computed as posterior medians applying the MCMC sampler proposed by Nakata & Tonetti (2015) to sales data after removal of firm and year effects. The next two rows report estimated sensitivities of tangible capital investment and R&D investment to smoothed posterior estimates of transitory shocks $\hat{\nu}_{jt}$ from the sales process estimation. The final six rows report the covariance matrix of the inverse hyperbolic sine (asymptotically log) of sales, tangible capital investment, and R&D investment, transformed to standard deviation and correlation units and computed after time and firm fixed effects.

Parameters Suggest Substantial Short-Term Risk & Sensitivity

Parameters	Description	Value
ρ	LT persistence	0.9178
σ_η	LT volatility	0.1642
σ_ν	ST volatility	0.1272
τ_i	Inv. sensitivity	-2.9960
τ_x	R&D sensitivity	-2.1622
ϕ_k	Inv. AC	0.4628
ϕ_o	R&D AC	1.3960
α_k	k elasticity	0.3419
α_o	o elasticity	0.4107
ST Cond. Variance $\sigma_\nu^2/(\sigma_\eta^2+\sigma_\nu^2)$	37.5%	

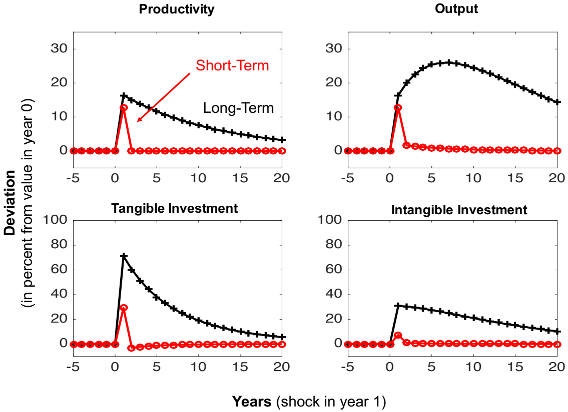
Note: The top panel of the table above reports parameter values in our best fit firm investment model. The parameters were chosen to minimize the sum of squared percentage deviations between a set of moments computed from our baseline Compustat sample over 1990-2013 and a simulated panel of firms in the model of identical size. The minimization was performed using a genetic algorithm, a type of stochastic global optimization routine. The bottom panel reports the share of conditional variance accounted for by the transitory ST in our best fit model.

Distorted Model Features
Investment Sensitivity



Note: The figure above plots capital choices k' (left panel) and o' (right panel) as a function of today's short-term shock ν. The figure plots the conditional mean of policies from the stationary distribution implied by the global solution of the best fit model (in red with circles, with distortions) and the no distortion benchmark (in black with plus signs). The no distortion policies are constant in ν and normalized to 0. Policies for the best fit model with distortions are expressed as percentage deviations from the no distortion case.

Response to a Short-Term Shock



Note: The figure plots impulse responses in the best fit model to a one-standard deviation profitability shock to a firm which comes from short-term ν (in red with circles) and long-term η (in black with plus signs) sources. The shocks arrive in year 1. Each panel plots percentage deviations of the indicated variable from the pre-shock or steady-state value at the firm, with the top left panel representing the exogenous impulse and all other panels representing endogenous responses. The impulse response functions are computed from a linearized solution to the model and are therefore invariant to initial conditions or scaling.

The Impact of Short-Term Shocks

A meaningful fraction of observed investment fluctuations appear to be responses to purely short-term, transitory shocks to firm profitability

Variance Decomposition	% from ν
Tangible Inv. Rate $\frac{i}{k}$	8.7
Intangible Inv. Rate $\frac{x}{o}$	2.2

Note: The table above reports the share of variance of the tangible and intangible investment rates accounted for by the ST shock ν in the linearized solution of the best fit model.

The resulting misallocation results in a sizable value loss in US alone, although our figures are likely a lower bound due to omitted growth effects

Destroyed Value	Amount
Average Loss	-0.3%
S&P 500	-$58b
Total U.S.	-$72b

Note: The first row of the table above reports the average change in firm value from the introduction of investment distortions in the best fit model, relative to a no distortion benchmark, computed using the stationary distribution of the distorted best fit model implied by the global solution of the model. The second (third) line converts the value loss to dollar magnitudes using the market capitalization of the S&P 500 (the total US stock market) in October 2016, equal to $19.3 trillion ($23.9 trillion) as reported by *Standard & Poors*.

A Broad, Useful New Target

We don't take a stand on the nature of underlying frictions, but future research which does so can further exploit ST/LT shocks and sensitivities:

Adjustment Costs
Zero (or smaller) investment responses to ST shocks imply lower AC needed to rationalize investment volatility, chipping away at a black box
AC Model

Financial Frictions
Financial frictions can induce investment sensitivity to ST shocks, resurrecting a specific form of sensitivity as a key moment for this literature
FF Model

Information Frictions
Managers may respond to ST shocks because they mistake them for LT shocks, so sensitivities place crucial discipline on information structures

Short-Termism or Agency Frictions
Managers respond to ST/LT shocks differently in presence of short-termist incentives induced by agency frictions, disciplining structural models

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Backup Slides

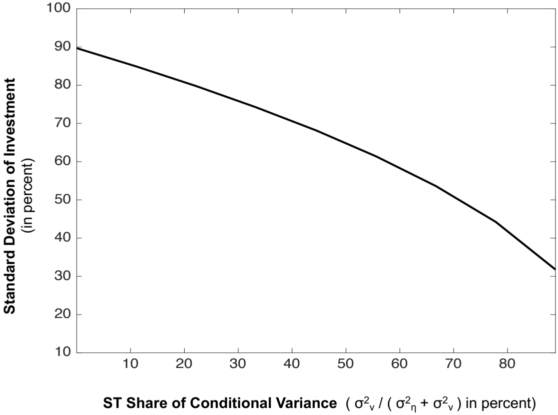
Descriptive Statistics

	Mean	Median	Std. Dev.	Firm-Years
Sales	1638.051	490.13	2774.463	14,307
Assets	2018.263	460.905	4402.774	14,307
Book Value of Capital	692.4463	107.028	2344.58	14,307
Capital Expenditures	124.2281	20.7915	482.6052	14,216
R&D Expenses	64.69228	8.665	207.1067	8,698
SG&A Expenses	323.5185	81.34	647.3065	13,317
Advertising Expenses	63.73171	5.627	173.6911	4,604
Employees	9.4906	2.48	30.943	14,307

Note: The table reports basic descriptive statistics for several variables drawn from our Compustat panel of firms covering 1990-2013 at the firm-fiscal year level. All values except for the number of employees are reported in millions of US dollars, and number of employees is reported in thousands of people. The final column reports the number of non-missing firm-years in our sample for the indicated variable. The variable names are mostly self-explanatory, although SG&A expenditures refer to selling, general, and administrative expenses, and the book value of capital refers to the book value of the tangible plants, property, and equipment stock. Information is drawn from the annual reports of US public companies.

Return

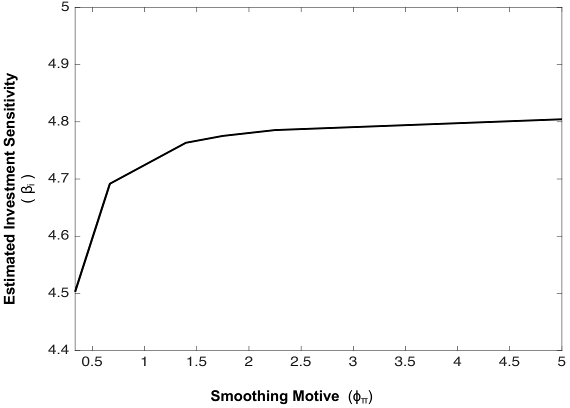
ST Shocks Change Adjustment Cost Inference



Note: The figure above plots the implied volatility of investment rates, in log units after removal of time and firm dummies, from a simulated panel of firms in the linearized solution of the model. The parameterization of the model is mostly identical to the best fit model after removal of investment distortions. From left to right on the horizontal axis, the variance of the ST shock ν is increased while keeping the total conditional volatility $\sigma_\eta^2 + \sigma_\nu^2$ constant.

Return

Smoothing Motives & Financial Frictions Map to Sensitivity

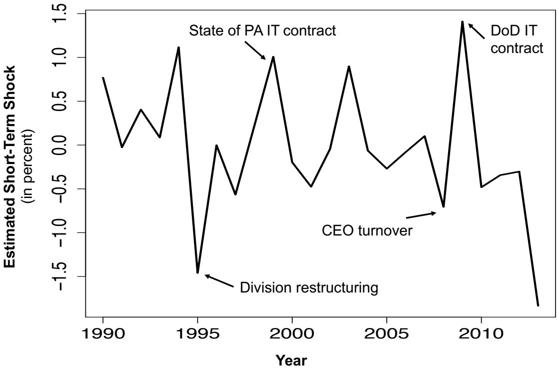


Note: The figure above plots the estimated sensitivity of tangible investment to smoothed estimates of ST shocks ν_{jt} in a simulated panel of firms from a linearized solution to an investment model identical to the one described in the presentation, without adjustment costs but including dividend smoothing costs $-\phi_\pi(\pi - \pi^*)^2$ as in Jermann & Quadrini (2012). The dividend smoothing parameter, in model units, is plotted on the horizontal axis.

Return

Unisys Corporation

Legacy mainframe services company with B2B, govt. contracting

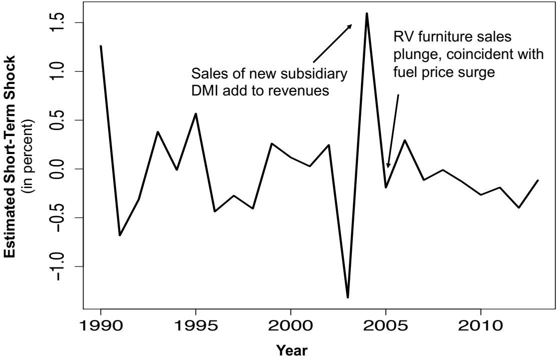


Note: The figure above plots the median posterior smoothed estimate of $\hat{\nu}_{jt}$ for the indicated company in each year of the sample period. The profitability proxy used for estimation is log sales, net of firm and year fixed effects. Events indicated on the plot reflect analysis of news reports on the company downloaded from the *Factiva* database as well as reported information from the company's annual reports.

Return

Flexsteel Industries

Furnishings manufacturer for homes, RVs, and businesses



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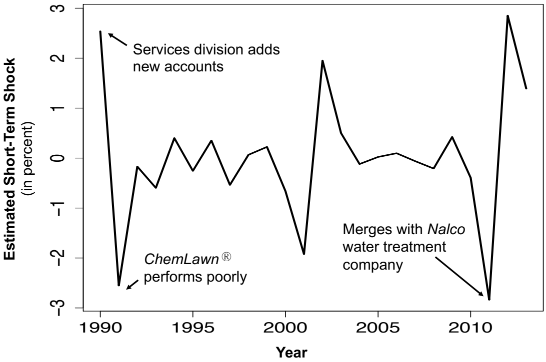
Return

Ecolab Inc.

Cleaning products and services provider

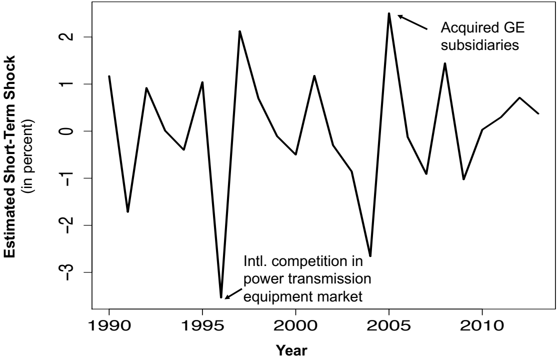


Note: The figure above plots the median posterior smoothed estimate of $\hat{\nu}_{jt}$ for the indicated company in each year of the sample period. The profitability proxy used for estimation is log sales, net of firm and year fixed effects. Events indicated on the plot reflect analysis of news reports on the company downloaded from the *Factiva* database as well as reported information from the company's annual reports.

Return

Regal Beloit Corporation

Power generation equipment and machine tools manufacturer



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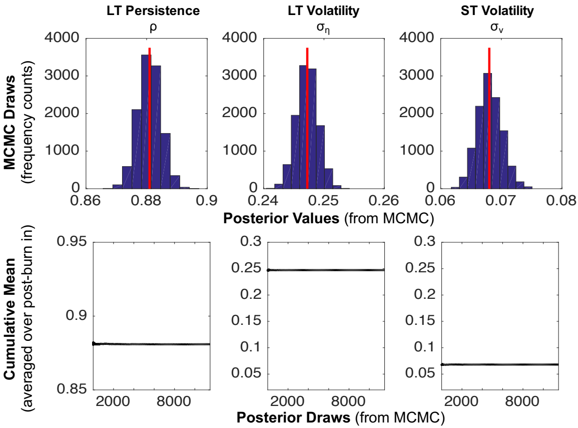
Return

Well Behaved MCMC Procedure for Sales Panel



Note: The top row plots posterior marginal histograms for each profitability process parameter, together with posterior medians in red. The bottom row plots the cumulative mean for progressive MCMC draws of each parameter. The total MCMC process is implemented with 15,000 draws and a 3,500-draw burn-in period.

Return

More LT Persistence than Usual

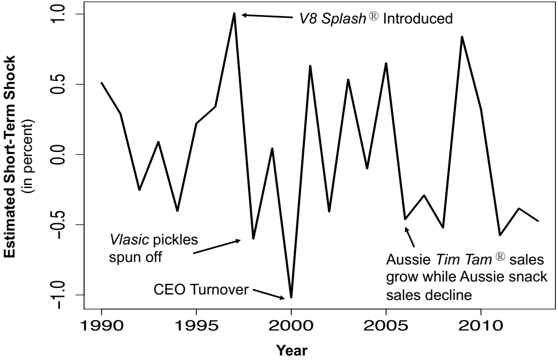
Calibration or estimation of a micro-level AR(1) profitability process is typical in the firm dynamics literature, with some other results below:

Source	LT Persistence	LT Volatility	Sample
Nikolov & Whited (2014)	0.597	0.282	U.S. Public Firms
Hennessy & Whited (2007)	0.684	0.118	U.S. Public Firms
Gourio & Rudanko (2014)	0.88	0.23	U.S. Public Firms
Midrigan & Xu (2013)	0.25	0.5	Korean Manuf. Estab.
Winberry (2016)	0.78	0.32	U.S. Firms
Cooper and Ejarque (2003)	0.857	0.1	U.S. Manuf. Estab.
Clementi & Palazzo (2015)	0.55	0.22	U.S. Manuf. Estab.
Castro, et al. (2015)	≈ 0.45	≈ 0.25	U.S. Manuf. Estab.
Asker, et al. (2014)	≈ 0.85	≈ 0.75	U.S. Manuf. Estab.
Cooper & Haltiwanger (2006)	0.885	0.64	U.S. Manuf. Estab.
Khan & Thomas (2008)	0.859	0.15	U.S. Manuf. Estab.
Khan & Thomas (2013)	0.659	0.118	U.S. Manuf. Establ.
TFP Panel	0.92	0.22	U.S. Public Firms

Return

Campbell's Soup Corporation

Eponymous soup, *Pepperidge Farm* snacks, international snacks ...



Note: The figure above plots the median posterior smoothed estimate of $\hat{\nu}_{jt}$ for the indicated company in each year of the sample period. The profitability proxy used for estimation is log sales, net of firm and year fixed effects. Events indicated on the plot reflect analysis of news reports on the company downloaded from the *Factiva* database as well as reported information from the company's annual reports.

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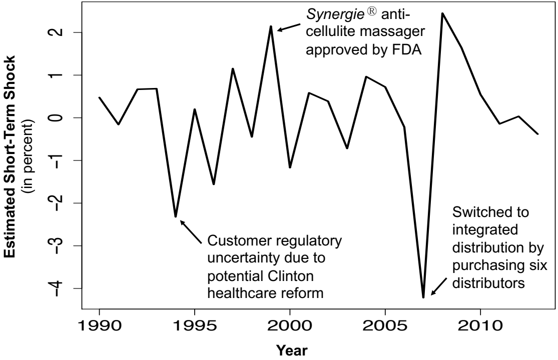
Dynatronics Corporation

Physical medicine device manufacturer



Note: The figure above plots the median posterior smoothed estimate of $\hat{\nu}_{jt}$ for the indicated company in each year of the sample period. The profitability proxy used for estimation is log sales, net of firm and year fixed effects. Events indicated on the plot reflect analysis of news reports on the company downloaded from the *Factiva* database as well as reported information from the company's annual reports.

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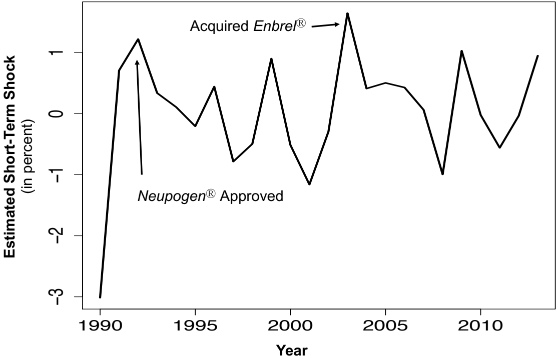
Amgen Corporation

Biotech-pharmaceuticals company with large drug portfolio



Note: The figure above plots the median posterior smoothed estimate of $\hat{\nu}_{jt}$ for the indicated company in each year of the sample period. The profitability proxy used for estimation is log sales, net of firm and year fixed effects. Events indicated on the plot reflect analysis of news reports on the company downloaded from the *Factiva* database as well as reported information from the company's annual reports.

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