The Micro and Macro of Managerial Beliefs

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Research Questions

***Empirically*, how accurate are managerial beliefs about own-firm future business conditions?**

***Quantitatively*, how do biases in managerial beliefs impact:**

- Individual firms' value, dynamic behavior?
- Aggregate consumer welfare, efficiency?

Why Should We Care?

Managerial beliefs impact dynamic decisions, outcomes

Micro: Even benevolent managers acting under biased beliefs may fail to maximize firm value

Macro: Pervasive biases may affect aggregate outcomes

- Misuse, misallocation of resources
- Equilibrium differs from first-best, rational expectations equilibrium

Why Should We Care?

Managerial beliefs impact dynamic decisions, outcomes

Micro: Even benevolent managers acting under biased beliefs may fail to maximize firm value

Macro: Pervasive biases may affect aggregate outcomes

- Misuse, misallocation of resources
- Equilibrium differs from first-best, rational expectations equilibrium

Yet: few quantitative benchmarks on the magnitudes and costs of biases

Baseline Setup

Output: $\log(y_t) = \log(z_t) + \alpha \log(n_t)$

Idiosyncratic shocks:

$$\log(z_{t+1}) = \mu + \rho \log(z_t) + \sigma \varepsilon_{t+1}$$

Managers' subjective beliefs:

$$\log(z_{t+1}) = \tilde{\mu} + \tilde{\rho} \log(z_t) + \tilde{\sigma} \varepsilon_{t+1}$$

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Characterizing beliefs:

- Unbiased: $\tilde{\mu} = \mu$, $\tilde{\sigma} = \sigma$, $\tilde{\rho} = \rho$
- Overoptimistic: $\tilde{\mu} > \mu$
- Overconfident (a.k.a. overprecise): $\tilde{\sigma} < \sigma$
- Overextrapolative: $\tilde{\rho} > \rho$

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Research questions:

1. How different are $\tilde{\mu}$ vs. μ, $\tilde{\sigma}$ vs. σ, $\tilde{\rho}$ vs ρ?

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Managers' subjective beliefs:

$$\log(z_{t+1}) = \tilde{\mu} + \tilde{\rho} \log(z_t) + \tilde{\sigma} \varepsilon_{t+1}$$

Research questions:

2. What are the micro and macro costs of using $\{\tilde{\mu}, \tilde{\sigma}, \tilde{\rho}\}$ instead of $\{\mu, \sigma, \rho\}$ when choosing n_{t+1} under uncertainty?

This Paper

1. **New survey evidence on US managers' beliefs**

2. **Build GE model with heterogeneous firms run by managers with biased beliefs**

3. **Quantify impact of biased beliefs**

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   - Subjective distribution of own-firm future sales growth

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   Estimate the model and $\{\mu, \tilde{\mu}, \sigma, \tilde{\sigma}, \rho, \tilde{\rho}\}$, targeting:
   - Three facts from **1.**
   - How beliefs relate to dynamic decisions, outcomes

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   - Three facts from **1.**
   - How beliefs relate to dynamic decisions, outcomes

3. **Quantify impact of biased beliefs**
   Micro: Make a single firm's manager unbiased
   Macro: Make all managers unbiased (GE)

Preview of Results

Related Literature

Biased Beliefs (Empirical): Tversky & Kahneman (1974), Camerer & Lovallo (1999), Bernardo & Welch (2001), Bertrand & Schoar (2003), Malmendier & Tate (2005, 2007, 2015), Aastebro (2007), Malmendier et al (2008), Taylor (2010) Campbell et all (2011), Hirshleifer et al (2012), Ben-David et al (2013), Alti & Tetlock (2014), Hanson & Greenwood (2014), Bachmann & Elstner (2015), Gennaioli et al (2016), Jeon (2017), Ma, Sraer & Thesmar (2018), Kucinskas & Peters (2019)

Managerial Beliefs and Biases (Theoretical): Stein(2003), Gervais et al (2001), Hackbarth (2008), Goel et al (2008), Fuster et al (2012), Gervais et al (2011), Kini and Williams (2012), Benigno and Karantounias (2017), Kim (2018)

Business Dynamics: Abel & Eberly (1997), Hopenhayn (1992) Hopenhayn & Rogerson (1993), Davis et al (2007), Cooper & Haltiwanger (2006), Hennessy & Whited (2005, 2007), Bloom (2009), Decker et al (2018)

Micro Frictions, Distortions & Macro Consequences: Restuccia & Rogerson (2008), Khan & Thomas (2008), Hsieh & Klenow (2009), Bachmann et al (2013), Asker et al (2014), David et al (2016), Terry (2017), David & Venkateswaran (2018), Sraer & Thesmar (2018)

Macro Models with Behavioral Biases: Fuster et al (2011), Jurado (2016), Gabaix (2017), Acemoglu & Jensen (2018), Bordalo, Gennaioli, Shleifer (2018) Bordalo, Gennaioli, Shleifer, & Terry (2019)

Data on Beliefs & Expectations: Dominitz (1998), Manski (2004, 2017), Coibion & Gorodnichenko (2012, 2015), McKenzie et al (2013), Roth & Wohlfart (2017), Bordalo et al (2017), Bloom et al (2017), Baker et al (2018), Bachman et al (2018), Binder et al (2018), Bordalo et al (2018), Boutros et al (2018), Carroll et al (2018), Chen et al (2018), Coibion et al (2018), Tanaka et al (2018), Rozsypal & Schlafmann (2018), D'Haultfoeuille, Gaillac, & Maurel (2018)

Outline

Evidence about Managerial Beliefs

General Equilibrium Model of Employment Dynamics

Structural Estimation

Micro & Macro Implications of Biases

Extensions

Atlanta Fed/Chicago-Booth/Stanford Survey of Business Uncertainty

Monthly panel survey collected by Atlanta Fed

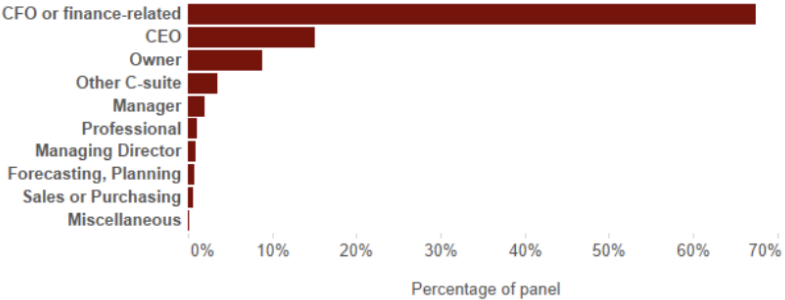
- $\approx$ 300 responses per month
- 10/2014 - present
- Altig, Barrero, Bloom, Davis, Meyer, Parker (2019)
- Official survey website here

Atlanta Fed/Chicago-Booth/Stanford Survey of Business Uncertainty

Survey goal: Elicit subjective probability distributions from high-level managers of US Firms

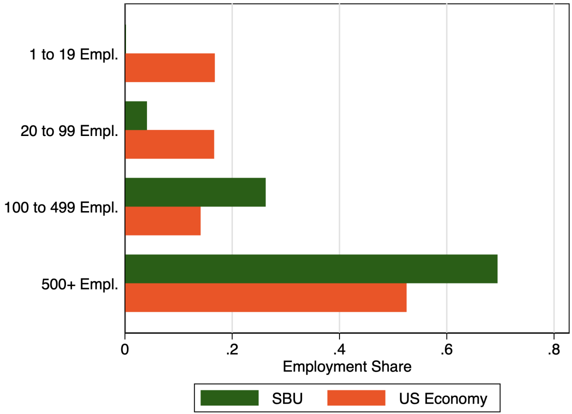
- Future own-firm sales & employment growth
- Individual responses are confidential
- Tracks beliefs & outcomes across time

SBU Respondents are Primarily CFOs & CEOs



Notes: This figure shows the distribution of SBU panel members by job title as of July 2018.

SBU is Broadly Representative, Oversamples Larger, Older Firms



Notes: This figure shows (1) the share of employment across all SBU responses from 10/2014 to 5/2019 made by firms in each firm size category; (2) the share of employment for each firm size category in the US economy according to the US Census Bureau's 2015 Statistics on US Businesses.

▸ By Region ▸ By Sector ▸ By Age ▸ Sampling Prob. by Size ▸ Frame & Sampling

SBU Survey of Business Uncertainty

FEDERAL RESERVE BANK *of* ATLANTA | CHICAGO BOOTH The University of Chicago Booth School of Business | Stanford University

For the current quarter, what would you estimate the total dollar value of your **SALES REVENUE** will be?

$ 5,000,000

SBU Survey of Business Uncertainty

FEDERAL RESERVE BANK *of* ATLANTA | CHICAGO BOOTH The University of Chicago Booth School of Business | Stanford University

Looking __ahead__, from now to four quarters from now, what approximate percentage **SALES REVENUE** growth rate would you assign to each of the following scenarios?

The LOWEST percentage sales revenue growth rate would be about:	-2	%
A LOW percentage sales revenue growth rate would be about:	0	%
A MIDDLE percentage sales revenue growth rate would be about:	4	%
A HIGH percentage sales revenue growth rate would be about:	6	%
The HIGHEST percentage sales revenue growth rate would be about:	10	%

SBU Survey of Business Uncertainty

FEDERAL RESERVE BANK *of* ATLANTA | CHICAGO BOOTH The University of Chicago Booth School of Business | Stanford University

Please assign a percentage likelihood to the **SALES REVENUE** growth rates you entered. (Values should sum to 100%)

LOWEST: The likelihood of realizing a **-2%** sales revenue growth rate would be:	10	%
LOW: The likelihood of realizing a **0%** sales revenue growth rate would be:	20	%
MIDDLE: The likelihood of realizing a **4%** sales revenue growth rate would be:	40	%
HIGH: The likelihood of realizing a **6%** sales revenue growth rate would be:	20	%
HIGHEST: The likelihood of realizing a **10%** sales revenue growth rate would be:	10	%
Total	100	%

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Forecast Errors & Sample Basics

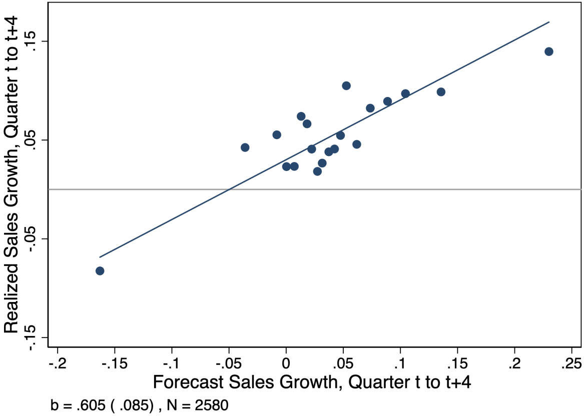
Main Sample: 2,580 forecast error observations about sales growth

- Observation: beliefs in quarter t, realization in $t + 4$
- $Forecast$ = mean of subjective distribution
- $Forecast\ error$ = $forecast$ - $realized$ sales growth
- $\sim$ 100 new forecast error observations each month

Additionally: 6,000+ subjective distribution observations about future sales and employment growth

Summary Statistics | Measuring Forecast Errors | Macro Volatility in Sample

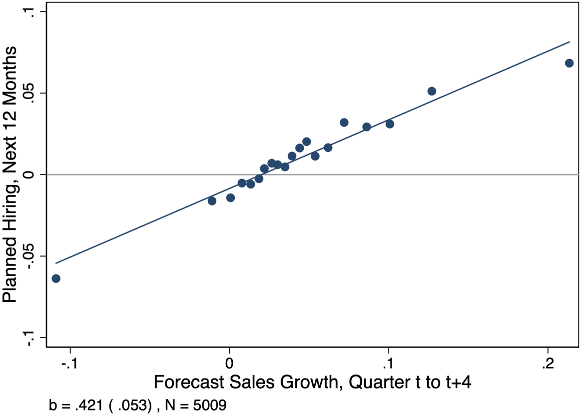
Fact 0: Managerial Beliefs Predict Outcomes, Decisions



Notes: This figure shows a bin-scatter of 4-quarter sales growth realizations against ex-ante forecasts for sales growth. Data are from the *SBU* covering all months between 10/2014 to 5/2019 .

R-squared table | Subjective Uncertainty | Firm & Date FE
Subjective Uncertainty Firm & Date FE

Fact 0: Managerial Beliefs Predict Outcomes, Decisions



Notes: This figure shows a bin-scatter of managerial hiring plans for the next 12 months against ex-ante forecasts for sales growth. Data are from the *SBU* covering all months between 10/2014 to 5/2019 .

▸ R-squared table ▸ Subjective Uncertainty ▸ Firm & Date FE
▸ Subjective Uncertainty Firm & Date FE

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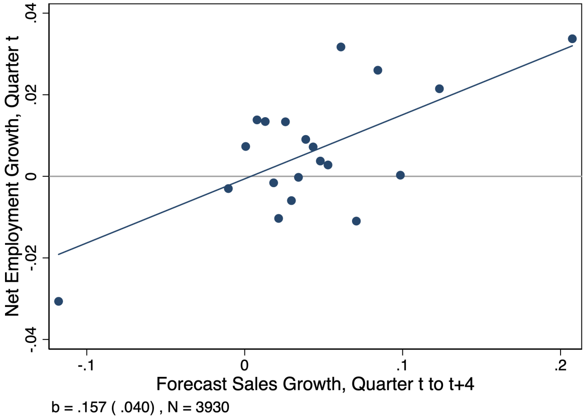
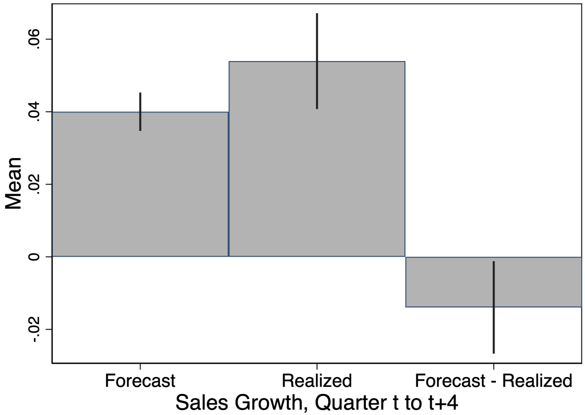


Notes: This figure shows a bin-scatter of net hiring (employment growth) since the previous quarter against forecasts for sales growth over the next 4 quarters. Data are from the *SBU* covering all months between 10/2014 to 5/2019 .

R-squared table | Subjective Uncertainty | Firm & Date FE
Subjective Uncertainty Firm & Date FE

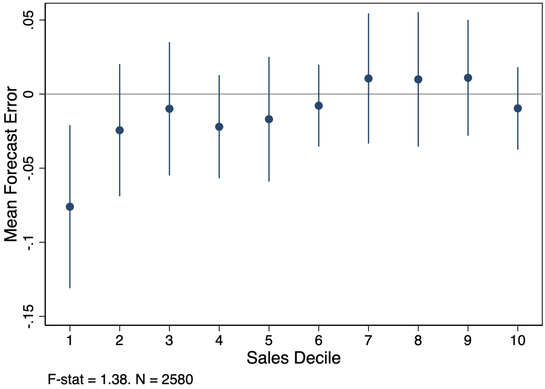
Fact 1: Managers are Not Over-Optimistic



Notes: This figure shows the mean forecast and realized sales growth, as well as the mean forecast error (= forecast minus realized) for sales growth across all responses in the SBU for which I can construct forecast errors. 95 percent confidence intervals are based firm-clustered standard errors. Sample period is from 10/2014 to 5/2019 . N = 2,580.

▸ Weighting ▸ Two-way clustering

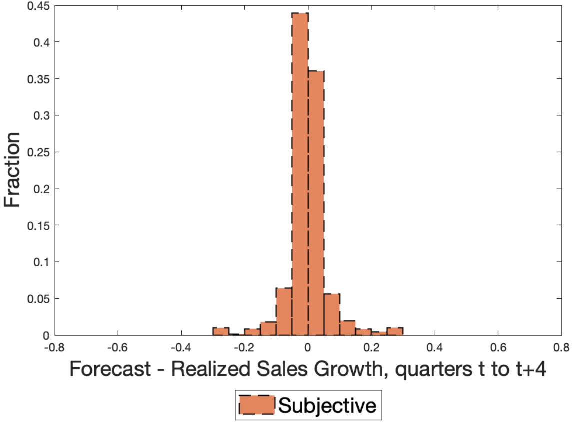
Fact 1: Managers are Not Over-Optimistic. Only Smallest Firms Pessimistic



Notes: Mean forecast error by decile of the current sales distribution. Data are from the *SBU* covering 10/2014 to 5/2019. Standard errors are clustered by firm. Bars are 95% confidence intervals based on standard errors clustered by firm. N = 2,580

▸ By Date ▸ By Sector ▸ By Number of Forecast Errors ▸ By Governance

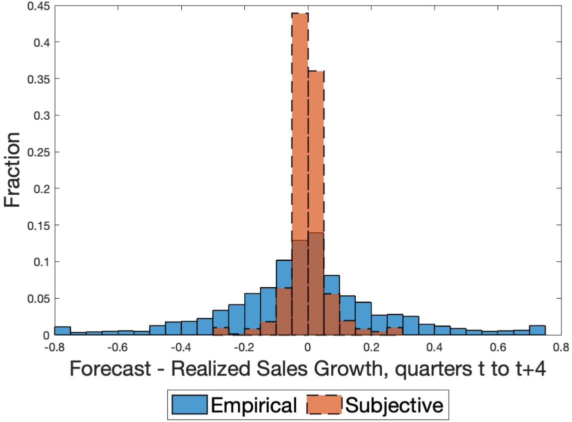
Fact 2: Managers are Overconfident



Notes: This figure plots the empirical distribution of forecast errors as well as the distribution of forecast errors that would arise if sales growth realizations were drawn from *SBU* respondents' subjective probability distributions. Sample period is from 10/2014 to 5/2019 . N = 2,580.

▸ Table ▸ By Date ▸ By Sector ▸ By Size ▸ By No. of Forecast Errors
▸ By Governance ▸ By Uncertainty ▸ Discretization ▸ Measurement Error

Fact 2: Managers are Overconfident



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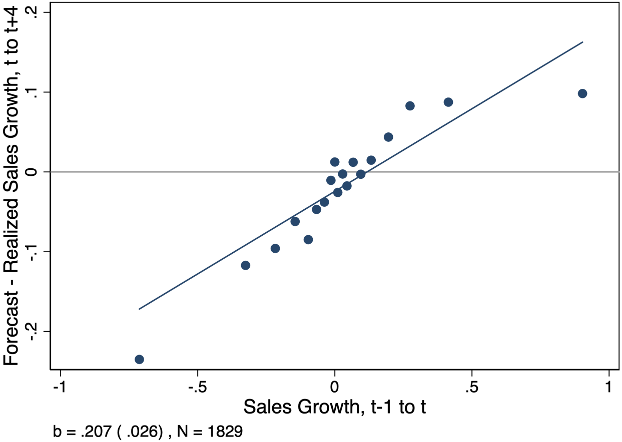
▸ By Governance ▸ By Uncertainty ▸ Discretization ▸ Measurement Error

Fact 3: Managers Overextrapolate



Notes: This figure shows a bin-scatter of realized forecast errors for sales growth between quarters t and $t+4$ against sales growth between quarters $t-1$ and t. Data are from the *SBU* covering 10/2014 to 5/2019 . N = 1,829.

▸ Decomposition ▸ Firm, Date Effects ▸ By Firm Size ▸ By Governance
▸ Fact 2 vs Fact 3 ▸ Reported Growth ▸ Lagged Errors

Three Facts about Managerial Beliefs Concerning Own-Firm Sales Growth

1. **Managers are not over-optimistic or pessimistic**
   Forecast - Realized Sales Growth ≈ 0

2. **Managers are overconfident**
   Excess Absolute Forecast Error $\approx .14$

3. **Managers overextrapolate**
   1 p.p. faster growth at time of forecast
   $\Rightarrow$ 0.2 p.p larger Forecast - Realized Sales Growth

Three Facts about Managerial Beliefs Concerning Own-Firm Sales Growth

1. **Managers are not over-optimistic or pessimistic**
   $\tilde{\mu} \approx \mu$

2. **Managers are overconfident**
   $\tilde{\sigma} < \sigma$

3. **Managers overextrapolate**
   $\tilde{\rho} > \rho$

Outline

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Firm Technology & Shocks

Operating income = sales - wage bill:

$$y(z_t, n_t; w_t) = z_t n_t^{\alpha} - w_t n_t$$

Idiosyncratic shocks to business conditions:

$$\log(z_{t+1}) = \mu + \rho \log(z_t) + \sigma \varepsilon_{t+1} \quad \varepsilon_{t+1} \sim \mathcal{N}(0, 1)$$

Labor chosen one quarter ahead:

$$n_{t+1} = (1 - q) n_t + h_t$$

No aggregate risk

Manager Beliefs

Objective driving process:

$$\log(z_{t+1}) = \mu + \rho \log(z_t) + \sigma \varepsilon_{t+1}$$

Managers' subjective beliefs:

$$\log(z_{t+1}) = \tilde{\mu} + \tilde{\rho} \log(z_t) + \tilde{\sigma} \varepsilon_{t+1}$$

Characterizing beliefs:

- Unbiased: $\tilde{\mu} = \mu$, $\tilde{\sigma} = \sigma$, $\tilde{\rho} = \rho$
- Overoptimistic: $\tilde{\mu} > \mu$
- Overconfident: $\tilde{\sigma} < \sigma$
- Overextrapolative: $\tilde{\rho} > \rho$

Firm Cash Flows

Cash flow = operating income - hiring/firing costs

$$\pi(z_t, n_t, n_{t+1}; w_t) = \left[\begin{array}{c} \underbrace{z_t n_t^\alpha}_{\text{Revenue}} - \underbrace{w_t n_t}_{\text{Wage Bill}} \\ \\ \underbrace{-\lambda n_t \left(\frac{n_{t+1} - n_t * (1-q)}{n_t} \right)^2}_{\text{Quadratic Adjustment Costs}} \end{array} \right]$$

Adjustment costs govern dynamic hiring/firing choices

- Managers trade off adjustment costs vs. beliefs about future MPN

Manager's Problem and Firm Value

Managers compensated with $\theta \in (0, 1]$ equity share.

Optimize their <u>subjective</u> valuation of the firm:

$$\tilde{V}(z_t, n_t) = \max_{n_{t+1} > 0} \left[\begin{array}{c} \pi(z_t, n_t, n_{t+1}; w_t) \\ \\ + \frac{1}{1+r_{t+1}} \tilde{\mathbf{E}}[\tilde{V}(z_{t+1}, n_{t+1})] \end{array} \right]$$

$\tilde{\mathbf{E}}_t[\cdot]$ is the managers' <u>subjective</u> expectations operator.

▸ Sequence Problem

Manager's Problem and Firm Value

Objective firm value under managers' policy $\kappa(z,n)$:

$$V(z_t, n_t) = \begin{bmatrix} \pi(z_t, n_t, \kappa(z_t, n_t); w_t) \\ + \frac{1}{1+r_{t+1}} \mathbf{E}[V(z_{t+1}, n_{t+1})] \end{bmatrix}$$

$\mathbf{E}_t[\cdot]$ operator uses the true stochastic process.

▸ Sequence Problem

Household Consumes & Supplies Labor

Lifetime utility maximization:

$$\max_{C_t, N_t, B_{t+1}} \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\gamma}}{1-\gamma} - \chi \frac{N^{1+\eta}}{1+\eta} \right]$$

Budget constraint:

$$C_t + B_{t+1} = (1 + r_t)B_t + w_t N_t + (1 - \theta)\Pi_t$$

Household owns remaining share $1 - \theta$ of firms:

- Perfectly insured against firm-specific risk

Stationary (Temporary) General Equilibrium

Equilibrium consists of: $\{w^*, r^*\}$, $\{C^*, N^*, B^*\}$, $\Phi(z, n)$

In which:

- Managers choose $n_{t+1} = \kappa(z_t, n_t)$ to optimize subjective firm value
- Stationary distribution of firms $\Phi(z, n)$
- HH optimizes choosing $C_t = C^*$, $N_t^S = N^*$, $B_{t+1} = B^*$.
- Markets clear: $\int n \mathrm{d}\Phi(z, n) = N^*$, $B^* = 0$

Temporary equilibrium concept: prices that clear the market, given beliefs from the data (see Mollavi, 2019)

Model Solution Details

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Structural Estimation Exercise

Estimate 9 parameters: $\vartheta = (\alpha, \lambda, \rho, \tilde{\rho}, \sigma, \tilde{\sigma}, \tilde{\mu}, \sigma_\xi, \sigma_\nu)'$

Target 19 moments: ▸ Detail

	Description	No. Moments
Fact 0	Beliefs vs. Outcomes, Decisions	12
Fact 1	No Optimism	1
Fact 2	Overconfidence	1
Fact 3	Overextrapolation	1
Dynamics	**Cov** Matrix $\{\Delta n_{t+1}, \Delta y_t\}$ $Cov(\Delta^l y_{t+4}, \Delta y_t)$	4

Notes: n_t denotes employment and y denotes sales. $\Delta^l y_{t+4}$ is the firm's sales growth between quarters t and $t+4$. All moments come from SBU data between 10/2014 and 5/2019.

Calibrate rest: $\mu = 0$, ▸ Calibrated Parameters

Implementation: Overidentified GMM (Moment-matching) ▸ Detail

Measurement Error

Assume:

1. Sales & employment measured with i.i.d error:
   $\xi \sim \log \mathcal{N}(0, \sigma_\xi)$
2. Expectations and uncertainty measured with i.i.d error:
   $\upsilon \sim \mathcal{N}(0, \sigma_\upsilon)$

Estimate: $(\sigma_\xi,\, \sigma_\upsilon)'$, include them in ϑ

Why is this important/a good idea?

- Greatly improves model fit
- Bias towards overconfidence, overextrapolation facts
- SBU is self-reported data. ME is interesting in its own right

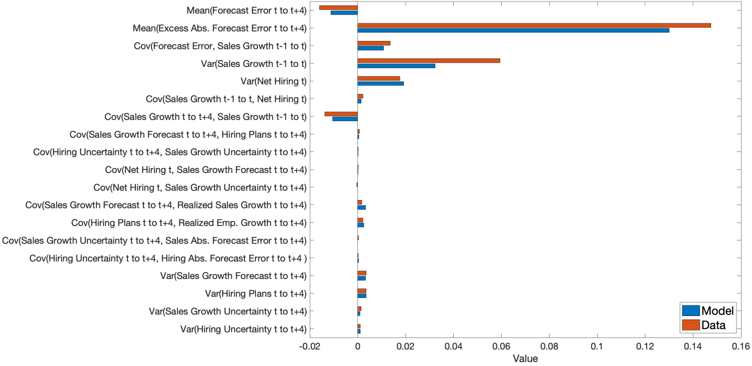
Parameter Estimates

Parameter	Explanation	Estimate (SE)
α	Revenue curvature	0.832 (0.007)
λ	Quadratic adj.cost	30.3 (0.446)
ρ	True shock persistence	0.856 (0.002)
$\tilde{\rho}$	Subjective shock pers.	0.911 (0.001)
σ	True shock volatility	0.114 (0.0002)
$\tilde{\sigma}$	Subjective shock vol.	0.044 (0.0001)
$\tilde{\mu}$	Subjective shock mean	-0.003 (5.25e-6)
σ_ξ	Sales, employment ME	0.068 (6.39e-5)
σ_ν	Beliefs ME	0.029 (0.0001)

Notes: This table shows parameter estimates for my baseline model with quadratic adjustment costs and measurement error. I estimate the parameters by minimizing the distance between 19 model-implied moments computed using the stationary distribution of firms across the (z, n) state space and the corresponding set of empirical moments. The weighting matrix is the inverse of the firm-level clustered covariance matrix of the moments across the two sets of moments. I perform the numerical optimization using simulated annealing.

Identification: ▸ Summary ▸ Andrews-Gentzkow-Shapiro (2017) Statistics

Estimated Model & Data Moments



Notes: All data moments are estimated using data from the SBU with the sample period covering 10/2014 to 5/2019 . All model moments are computed from the stationary distribution of firms across (z, n) space.

▸ Table Version ▸ T-statistics
▸ Untargeted Benchmark: Hiring and Lab. Productivity

Magnitude of Biases

No optimism or pessimism: $\tilde{\mu} = -0.003 \quad \mu = 0$

- Underestimate mean innovation to $\log(z)$ by $\approx 0.025 \times \sigma$

Overconfidence: $\tilde{\sigma} = 0.044 \quad \sigma = 0.114$

- Underestimate SD by 61.5%

Overextrapolation: $\tilde{\rho} = 0.911 \quad \rho = 0.856$

- Believe half-life of shocks is 7.4 quarters
- True half-life only 4.4 quarters

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Two Counterfactuals

1. **Micro: Replace a single biased manager at the beginning of quarter t**

   How much does objective firm value $V(\cdot)$ increase by hiring rationally $\quad \forall \tau \geq t$?

   Holding all else equal, including:

   - Firm's current business conditions, labor (z, n)
   - Equilibrium wage

Micro Impact of Biased Beliefs

How much would firm value increase today by replacing biased manager?

Counterfactual	$\Delta V\%$
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma, \tilde{\mu} = \mu$	2.13

Notes: This table shows how much firm value would increase by replacing a biased manager with another who has correct beliefs. At each point in the (z, n) state space I compute the objective value generated by the biased managers in my estimated economy, as well as the objective value generated by a counterfactual manager lacking pessimism, overconfidence, and/or overextrapolation. Then I compute the mean percent gain in firm value by averaging the gains across the state space under the stationary distribution of the economy with biases.

▸ Impact of Individual Biases ▸ Robustness ▸ Magnitude of Firm Value Implications

Two Counterfactuals

2. **Macro: Economy with only unbiased managers**

   How do aggregate outcomes differ relative to baseline economy with biased managers?

   Comparing aggregate steady-states in equilibrium

Consumer Welfare, Aggregate Output, & Labor Productivity are Higher Without Biases

Managerial Equity (θ)	Δ Cons. Welfare %	ΔY%	$\Delta\,(Y/N)$ %
0.05	0.50	1.07	0.07

Notes: This table shows the difference in household consumption-equivalent welfare, aggregate output (GDP), and aggregate labor productivity in an economy with unbiased managers relative to the steady state of my baseline economy with biases.

▸ Model Aggregates ▸ Magnitude of Welfare Implications

Consumer Welfare, Aggregate Output, & Labor Productivity are Higher Without Biases

Managerial Equity (θ)	Δ Cons. Welfare %	ΔY%	$\Delta\,(Y/N)$ %
0.05	0.50	1.07	0.07
0.25	1.20	0.82	0.13

Notes: This table shows the difference in household consumption-equivalent welfare, aggregate output (GDP), and aggregate labor productivity in an economy with unbiased managers relative to the steady state of my baseline economy with biases.

▸ Model Aggregates ▸ Magnitude of Welfare Implications

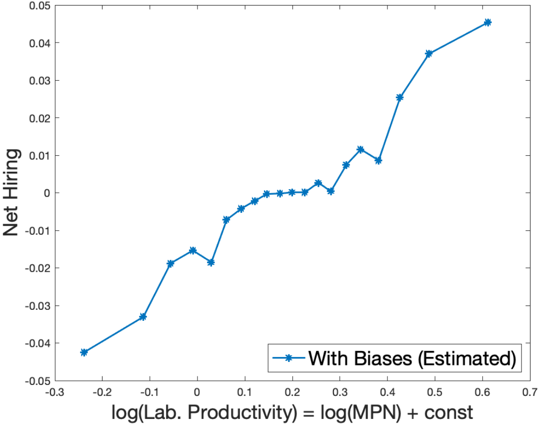
Consumer Welfare, Aggregate Output, & Labor Productivity are Higher Without Biases

Managerial Equity (θ)	Δ Cons. Welfare %	$\Delta Y\%$	$\Delta\,(Y/N)\,\%$
0.05	0.50	1.07	0.07
0.25	1.20	0.82	0.13
0.50	2.34	0.30	0.26

Notes: This table shows the difference in household consumption-equivalent welfare, aggregate output (GDP), and aggregate labor productivity in an economy with unbiased managers relative to the steady state of my baseline economy with biases.

▸ Model Aggregates ▸ Magnitude of Welfare Implications

Biases Encourage Excessive Reallocation



Notes: This figure shows the joint distribution of log(labor productivity) on the horizontal axis and net hiring on the vertical axis in my baseline economy with biases and a counterfactual economy in which all managers are unbiased. I sort the stationary distribution of each economy into 20 quantiles by log-labor productivity and plot the mean in each quantile on the against the mean net hiring rate.

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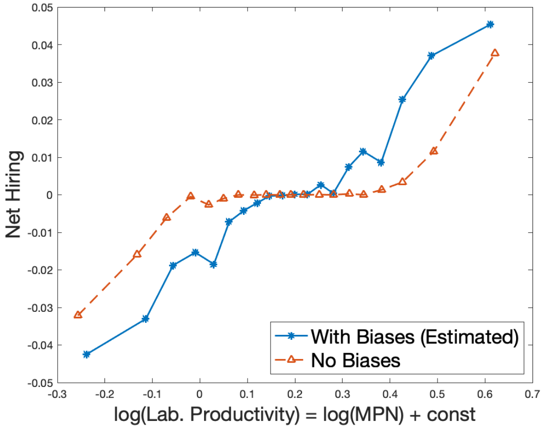

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Biases Encourage Excessive Reallocation

Overextrapolation ($\tilde{\rho} > \rho$)

- Shocks seem more persistent than they are
- Makes sense to hire/lay off workers in response

Overconfidence ($\tilde{\sigma} < \sigma$)

- Diminishes real-options, wait-and-see incentives
- Favors more aggressive hiring/firing

Both: Encourage excess spending on adjustment costs

Biases Encourage Excessive Reallocation

Economy without biases:

- Less reallocation
- Higher static "misallocation"
- Fewer resources spent on (unnecessary) adjustment costs

Δ Realloc. %	$\Delta\sigma(MPN)$ %	$\Delta\left(AC/Y\right) \times 100$
- 59.6	3.5	- 1.2

Notes: This table shows the difference in reallocation (= total job creation and destruction), dispersion in the marginal product of labor, and adjustment costs as a share of GDP in an economy with unbiased managers relative to the steady state of my baseline economy with biases.

Impact of Individual Biases | GE Price Effects | Robustness | Biases & Distortionary Taxes

Tax on Firing Can Be Welfare-Improving

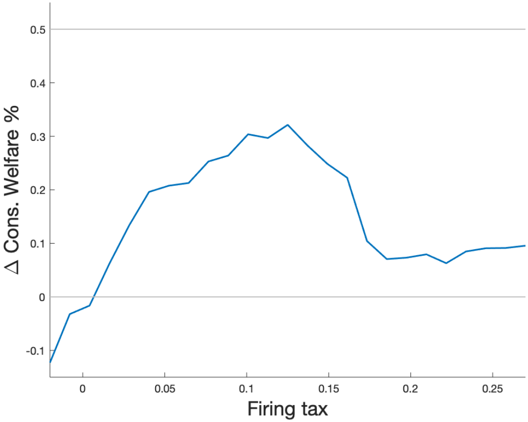
Add Firing Tax:

$$\pi(z_t, n_t, n_{t+1}; w_t) = \left[\begin{array}{c} \underbrace{z_t n_t^{\alpha}}_{\text{Revenue}} - \underbrace{w_t n_t}_{\text{Wage Bill}} \\ \\ \underbrace{- w_t n_t \tau_f \cdot \mathbf{1}(n_{t+1} < n_t))}_{\text{Firing Tax}} \\ \\ \underbrace{- \lambda n_t \left(\frac{n_{t+1} - n_t * (1-q)}{n_t} \right)^2}_{\text{Quadratic Adjustment Costs}} \end{array} \right]$$

Transfer Tax Revenue T_t Back to Household:

$$C_t + B_{t+1} = (1 + r_t) B_t + w_t N_t + (1 - \theta)\Pi_t + T_t$$

Tax on Firing Can Be Welfare-Improving



Notes: This figure shows how consumer welfare differs between an economy with a tax on firing (whose magnitude is determined on the horizontal axis) relative to the baseline estimated economy with no tax. In both cases managers are biased.

Conclusion

Empirically, managers:

- Are not over-optimistic nor pessimistic: $\tilde{\mu} \approx \mu$
- Are overconfident: $\tilde{\sigma} < \sigma$
- Overextrapolate from current conditions: $\tilde{\rho} > \rho$

How costly are biases in managerial beliefs?

- Micro: **2.1%** current firm value (holding all else constant)
- Macro: **0.5** to **2.3%** consumer welfare
  - Biased managers overreact to shocks
  - Too many resources spent on reallocation

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For comparison:

- Cost of dividend smoothing due to managerial career concerns: **2.1%** firm val. (Wu 2018)
- Cost of business cycles: **0.1 - 1.5%** (Krusell et al, 2009)

Broader Implications

Beliefs-induced overreaction:

- Amplification mechanism?
  Bordalo et al. (2019)
- Other firm decisions: capital structure, R&D investment, entry/exit, price-setting
- Other modeling frameworks: business cycles, strategic competition

Linking beliefs to actions is key for:

- Policy
- Outcomes at micro to macro levels

BACK-UP SLIDES

Preview of Results

Empirically, managers:

- Are not over-optimistic nor pessimistic: $\tilde{\mu} \approx \mu$
- Are overconfident: $\tilde{\sigma} \approx 0.39 \times \sigma$
- Overextrapolate: quarterly $\tilde{\rho} \approx 0.91$ but $\rho \approx 0.86$

Eliminating biases results in:

- Micro: **2.1%** higher firm value
- Macro: **0.5 to 2.3%** higher consumption equivalent welfare
  - Biased managers overreact to shocks
  - Too many resources spent on reallocation

Back

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Agency Conflict Examples

Empire building:

- Incentive to hire pessimistic managers
- I don't find evidence of pessimism

Tournament incentives & unobservable manager ability.

- Incentive to hire overconfident managers (e.g. Goel & Thakor, 2008)
- I find is the least costly bias

Risk-averse manager & risk-neutral shareholders:

- Again, incentive to hire overconfident managers

Not sure about a conflict for overextrapolation:

- Most costly bias in this paper

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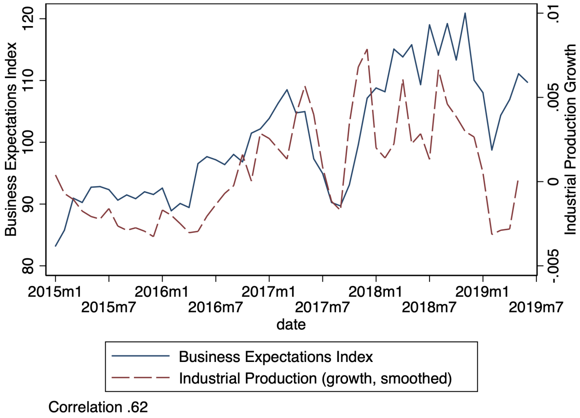
1st Moment Index vs. Industrial Production Growth



Notes: This figure shows our Business Expectations Index against the latest growth rate of the monthly Industrial Production Index. We smooth both series using a backward-looking moving average. See Altig et al (2019) for details.

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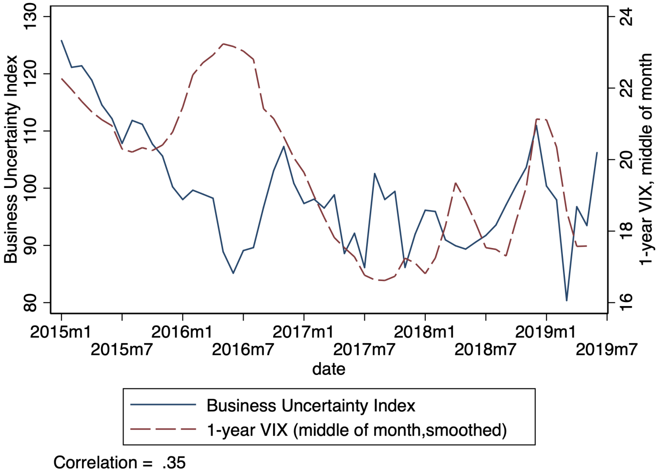
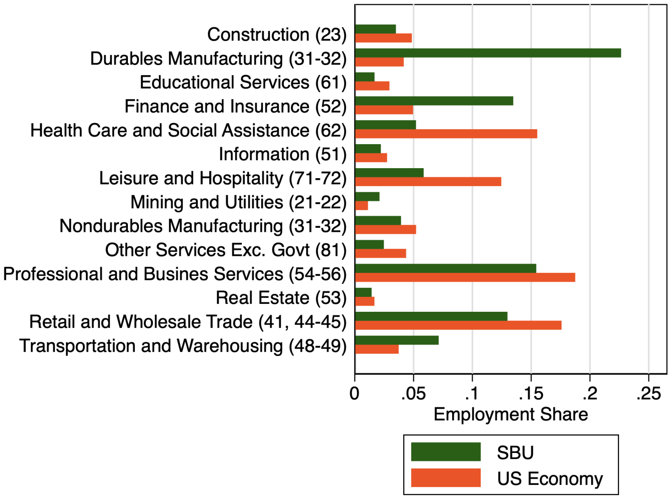
2nd Moment Index vs. VIX



Notes: This figure shows our Business Uncertainty Index against the level of the 1-year VIX in the middle of each month. We smooth both series using a backward-looking moving average. See Altig et al (2019) for details.

▸ Back

SBU Firms Come From All Sectors



Notes: This figure shows (1) the share of employment across all SBU responses from 10/2014 to 5/2019 made by firms in each sector; (2) the share of employment in each sector of the US economy according to the US Census Bureau's 2015 Statistics on US Businesses.

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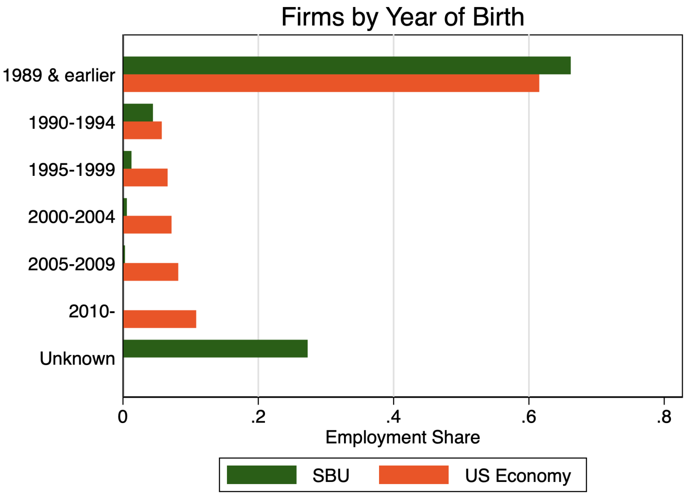
SBU Firms are Older



Notes: This figure shows (1) the share of employment across all SBU responses from 10/2014 to 5/2019 by the firm's year of birth; (2) the share of employment across firms by year of birth in the US economy according to the US Census Bureau's 2015 Business Dynamics Statistics.

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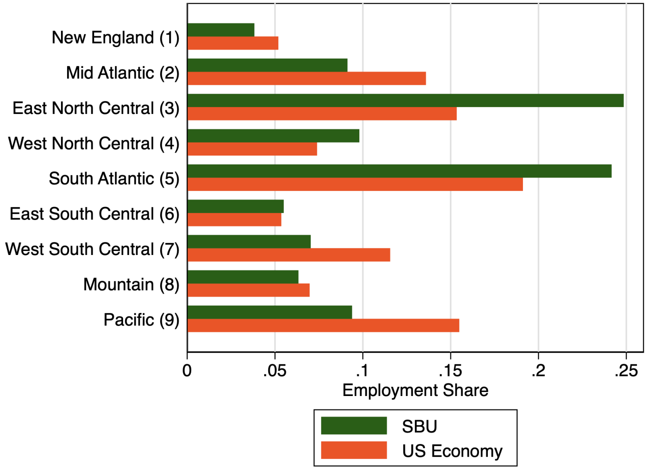
SBU vs. US Economy: Geography



Notes: This figure shows (1) the share of employment across all SBU responses from 10/2014 to 5/2019 made by firms in each region (i.e. Census Division); (2) the share of employment in each region of the US economy according to the US Census Bureau's 2015 Statistics on US Businesses.

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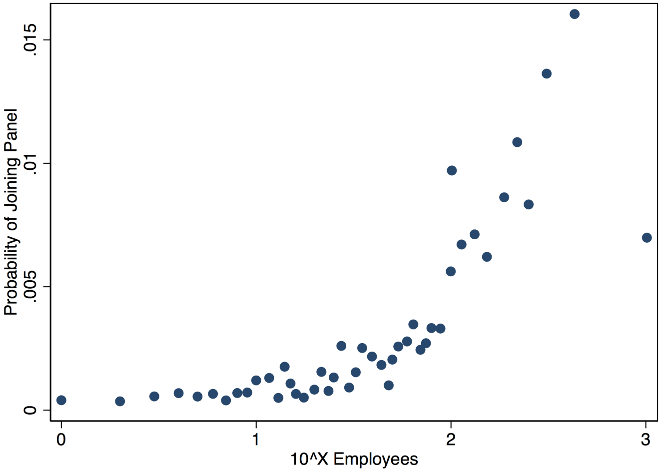
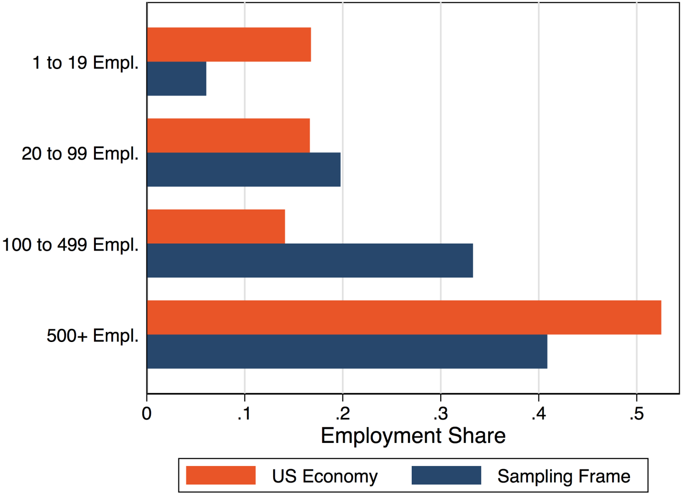
Sampling Probability by Firm Size



Notes: This figure shows the probability a firm in the SBU Sampling frame (from Dun & Bradstreet) ultimately agrees to join the survey panel, conditional on firm size (in log base 10 employment).

▸ Back

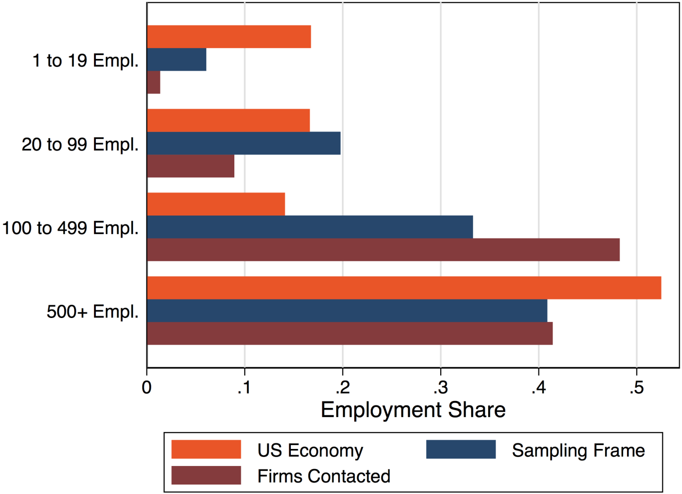
SBU Sampling



Notes: This figure shows the share of employment in: (1) the US economy; (2) the SBU sampling frame (3) firms contacted by survey recruiters; (4) SBU responses.

Back

SBU Sampling



Notes: This figure shows the share of employment in: (1) the US economy; (2) the SBU sampling frame (3) firms contacted by survey recruiters; (4) SBU responses.

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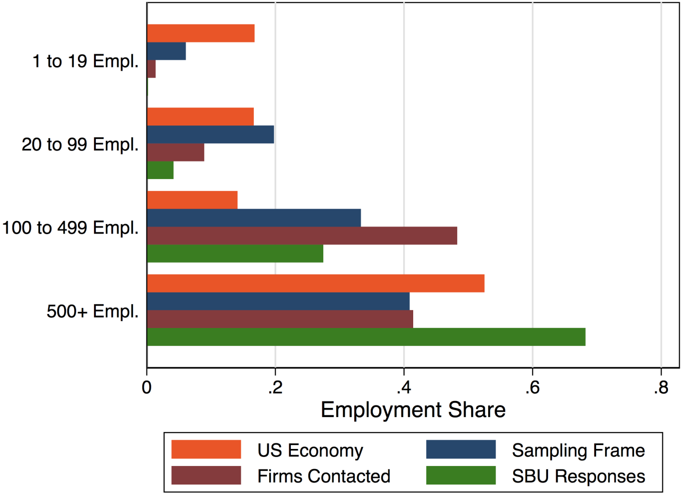
SBU Sampling



Notes: This figure shows the share of employment in: (1) the US economy; (2) the SBU sampling frame (3) firms contacted by survey recruiters; (4) SBU responses.

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SBU Sampling

Firm Size (Emp.)	Employment Shares			
	Census BDS	Sampling Frame	Contacted	SBU Responses
a) 1 to 4	4.90%	0.80%	0.10%	0.02%
b) 5 to 9	5.50%	0.90%	0.20%	0.03%
c) 10 to 19	6.80%	1.60%	0.50%	0.14%
d) 20 to 49	9.90%	4.60%	2.00%	0.95%
e) 50 to 99	6.90%	6.20%	3.70%	3.19%
f) 100 to 249	8.30%	9.70%	12.20%	12.93%
g) 250 to 499	5.80%	8.50%	18.80%	14.02%
h) 500 to 999	5.40%	6.50%	15.30%	11.80%
i) 1000 to 2499	7.10%	9.60%	7.10%	13.16%
j) 2500 to 4999	5.70%	9.10%	5.30%	18.95%
k) 5000 to 9999	5.70%	10.70%	8.50%	15.06%
l) 10000+	28.10%	31.90%	26.20%	9.74%

Notes: This figure shows the share of employment in: (1) the US economy; (2) the SBU sampling frame (3) firms contacted by survey recruiters; (4) SBU responses.

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Measuring Realized Growth

Start with survey response in month m belonging to quarter t.

- These are beliefs about sales growth between t and $t+4$.
- I have the firm's current quarterly sales: y_t

Ideally, measure the **realized sales** y^R_{t+4} in quarter $t+4$ reported in month $m+12$.

If sales level missing in month $m+12$ I proceed as follows:

- If m is the 1st month of quarter t (e.g January), try sales level reported in $m+13$ or $m+14$
- If m is the 2nd month of quarter t (e.g February), try sales level reported in $m+11$ or $m+13$
- If m is the 3rd month of quarter t (e.g March), try try sales level reported in $m+11$ or $m+10$

The **realized growth rate** is then: $g_t = \frac{y^R_{t+4} - y_t}{\frac{1}{2}(y^R_{t+4} + y_t)}$. Back

Summary Statistics

Variable	(1) N	(2) mean	(3) sd	(5) p25	(6) p50	(7) p75
Expected Employment Growth, Next 12 Months	6,442	0.009	0.081	-0.011	0.007	0.034
Uncertainty about Employment Growth, Next 12 Months	6,445	0.057	0.064	0.022	0.038	0.065
Expected Sales Growth, Next 4 Quarters	6,541	0.041	0.081	0.011	0.036	0.068
Uncertainty about Sales Growth, Next 4 Quarters	6,542	0.045	0.049	0.016	0.028	0.053
Realized Employment Growth, Next 12 Months	3,249	0.025	0.166	-0.043	0.014	0.087
Realized Sales Growth, Next Four Quarters	2,633	0.053	0.261	-0.057	0.050	0.178
Forecast Error for Sales Growth, Next 4 Quarters	2,580	-0.014	0.253	-0.140	-0.013	0.099
Sales, Current Quarter	6,729	36.3	108.9	2.75	7.5	21.7
Current Employment	7,720	410.20	1005.65	61	142	300
Sales Growth, Past Quarter	4,520	0.012	0.362	-0.095	0.000	0.113
Employment Growth (i.e. Net Hiring), Past Quarter	4,494	0.005	0.144	-0.029	0.000	0.038
Reported Employment Growth, Past 12 Months	6,801	0.021	0.123	-0.018	0.018	0.069

Notes: This table shows summary statistics for key variables from the Survey of Business Uncertainty, pooling responses from all managers and survey waves between 10/2014 and 5/2019. Expectations and uncertainty are the mean and mean absolute deviation of managers' subjective distribution as reported in the SBU. Forecast errors are the manager's expectation, less the actual sales growth measured over the next four quarters. I compute all growth rates by normalizing the change by the average of the starting and ending values. All variables are winsorized at the 1st and 99th percentiles.

▸ Back

Sales Growth Forecasts & Forecast Errors

$$\widetilde{\mathbf{E}}_t[g_{t+4}] \equiv \widetilde{\mathbf{E}}[g_{t+4}|\mathcal{I}_t] = \sum_{j=1}^{5} \tilde{p}_j g_{j,t+4}$$

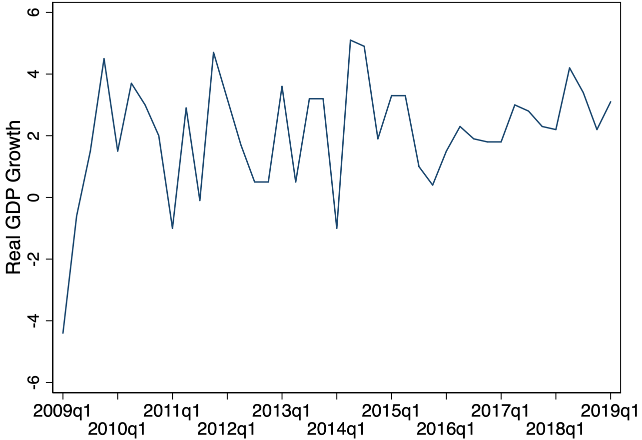
- $\widetilde{\mathbf{E}}_t[\cdot]$ = subjective expectation given info. set at tx
- g_{t+4} = growth rate of quarterly sales b/n quarters t, $t+4$
- $g_{j,t+4}$ = 4-quarter sales growth under jth scenario
- $\tilde{p}_{j,t+4}$ = subjective probability of scenario j

Forecast Error: Forecast - Realized Sales Growth

$$ForecastError_{t,t+4} = \widetilde{\mathbf{E}}_t[g_{t+4}] - g_{t+4}$$

▸ Measuring Realized Growth Rates ▸ Back

Low Macro Volatility During SBU Sample



Notes: This figure shows the evolution of the annualized growth rate of US real GDP by quarter since Q1.2007. The red lines indicate the start and end of the Great Recession. The green line indicates the start of the SBU Sample.

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Fact 0: Beliefs Data Predicts Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	**Realized Sales Growth, *t* to *t+4***			**Realized Hiring, *t* to *t+4***		
Sales Growth Forecast, *t* to *t+4*		**0.873***** **(0.144)**	**0.716***** **(0.242)**			
Forecast (Planned) Hiring, *t* to *t+4*					**0.865***** **(0.177)**	**0.764***** **(0.095)**
Sales Growth, *t-1* to *t*	0.002 (0.015)	-0.007 (0.014)		0.041** (0.017)	0.023* (0.013)	
Net Hiring, *t*	0.044 (0.049)	0.045 (0.042)		-0.103* (0.055)	-0.071* (0.037)	
Investment Rate, *t*	-0.066*** (0.022)	-0.050*** (0.017)		0.001 (0.017)	0.000 (0.014)	
log(Employees), *t*	-0.019** (0.008)	-0.016** (0.007)		0.001 (0.006)	-0.005 (0.005)	
Industry FE (14)	Y	Y		Y	Y	
Region FE (9)	Y	Y		Y	Y	
Age FE (22)	Y	Y		Y	Y	
Observations	951	951	1,906	813	813	2,190
Within R-squared	**0.0415**	**0.145**		**0.0197**	**0.214**	
R-squared	**0.327**	**0.400**	**0.166**	**0.151**	**0.319**	**0.167**

Notes: Columns (1) to (3) regress actual sales growth between quarters *t* and *t+4* on information available in the quarter of the forecast. Columns (4) to (6) do the same for actual net hiring between *t* and *t+4*. I respectively include the respondent's forecast for sales growth or net hiring to show it has significant predictive power and its inclusion increases the R-squared on the margin. I weight regressions by measures of accuracy for realized sales growth and actual hiring. Standard errors in parentheses, clustered by firm. Data are from the SBU covering 10/2014 to 5/2019 collapsed to quarterly frequency. *** p<0.01, ** p<0.05, * p<0.1

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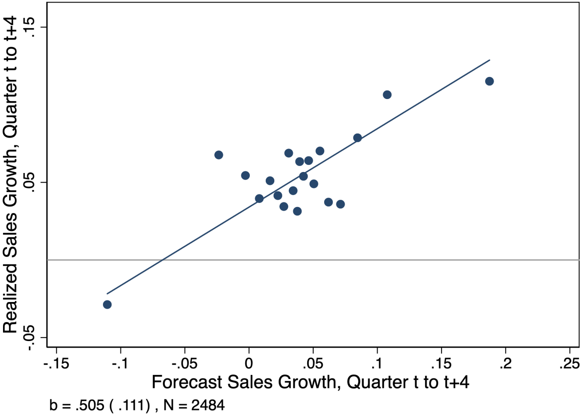
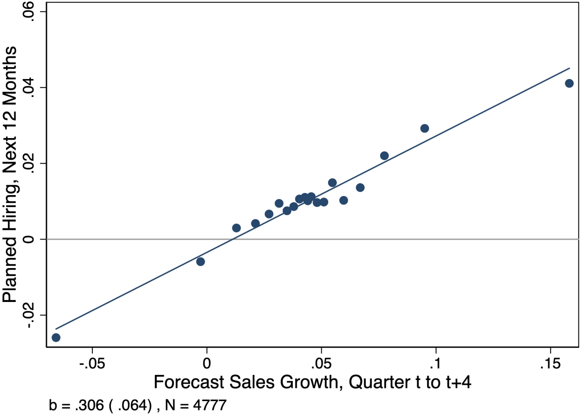
Fact 0: Beliefs Data Predicts Outcomes, Planned & Current Hiring



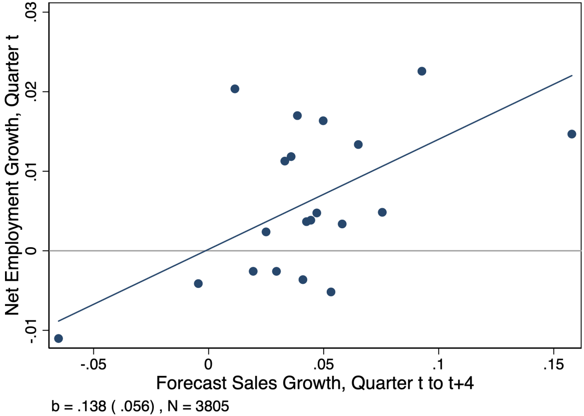
Notes: This figure shows a bin-scatter of 4-quarter sales growth realizations against ex-ante forecasts for sales growth, controlling for firm and date fixed effects. Data are from the *SBU* covering all months between 10/2014 to 5/2019.

Fact 0: Beliefs Data Predicts Outcomes, Planned & Current Hiring



Notes: This figure shows a bin-scatter of managerial hiring plans for the next 12 months against forecasts for sales growth for the next 4 quarters, controlling for firm and date fixed effects. Data are from the *SBU* covering all months between 10/2014 to 5/2019.

Fact 0: Beliefs Data Predicts Outcomes, Planned & Current Hiring



Notes: This figure shows a bin-scatter of net hiring (employment growth) since the previous quarter against forecasts for sales growth over the next 4 quarters, controlling for firm and date fixed effects. Data are from the *SBU* covering all months between 10/2014 to 5/2019.

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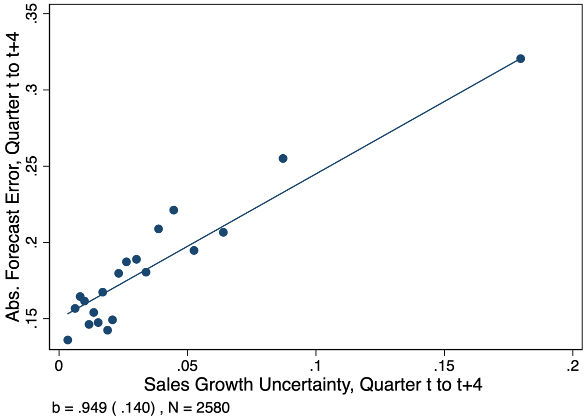
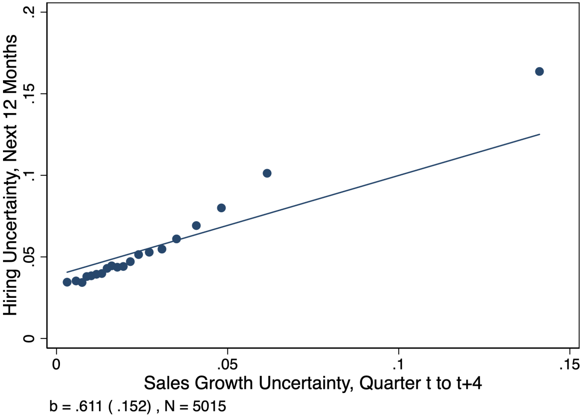
Fact 0: Uncertainty vs. Outcomes, Planned & Current Hiring



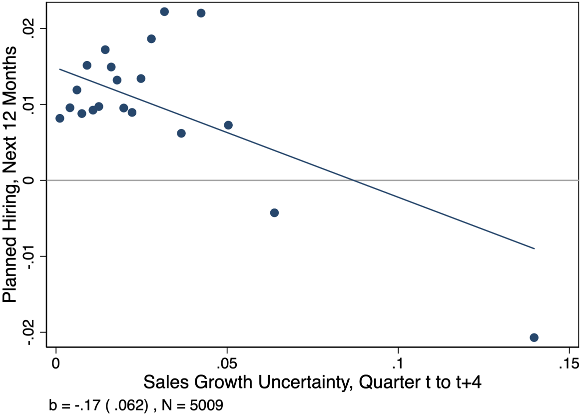
Notes: This figure shows a bin-scatter of empirical absolute forecast errors for sales growth between quarters t to $t+4$ versus ex-ante subjective uncertainty (mean absolute deviation) for sales growth from t to $t+4$. Data are from the *SBU* covering all months between 10/2014 to 5/2019. N = 2,580

Fact 0: Uncertainty vs. Outcomes, Planned & Current Hiring



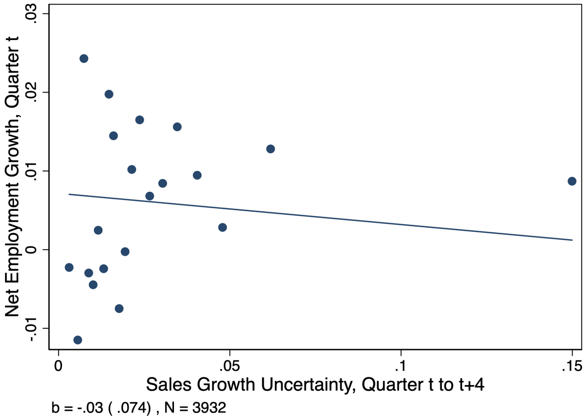
Notes: This figure shows a bin-scatter of hiring uncertainty for the next 12 months (subjective mean absolute deviations) versus subjective uncertainty sales growth from t to $t + 4$. Data are from the *SBU* covering all months between 10/2014 to 5/2019. N = 2,580

Fact 0: Uncertainty vs. Outcomes, Planned & Current Hiring



Notes: This figure shows a bin-scatter of planned hiring for the next 12 months versus ex-subjective mean absolute deviation for sales growth from t to $t+4$, controlling for the manager's sales growth forecast. Data are from the *SBU* covering all months between 10/2014 to 5/2019. N = 2,580

Fact 0: Uncertainty vs. Outcomes, Planned & Current Hiring



Notes: This figure shows a bin-scatter of current hiring in the past quarter versus ex- subjective mean absolute deviation for sales growth from t to $t + 4$. Data are from the *SBU* covering all months between 10/2014 to 5/2019. N = 2,580

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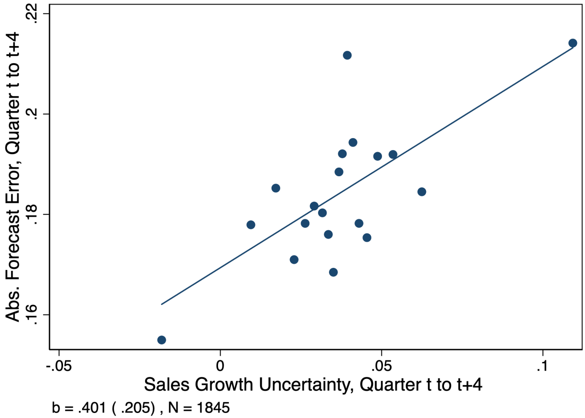
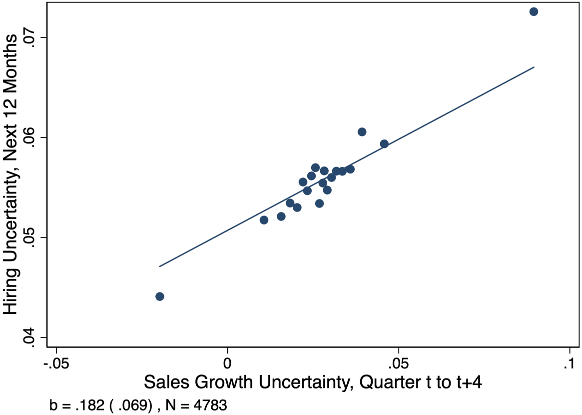
Fact 0: Uncertainty vs. Outcomes, Planned & Current Hiring



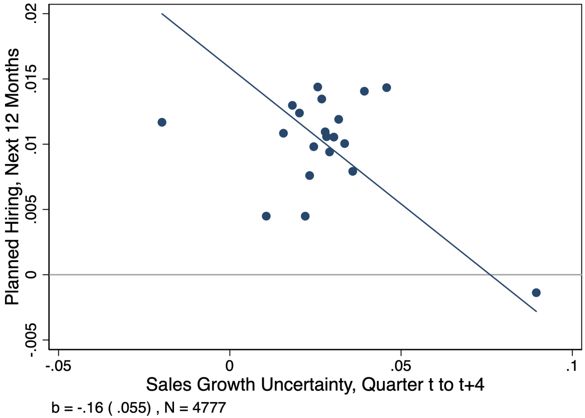
Notes: This figure shows a bin-scatter of empirical absolute forecast errors for sales growth between quarters t to $t+4$ versus ex-ante subjective mean absolute deviation for sales growth from t to $t+4$, controlling for firm and date fixed effects. Data are from the *SBU* covering all months between 10/2014 to 5/2019. N = 2,580

Fact 0: Uncertainty vs. Outcomes, Planned & Current Hiring



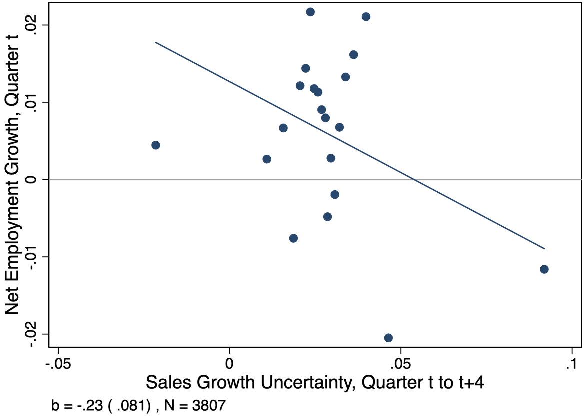
Notes: This figure shows a bin-scatter of hiring uncertainty for the next 12 months (subjective mean absolute deviations) versus ex- subjective mean absolute deviation for sales growth from t to $t+4$, controlling for firm and date fixed effects. Data are from the *SBU* covering all months between 10/2014 to 5/2019. N = 2,580

Fact 0: Uncertainty vs. Outcomes, Planned & Current Hiring



Notes: This figure shows a bin-scatter of planned hiring for the next 12 months versus ex-subjective mean absolute deviation for sales growth from t to $t+4$, controlling the manager's sales growth forecast and firm and date fixed effects. Data are from the *SBU* covering all months between 10/2014 to 5/2019. N = 2,580

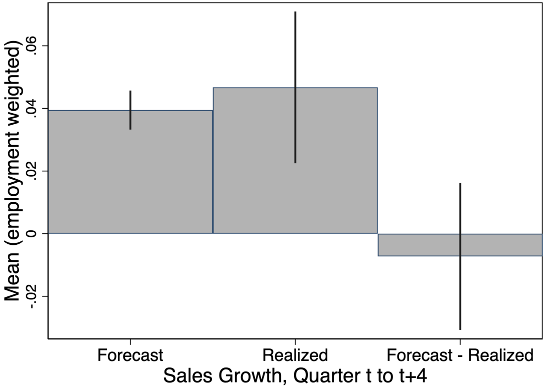
Fact 0: Uncertainty vs. Outcomes, Planned & Current Hiring



Notes: This figure shows a bin-scatter of current hiring in the past quarter versus ex- subjective mean absolute deviation for sales growth from t to $t+4$, controlling for firm and date fixed effects. Data are from the *SBU* covering all months between 10/2014 to 5/2019. N = 2,580

Back

Fact 1: Managers are Neither Over-Optimistic Nor Pessimistic (Empl. Weighted)



Notes: This figure shows the employment-weighted mean forecast and realized sales growth, as well as the mean forecast error (= forecast minus realized) for sales growth across all responses in the SBU for which I can construct forecast errors. 95 percent confidence intervals are based firm-clustered standard errors. Sample period is from 10/2014 to 5/2019 . N = 2,580.

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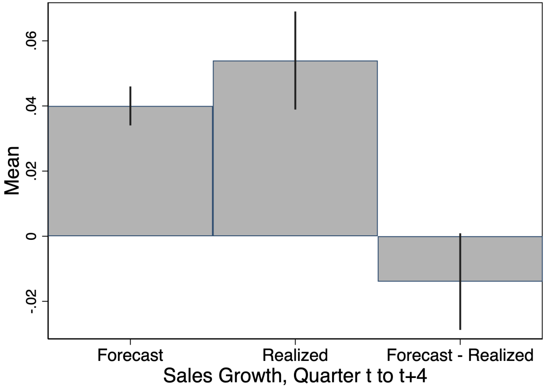
Fact 1: Managers are Neither Over-Optimistic Nor Pessimistic (Date & Firm Clustered Errors)



Notes: This figure shows the mean forecast and realized sales growth, as well as the mean forecast error (= forecast minus realized) for sales growth across all responses in the SBU for which I can construct forecast errors. 95 percent confidence intervals are based twoway clustered standard errors by firm and date. Sample period is from 10/2014 to 5/2019 . N = 2,580.

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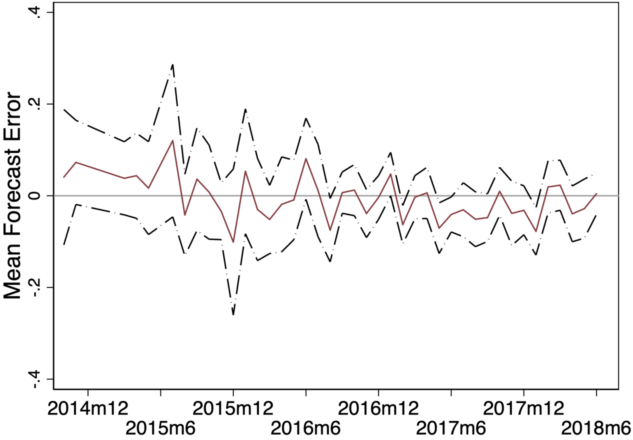
Fact 1: Managers are Neither Over-Optimistic Nor Pessimistic



Notes: Mean forecast error by month. Data are from the *SBU* covering 10/2014 to 5/2019. 95% confidence bands are based on standard errors clustered by firm. N = 2,580

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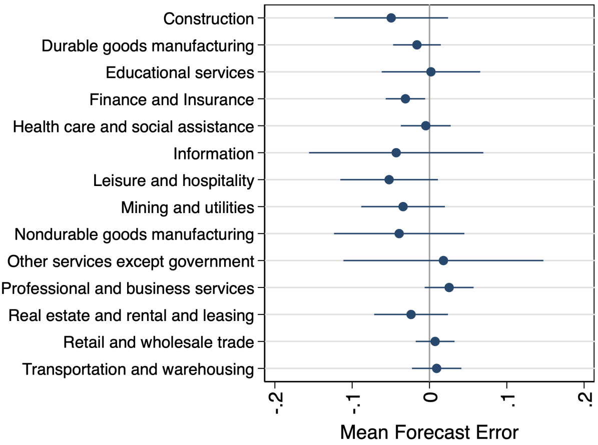
Fact 1: Managers are Neither Over-Optimistic Nor Pessimistic



Notes: Mean forecast error by one-digit sector. Data are from the *SBU* covering 10/2014 to 5/2019. Confidence intervals are based on standard errors clustered by firm. N = 2,580

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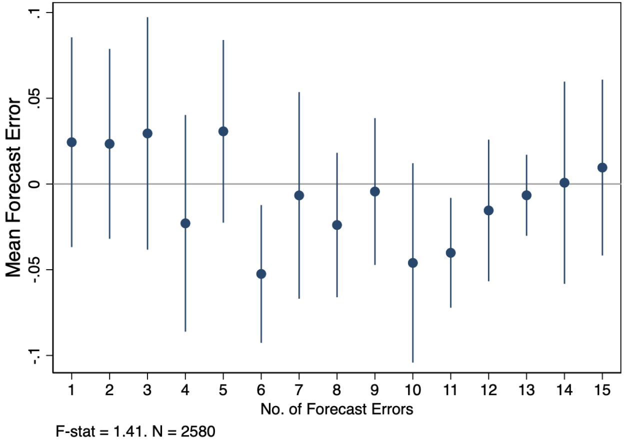
Fact 1: Managers are Neither Over-Optimistic Nor Pessimistic



Notes: Mean forecast error by one-digit sector. Data are from the *SBU* covering 10/2014 to 5/2019. Confidence intervals are based on standard errors clustered by firm. N = 2,580

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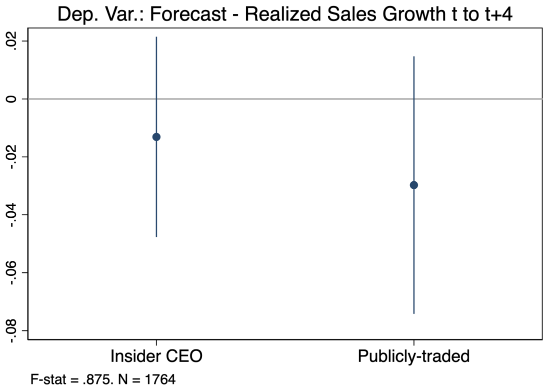
Fact 1: Managers are Neither Over-Optimistic Nor Pessimistic



Notes: This figure shows the coefficients from a regression of managerial forecast errors for sales growth over the next 4 quarters on indicator variables for whether the firm is publicly-traded and whether the CEO is a major shareholder or part of a family who are major shareholders. Data are from the *SBU* covering 10/2014 to 5/2019. Confidence intervals are based on standard errors clustered by firm. N = 2,580

Table Version Back

Fact 1: Managers are Neither Over-Optimistic Nor Pessimistic

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	**Forecast - Realized Sales Growth, Quarter *t* to *t+4***					
1(Insider CEO)	-0.006		-0.013	-0.007		0.001
	(0.016)		(0.018)	(0.028)		(0.032)
1(Publicly-traded)		-0.022	-0.030		0.013	0.014
		(0.020)	(0.023)		(0.024)	(0.026)
Employment-weighted				Y	Y	Y
Observations	1,764	1,781	1,764	1,743	1,760	1,743
R-squared	0.000	0.001	0.001	0.000	0.001	0.001
Firms	207	209	207	205	207	205

Notes: This table reports estimates from a regression of forecast minus realized sales growth, looking four quarters ahead on indicator variables for whether the firm has (1) an insider CEO, namely a CEO who is a major shareholder or part of a family who are major shareholders in the firm, and (2) whether the firm is publicly-traded. Data are from the SBU and include all firms and survey waves from 10/2014 to 5/2019. Data on firm ownership come from a special question that was part of SBU survey waves during February and March 2019. Robust standard errors in parentheses, clustered by firm. *** p<0.01, ** p<0.05, * p<0.1

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Absolute Forecast Errors

Absolute forecast error (AFE):

$$|\tilde{\mathbf{E}}[SalesGrowth_{t,t+4}] - SalesGrowth_{t,t+4}|$$

Subjective mean absolute deviation (SMAD):

$$\tilde{\mathbf{E}}\left[|\tilde{\mathbf{E}}[SalesGrowth_{t,t+4}] - SalesGrowth_{t,t+4}|\right]$$

Excess absolute forecast error
= Mean(AFE- SMAD):

$$\mathbb{E}\left[\begin{array}{c} |\tilde{\mathbf{E}}[SalesGrowth_{t,t+4}] - SalesGrowth_{t,t+4}| \\ -\tilde{\mathbf{E}}\left[|\tilde{\mathbf{E}}[SalesGrowth_{t,t+4}] - SalesGrowth_{t,t+4}|\right] \end{array}\right]$$

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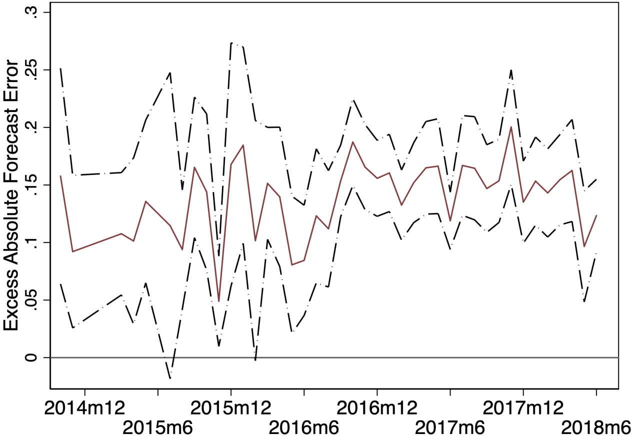
Fact 2: Managers are Overconfident

	Absolute Forecast Error		Excess Error
	Empirical	Subjective	Empirical - Subjective
Mean	0.183	0.035	0.148
SE	(0.007)	(0.002)	(0.006)
Obs.	2,580	2,580	2,580
Firms	446	446	446

Notes: This table reports the means empirical and subjective absolute forecast errors as well as the difference between the two. A respondent's subjective absolute forecast error is the subjective mean absolute deviation from her forecast. Standard errors are clustered by firm. Sample period is from 10/2014 to 5/2019 . N = 2,580.

▸ Definition: Excess Absolute Forecast Error ▸ Back

Fact 2: Managers are Overconfident



Notes: This figure shows the mean excess absolute forecast error (absolute forecast error minus subjective mean absolute deviation) for sales growth looking four quarters ahead, by month. Data are from the *SBU* covering 10/2014 to 5/2019 . 95 % confidence bands are based on standard errors clustered by firm. N = 2,580

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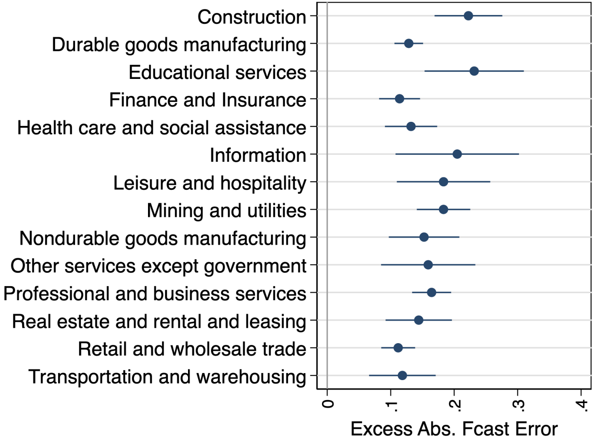
Fact 2: Managers are Overconfident



Notes: This figure shows the mean excess absolute forecast error (absolute forecast error minus subjective mean absolute deviation) for sales growth looking four quarters ahead, by one-digit sector. Data are from the *SBU* covering 10/2014 to 5/2019 . 95 % confidence intervals are based on standard errors clustered by firm. N = 2,580

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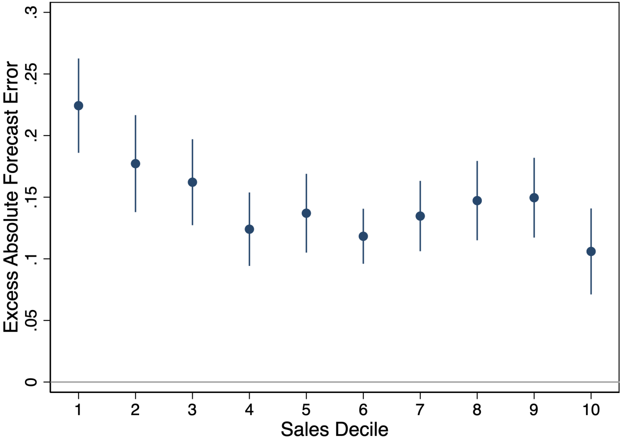
Fact 2: Managers are Overconfident



Notes: This figure shows the mean excess absolute forecast error (absolute forecast error minus subjective mean absolute deviation) for sales growth looking four quarters ahead for each decile of the firm size distribution in terms of sales. Data are from the *SBU* covering 10/2014 to 5/2019 . 95 % confidence intervals are based on standard errors clustered by firm. N = 2,580

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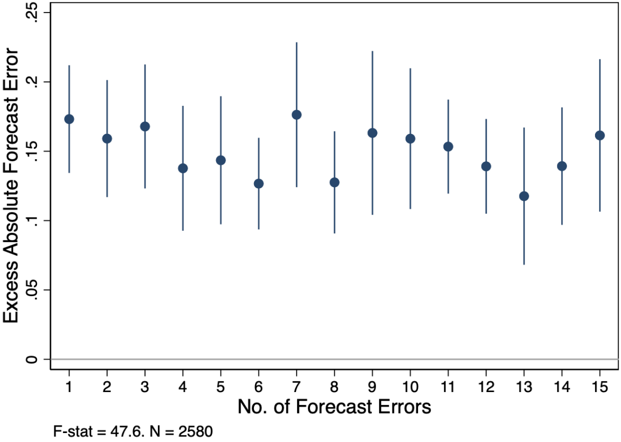
Fact 2: Managers are Overconfident



Notes: This figure shows the mean excess absolute forecast error (absolute forecast error minus subjective mean absolute deviation) for sales growth looking four quarters ahead, by number of forecast errors. Data are from the *SBU* covering 10/2014 to 5/2019 . 95 % confidence intervals are based on standard errors clustered by firm. N = 2,580

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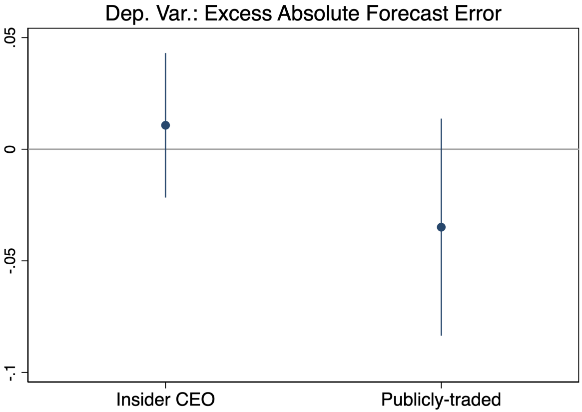
Fact 2: Managers are Overconfident



Notes: This figure regresses the mean excess absolute forecast error (absolute forecast error minus subjective mean absolute deviation) for sales growth looking four quarters ahead, on indicators for whether the firm has an insider CEO or the firm is publicly-traded. An insider CEO is one who is a major shareholder or belongs to a family who are major shareholders. Data are from the *SBU* covering 10/2014 to 5/2019 . 95 % confidence intervals are based on standard errors clustered by firm. N = 2,580

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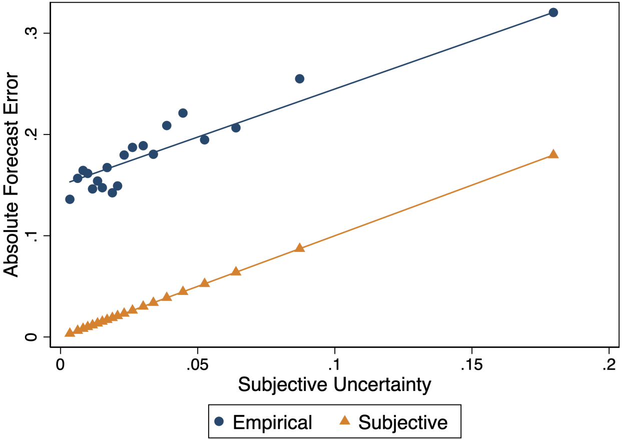
Subjective Uncertainty Accounts for Slope, Not Level of Errors



Notes: Bin-scatter plot of realized and subjective absolute forecast errors against ex-ante subjective uncertainty, i.e. the standard deviation of respondents' subjective probability distributions. Data are from the *SBU* covering 10/2014 to 5/2019 . N = 2,580.

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Is Overconfidence a Product of the Discrete 5-point Approximation?

Short answer: No. It's a product of where they place the support points

Long answer: I try discretizing empirical distribution of sales growth using 2 approaches:

1. "Tauchen" approach: Pick 5 equidistant points, ignoring p tail mass. Assign probabilities according to CDF.
2. "Quantile" approach: Pick appropriate points for typical probability vector, ignoring p tail mass.

Under both approaches:
Ignoring tail mass $p \approx 0.4$ leads to an excess absolute forecast error less than half as large as in the data.

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"Tauchen" Approach

1. Pick p tail mass to disregard
2. Pick 5 equidistant points q_i $i = 1, 2, 3, 4, 5$ on remaining support.
3. Assign probabilities π_i, $i = 1, 2, 3, 4, 5$ satisfying: $p_1 = F(\frac{q_1+q_2}{2})$, $p_2 = F(\frac{q_2+q3}{2}) - F(\frac{q_1+q2}{2})$, etc.

How large are excess absolute forecast errors?

Mass Excluded p	**0.01**	**0.05**	**0.1**	**0.2**	**0.4**	**Data**
Excess Abs. Error	0.030	0.021	0.028	0.043	0.077	0.148

Notes: This table shows the excess absolute forecast error that would arise from approximating the empirical distribution of realized sales growth between quarters t and $t+4$ under the "Tauchen" method of discretization. Before discretizing, I remove heterogeneity in realized sales growth attributable to differences in subjective first and second moments, leaving the empirical distribution of realized sales growth for the typical expectation and subjective uncertainty across all 1,574 forecast error observations in the *SBU*.

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"Quantile" Approach

1. Start with typical probability vector in responses $\pi = (0.1, 0.2, 0.4, 0.2, 0.1)'$
2. Pick p tail mass to disregard
3. Pick 5 bins q_i $i = 1, 2, 3, 4, 5$ on remaining support satistying:
   $\pi_1 = F(\frac{q_1+q2}{2})$, $\pi_2 = F(\frac{q_2+q_3}{2}) - F(\frac{q_1+q_2}{2})$, etc.

How large are excess absolute forecast errors?

Mass Excluded p	**0.01**	**0.05**	**0.1**	**0.2**	**0.4**	**Data**
Excess Abs. Error	-0.015	0.015	0.031	0.045	0.058	0.148

Notes: This table shows the excess absolute forecast error that would arise from approximating the empirical distribution of realized sales growth between quarters t and $t+4$ under the "Quantile" method of discretization. Before discretizing, I remove heterogeneity in realized sales growth attributable to differences in subjective first and second moments, leaving the empirical distribution of realized sales growth for the typical expectation and subjective uncertainty across all 1,574 forecast error observations in the *SBU*.

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"Tauchen" Approach for Normal Distribution

1. Pick p tail mass to disregard
2. Pick 5 equidistant bins q_i $i = 1, 2, 3, 4, 5$ on remaining support.
3. Assign probabilities π_i, $i = 1, 2, 3, 4, 5$ satisfying: $p_1 = F(\frac{q_1+q2}{2})$, $p_2 = F(\frac{q_2+q3}{2}) - F(\frac{q_1+q2}{2})$, etc.

How large are excess absolute forecast errors?

Mass Excluded p	**0.01**	**0.05**	**0.1**	**0.2**	**0.4**	**Data**
Excess Abs. Error	0.016	0.013	0.016	0.027	0.059	0.148

Notes: This table shows the excess absolute forecast error that would arise from approximating a normal distribution with variance equal to that of the empirical distribution of sales growth between t and $t+4$ under the "Tauchen" method of discretization. Before discretizing, I remove heterogeneity in realized sales growth attributable to differences in subjective first and second moments using *SBU* data. Then I simulate 1,574 draws from a Normal distribution and compute the excess absolute forecast error from using the discrete approximation to generate forecasts and subjective mean absolute deviations.

▸ Back

"Quantile" Approach for Normal Distribution

1. Start with typical probability vector in responses $\pi = (0.1, 0.2, 0.4, 0.2, 0.1)'$
2. Pick p tail mass to disregard
3. Pick 5 bins q_i $i = 1, 2, 3, 4, 5$ on remaining support satistying:
   $\pi_1 = \Phi(\frac{q_1+q2}{2})$, $\pi_2 = \Phi(\frac{q_2+q_3}{2}) - \Phi(\frac{q_1+q_2}{2})$, etc.

How large are excess absolute forecast errors?

Mass Excluded p	**0.01**	**0.05**	**0.1**	**0.2**	**0.4**	**Data**
Excess Abs. Error	0.013	0.029	0.038	0.047	0.059	0.148

Notes: This table shows the excess absolute forecast error that would arise from approximating a normal distribution with variance equal to that of the empirical distribution of sales growth between t and $t+4$ under the "Quantile" method of discretization. Before discretizing, I remove heterogeneity in realized sales growth attributable to differences in subjective first and second moments using *SBU* data. Then I simulate 1,574 draws from a Normal distribution and compute the excess absolute forecast error from using the discrete approximation to generate forecasts and subjective mean absolute deviations.

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Overconfidence or Measurement Error?

Issue: If realized sales growth is imprecise, could result in large measured absolute forecast errors.

Even if managers are not overconfident.

Test: Do my measured forecast errors look implausibly large?

- Sales growth forecast errors, 4-quarter horizon, I/B/E/S
- Magnitude of analysts errors vs. SBU measured errors
- Magnitude of analysts' errors vs. SBU subjective errors

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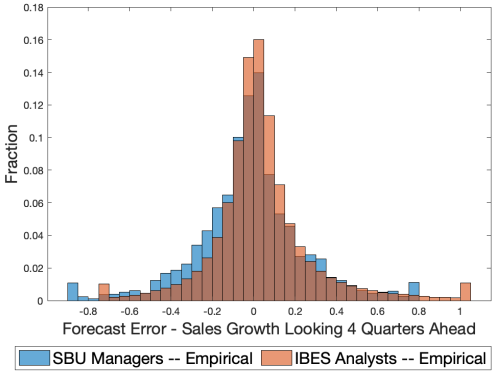
Are Managers' Empirical Forecast Errors implausibly Large?



Notes: This figure plots the empirical distribution of managers' forecast errors for sales growth looking four quarters ahead from the SBU as well as the empirical distribution of analyst forecast errors for sales growth four quarters ahead from IBES. Sample period for the SBU is from 10/2014 to 5/2019 and for IBES it is 1990 to 2017. N = 2,580 in the SBU, and N = 755,685 in IBES.

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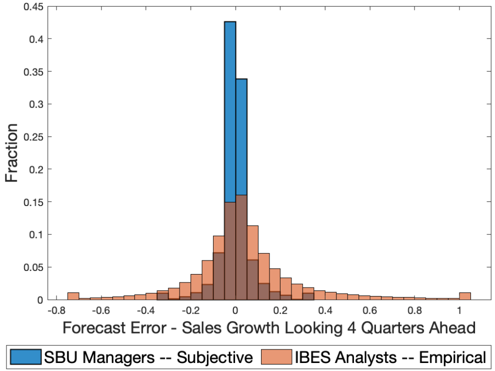
Are Managers' Subjective Forecast Errors implausibly Small?



Notes: This figure plots the subjective distribution of managers' forecast errors for sales growth looking four quarters ahead from the SBU as well as the empirical distribution of analyst forecast errors for sales growth four quarters ahead from IBES. Sample period for the SBU is from 10/2014 to 5/2019 and for IBES it is 1990 to 2017. N = 2,580 in the SBU, and N = 755,685 in IBES.

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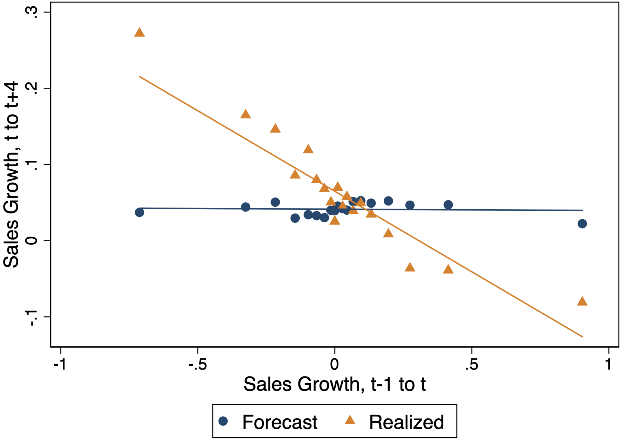
Fact 3: Managers Overextrapolate



Notes: This figure shows a bin-scatter of realized and forecast sales growth in quarters t to t + 4 against sales growth between the quarters t-1 and t. Data are from the *SBU* covering 10/2014 to 5/2019 . N = 1,829

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Fact 3: Managers Overextrapolate: Not Explained by Time, Firm Effects

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	**Forecast - Realized Sales Growth, quarters t to t+4**					
Sales Growth, quarters t-1 to t	0.173***	0.205***	0.220***	0.232***	0.246***	0.212***
	(0.059)	(0.026)	(0.029)	(0.029)	(0.032)	(0.041)
Constant	-0.004					
	(0.016)					
Date FE		Y		Y	Y	Y
Date x Sector FE			Y			
Firm FE				Y	Y	Y
No. of Forecast Errors >5					Y	
Employment-weighted						Y
Observations	1,825	1,829	1,754	1,775	1,590	1,774
R-squared	0.043	0.085	0.251	0.359	0.329	0.461

Notes: Robust standard errors in parentheses, clustered by firm. Data are subjective probability distributions and forecast errors about sales growth looking 4 quarters ahead from the *Survey of Business Uncertainty* covering all months between October 2014 and May 2019. *** p<0.01, ** p<0.05, * p<0.1

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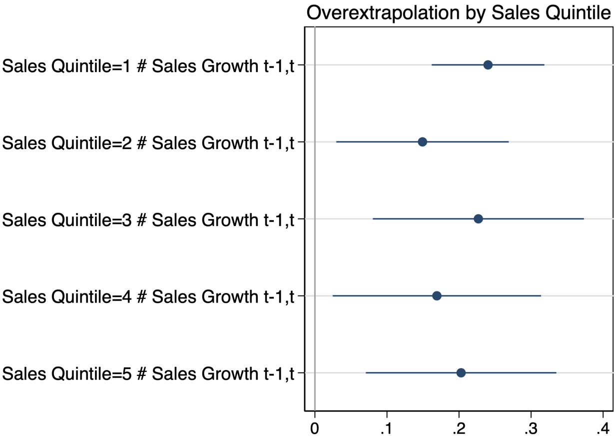
Fact 3: Managers Overextrapolate



Notes: In this figure, I plot the coefficients from regression of forecast errors for sales growth looking four quarters ahead on sales growth in the quarter prior to providing a subjective probability distribution, allowing for different coefficients for each quintile of the sales distribution. Bars reflect 95% confidence intervals based on standard errors clustered by firm.

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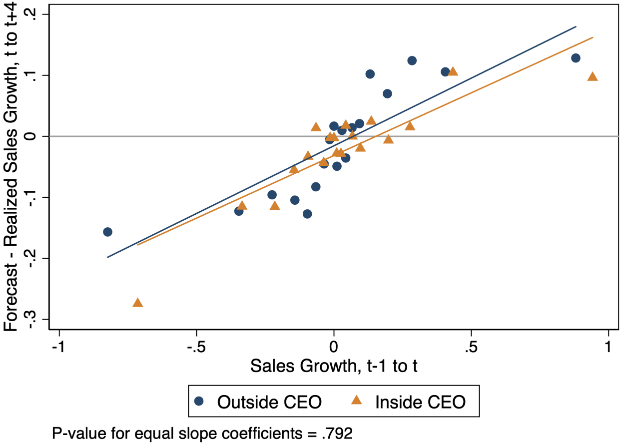
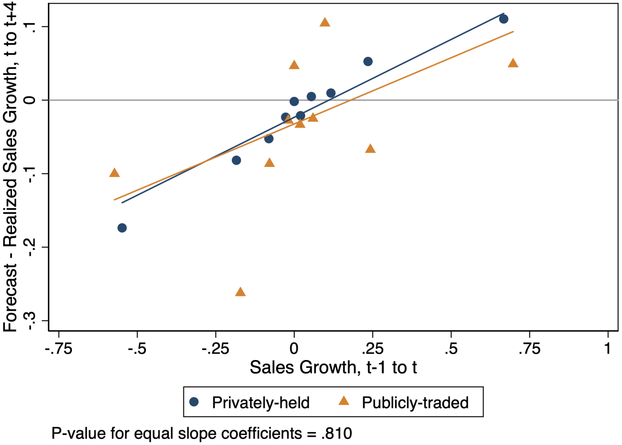
Fact 3: Managers Overextrapolate



Notes: This figure shows a bin-scatter of forecast minus realized sales growth in quarters t to t + 4 against sales growth between the quarters t-1 and t, separately for firms that have an insider CEO (i.e. who is a major shareholder or part of the main shareholding family) versus not. Data are from the *SBU* covering 10/2014 to 5/2019 . N(Insider CEO Sample) = 759. N(Non-Insider CEO Sample) = 608

Fact 3: Managers Overextrapolate



Notes: This figure shows a bin-scatter of forecast minus realized sales growth in quarters t to t + 4 against sales growth between the quarters t-1 and t, separately for firms that are publicly-traded versus not. Data are from the *SBU* covering 10/2014 to 5/2019 . N(Publicly-traded) = 155. N(Privately-held) = 1,224

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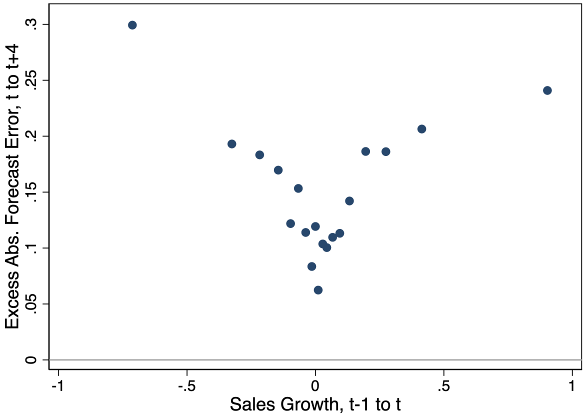
Fact 3: Overconfidence Distinct From Overextrapolation



Notes: This figure shows a bin-scatter plot of excess absolute forecast errors for quarters t to $t+4$ = (absolute forecast error - subjective mean absolute deviation) on the vertical axis against sales growth for the firm between quarters $t-1$ to t. Data are from the *SBU* covering 10/2014 to 5/2019 . N = 1,829.

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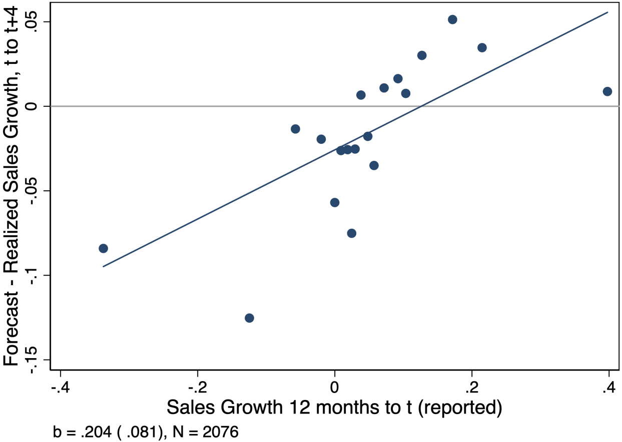
Fact 3: Managers Overextrapolate: Based on Reported Sales Growth



Notes: This figure shows a bin-scatter of forecast minus realized sales growth over quarters t to $t + 4$ on the y-axis against the respondent's reported sales growth in the 12 months prior. Data are from the *SBU* covering 10/2014 to 5/2019 . N = 2,076.

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Fact 3: Managers Overextrapolate: Based on Reported Sales Growth

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	**Forecast - Realized Sales Growth, quarters t to t+4**					
Reported Sales Growth, past 12 months	0.205**	0.216***	0.216***	0.375***	0.382***	0.509***
	(0.081)	(0.082)	(0.073)	(0.064)	(0.066)	(0.087)
Constant	-0.026***					
	(0.008)					
Date FE		Y		Y	Y	Y
Date x Sector FE			Y			
Firm FE				Y	Y	Y
No. of Forecast Errors >5					Y	
Employment-weighted						Y
Observations	2,076	2,076	2,048	2,015	1,709	2,013
R-squared	0.012	0.030	0.171	0.333	0.288	0.413

Notes: Robust standard errors in parentheses, clustered by firm. Data are subjective probability distributions and forecast errors about sales growth looking 4 quarters ahead from the *Survey of Business Uncertainty* covering all months between October 2014 and May 2019. *** p<0.01, ** p<0.05, * p<0.1

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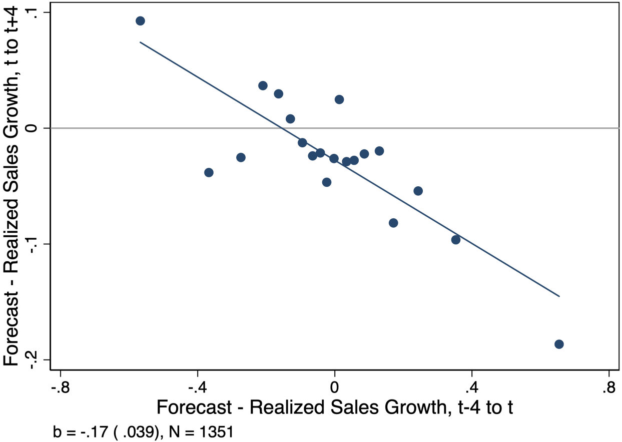
Fact 3: Managers Overextrapolate: Errors Serially Correlated



Notes: This figure shows a bin-scatter of forecast minus realized sales growth over quarters t to $t+4$ on the y-axis against forecast minus realized sales growth between quarters $t-4$ and t. Data are from the *SBU* covering 10/2014 to 5/2019 . N = 1,351.

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Fact 3: Managers Overextrapolate: Errors Serially Correlated

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	**Forecast - Realized Sales Growth, quarters t to t+4**					
Forecast - Realized Sales Growth, quarters *t-4* to *t*	-0.159**	-0.182***	-0.185***	-0.309***	-0.304***	-0.317***
	(0.067)	(0.040)	(0.045)	(0.042)	(0.042)	(0.052)
Constant	-0.008					
	(0.020)					
Date FE		Y		Y	Y	Y
Date x Sector FE			Y			
Firm FE				Y	Y	Y
No. of Forecast Errors >5					Y	
Employment-weighted						Y
Observations	1,332	1,351	1,257	1,316	1,251	1,298
R-squared	0.027	0.052	0.232	0.348	0.335	0.499

Notes: Robust standard errors in parentheses, clustered by firm. Data are subjective probability distributions and forecast errors about sales growth looking 4 quarters ahead from the *Survey of Business Uncertainty* covering all months between October 2014 and May 2019. *** p<0.01, ** p<0.05, * p<0.1

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Manager's Problem and Firm Value

Managers compensated with $\theta \in (0, 1]$ equity share.

Optimize their subjective valuation of the firm:

$$\tilde{V}(z_0, n_0) = \max_{\{n_{t+1}\}_{t=0}^{\infty}} \tilde{\mathbf{E}}_0 \left[\sum_{t=0}^{\infty} \frac{\pi(z_t, n_t, n_{t+1}; w_t)}{R_t} \right]$$

$\tilde{\mathbf{E}}_t[\cdot]$ is the managers' subjective expectations operator.

▸ Recursive Problem

Manager's Problem and Firm Value

Objective firm value under managers' policy $\kappa(z,n)$:

$$V(z_0, n_0) = \mathbf{E}_0 \left[\sum_{t=0}^{\infty} \frac{\pi(z_t, n_t, \kappa(z_t, n_t); w_t)}{R_t} \right]$$

$\mathbf{E}_t[\cdot]$ operator uses the true stochastic process.

▸ Recursive Problem

Solving the Model

1. **Solve for managers' policy functions $n_{t+1} = \kappa(z, n; w)$:**
   - Algorithm: Value function iteration on discretized state-space
   - Use biased Markov chain for $Pr(z_{t+1}|z_t)$

2. **Compute stationary distribution $\Phi(z, n)$ of firms using:**
   - Biased policy function $n_{t+1} = \kappa(z, n; w)$
   - True Markov chain for $Pr(z_{t+1}|z_t)$
   - Implementation: non-stochastic simulation (Young, 2010)

3. **Wage w^* clears the labor market:** $N^* = N^S = \int n d\Phi(z, n)$

Note: Household's Euler equation $\Rightarrow 1 + r^* = 1/\beta$.

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Full Set of Target Moments

Fact	Moment
0	Cov(Planned Hiring, Sales Growth Forecast)
	Cov(Hiring Uncertainty, Sales Growth Uncertainty)
	Cov(Current Hiring, Sales Growth Forecast)
	Cov(Current Hiring, Sales Growth Uncertainty)
	Cov(Sales Growth Forecast, Realized Sales Growth)
	Cov(Planned Hiring, Realized Employment Growth)
	Cov(Sales Growth Uncertainty, Sales Abs. Forecast Error)
	Cov(Hiring Uncertainty, Hiring Abs. Forecast Error)
	Var(Forecast Sales Growth)
	Var(Planned Hiring)
	Var(Sales Growth Uncertainty)
	Var(Hiring Uncertainty)
1	Mean(Forecast - Realized Sales Growth)
2	Mean(Sales Abs. Forecast Error - Sales Growth Uncertainty)
3	Cov(Forecast - Realized Sales Growth $t, t+4$, Sales Growth $t-1, t$
Dynamics	Cov(Current Hiring, Sales Growth $t-1, t$)
	Var(Current Hiring)
	Var(Sales Growth $t-1, t$)
	Cov(Realized Sales Growth $t, t+4$, Sales Growth $t-1, t$)

▸ Back ▸ Full Variable Definitions

SBU Variables & Model Equivalents

Symbol	Name	Formula/Description
Δy_t	Sales Growth $t-1, t$	$2\frac{y_t - y_{t-1}}{y_t + y_{t-1}}$
Δn_{t+1}	Current Hiring	$2\frac{n_{t+1} - n_t}{n_{t+1} + n_t}$
$\tilde{\mathbf{E}}_t[\Delta^l y_{t+4}]$	Forecast Sales Growth	Subjective mean
$\Delta^l y_{t+4}$	Realized Sales Growth	$2\frac{y_{t+4} - y_t}{y_{t+4} + y_t}$
$\tilde{\mathbf{E}}_t[\Delta^l n_{t+5}]$	Planned Hiring	Subjective mean
$\Delta^l n_{t+5}$	Realized Emp. Growth	$2\frac{n_{t+5} - n_{t+1}}{n_{t+5} + n_{t+1}}$
$\mathbf{M\tilde{A}D}_t[\Delta^l y_{t+4}]$	Sales Growth Uncertainty	Subjective mean abs. dev.
$\mathbf{M\tilde{A}D}_t[\Delta^l n_{t+5}]$	Hiring Uncertainty	Subjective mean abs. dev.
$SalesAFE_{t,t+4}$	Sales Abs. Forecast Error	$\left\Vert \tilde{\mathbf{E}}_t[\Delta^l y_{t+4}] - \Delta^l y_{t+4} \right\Vert$
$EmpAFE_{t+1,t+5}$	Hiring Abs. Forecast Error	$\left\Vert \tilde{\mathbf{E}}_t[\Delta^l n_{t+5}] - \Delta^l n_{t+5} \right\Vert$

Notes: I select quarterly observations from the SBU taking the last observation of the calendar quarter. I assume a firm's new hires in quarter t are not yet productive, so I identify n_{t+1} with the firm's employment at the end of period t. The operator $\tilde{\mathbf{E}}_t[\cdot]$ denotes a subjective expectation as of date t.

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GMM Estimation Details

$$\min_{\theta}[m(\vartheta) - m(X)]' W [m(\vartheta) - m(X)]$$

Implementation:

- Numerical optimization using Simulated Annealing
- Weight matrix $W = \mathbf{Cov}(m(X))^{-1}$
- At each iteration, compute $m(\vartheta)$ numerically:

  $\mathbb{E}[X(z,n)] = \sum_{z,n} X(z,n)\phi(z,n)$
- ▸ Computing 4-Quarters Ahead Forecast Errors and Moments

▸ Back

Forecast Error Moments in Model

Future sales $y_{t+4}|z_t, k_t$ are a function of $\zeta = \{z_{t+1} ... z_{t+4}\}$ under repeated application of the manager's policy fn $n_{t+1} = \kappa(z_t, n_t)$

- $y_{t+4}(\zeta|z_t, n_t)$ occurs with probability $Pr(\zeta|z_t)$
- Manager believes it happens with probability $\tilde{Pr}(\zeta|z_t)$
- Manager's Forecast $= \tilde{\mathbf{E}}[y_{t+4}|z_t, n_t] = \sum_\zeta y_{t+4}(\zeta|z_t, n_t) * \tilde{Pr}(\zeta|z_t)$
- Define $ForecastError(\zeta|z_t, n_t) \equiv \tilde{\mathbf{E}}[y_{t+4}|z_t, n_t] - y_{t+4}(\zeta|z_t, n_t)$

First I compute: $ForecastError(\zeta|z_t, n_t) \quad \forall(z_t, n_t)$
Then I apply LIE using the stationary distribution $\phi(z_t, n_t)$**:**

1. $\mathbb{E}[ForecastError|z_t, n_t] = \sum_\zeta ForecastError(\zeta|z_t, n_t)\tilde{Pr}(\zeta|z_t)$
2. $\mathbb{E}[ForecastError] = \sum_{z_t, k_t} \mathbb{E}[ForecastError|z_t, k_t] * \phi(z_t, k_t)$

▸ Back to estimation detail

Calibrated Parameters

Param.	Value	Description	Target/Source
q	0.08	Quarterly separation rate	Shimer (2005)
μ	0	Mean $\log(z)$	Normalization
γ	2	Inverse IES	Hall (2009)
η	2	Inverse Frisch elasticity	Chetty et al (2011)
β	$0.96^{1/4}$	HH discount factor	Ann. interest rate 4%
χ	29.67	Disutility of work	S.S. labor $N^* = 1/3$
θ	0.05	Managerial equity	Nikolov & Whited (2014)

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Estimated Model & Data Moments

Moment	Model	Data
Mean(Forecast Error$_{t,t+4}$)	-0.011	-0.016
Mean(Excess Abs. Forecast Error$_{t,t+4}$)	0.130	0.148
Cov(Forecast Error, Sales Growth$_{t-1,t}$)	0.011	0.014
Var(Sales Growth$_{t-1,t}$)	0.032	0.059
Var(Net Hiring$_t$)	0.019	0.018
Cov(Net Hiring$_t$, Sales Growth$_{t-1,t}$)	0.001	0.002
Cov(Sales Growth$_{t,t+4}$, Sales Growth$_{t-1,t}$)	-0.011	-0.014
Cov(Sales Growth Forecast$_{t,t+4}$, Hiring Plans$_{t,t+4}$)	0.482e-3	0.671e-3
Cov(Hiring Uncertainty$_{t,t+4}$, Sales Growth Uncertainty$_{t,t+4}$)	0.140e-3	0.289e-3
Cov(Net Hiring t, Sales Growth Forecast$_{t,t+4}$)	0.090e-3	0.287e-3
Cov(Net Hiring t, Sales Growth Uncertainty$_{t,t+4}$)	0.002e-3	-0.370e-3
Cov(Sales Growth Forecast$_{t,t+4}$, Realized Sales Growth$_{t,t+4}$)	0.331e-2	0.167e-2
Cov(Hiring Plans$_{t,t+4}$, Realized Emp. Growth$_{t,t+4}$)	0.252e-2	0.221e-3
Cov(Sales Growth Uncertainty$_{t,t+4}$, Sales Abs. Forecast Error$_{t,t+4}$)	0.045e-3	0.336e-3
Cov(Hiring Uncertainty$_{t,t+4}$, Hiring Abs. Forecast Error$_{t,t+4}$)	0.349e-3	0.279e-3
Var(Sales Growth Forecast$_{t,t+4}$)	0.329e-2	0.356e-2
Var(Hiring Plans$_{t,t+4}$)	0.357e-2	0.357e-2
Var(Sales Growth Uncertainty$_{t,t+4}$)	0.094e-2	0.146e-2
Var(Hiring Uncertainty$_{t,t+4}$)	0.113e-2	0.115e-2

Notes: All data moments are estimated using data from the SBU with the sample period covering 10/2014 to 5/2019 . All model moments are computed from the stationary distribution of firms across (z, n) space.

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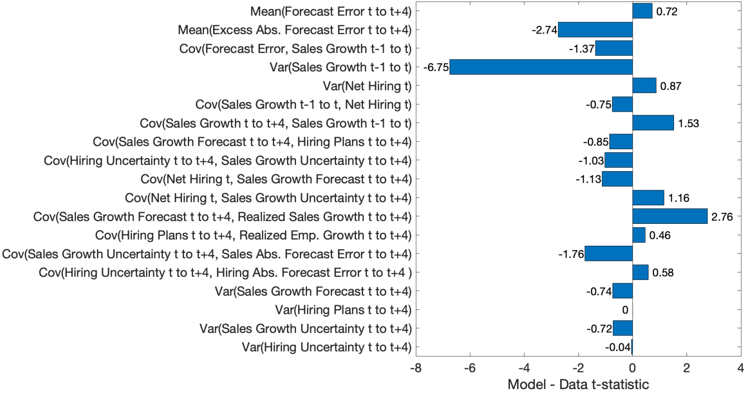
Model vs. Data: T-statistics



Notes: This figure shows the t-statistics for tests of the null hypothesis that each targeted model moment minus its data equivalent is zero. All data moments are estimated using data from the SBU with the sample period covering 10/2014 to 5/2019 . Standard errors are clustered by firm.

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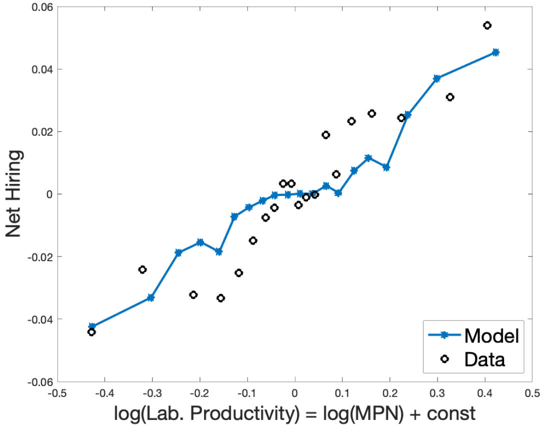
Hiring & MPN: Model vs Data



Notes: This figure shows bin-scatter plots of of net hiring (employment growth t to $t+1$) against the natural logarithm of the (sales/employment) ratio at t in the SBU data and my estimated model. I compute all model-implied moments from the stationary distribution for firms across the (z, n) state space. Variables from the data are winsorized at the 5th and 95th percentiles

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Identification

- **Forecast error moments (facts 1 - 3)** help pin down $\{\tilde{\mu}-\mu, \tilde{\sigma}/\sigma, \tilde{\rho}-\rho\}$, conditional on $\{\alpha, \lambda, \sigma, \rho\}$,
- **Labor and sales dynamics** help pin down $\{\alpha, \lambda, \sigma, \rho\}$, conditional on $\{\tilde{\mu}, \tilde{\sigma}, \tilde{\rho}\}$.
- **Beliefs, decisions, outcomes moments**

Moment	**Parameters**
Mean(Forecast Error)	$\tilde{\mu}-\mu$
Mean(Excess Abs. Forecast Error)	$\tilde{\sigma}/\sigma$
Cov(Forecast Error, Sales Growth$_{t-1,t}$)	$\tilde{\rho}-\rho$
Cov(Planned Hiring, Sales Growth Forecast)	α, λ
Var(Sales Growth$_{t-1,t}$)	σ, λ
Cov(Net Hiring$_{t,t+1}$, Sales Growth$_{t-1,t}$)	λ, α
Cov(Sales Growth$_{t,t+4}$, Sales Growth$_{t-1,t}$)	ρ, $\tilde{\rho}$
Var(Net Hiring)$_t$	σ_ξ
Variances of Sales, Employment Growth Forecasts & Uncertainty	σ_ν

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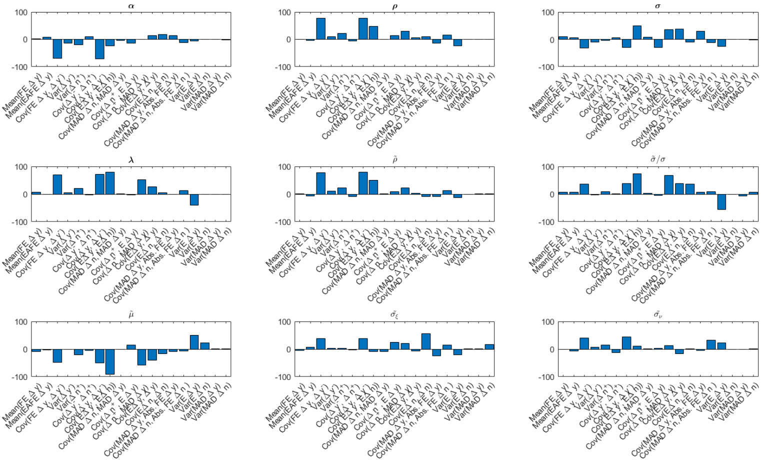
Local Identification Diagnostic



Notes: This figure shows Andrews-Gentzkow-Shapiro (2017) sensitivies for each of the parameters in the baseline model with respect to targeted moments. Each bar corresponds to the coefficient from a theoretical local regression of parameters on moments, with units expressed in terms of standard deviations.

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Micro Impact of Biased Beliefs

How much would firm value increase today by replacing biased manager?

Counterfactual	$\Delta V\%$
$\tilde{\sigma} = \sigma$ only	1.40
$\tilde{\rho} = \rho$ only	0.81
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma$	1.96
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma, \tilde{\mu} = \mu$	2.13

Notes: This table shows how much firm value would increase by replacing a biased manager with another who has fewer or no biases in beliefs. At each point in the (z, n) state space I compute the objective value generated by the biased managers in my estimated economy, as well as the objective value generated by a counterfactual manager lacking pessimism, overconfidence, and/or overextrapolation. Then I compute the mean percent gain in firm value by averaging the gains across the state space under the stationary distribution of the economy with biases.

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Micro Results Robustness

Counterfactual	$\Delta V\%$				
	Baseline	Hi AC	Lo AC	Low q	Lo α
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma, \tilde{\mu} = \mu$	2.13	0.66	1.87	2.46	0.68

Notes: This table shows how much firm value would increase by replacing a biased manager with another who has no biases in beliefs. At each point in the (z, n) state space I compute the objective value generated by the biased managers in my estimated economy, as well as the objective value generated by the counterfactual unbiased manager. Then I compute the mean percent gain in firm value by averaging the gains across the state space under the stationary distribution of the economy with biases. Columns correspond to alternative model specifications: (1) is the baseline estimated model (2) and (3) have high and adjustment costs, with triple and one-third my estimated value (4) a model with durable labor, i.e. a low separation rate of $q = 0.026$ rather than $q = 0.085$ (both quarterly).

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Micro Results Robustness

Counterfactual	$\Delta V\%$				
	Baseline	Hi AC	Lo AC	Low q	Lo α
$\tilde{\sigma} = \sigma$ only	1.40	0.58	0.78	1.63	0.44
$\tilde{\rho} = \rho$ only	0.81	0.32	0.52	0.97	0.36
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma$	1.96	0.55	1.66	2.26	0.64
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma, \tilde{\mu} = \mu$	2.13	0.66	1.87	2.46	0.68

Notes: This table shows how much firm value would increase by replacing a biased manager with another who has fewer or no biases in beliefs. At each point in the (z, n) state space I compute the objective value generated by the biased managers in my estimated economy, as well as the objective value generated by a counterfactual manager lacking pessimism, overconfidence, and/or overextrapolation. Then I compute the mean percent gain in firm value by averaging the gains across the state space under the stationary distribution of the economy with biases. Columns correspond to alternative model specifications: (1) is the baseline estimated model (2) and (3) have high and adjustment costs, with triple and one-third my estimated value (4) a model with durable labor, i.e. a low separation rate of $q = 0.026$ rather than $q = 0.085$ (both quarterly). Column (5) imposes a high de

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Firm Value Impact of Biases In Perspective

Impact of	Δ Firm Val. %	Notes
CEO entrenchment	3.1	Taylor (2010)
Agency conflicts & cash	3 - 8	Nikolov & Whited (2014)
Short-termism	1.0	Terry (2017)
Dividend-smoothing	2.0	Wu (2018)
Biased beliefs	2.1	This paper

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Model Aggregates (1/2)

Notes:

- Manager is risk-neutral, owns $\theta \in (0,1]$ of her firm's equity, consumes her share of profits (losses).
- The manager's policy function is $\kappa(z,n)$

GDP:

$$\begin{aligned}
Y &= \int_{z,n} z n^{\alpha} - \lambda \left(\frac{\kappa(z,n) - (1-q)n}{n} \right)^2 n \mathrm{d}\Phi(z,n) \\
&= \hat{Y} - AC \\
&= C + \theta \Pi \\
&= wN + \Pi
\end{aligned}$$

Labor: $N = \int_{z,n} n \mathrm{d}\Phi(z,n)$

Consumption: $C = wN + (1-\theta)\Pi$

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Model Aggregates (2/2)

Profits:

$$\Pi = \int_{z,n} \begin{bmatrix} zn^{\alpha} - wn \\ -\lambda\left(\frac{\kappa(z,n)-n(1-q)}{n}\right)n \end{bmatrix} \mathrm{d}\Phi(z,n;w,r)$$
$$= \int_{z,n} \left[\ \pi(z,n,\kappa(z,n);w)\ \right] \mathrm{d}\Phi(z,n)$$

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Welfare Impact of Biases In Perspective

Welfare Impact of	% C. Equiv.	Notes
General misallocation	30 - 40	Hsieh & Klenow (2009)
Business cycles	0.1 - 1.5	Krusell et al (2009)
Gains from trade	1.1 - 8.1	Melitz & Redding (2015)
Information frictions	4.0	David et al (2016)
Short-termism	0.44	Terry (2017)
Biased beliefs	2.34	This paper

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Macro Impact of Individual Biases

Counterfactual	Δ C. Welfare%	$\Delta\sigma(MPN)$%	$\Delta\left(\frac{AC}{Y}\right)\times 100$
$\tilde{\sigma}=\sigma$ only	0.28	0.7	-0.25
$\tilde{\rho}=\rho$ only	0.22	3.6	-1.23
$\tilde{\rho}=\rho, \tilde{\sigma}=\sigma$	0.39	3.6	-1.26
$\tilde{\rho}=\rho, \tilde{\sigma}=\sigma, \tilde{\mu}=\mu$	0.50	3.5	-1.20

Notes: This table shows the difference in household consumption-equivalent welfare, static dispersion in the marginal product of labor, and adjustment costs paid as a share of GDP in the steady state of an economy whose managers lack one or more of overconfidence ($\tilde{\sigma}=\sigma$), overextrapolation ($\tilde{\rho}=\rho$), or pessimism ($\tilde{\mu}=\mu$) relative to the steady state of my baseline economy with biased managers. Managers' equity share, θ is 5 percent all cases.

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Macro Results Robustness

Counterfactual	Δ C. Welfare %				
	Baseline	Hi AC	Lo AC	Lo q	Lo α
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma, \tilde{\mu} = \mu$	2.34	6.91	0.66	0.90	1.58

Notes: This table shows the difference in household consumption-equivalent welfare in the steady state of an economy whose managers are rational ($\tilde{\sigma} = \sigma$, $\tilde{\rho} = \rho$, and $\tilde{\mu} = \mu$) relative to the steady state of my baseline economy with beliefs biases. Columns correspond to alternative model specifications: (1) is the baseline estimated model (2) and (3) have high and adjustment costs, with triple and one-third my estimated value (4) a model with durable labor, i.e. a low separation rate of $q = 0.026$ rather than $q = 0.085$ (both quarterly). Column 5 imposes returns to scale $\alpha = 0.8$ rather than my estimated $\alpha = 0.61$..

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Macro Results Robustness

Counterfactual	Δ C. Welfare %				
	Baseline	Hi AC	Lo AC	Lo q	Lo α
$\tilde{\sigma} = \sigma$ only	0.40	4.71	1.64	1.64	1.54
$\tilde{\rho} = \rho$ only	0.68	1.63	-0.21	0.16	0.18
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma$	0.91	4.17	0.84	1.14	1.09
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma, \tilde{\mu} = \mu$	2.34	6.91	1.45	1.88	1.79

Notes: This table shows the difference in household consumption-equivalent welfare in the steady state of an economy whose managers lack one or more of overconfidence ($\tilde{\sigma} = \sigma$), overextrapolation ($\tilde{\rho} = \rho$), or pessimism ($\tilde{\mu} = \mu$) relative to the steady state of my baseline economy with beliefs biases. Columns correspond to alternative model specifications: (1) is the baseline estimated model (2) and (3) have high and adjustment costs, with triple and one-third my estimated value (4) a model with durable labor, i.e. a low separation rate of $q = 0.026$ rather than $q = 0.085$ (both quarterly).

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General Equilibrium Effects

Key question for aggregate outcomes in GE:

Does aggregate labor demand N increase/decrease when adding/removing biases?

- Wages respond to changes in labor demand N
- Higher wages $\Rightarrow$ shift gains toward consumers
- Higher wages $\Rightarrow$ lower firms' profits $\pi(\cdot)$, Π

Biases Have GE Effects via Labor Demand & Supply

Man. Equity (θ)	ΔC. Welfare%	$\Delta\Pi$ %	Δw %	Tot. Welfare
0.05	0.50	-10.8	4.86	0.33
0.25	1.2	-11.0	4.94	0.31
0.5	2.34	-11.9	5.26	0.27

Notes: This table shows the difference in household consumption-equivalent welfare, total profits, wages, and total welfare in the steady state of an economy whose managers have rational expectations relative to the steady state of my baseline economy with biased managers. Each line computes these counterfactual outcomes as a function of manager's equity share θ, which affects general equilibrium conditions.

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Managerial Biases & Other Public Policies

How do other distortions change the welfare impact of biases?

Do managerial biases amplify the impact of other distortions?

▸ Back

Managerial Biases & Other Public Policies

Add Labor Income Tax to Household Budget:

$$C_t + B_{t+1} = (1 + r_t)B_t + (1 - \tau_n)w_t N_t + (1 - \theta)\Pi_t + T_t$$

Add Payroll Tax to Firm Cash Flows:

$$\pi(z_t, n_t, n_{t+1}; w_t) = \left[\begin{array}{c} \underbrace{z_t n_t^{\alpha}}_{\text{Revenue}} - \underbrace{(1 + \tau_p) w_t n_t}_{\text{Wage Bill}} \\ \\ - \underbrace{\lambda n_t \left(\frac{n_{t+1} - n_t * (1 - q)}{n_t} \right)^2}_{\text{Quadratic Adjustment Costs}} \end{array} \right]$$

Transfers: $T_t = (\tau_n + \tau_p) w_t N_t$

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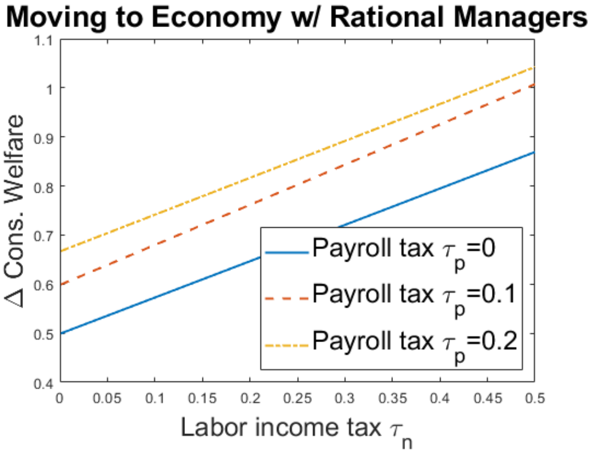
Taxes Amplify Welfare Impact of Managerial Biases



Notes: This figure shows the welfare change of moving to an economy with rational managers as a function of the payroll and labor income taxes of the baseline economy. For each point in the figure, I re-calibrate the household's disutility of labor so as to attain aggregate labor $N = 1/3$ in the baseline equilibrium with the combination of taxes in the figure.

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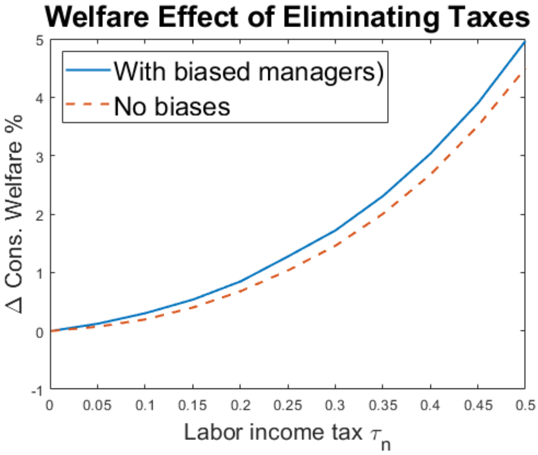
Managerial Biases Amplify Welfare Impact of Taxes



Notes: This figure shows the welfare change of removing labor income taxes, starting from an economy with tax τ_n and no payroll taxes ($\tau_p = 0$). Each line shows this welfare change depending on whether managers are biased or have rational expectations.

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Extensions: How do model estimates differ across subsamples of firms?

Large vs small firms:

Firm's with an "insider" CEO versus not

- Whether the CEO is a major shareholder or part of a family of major shareholders

Publicly-traded vs. privately held firms

Small SBU Firms Are More Biased

Param.	Explanation	Estimate (SE)	
		Small	Large
α	Earnings curvature	0.611 (0.089)	0.588 (0.113)
λ	Quadratic adj.cost	28.71 (1.42)	24.08 (2.36)
ρ	True shock persistence	0.752 (0.008)	0.864 (0.011)
$\tilde{\rho}$	Subjective shock pers.	0.889 (0.007)	0.924 (0.013)
σ	True shock volatility	0.232 (0.001)	0.190 (0.001)
$\tilde{\sigma}$	Subjective shock vol.	0.086 (0.002)	0.099 (0.002)
$\tilde{\mu}$	Subjective shock mean	-0.004 (0.0001)	-0.001 (0.0001)

Notes: This table shows parameter estimates for the baseline model specification estimated on subsamples of SBU firms with below and above median employment.

Small SBU Firms Are More Biased

Counterfactual	$\Delta V\%$	
	Small	**Large**
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma, \tilde{\mu} = \mu$	2.0	0.8

Notes: This table shows the percent change in firm value from replacing a biased manager with an unbiased one based on estimates of the baseline model. I show numbers separately for subsamples of SBU firms with below vs. above median employment.

Firms with Insider CEOs are Similarly Biased

Param.	Explanation	Estimate (SE)	
		Insider CEO	**Outsider CEO**
α	Earnings curvature	0.601 (0.014)	0.591 (0.011)
λ_q	Quadratic adj.cost	0.154 (0.010)	0.121 (0.002)
λ_i	K resale loss	0.103 (0.006)	0.131 (0.003)
ρ	True shock persistence	0.805 (0.003)	0.863 (0.003)
$\tilde{\rho}$	Subjective shock pers.	0.965 (0.006)	0.969 (0.001)
σ	True shock volatility	0.158 (0.001)	0.187 (0.0003)
$\tilde{\sigma}$	Subjective shock vol.	0.062 (0.003)	0.089 (0.0006)
$\tilde{\mu}$	Subjective shock mean	-0.002 (0.0001)	-0.002 (0.0001)

Notes: This table shows parameter estimates for the capital-based model specification for subsamples of Compustat firms with highly-entrenched vs. not highly-entrenched management (Bebchuk et al 2009).

Firms with Insider CEOs are Similarly Biased

Counterfactual	$\Delta V\%$	
	Insider CEO	**Outsider CEO**
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma, \tilde{\mu} = \mu$	3.3	4.1

Notes: This table shows percent change in firm value from replacing a biased manager with an unbiased one based on estimates of the capital-based model. I show numbers separately for subsamples of Compustat with highly-entrenched vs. not highly-entrenched management (Bebchuk et al 2009).

Publicly-traded and Private Firms are Similarly Biased

Param.	Explanation	Estimate (SE)	
		Public	Private
α	Earnings curvature	0.602 (0.049)	0.606 (0.006)
λ_q	Quadratic adj.cost	0.089 (0.093)	0.083 (0.002)
λ_i	K resale loss	0.128 (0.006)	0.102 (0.001)
ρ	True shock persistence	0.831 (0.012)	0.856 (0.002)
$\tilde{\rho}$	Subjective shock pers.	0.959 (0.008)	0.951 (0.001)
σ	True shock volatility	0.182 (0.001)	0.212 (0.0001)
$\tilde{\sigma}$	Subjective shock vol.	0.079 (0.002)	0.108 (0.0001)
$\tilde{\mu}$	Subjective shock mean	-0.001 (0.0004)	-0.001 (0.00003)

Notes: This table shows parameter estimates for the capital-based model specification for subsamples of Compustat firms with employment under 7500 comparing those that have made acquisitions in the past 8 quarters (AQCQ¿0) versus those who have not.

Publicly-traded and Private Firms are Similarly Biased

Counterfactual	$\Delta V\%$	
	Public	**Private**
$\tilde{\rho} = \rho, \tilde{\sigma} = \sigma, \tilde{\mu} = \mu$	3.3	2.8

Notes: This table shows percent change in firm value from replacing a biased manager with an unbiased one based on estimates of the capital-based model. I show numbers separately for subsamples of Compustat firms with employment under 7500 comparing those that have made acquisitions in the past 8 quarters (AQCQ¿0) versus those who have not.