Business Uncertainty in Developing & Emerging Economies*

Edgar Avalos[a] Jose Maria Barrero[b] Elwyn Davies[a]
Leonardo Iacovone[c] Jesica Torres[a]

[a]The World Bank [b]ITAM Business [c]The World Bank & the Hertie School

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*The views expressed in this paper and presentation are solely those of the authors and do not necessarily reflect the views of the World Bank, its Executive Directors, or the countries they represent.

RESEARCH QUESTIONS

How do managers *perceive* uncertainty about future own-firm sales under *high* versus *low volatility*?

How do differences in business uncertainty & volatility matter for *investment, entrepreneurship, and productivity*?

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How do differences in business uncertainty & volatility matter for *investment, entrepreneurship, and productivity*?

This paper: Exploit differences in uncertainty & volatility across *developing & emerging economies*, contrast with the US

Why Are These Open Questions?

Hard to observe how businesses perceive uncertainty.
Survey-based measures mostly from 2015 & later in UK, US, Germany.
Altig et al. (2022), Bachmann et al. (2022)

Much focus on cyclical impact of uncertainty in advanced economies.
Bloom (2009), Bachmann, Elstner, Sims (2013), Bachmann & Bayer (2013),
Berger, Dew-Becker & Giglio (2020), Bloom, Baker, & Terry (2022), Xu, Bekaert, & Engstrom (2022),

Altogether, hard to find settings with:

- Good measures of uncertainty based on manager perceptions
- Variation in uncertainty & volatility

THIS PAPER

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Trace out implications for *entrepreneurial dynamics* & *investment*

- Dynamic model: real options, entry/exit, investment frictions

- Quantify: How (much) do our facts + the model matter in accounting for **cross-country differences in GDP/person**?

KEY TAKEAWAYS

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     Even *controlling* for industry, firm size, exchange rate volatility,...

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     More so (in % terms) in ***low-volatiity, rich*** countries

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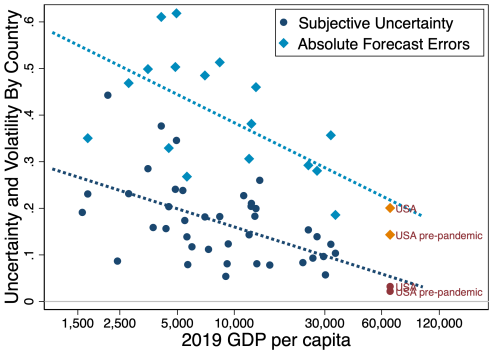
   - **Business uncertainty & volatility *decline* with GDP/person**
     Even *controlling* for industry, firm size, exchange rate volatility,...
   - **Managers are *overprecise* (understate sales volatility)**
     More so (in % terms) in ***low-volatiity, rich*** countries

2. **Higher volatility in poor countries + real options ⇒ bigger TFP gaps**
   Up to **35% *lower TFP*** than in a world with low & uniform-volatility

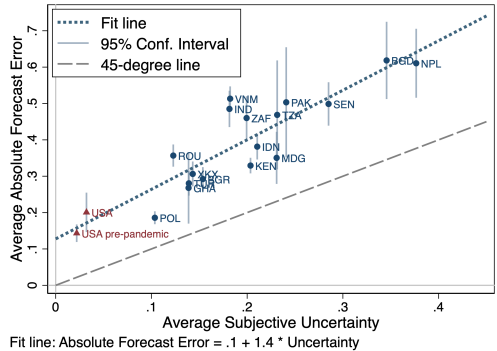
3. ***Overprecison* in rich countries improves selection, reallocation**
   ⇒ Dampens the volatility effect

Two New Facts about Business Uncertainty

Uncertainty & Volatility Decline with GDP/person



Overprecision in All Countries: Abs. Forecast Errors > Uncertainty



Fit line: Absolute Forecast Error = .1 + 1.4 * Uncertainty

Notes: The left figure plots employment-weighted subjective uncertainty in each country averaging across waves of the World Business Pulse and Enterprise Surveys against the country's 2019 GDP per capita on the horizontal axis. The right figure shows employment-weighted average overprecision (the difference between absolute forecast errors and uncertainty) in each country against GDP per capita. We weight firms by employment within each country. UK and US uncertainty values are the averages for Apr, 2020 - Dec, 2021 and Apr, 2020 - Mar, 2022 respectively.

Outline

Data & methodology

- Validation: firm-level patterns

Business uncertainty & volatility across countries

How do uncertainty & volatility change our accounting of cross-country differences in GDP/person?

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World Bank Group
Business Pulse & Enterprise Surveys

Goal: Information about firm operations, sales, employment, forecasts

Implementation: Phone interviews with firm owners/top managers Details

Coverage:

- **This paper:** **41** countries from all WB lending regions, Apr. 2020–Mar. 2022
- *Registered firms* identified from Census listings, business registers
  Should include informal employment at these businesses
- Small (5 to 10 employees) to large (100+ employees) firms
- Multiple waves in 18 countries $\Rightarrow$ *panel dimension*

The Expectations & Uncertainty Module

Looking ahead to the next 6 months, do you expect that your sales will increase, decrease, or remain the same, compared to the same period [in 2019]?

- *Increase [decrease] by how much?*

On a scale of 0 to 100, what is the chance (probability) you believe this will happen?

THE EXPECTATIONS & UNCERTAINTY MODULE

In a more optimistic (better) scenario, do you expect that your sales for the next 6 months will increase, decrease, or remain the same, compared to the same period [in 2019]?

- *Increase [decrease] by how much?*
- *On a scale of 0 to 100, what is the chance (probability) you believe this will happen?*

Similar question for a *pessimistic (worse)* scenario

3-point Subjective Probability Distributions

For each firm j and scenario i: $\{g_{ij}, p_{ij}\}_{i=1}^{3}$ Feasibility Summary Stats

- g_{ij} = 6-months-ahead sales in scenario i (% change from prior year)
- p_{ij} = probability of scenario i occurring
- Version of the methodology developed by Altig et al. (2022)

Sales expectation (1st moment) $\text{Mean}_j = \sum_{i=1}^{3} p_{ij} g_{ij}$

Sales uncertainty (2nd moment): $\text{Uncertainty}_j = \sum_{i=1}^{3} p_{ij} \left\| g_{ij} - \text{Mean}_j \right\|$

Absolute Forecast Error: $\text{AFE}_j = \left\| \text{Realized Sales}_j - \text{Mean}_j \right\|$

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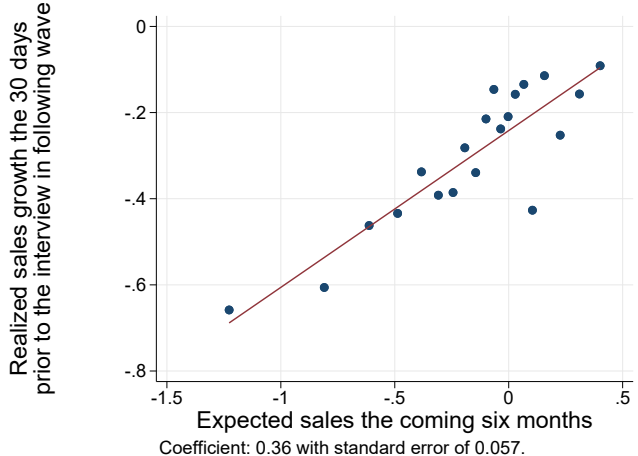
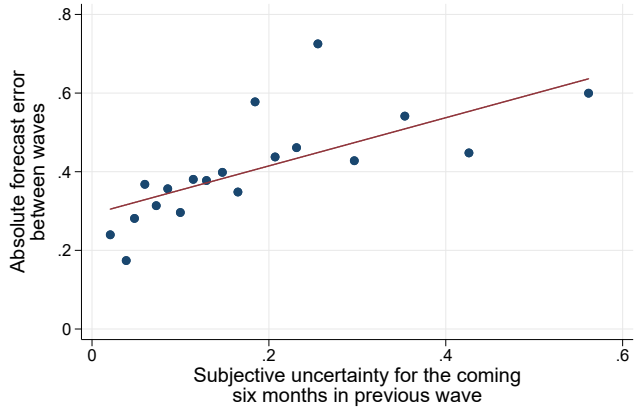
Expectations Predict Future Sales Growth



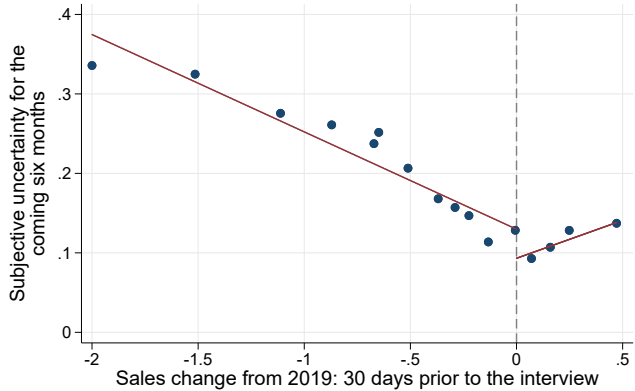
Notes: The figure shows a binned scatter plots of realized sales in the 30 days prior to the following-wave interview on the vertical-axis against sales expectations for the next six months on the horizontal axis. Both realized sales and future expected sales are expressed relative to the same periods of 2019. The sample includes only the firm-level panel of firms which appear in at least two rounds of the survey. See Table A4 in the appendix for a list of countries where a panel is available. We weight firms by employment within each country. The reported statistics below the figure correspond to the least squares regression in the underlying micro data and the corresponding robust standard error.

Uncertainty Predicts Abs. Forecast Errors



Notes: The figure shows a binned scatter plot of the absolute value of the error (difference) between six-months-ahead sales forecasts (expectations) elicited and realized sales in the 30 days leading to the following wave interview on the vertical-axis against subjective uncertainty about six-months-ahead sales elicited in the earlier wave on the horizontal-axis. Sales expectations and realizations are all expressed relative to the same period in 2019. The sample includes only the firm-level panel of firms which appear in at least two rounds of the survey. We weight firms by employment in each country. The reported statistics below each figure correspond to the least squares regression in the underlying micro data and the corresponding robust standard error.

Uncertainty is V-shaped in Sales Shifts



Notes: The figure shows an employment-weighted binned scatter plot of subjective uncertainty about six-months-ahead sales on the vertical axis against realized sales the 30 days prior to the interview on the horizontal axis. The reported statistics below each figure correspond to the least squares regression in the underlying micro data and the corresponding robust standard error. Both realized sales growth and future expected sales growth are expressed relative to the same periods of 2019. The sample includes businesses from all countries and waves.

▸ Expectations ▸ Expectations Revisions ▸ Lag Abs. Forecast Errors

Validating Our Measures of Expectations & Uncertainty

1. **Expectations predict future outcomes**
   Uncertainty predicts future absolute forecast errors
   (Barrero, 2022; Altig et al., 2022)

2. **Higher uncertainty in volatile and changing environments**
   (Altig et al. 2020; Bloom et al., 2021; Bachmann et al., 2021)

3. **Employment correlates with expectations, uncertainty in the cross section** Detail

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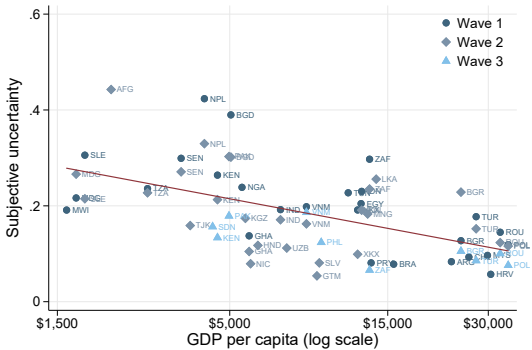
Business uncertainty & volatility across countries

How do uncertainty & volatility change our accounting of cross-country differences in GDP/person?

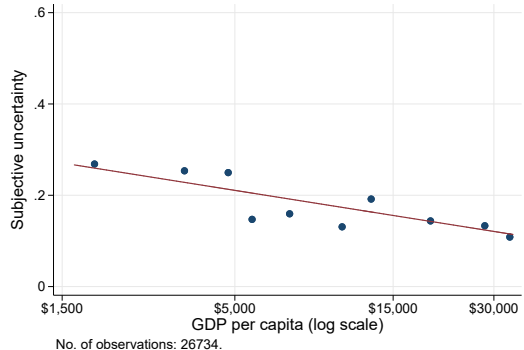
Business Uncertainty vs. GDP/person

Raw Relationship by Country-Wave



No. of observations: 27046.

Firm Size, Sector, Time Controls



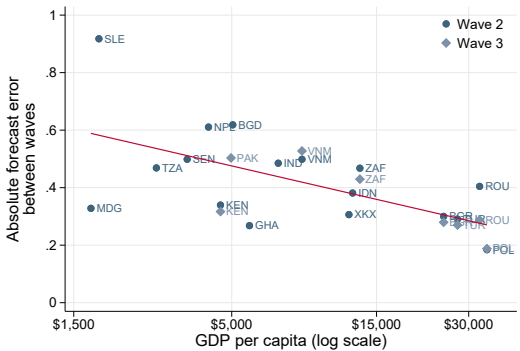
No. of observations: 26734.
Coefficient: -0.05 with standard error of 0.001.

Notes: The left figure plots employment-weighted subjective uncertainty in each country-wave of the World Bank Business Pulse and Enterprise Surveys against the country's 2019 PPP GDP per capita in USD on the horizontal axis. The right figure shows the employment-weighted relationship across firms, controlling for firm size (log(employment)), sector fixed effects, and calendar quarter fixed effects.

▸ Regression: Firm & Macro Controls ▸ Expectations ▸ Regression: Corruption, Trust, Individualism

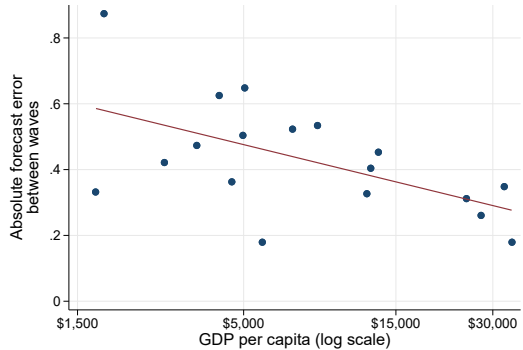
Forecast Accuracy vs. GDP/person

Raw Cross-Country Relationship



No. of observations: 4853.

Firm Size, Sector, Time Controls

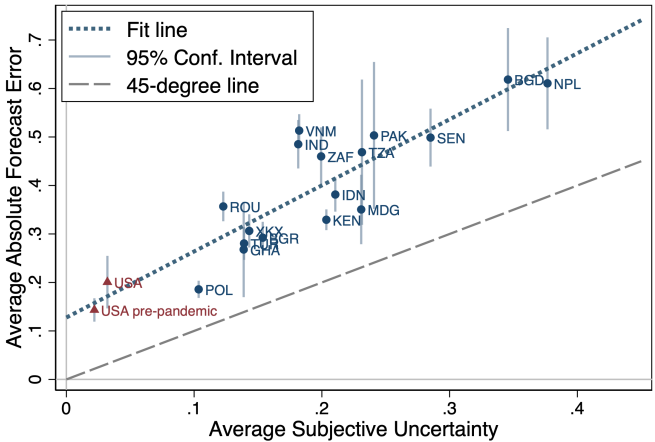


No. of observations: 4819.

Notes: The left figure plots employment-weighted absolute forecast errors in each country-wave of the World Bank Business Pulse and Enterprise Surveys against the country's 2019 GDP per capita on the horizontal axis. The right figure shows the employment-weighted relationship across firms, controlling for firm size (log(employment)), sector fixed effects, and calendar quarter fixed effects.

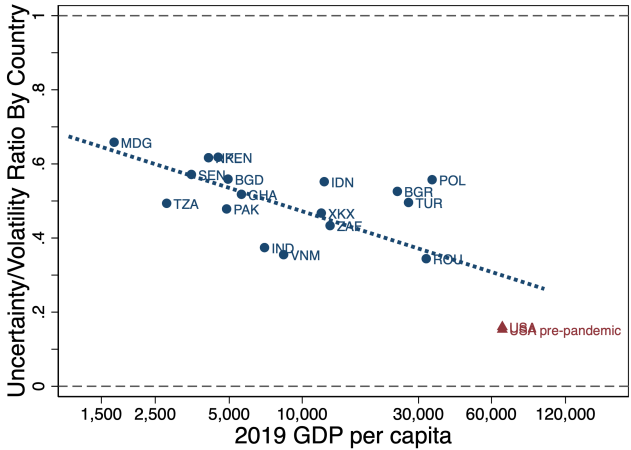
▸ Regression Table

Managers are Overprecise in Every Country



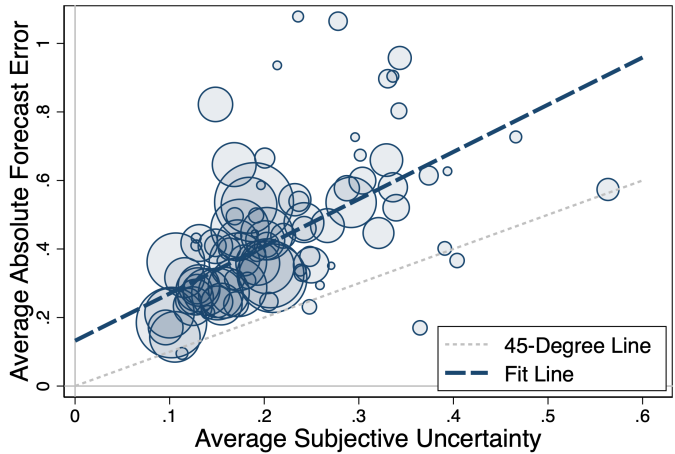
Notes: The figure shows employment-weighted average absolute forecast errors by country against subjective uncertainty. We drop Sierra Leone due to an unusually large absolute forecast error.

And More Overprecise (in % Terms) In Richer Countries



Notes: The figure shows the ratio of employment-weighted average absolute forecast errors to subjective uncertainty by country against 2019 PPP GDP per capita in USD. We drop Sierra Leone due to an unusually large absolute forecast error.

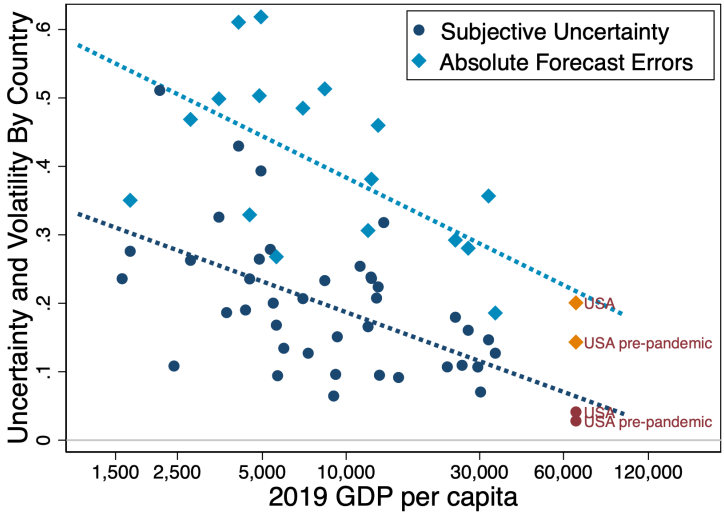
Also Overprecise In 85/89 Country-Sectors



Fit line: Absolute Forecast Error = .13 (.05) + Uncertainty * 1.38 (.22) . N = 89

Notes: The figure shows employment-weighted average absolute forecast errors against average subjective uncertainty by country-sector. The size of the bubbles is proportional to the number of forecast error observations in each country-sector. The thick blue line shows the line of best fit, again weighting each country sector by the number of forecast observations. We exclude country sectors with less than 20 absolute forecast error observations.

All Together Now



Notes: The figure shows employment-weighted average absolute forecast errors and subjective uncertainty by country against 2019 PPP GDP per capita in USD. US data are from the Atlanta Fed's Survey of Business Uncertainty (SBU).

Could Common Shocks Be Behind Our Overprecision Result?

We Measure Overprecision When:

$$\text{Avg. Uncertainty} < \text{Avg. Absolute Forecast Error}$$

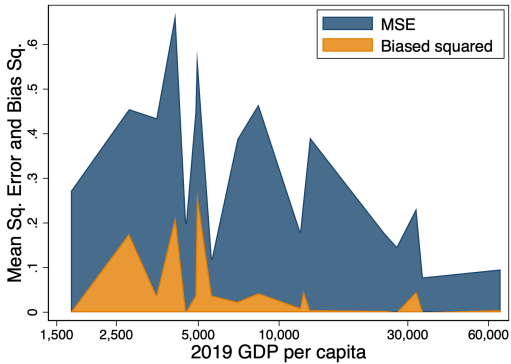
Recall: These are analogous measures, subjective vs. realized.

- $\text{Uncertainty}_j = \sum_{i=1}^{3} p_{ij} \left\| g_{ij} - \text{Mean}_j \right\|$
- $\text{AFE}_j = \| \text{Realized Sales}_j - \text{Mean}_j \|$

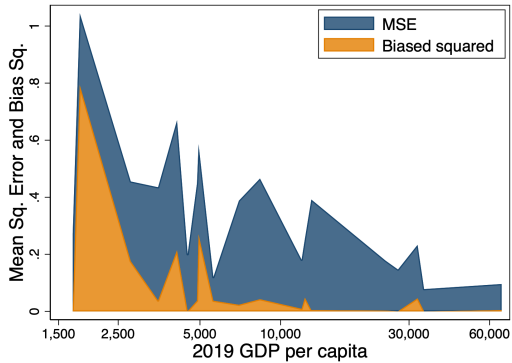
BUT a large, common, unexpected shock at the country or country-sector level would raise Avg. Absolute Forecast Error and not Uncertainty

Mean Sq. Error = Bias^2 + Variance
How Big is the Bias Component?

Main Cross Country Sample (Excluding Sierra Leone)

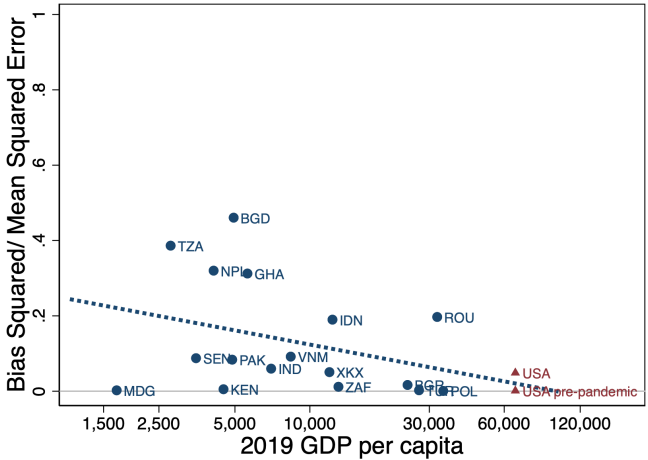


All Countries (With Sierra Leone)



Notes: In each country we compute the mean squared forecast error and the bias squared (i.e., the square of the average forecast error). Then we plot them to show how big the bias component is relative to the full mean squared error. When computing country moments we weight each firm by its employment.

Bias^2 ≪MSE, But Declines With GDP/Person



Notes: In each country we compute the mean squared forecast error and the bias squared (i.e., the square of the average forecast error). Then we plot the ratio between bias squared and mean squared error by country again 2019 GDP per capita.

▸ Overprecision with high/low Bias Sq./MSE ratios ▸ Overprecision vs. Common Shocks

FACTS RECAP

1. **Subjective uncertainty & realized volatility *decline* with GDP/person**

2. **Managers are *overprecise* (understate sales volatility)**
   More so (in % terms) in ***low-volatiity, rich*** countries

3. **Bias contributes modestly to volatility.**
   $\text{Bias}^2/\text{MSE} < 0.2$ in most cases
   BUT bias component declines with GDP/person

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- Validation: firm-level patterns

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How do uncertainty & volatility change our accounting of cross-country differences in GDP/person?

Model Setup to Match Our Facts

Variable profit: $\log(y) = \underbrace{\log(A)}_{\text{country-level TFP}} + \underbrace{\log(z)}_{\text{firm-specific}} + \underbrace{\alpha \log(k)}_{\text{factor input}}$

Objective shock process: $\log(z') = \rho \log(z) + \sigma\varepsilon$

Subjective shock process: $\log(z') = \rho \log(z) + \tilde{\sigma}\varepsilon$

Common, unanticipated shock to y': $(1 + \mathcal{A}')$ realized after choosing k'

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Common, unanticipated shock to y': $(1 + \mathcal{A}')$ realized after choosing k'

Key cross-country facts:

1. **Uncertainty, volatility *decline* with development:**

$$Corr(\tilde{\sigma}, A)) < 0, \quad Corr(\sigma, A)) < 0, \quad Corr(\|\mathcal{A}'\|, A)) < 0$$

2. **Overprecision:** $\tilde{\sigma} < \sigma \quad \forall$ countries, $\quad Corr(A, \tilde{\sigma}/\sigma) < 0$

Add Real Investment & Entry/Exit Options

Investment is **Partially Irreversible**

Incumbents See (z, k), Have the Option to **Liquidate OR Invest, Continue**

Entrants See z_0, Have The Option to **Stay Out OR Inject Initial Capital**

External Finance Is **Costly For Incumbents and Entrants**

▸ Model Details

Accounting Exercise

Fix: Decr. Returns, Inv. Frictions, z-shock Persistence, Discount Rate ▸ Detail

Stationary Equilibrium in Each Country ▸ Detail

Fit 5 Moments With 5 Parameters

Country	Relative GDP/person	Uncertainty	Abs. Forecast Errors	Bias^2/ MSE	Exit Rate
"US"	1.00	.05	.22	.02	.05
"Poland"	0.50	.09	.28	.06	.05
"Brazil"	0.23	.13	.35	.10	.05
"Kenya"	0.08	.20	.44	.16	.05
Key Parameter	A TFP	$\tilde{\sigma}$ Subj. SD	σ Obj. SD	$\mathcal{A}'$ Bias	f Fixed cost

Notes: We use the cross-country line of best fit for uncertainty, forecast errors, and the Bias^2/MSE ratio to obtain the target values for 4 simulated countries with PPP GDP/person of \$66,000 ("US"), \$33,000 ("Poland"), \$15,000 ("Brazil") and \$5,000 ("Kenya"). We target an exit rate of 10% per year based on the long-run average for the US, Mexico, and several European Countries (e.g., Kochen, 2023).

Tracing Out the Implications of Cross Country Uncertainty & Volatility

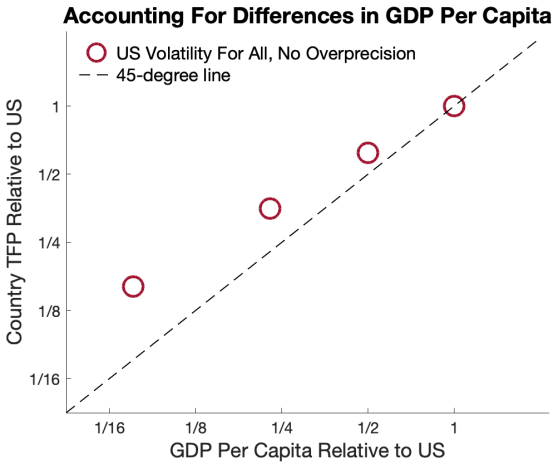
Account for cross-country differences in GDP/person if:

- Countries have "US"-level volatility and Bias^2/MSE
- Country-specific volatility, no overprecision
- Country-specific volatility and overprecision

We will see differences in TFP A if uncertainty & volatility:

- Interact with investment frictions
- Thereby change investment & entrepreneurial dynamics

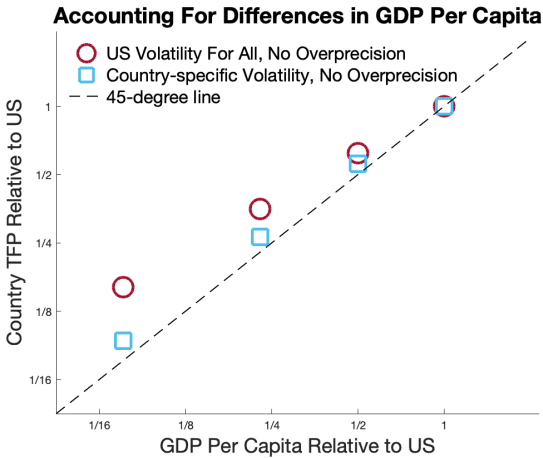
START: US VOLATILITY, NO OVERPRECISION



A Declines with GDP/person

- Same frictions
- Same volatility, uncertainty
- Differences in A (TFP) need to do all the work

Add: Differences In Volatility By Country, Still No Overprecision



Volatility + convex payoffs/actions (real options: frictions, entry/exit)

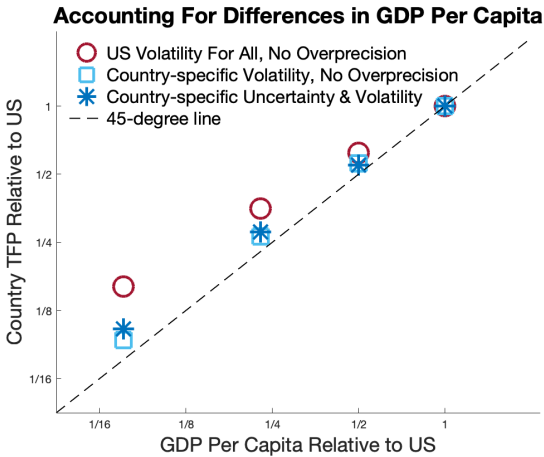
$\Rightarrow$ some firms become more valuable, grow huge
(Oi-Hartman-Abel effect)

Need *lower* relative As to account for GDP/person gaps:

- **42%** for "Kenya"
- **24%** for "Brazil"

Convex Decision Rules | Volatility Effect

ADD: OVERPRECISION BY COUNTRY



Now entrepreneurs undervalue investment, growth, entry options

$\Rightarrow$ *Better* selection, reallocation, more so in rich countries

TFP A in needn't be so low, only

- **35%** lower for "Kenya"
- **21%** lower for "Brazil"

than in a US-volatility world

▸ Convex Payoffs ▸ Diminished Real Options

▸ Accounting Exercise Parameters

TAKING STOCK

Our facts amplify the role of TFP in accounting for cross-country GDP/person gaps:

- (Persistent) Volatility provides growth opportunities
- Infer low TFP, to explain why poor-countries don't invest even with those opportunities
- High overprecision in rich countries dampens the volatility effect $\Rightarrow$ better selection, reallocation in rich countries helps explain why they are rich

Potential Finance Extensions

Finance as a Brake to Investment in Developing/Emerging Economies?

- Higher risk compensation raises cost of capital r (David & Simonovska, 2017)
- Costlier access to external financing (ψ, ψ_e)
- More frictions to capital/labor reallocation (e.g., adjustment cost γ), possibly due to poorly-functioning financial markets, institutions
- High volatility, weak institutions $\Rightarrow$ weaker investment in intangible capital (own-firm productivity)

Adding these to the model, how much <u>less</u> work does TFP have to do?

Conclusion & Key Takeaways

Business Uncertainty/Volatility *Decrease* with GDP/person
But Managers Are *Overprecise* (Underestimate True Volatility)

Facts Plus a Quantitative Model Imply a Bigger Role for Aggregate TFP in Explaining Cross-Country GDP/Person Gaps

We Infer Lower Relative TFP In Developing/Emerging Economies Compared To A World With No Overprecision and US-Level Volatility

11% for "Poland", **21%** for "Brazil", **35%** for "Kenya"

APPENDIX

Summary Statistics

Support Point Scenarios & Probabilities

	Scenario	Mean	SD	SD (Within)
Support point, future sales	Pessimistic	-0.45	0.56	0.48
	Central	-0.08	0.42	0.37
	Optimistic	0.16	0.30	0.27
Probability	Pessimistic	27.5	15.9	15.1
	Central	38.8	16.7	15.6
	Optimistic	34.2	15.7	15.0

Expectations & Uncertainty Measures

	Mean	SD	SD (Within)
Expected 6-months-ahead sales	-0.06	0.35	0.34
Subjective uncertainty 6-months-ahead sales	0.21	0.20	0.18
Abs. forecast error 6 months-ahead sales	0.42	0.41	0.38

Notes: The top panel reports unweighted means and standard deviations. The bottom panel reports the employment-weighted mean and standard deviation. The within-SD is the standard deviation within country and wave. The sample includes 28,612 survey responses for which we can obtain first and second moments and 4,868 forecast error observations. Sales outcomes in each scenario are for a six-month look-ahead period, and sales levels are expressed as arc-changes relative to the same period in the prior year.

Back

Expectations, Uncertainty, & Employment

	(1)	(2)	(3)
	Change in employment last 30 days		
Expected change in sales	0.036***	0.026***	0.011
	(0.009)	(0.006)	(0.008)
Subjective uncertainty	-0.019^{+}	-0.025*	-0.027*
	(0.012)	(0.014)	(0.014)
Country x Sector FE	No	Yes	Yes
Quarter FE	No	No	Yes
Observations	19543	19542	18590
R^2	0.010	0.078	0.100
Within R^2		0.006	0.002
No. of clusters	185	184	179

Notes: We compute changes in employment in the 30 days prior to the survey interview using data on current employment and survey questions about recent changes in employment, and express them as arc-changes. The table reports standard errors clustered by country-sector. $^{+}$ $p < 0.15$ * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ Back

Survey Design & Collection

Collection: Phone interviews w/ enumerator in native language

Respondents are firm owners/top managers:

- 68% are the owner, CEO/CFO, 19% are the top manager
- 6% are head accountant or in-house counsel, 7% other

Survey design: Uniform by World Bank

Implementation: collaboration with statistical agencies, govt. departments, or business associations in each country

- In practice, implementation varies modestly across countries

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FEASIBLE TO ELICIT PROBABILITY DISTRIBUTIONS IN DEVELOPING/EMERGING ECONOMIES

70% of firms provide usable distributions

- **49%** of distributions add to 100% and have Uncertainty > 0
- **21%** have 2+ scenarios and we impute or rescale missing probabilities
  - Altig et al. (2022): **support points** matter most for 1st & 2nd moments
- ***Larger firms*** are more likely to provide usable distributions Detail

For comparison: $\sim$**85%** of usable distributions in Bloom et al. (2021)

- Similar module in the 2015/2020 US Annual Survey of Manufacturers

Back

Uncertainty vs. GDP & Institutions

	(1)	(2)	(3)	(4)
		Subjective uncertainty		
GDP per capita (log)	-0.051***	-0.034***	-0.053***	-0.018**
	(0.012)	(0.010)	(0.010)	(0.007)
"People can be trusted" (WVS)	0.111	0.096		
	(0.110)	(0.071)		
"There is corruption in my country" (WVS)	-0.010	0.030**		
	(0.009)	(0.011)		
Individualism (Hofstede)			-0.000	-0.000
			(0.001)	(0.000)
Macro, sector, firm volatility/dispersion	No	Yes	No	Yes
Mobility and size	Yes	Yes	Yes	Yes
Sector and quarter dummies	Yes	Yes	Yes	Yes
Observations	11,895	11,895	21,279	21,279
Within R^2	0.062	0.165	0.084	0.199
No. of clusters	86	86	135	135

Notes: Macro, sector, and firm-level volatility/dispersion measure GDP volatility from 2009 to 2019, exchange rate volatility in the 30 days prior to the survey, sales change dispersion by country-sector-wave, and sales change at the firm level in the previous 30 days. We obtain exchange rate regimes from the 2020 IMF Annual Report. The indicators fir trust and corruption are (unweighted) country averages from the World Values Survey. The individualism indicator comes from Hofstede Insights. *Mobility* is the level of mobility around transit stations in the 30 days before the interview according to Google Mobility Trends. Standard errors are clustered by country-sector. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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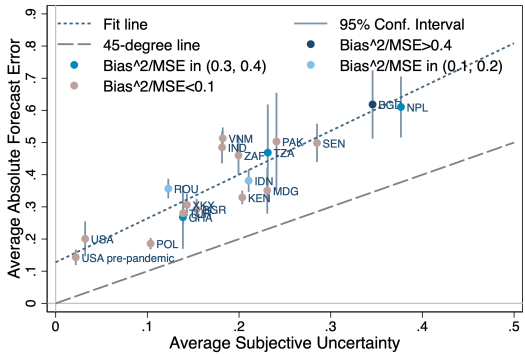
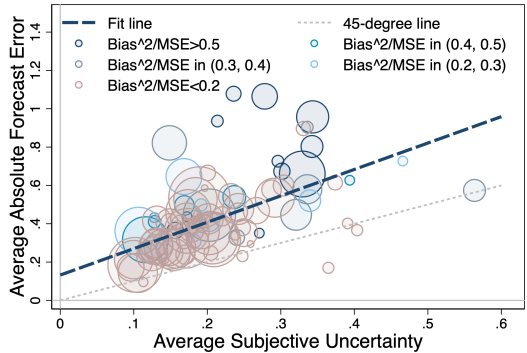
Similar Overprecision By Bias^2/MSE Levels

Across Countries



Fit line: Absolute Forecast Error = .1 + 1.4 * Uncertainty

Across Country-Sectors



Fit line: Absolute Forecast Error = .13 (.05) + Uncertainty * 1.38 (.22) . N = 89

Notes: In each country we compute the mean squared forecast error and the bias squared (i.e., the square of the average forecast error). The left chart plots the ratio between bias squared and mean squared error by country. The right chart plots volatility (average absolute forecast errors) against uncertainty by country, distinguishing countries by the bias component. When computing country moments we weight each firm by its employment.

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Similar Overprecision By Bias^2/MSE Levels

Average Gap Between Uncertainty & Abs. Forecast Errors						
	Across Countries			Across Country-Sectors		
	Difference	Ratio	N	Difference	Ratio	N
All	0.20 (0.02)	0.47 (0.03)	19	0.20 (0.01)	0.51 (0.02)	89
Bias^2/MSE < 0.5	0.20 (0.02)	0.47 (0.03)	19	0.19 (0.01)	0.51 (0.02)	78
Bias^2/MSE < 0.4	0.19 (0.02)	0.47 (0.03)	18	0.19 (0.01)	0.51 (0.02)	73
Bias^2/MSE < 0.3	0.19 (0.02)	0.45 (0.04)	15	0.19 (0.01)	0.51 (0.02)	65
Bias^2/MSE < 0.2	0.19 (0.02)	0.45 (0.04)	15	0.18 (0.01)	0.53 (0.02)	58
Bias^2/MSE < 0.1	0.19 (0.02)	0.45 (0.04)	13	0.18 (0.02)	0.52 (0.02)	42

Notes: We compute the mean gap between subjective uncertainty and absolute forecast errors across countries and across country-sectors in our data. We compute the gap as the difference (average absolute forecast error less average subjective uncertainty) or ratio (average absolute forecast error divided by average subjective uncertainty) and report the standard error of the cross-country or cross–country-sector mean. Each row focuses on a subsample defined by the ratio of the Bias Squared to Mean Squared Error at the country or country-sector level.

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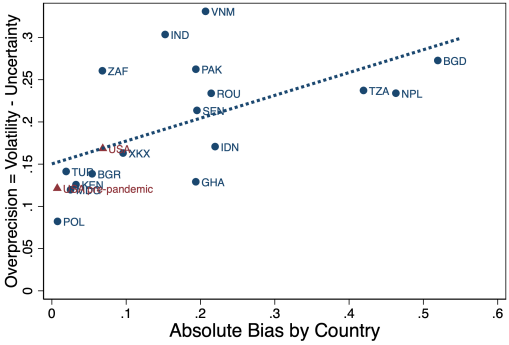
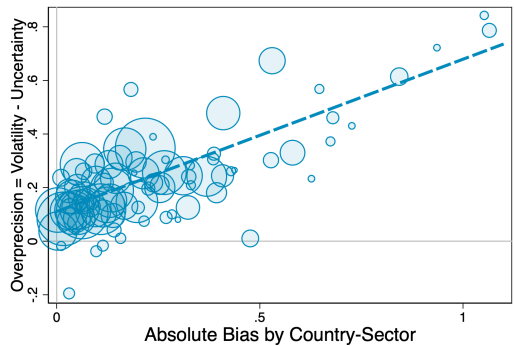
Overprecision Exists Even When ||Bias|| ≈ 0

Across Countries



Fit line: Overprecision = .2 + .3 * |Avg. Forecast Error|

Across Country-Sectors



Fit line: Overprecision = .11 (.01) + |Avg. Forecast Error| * .57 (.08). N = 89

Notes: The figure on the left shows overprecision, defined as the average absolute forecast error by country minus average subjective uncertainty about future sales, against the absolute value of the average forecast error by country. The figure on the right shows the same variables, but now taking averages at the country-sector level. The size of the bubbles on the right is proportional to the number of observations by country-sector. When computing country and country-sector averages we weight each firm by its employment.

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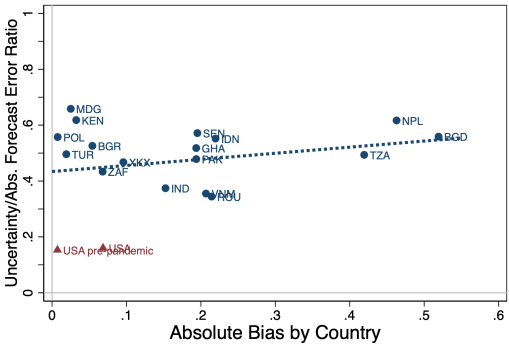
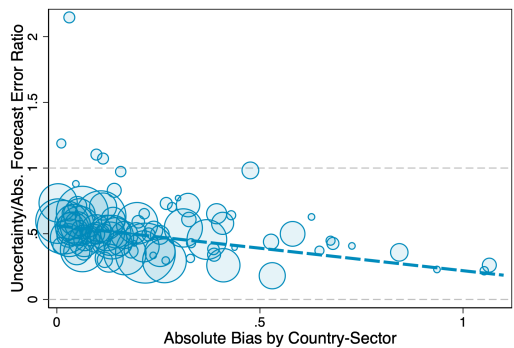
Overprecision Exists Even When ||Bias|| ≈ 0

Across Countries



Fit line: Overprecision = .4 + .2 * |Avg. Forecast Error|

Across Country-Sectors



Fit line: Overprecision = .56 (.02) + |Avg. Forecast Error| * -.34 (.1). N = 89

Notes: The figure on the left shows overprecision, defined as the average absolute forecast error by country minus average subjective uncertainty about future sales, against the absolute value of the average forecast error by country. The figure on the right shows the same variables, but now taking averages at the country-sector level. The size of the bubbles on the right is proportional to the number of observations by country-sector. When computing country and country-sector averages we weight each firm by its employment.

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Add Real Options: Investment Frictions, Entry & Exit

Investment is Partially Irreversible (Also When Liquidating):

$$Cost(k,k') = [k' - (1-\delta)k] \cdot \left(1 - \underbrace{\gamma}_{\text{resale loss}} \cdot \mathbf{1}\{k' < (1-\delta)k\}\right)$$

Free Cash Flow: $\pi(z,k,k') = Azk^{\alpha} - f - Cost(k,k')$

Costly External Finance: If $\pi(A,z,k,k') < 0$, raise $(1+\psi) \times \pi(\cdot)$

- Baseline calibration sets $\psi = \infty$, so no external finance for incumbents

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Entrepreneur's Problem

Incumbent Chooses Between Liquidating or Continuing:

$$
\begin{aligned}
\tilde{V}(z,k) &= \max\left\{\tilde{V}^l(z,k), \tilde{V}^c(z,k)\right\} \quad \text{where} \\
\tilde{V}^c(z,k) &= \max_{k'}\left\{\pi(A,z,k,k')\cdot(1+\psi\cdot\mathbf{1}(\pi(\cdot)<0)) + \frac{1}{1+r}\tilde{\mathbf{E}}[\tilde{V}(z',k')]\right\} \\
\tilde{V}^l(z,k) &= \pi(A,z,k,0)
\end{aligned}
$$

Entrant Observes Initial Profitability z_0, Chooses Whether To Enter and Initial k_1 Injection Subject to Financing Cost ψ_e:

$$
\tilde{V}^e(z_1) = \max\left\{0, \quad \max_{k_1}\left\{-k_1\cdot(1+\psi_e) + \frac{1}{1+r}\tilde{\mathbf{E}}[\tilde{V}(z_1,k_1)]\right\}\right\}
$$

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Fixed Parameters

Parameter	Description	Value	Notes
$\tilde{\alpha}$	Capital share, output	0.35	Conventional
ν	Decreasing returns, output	0.80	20% markups
α	Decreasing returns, variable profit	0.58	$\tilde{\alpha}\nu/(1-(1-\tilde{\alpha})\nu)$
ρ	$Corr(z', z)$	0.90	.95/qtr, cf. Khan & Thomas ('08)
δ	Depreciation	0.05	10% annual
γ, ξ	Capital resale loss	0.30	30% resale loss
ψ	Cost of external fin, incumbent	∞	No negative dividends
ψ_e	Cost of initial capital, entrant	0.05	cf. Hennessy & Whited ('05)
r	Discount rate	0.01	2% annual

Notes: This table shows the parameters for the technology, investment frictions, and discount rate that we hold constant across the accounting exercises that fit relative GDP per capita, uncertainty, absolute forecast errors, and the exit rate by country.

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Competitive Equilibrium

Discount rate r determined exogenously (e.g. by the global interest rate).

Normalize labor supply to 1 in each country.

Entrepreneurs choose labor statically given $(\tilde{A}, \tilde{z}, k)$ and wage w.

$$\textbf{Variable profits: } Azk^{\alpha} \equiv \max_{n} \hat{A}\hat{z}(k^{\hat{\alpha}}n^{1-\hat{\alpha}})^{\nu} - wn$$

Wage w is consistent with labor market clearing in each country, so $\int_{z,k} n(z,k)\mathrm{d}\Phi(z,k) = 1$

Stationary distribution of firms $\phi(z,k)$ across the state space.

Common, unanticipated shock to y', $(1+\mathcal{A}')$ realized after equilibrium conditions set.

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Accounting Exercise: Parameters (1/3)

Relative TFP by Country ($\hat{A}_i/\hat{A}_{US}$)

	"Poland"	"Brazil"	"Kenya"
US Volatility	0.621	0.352	0.160
Country Vol.	0.557	0.266	0.092
Country Volatility + Overprecision	0.549	0.279	0.104

Fixed Cost of Operation (f)

	"US"	"Poland"	"Brazil"	"Kenya"
US Volatility	30.3	15.5	7.07	2.35
Country Volatility	30.3	13.5	4.86	1.25
Country Vol. + Overprecision	11.5	3.92	1.21	0.210

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Accounting Exercise: Parameters (2/3)

Objective Shock Volatility (σ)

	"US"	"Poland"	"Brazil"	"Kenya"
US Volatility	0.28	0.28	0.28	0.28
Country Volatility	0.28	0.36	0.45	0.61
Country Vol. + Overprecision	0.28	0.35	0.44	0.58

Subjective Shock Volatility ($\tilde{\sigma}$)

	"US"	"Poland"	"Brazil"	"Kenya"
Country Vol + Overprecision	0.05	0.10	0.17	0.26
Overprecision Ratio ($\tilde{\sigma}/\sigma$)	0.10	0.29	0.38	0.44

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Accounting Exercise: Parameters (3/3)

Positive, Unanticipated, Common Shock to y' ($\mathcal{A}'$)

	"US"	**"Poland"**	**"Brazil"**	**"Kenya"**
US Volatility	0.04	0.04	0.04	0.26
Country Volatility	0.04	0.09	0.16	0.26
Country Vol. + Overprecision	0.04	0.09	0.16	0.27

Comparative Static: Volatility & Uncertainty Both Rise

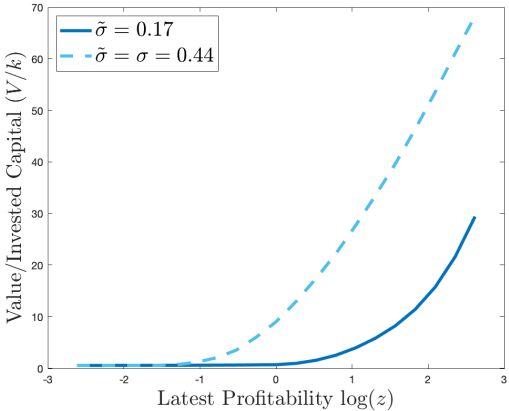
What Happens to *Firm Size* and *Productivity* As We Raise $\tilde{\sigma}$ if $\sigma = \tilde{\sigma} + \kappa$?

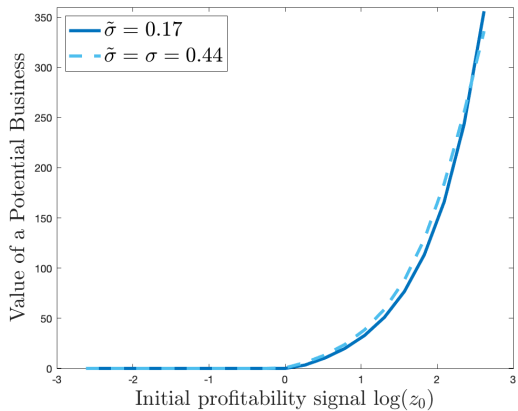
- Similar to going from richer to poorer countries

Two Effects Because Two Things Move:

1. **Overprecision** ($\tilde{\sigma}/\sigma$) means entrepreneurs ***undervalue*** **real options**
   - Gets better as $\tilde{\sigma}$ rises since $\lim_{\tilde{\sigma}\to\infty} \tilde{\sigma}/(\tilde{\sigma} + \kappa) = 1$
2. **Increased volatility** $\Rightarrow$ more opportunities for firms to grow (conditional on staying in the market)

Value Functions Are Convex in z: $\tilde{\sigma}$ Raises Value of Real Options





Notes: In the left chart, we normalize incumbent value by current invested capital. In the right chart, we show the raw value of the entrant firm.

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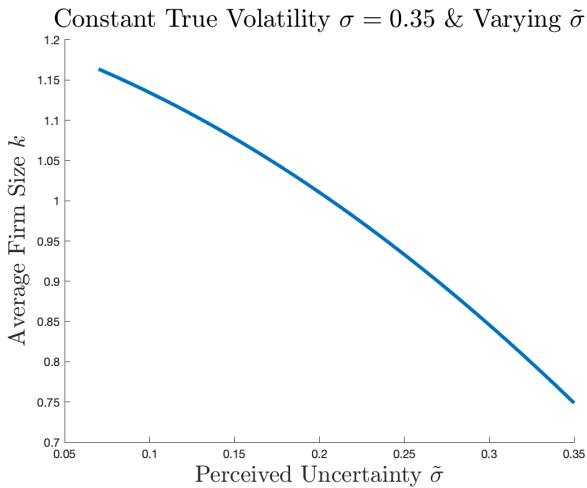
Diminished Real Options Effect Worsens Selection In Poor Countries



Notes: Firm size normalized to 1 for the median value along the x-axis.

As Overprecision Gets Better In % Terms,

More incentives to enter/remain in the market even if current productivity z is not great.

$\Rightarrow$ smaller, low-productivity firms become more abundant

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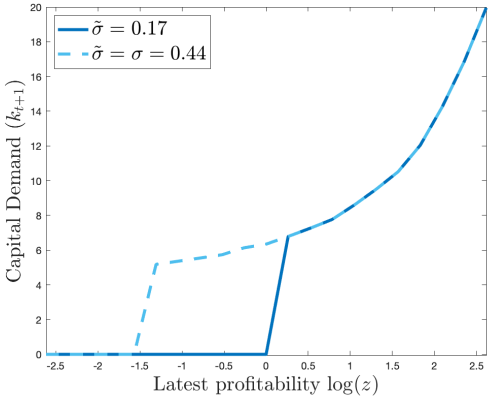
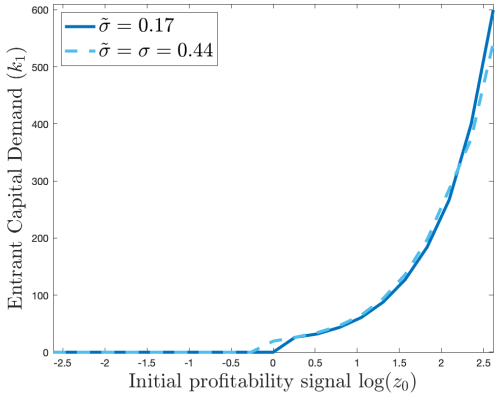
Policy Functions Are Convex in $\log(z)$, Better Selection Under Lower σ





Notes: We plot the demand for capital next period as a function of firm profitability $\log(z)$ and a given level of current capital k. We use the parameters for a firm in "Poland" when the manager's uncertainty is equal to the calibrated value $\tilde{\sigma}$ and equal to the calibrated value for volatility σ.

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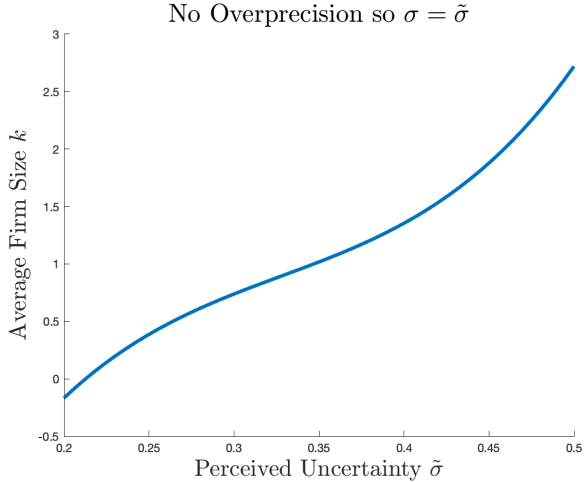
Volatility Raises Firm Size



Notes: Firm size normalized to 1 for the median value along the x-axis.

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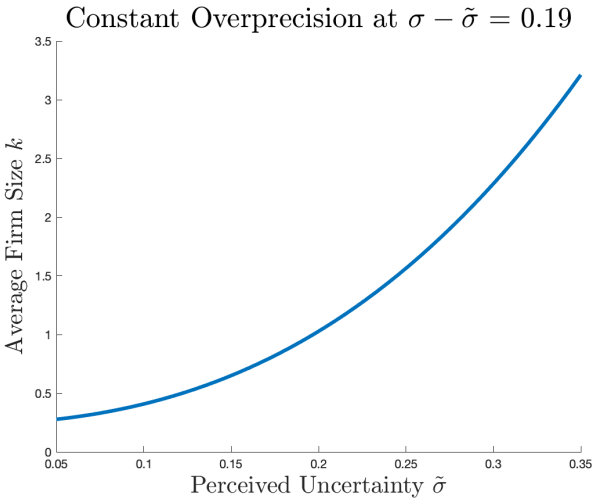
Volatility Increases As We Move to Poor Countries

Higher probability of right-tail shocks + convex policy functions $\Rightarrow$ larger firm sizes in equilibrium

Large, high-productivity firms dominate poor countries (out of luck)

Volatility Effect Seems to Win



When $\sigma = \tilde{\sigma} + \kappa$, Raising $\tilde{\sigma}$:

- Pulls $\tilde{\sigma}/\sigma$ towards 1
- Raises true volatility

For plausible parameterizations, $\Rightarrow$ **larger, higher productivity firms**, and higher exit rates.

Business Uncertainty vs. GDP/person

	(1)	(2)	(3)	(4)	(5)	(6)
	Subjective Uncertainty (mean deviation)					
GDP per capita (log)	-0.050***	-0.040***	-0.038***	-0.036***	-0.034***	-0.027***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Absolute change in sales		0.108***	0.108***	0.103***	0.100***	0.100***
		(0.007)	(0.007)	(0.007)	(0.008)	(0.007)
GDP SD 09-19 / Mean			0.462**	0.445**	0.482**	0.742***
			(0.223)	(0.217)	(0.233)	(0.210)
SD Δ sales by country-wave-sector				0.077***	0.081***	0.074**
				(0.029)	(0.031)	(0.031)
Exchange rate volatility last 30 days					0.278	0.863***
					(0.200)	(0.284)
Exchange rate regime dummies	No	No	No	No	No	Yes
Mobility and size	Yes	Yes	Yes	Yes	Yes	Yes
Sector and quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,734	25,892	25,892	25,892	24,859	24,859
Within R^2	0.079	0.157	0.161	0.164	0.164	0.174
No. of clusters	195	195	195	195	185	185

Notes: Linear regressions with subjective uncertainty about six-months-ahead sales (relative to the same period in 2019) as dependent variable. *Change in sales* is the arc change in sales in the 30 days before the interview. Heteroskedasticity-robust standard errors are clustered at the country-sector level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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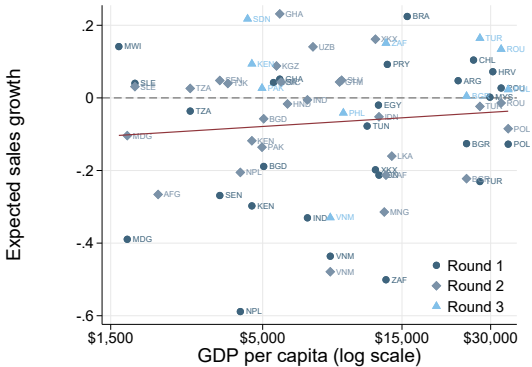
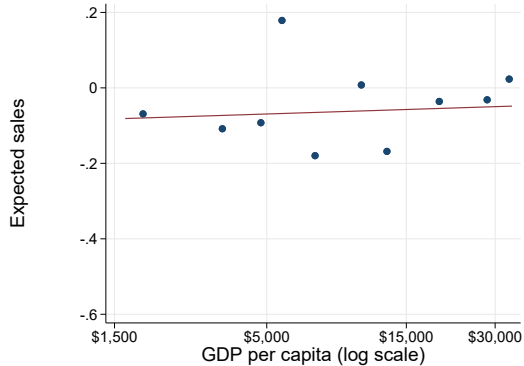
Business Expectations vs. GDP/person: No Clear Relationship Here

Raw Cross-Country Relationship



Firm Size, Sector, Time Controls



Notes: The left figure plots employment-weighted subjective uncertainty in each country-wave of the World Bank Business Pulse and Enterprise Surveys against the country's 2019 GDP per capita on the horizontal axis. The right figure shows the employment-weighted relationship across firms, controlling for firm size (log(employment)), sector fixed effects, and calendar quarter fixed effects.

▸ Table + controls ▸ Back

Forecast Accuracy vs. GDP/person

	(1)	(2)	(3)	(4)	(5)	(6)
			Absolute Forecast Error			
GDP per capita (log)	-0.104***	-0.089***	-0.088***	-0.075**	-0.075**	-0.039*
	(0.027)	(0.027)	(0.030)	(0.031)	(0.030)	(0.023)
Uncertainty in previous wave (md)		0.260***	0.260***	0.242***	0.237***	0.216**
		(0.084)	(0.084)	(0.085)	(0.085)	(0.083)
GDP SD 09-19 / Mean			0.165	-0.108	-0.559	-1.521
			(1.190)	(1.189)	(1.267)	(1.562)
SD Δ sales by country-wave-sector				0.338***	0.347***	0.367***
				(0.127)	(0.122)	(0.115)
Exchange rate volatility last 30 days					-1.284	-0.615
					(0.813)	(0.475)
Exchange rate regime dummies	No	No	No	No	No	Yes
Mobility and size	Yes	Yes	Yes	Yes	Yes	Yes
Sector and quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4659	4659	4659	4657	4657	4657
Within R^2	0.055	0.069	0.069	0.081	0.083	0.093
No. of clusters	88	88	88	86	86	86

Notes: Linear regressions with absolute errors about six-months-ahead sales (relative to the same period in 2019) between waves 1 and 2 as dependent variable. Size is measured as log employment and all specifications are weighted by employment. Robust standard errors are clustered by country-sector. All columns control for the the number of days between the wave 1 and wave 2 interviews. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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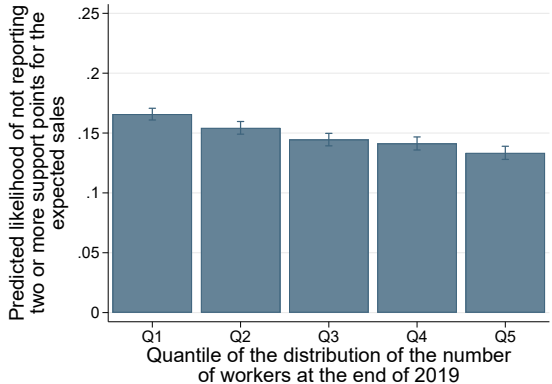
Larger Firms Are Less Likely to Provide Unusable Distributions



Notes: This figure plots the predicted likelihood of providing a distribution that does not have two or three support points. Each bar reports the average predicted probability across firms in a given quintile of the country-wave-sector size distrbution. Our estimates come from a regression of an indicator variable for providing an unusable distribution that includes country, size, and quarter fixed effects. Size is measured using the number of workers at the end of December 2019 (the pre-pandemic baseline).

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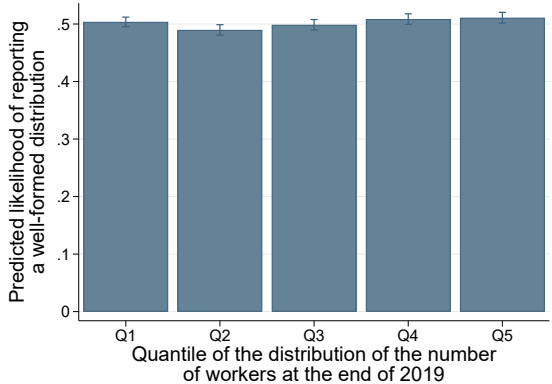
Larger Firms Are Slightly More Likely to Provide "Well-Formed" Distributions



Notes: This figure plots the predicted likelihood of providing a distribution that is well-formed: it has 2 or 3 support points and the probabilities add to 100%. Each bar reports the average predicted probability across firms in a given quintile of the country-wave-sector size distribution. Our estimates come from a regression of an indicator variable for providing a "well-formed" distribution that includes country, size, and quarter fixed effects. Size is measured using the number of workers at the end of December 2019 (the pre-pandemic baseline).

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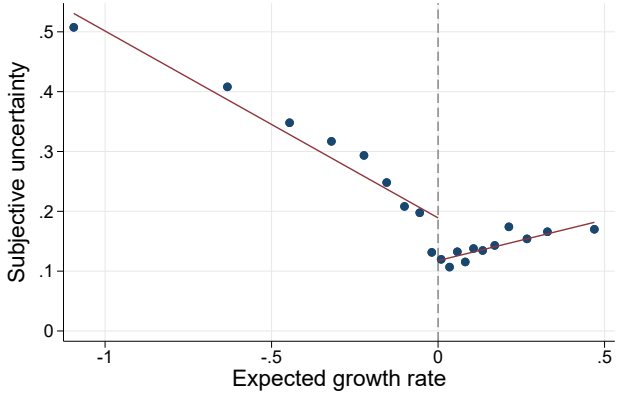
Uncertainty is V-shaped in ||Expectations||

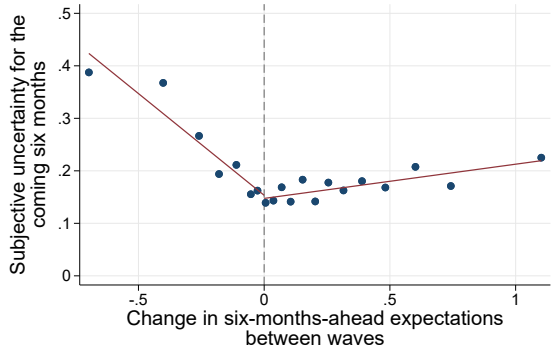


Coefficient of the left-side: -0.31 with standard error of 0.012.
Coefficient of the right-side: 0.14 with standard error of 0.017.

Notes: The figure shows an employment-weighted binned scatter plot of firm-level subjective uncertainty against sales expectations pooling the different country-wave cross-sections. Sales expectations and uncertainty concern the next 6 months relative to the same period of 2019. The reported statistics below the figure in panel b correspond to the least squares regression in the underlying micro data and the corresponding robust standard error. The sample includes businesses from all countries and waves.

▸ Across countries ▸ Back

Uncertainty is V-shaped in Revisions to Expectations



Notes: The figure shows an employment-weighted binned scatter plot of subjective uncertainty about six-months-ahead sales in wave 2 on the vertical axis against the change in expected sales growth between waves on the horizontal axis. The sample includes only the firm-level balanced panel for the first two waves of the survey. The reported statistics below the figure correspond to the least squares regression in the underlying micro data and the corresponding robust standard error. Six-months-ahead sales are expressed in relation to to the same period of 2019.

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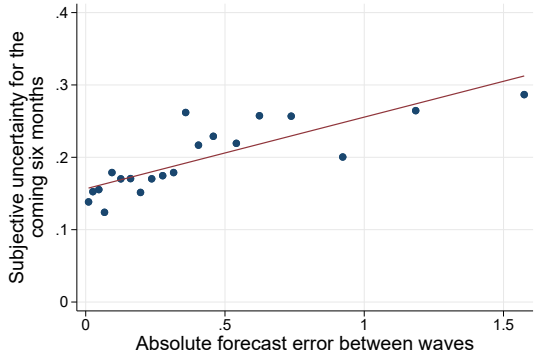
Uncertainty Rises with Lagged Absolute Forecast Errors



Coefficient: 0.10 with standard error of 0.021.

Notes: The figure shows a binned scatter plot of subjective uncertainty about six-months-ahead sales as expressed in wave 2 on the vertical axis against the absolute error (i.e. difference) between forecast six-months-ahead sales from wave 1 and realized sales in the 30 days prior to the wave 2 interview. The sample includes only the firm-level balanced panel for the first two waves of the survey. The reported statistics below the figure correspond to the least squares regression in the underlying micro data and the corresponding robust standard error. Both realized sales and future expected sales are expressed relative to the same periods of 2019.

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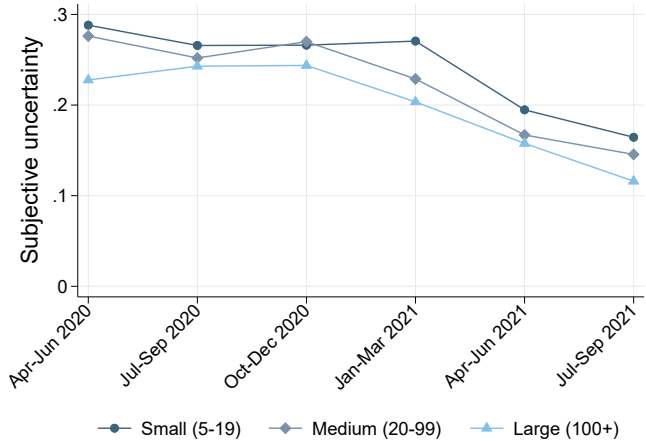
Business Uncertainty vs. Firm Size



Notes: The figure shows average uncertainty about six-months-ahead sales growth by firm size category and quarter after adjusting for country and sector effects. In each case, these averages correspond to the average prediction from a linear regression on dummies for country, sector, and the interaction of size and quarter and sector and quarter. Computations weighted by employment. The future sales horizon corresponds to the next 6 months and future sales are expressed relative to the same period of 2019.

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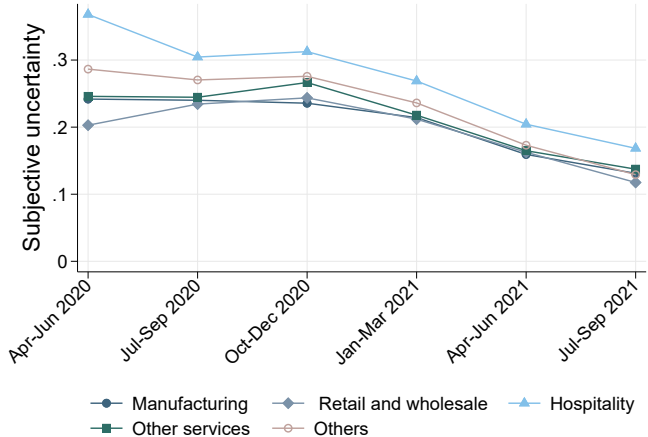
Business Uncertainty vs. Sector



Notes: The figure on the right shows average uncertainty about six-months-ahead sales growth by sector and quarter after adjusting for country and size effects. In each case, these averages correspond to the average prediction from a linear regression on dummies for country, size, and the interaction of sector and quarter and size and quarter. Computations weighted by employment. The future sales horizon corresponds to the next 6 months and future sales are expressed relative to the same period of 2019.

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Business Expectations Across Countries

	(1)	(2)	(3)	(4)
	Sales Expectations			
GDP per capita (log)	0.011			0.000
	(0.012)			(0.011)
Transit mobility		0.002***		0.002***
		(0.001)		(0.000)
Absolute change in sales			-0.174***	-0.165***
			(0.021)	(0.020)
Size	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Quarter dummies	Yes	Yes	Yes	Yes
Observations	26,734	26,734	25,892	25,892
Within R^2	0.001	0.013	0.063	0.071
No of clusters	195	195	195	195

Notes Linear regressions with expectations about six-months-ahead sales (relative to the same period in 2019) as the dependent variable. *Transit mobility* is the level of mobility observed around transit stations in the 30 days before the interview according to Google Mobility Trends. *Change in sales* refers to the arc change in sales in the 30 days before the interview. Heteroskedasticity-robust standard errors are clustered at the country-sector level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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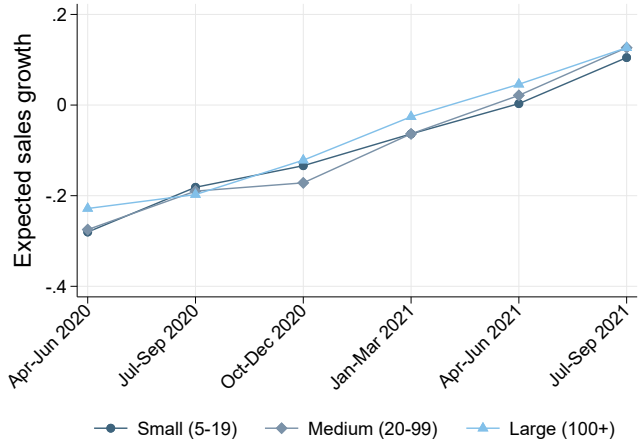
Business Expectations vs. Firm Size



Notes: The figure shows the average expected six-months-ahead sales by firm sector and quarter after adjusting for country and size effects. In each case, these averages correspond to the average prediction from a linear regression on dummies for country, sector, and the interaction of size and quarter and sector and quarter. Computations weighted by employment. Expected sales corresponds to the next 6 months relative to the same period of 2019.

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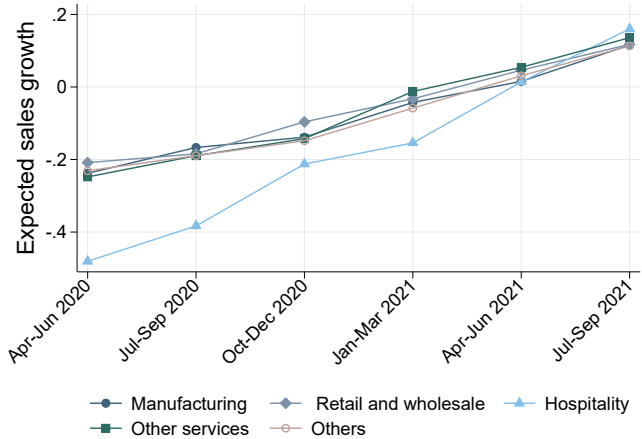
Business Expectations vs. Sector



Notes: The figure shows average expected six-months-ahead sales by firm size category and quarter after adjusting for country and sector effects. In each case, these averages correspond to the average prediction from a linear regression on dummies for country, size, and the interaction of sector and quarter and size and quarter. Computations weighted by employment. Expected sales corresponds to the next 6 months relative to the same period of 2019.

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