

Supply Chain Networks and The Macroeconomic Expectations of Firms¹

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¹The views expressed here are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Cleveland, the Federal Reserve System, or Inter-American Development Bank.

Motivation

- ▶ Macro expectations and uncertainty: important drivers of aggregate fluctuations.
Beaudry and Portier (2007), Angeletos and La'O (2013), Bloom et al. (2018).
- ▶ Documented **direct** effects on firm decisions (price, investment, ...).
Coibion et al. (2020), Kumar et al. (2023), Abberger et al. (2024).

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- ▶ Firms operate on production networks: important ramifications for aggregate shock transmission and policy. La'O and Tahbaz-Salehi (2022), Rubbo (2023).
- ▶ $\Rightarrow$ macro expectations or uncertainty of a single firm **spillover** on the expectations/uncertainty/actions of other firms in the network.

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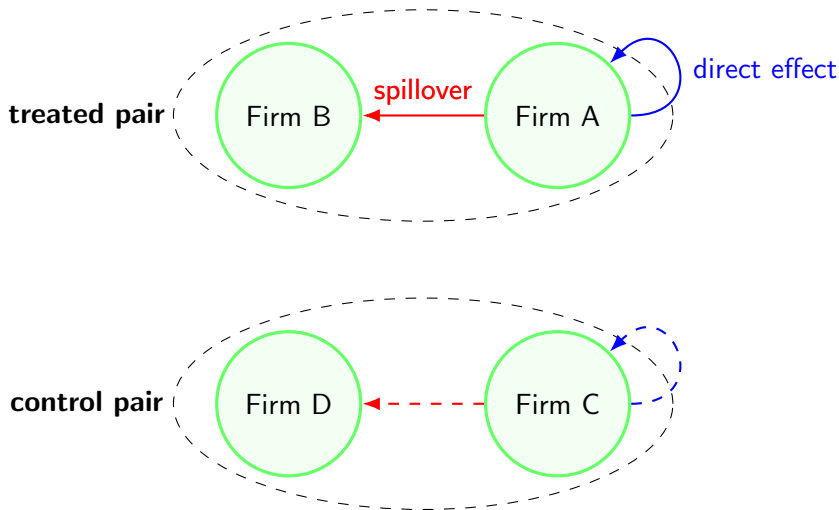
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This paper: Quantify the spillover effects and uncover the main mechanisms.

Spoiler: **Spillover** effects $\approx$ **direct** effects; communication – key mechanism.

Contributions

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 - ▶ Confirm documented direct effects.
3. Uncover the mechanisms behind the estimated spillover effects.
 - ▶ Two channels: actions of directly treated firms and communication between firms.
4. Complement the Rubbo (2023) production network model with uncertainty and a communication network.
 - ▶ Laboratory to study the role of communication for the transmission of output expectations and uncertainty to prices and inflation.

Main Results

1. **Higher expected future growth** causes firms to
 - ▶ **increase** prices and employment.
2. **Higher uncertainty** about future growth causes main and connected firms to
 - ▶ **lower** prices, employment, and investment.
3. Spillover effects $\approx$ direct effects. Key mechanism: **communication**.
4. Communication symmetrizes the transmission of uncertainty shocks upstream and downstream.
5. It amplifies the impact of macro uncertainty on inflation, but it reduces inflation persistence.

Related Literature

1. Effects of macroeconomic expectations on optimal decisions.

- ▶ *Firms*: Coibion et al. (2020), Werning (2022), Kumar et al. (2023), Abberger et al. (2024), Delgado et al. (2025).
- ▶ *HHs*: Hajdini et al. (2022), Coibion et al. (2023), Coibion et al. (2024).

2. Effects of aggregate uncertainty.

- ▶ Bloom (2009), Jurado et al. (2015), Kumar et al. (2023), Alfaro et al. (2024), Baker et al. (2024).
- ▶ *Knightian uncertainty*: Epstein and Wang (1994), Ilut and Schneider (2014).

3. Role of networks for macro outcomes and expectations.

- ▶ *Shock transmission and policy*: Gabaix (2011), Acemoglu et al. (2012), Pasten et al. (2020), La'O and Tahbaz-Salehi (2022), Rubbo (2023), Ozdagli and Weber (2023).
- ▶ *Supply disruptions*: Bonadio et al. (2021), Di Giovanni et al. (2022), Ascari et al. (2024).
- ▶ *Social networks*: Bailey et al. (2018), Garcia-Lembergman et al. (2024).

Data

- ▶ Two-wave survey of firm managers in New Zealand in 2024.
- ▶ Firms characterized as pairs of customer – main supplier (≈ 1000 surveyed pairs).
- ▶ Data on firms and managers characteristics. [Summary statistics](#)
- ▶ Data on communication between firm pairs.

Summary of the RCT Experiment

1. Directly treated firms randomized into 3 groups:
 - ▶ control
 - ▶ 2 info treatment groups
2. Elicit priors: [details](#)
 - ▶ Expectations and uncertainty about future growth.
 - ▶ Plans on prices, investment, employment, wages.
3. Information treatments: [details](#)
 - ▶ Professionals' real GDP growth forecast.
 - ▶ Professionals' uncertainty around real GDP growth forecast.
4. Elicit posteriors in first and second wave: [questions](#)
 - ▶ Expectations and uncertainty about growth in the future.
 - ▶ Actual changes in prices, investment, employment, wages over the past 3 months.
5. Elicit information on the intensity of communication between firms in a pair.

Empirical Strategy

- ▶ Step 1: estimate treatment effects on posterior output growth expectations and uncertainty for directly treated and connected firms.
- ▶ Step 2: use the exogenous variation in output growth expectations and uncertainty to isolate the effects on the directly treated (direct) and connected firms (spillover).
- ▶ Step 3: inspect mechanisms using data on firms' actions and communication information.

Step 1: Treatment Effects on Expectations

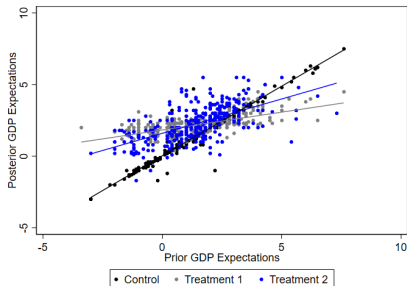
$$Posterior_i^k = \alpha + \beta Prior_i^k + \sum_{n=1}^2 \gamma_n^k T_{n,i} + \sum_{n=1}^2 \theta_n^k \left(Prior_i^k \times T_{n,i} \right) + \varepsilon_i, \quad (1)$$

- ▶ $Posterior_i^k$ – posterior beliefs of firm i in baseline or follow-up period
 - ▶ $k \in \{Mean (m), Uncertainty (u)\}$
- ▶ $Prior_i^k$ – posterior beliefs of firm i in baseline period
- ▶ $T_{n,i} = 1$ if firm i received treatment n

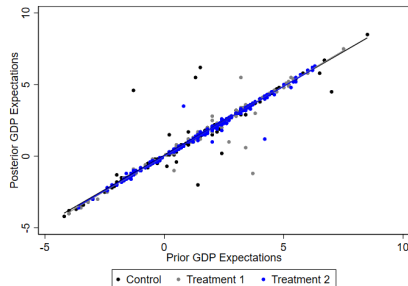
Treatment Effects on Treated vs Connected Firms in Baseline Period

Expected future output growth

Main Firms



Connected Firms

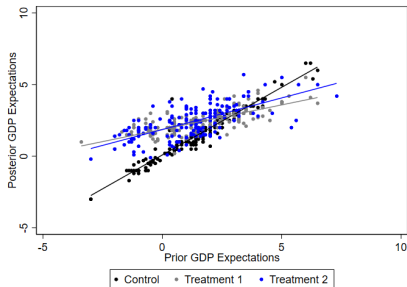


- **Only** the main, directly treated, firms are affected in the baseline period.
estimates

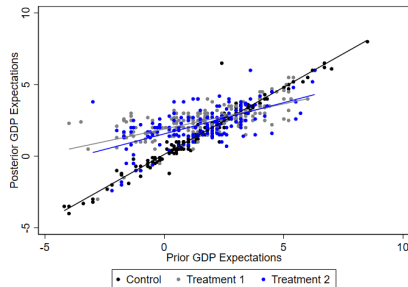
Treatment Effects on Treated vs Connected Firms in Follow-up Period

Expected future output growth

Main Firms



Connected Firms



- ▶ **Both** main and connected firms affected in the follow-up. [estimates](#)
- ▶ **Similar** findings for the effects of uncertainty about future growth. [estimates](#)

Step 2: Instrumental Variable Approach

Main firms

$$Action_i = \alpha + \beta_0 Plan_i + \underbrace{\beta_m Posterior_i^{mean}}_{\text{exp. future growth}} + \underbrace{\beta_u Posterior_i^{uncertainty}}_{\text{future growth uncert.}} + X_i' \delta + \varepsilon_i, \quad (2)$$

1. Rely on treatment effects to instrument for $Posterior_i^{mean}$ and $Posterior_i^{uncertainty}$:

$$\text{IV for } Posterior_i^k : \sum_{n=1}^2 \hat{\gamma}_n^k T_{n,i} + \sum_{n=1}^2 \hat{\theta}_n^k \left(Prior_i^k \times T_{n,i} \right)$$

2. X_i : prior expectations and uncertainty for firm i

Instrumental Variable Approach for Connected Firms

$$Action_j = \alpha + \beta_0 Plan_j + \underbrace{\beta_a Action_{i-j}^{main}}_{\text{action of } i} + \underbrace{\beta_m Posterior_j^{mean}}_{\text{exp. future growth}} + \underbrace{\beta_u Posterior_j^{uncert.}}_{\text{future growth uncert.}} + X_j' \delta + \varepsilon_j, \quad (3)$$

1. $Action_{i-j}^{main}$: action of the main firm that j is connected with.

$$Action_j = \alpha + \beta Plan_j + \sum_{n=1}^2 \psi_n T_{n,j} + \sum_{n=1}^2 \phi_n (Plan_j \times T_{n,j}) + \varepsilon_j \quad \text{estimates}$$

$$\text{IV for } Action_{i-j}^{main} : \sum_{n=1}^2 \hat{\psi}_n T_{n,j} + \sum_{n=1}^2 \hat{\phi}_n (Plan_j \times T_{n,j})$$

2. X_j : ... + planned action of main firm i that j is connected with.

Growth Expectations and Uncertainty Causally Affect Firms' Actions

	Price		Investment		Employment		Wage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Posterior^{mean}</i>	0.163 (0.114)	0.419*** (0.125)	0.008 (0.224)	0.065 (0.170)	0.912** (0.419)	0.644* (0.386)	0.024 (0.026)	-0.019 (0.015)
<i>Posterior^{uncertainty}</i>	-0.335*** (0.042)	-0.331*** (0.071)	-0.824*** (0.083)	-0.515*** (0.103)	-0.810*** (0.173)	-0.779*** (0.217)	0.005 (0.010)	0.007 (0.011)
<i>Action^{main}</i>		0.236* (0.139)		0.317*** (0.083)		0.091 (0.083)		0.348 (0.323)
Observations	485	453	478	452	479	454	479	452
Firm Type	Main	Connected	Main	Connected	Main	Connected	Main	Connected
F(mean)	110.8	50.7	151.8	48.1	118.9	60.1	109.3	44.0
F(uncertainty)	365.3	187.8	777.3	158.7	402.0	191.0	386.8	191.9
F(action)		45.5		64.6		16.1		0.9

- Higher expected future real GDP growth – positive demand shock.
- Higher uncertainty about future real GDP growth – negative demand shock.
- Direct effects $\approx$ spillover effects

Step 3: Exploring Mechanisms for Spillover Effects

The post-treatment expectations of a connected firm j can move because the directly treated firm

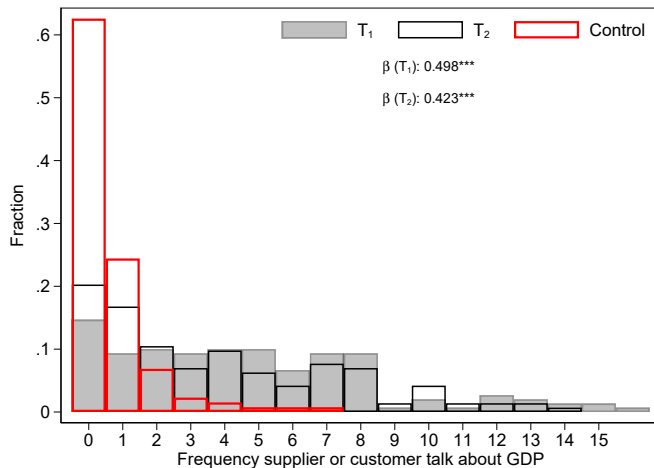
1. communicates the treatment information or its updated expectations with j
2. acts on the new information $\Rightarrow$ firm j updates its expectations

$$Posterior_j = \alpha + \underbrace{Posteriors_{i-j}^{main'} \gamma}_{1: \text{communication}} + \underbrace{Actions_{i-j}^{main'} \theta}_{2: \text{observing actions}} + X_j' \delta + \varepsilon_j \quad (4)$$

Communication Mechanism Dominates

	<i>Posterior</i> ^{mean,conn}		<i>Posterior</i> ^{uncertainty,conn}	
	(1)	(2)	(3)	(4)
<i>Posterior</i> ^{mean,main}	0.558*** (0.136)		-0.537*** (0.166)	
<i>Posterior</i> ^{uncertainty,main}	-0.062 (0.046)		0.597*** (0.073)	
<i>Price</i> ^{main}	0.070 (0.120)	0.413** (0.187)	-0.046 (0.147)	-1.266*** (0.398)
<i>Other Action</i> ^{main}	✓	✓	✓	✓
Observations	385	404	385	404
F(mean)	68.3		68.3	
F(uncertainty)	290.5		290.5	
F(price)	24.6	24.4	24.6	24.4

Indeed, Treated Firms Talk More About Output Growth



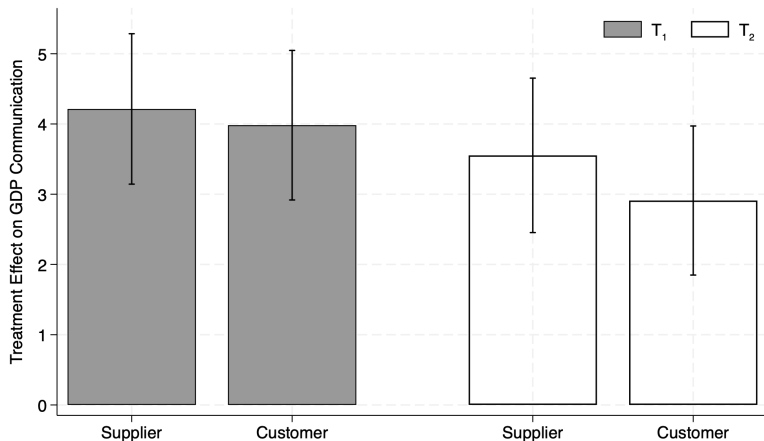
Note: $\beta(T_n)$ is the treatment effect on communicating at least once.

No Heterogeneous Effects on Connected Firms' Expectations / Uncertainty

$$\begin{aligned}
 Posterior_j^k = & \alpha + \beta Prior_j^k + \sum_{n=1}^2 \psi_n^k (T_{n,j} \times Prior_j^k \times H_{i-j}^{main}) \\
 & + \sum_{n=1}^2 \left(\gamma_n^k T_{n,j} + \theta_n^k (Prior_j^k \times T_{n,j}) \right) + \varepsilon_j
 \end{aligned} \tag{5}$$

	<i>Posterior^{mean}</i>			<i>Posterior^{uncertainty}</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
$T_1 \times Prior \times H$	0.100 (0.094)	0.004 (0.004)	0.005 (0.082)	-0.009 (0.091)	0.004 (0.005)	-0.048 (0.085)
$T_2 \times Prior \times H$	0.114 (0.125)	0.015** (0.007)	0.016 (0.123)	0.008 (0.090)	0.004 (0.004)	0.006 (0.089)
Heterogeneity, H	Upstream	Exp. Share	N connections	Upstream	Exp. Share	N connections
N	505	354	381	513	360	389

Treated Suppliers Communicate as Often as Treated Customers



Note: Treatment effect on the number of times the main firm reported communicating with the connected firm. 95% confidence intervals are displayed.

Summary of Empirical Results

- ▶ Higher expected growth leads to higher prices and employment.
- ▶ Higher uncertainty about future growth leads to lower prices, investment, and employment.
- ▶ Direct effects nearly as high as spillover effects.
- ▶ Connected firms are affected primarily because the directly treated firms communicate information.
 - ▶ No evidence of strategic motives in communication.

Production Network Model à la Rubbo (2023)

$$\mathbf{p}_t = \Delta \left(\kappa y_t + \beta \Omega \tilde{\mathbb{E}}_t [\mathbf{p}_{t+1}] + \Omega \mathbf{p}_{t-1} \right) \quad (6)$$

- ▶ Output growth: $y_{t+1} = \mu_t^* + \varepsilon_{t+1}$
- ▶ Iterating (6) forward: output growth (y) expectations important for current prices!

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- ▶ Output growth: $y_{t+1} = \mu_t^* + \varepsilon_{t+1}$
- ▶ Iterating (6) forward: output growth (y) expectations important for current prices!
- ▶ Firms: Knightian uncertainty about μ_t^* and ambiguity aversion. (Ilut and Schneider (2014)) [details](#)
- ▶ Receive info about forecasters' uncertainty: $\tilde{\mathbb{E}}_{jt}^{post} y_{t+1} = (1 - g_j) \tilde{\mathbb{E}}_{jt}^{prior} y_{t+1} + g_j s_{jt}$
- ▶ A communication network $\mathcal{C} = [c_{ij}]$ exists among trading firms

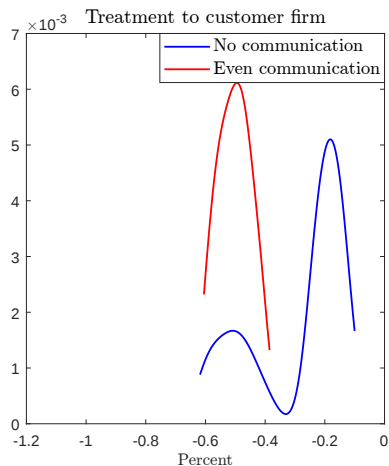
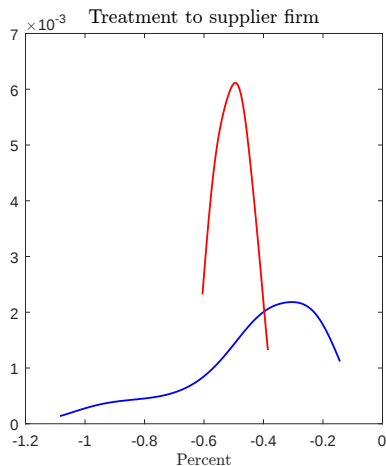
$$\tilde{\mathbb{E}}_{jt} y_{t+1} = \left(1 - \sum_{k \neq j}^N c_{kj} \right) \tilde{\mathbb{E}}_{jt}^{post} y_{t+1} + \sum_{k \neq j}^N c_{kj} \tilde{\mathbb{E}}_{kt}^{post} y_{t+1} \quad (7)$$

Quantitative Exercise

- ▶ 3-firm model
 - ▶ Firm 3 (customer) purchases inputs from firms 1 and 2
 - ▶ Firm 2 (supplier) purchases inputs from firm 1
- ▶ Simulate $\mathbf{p}_t$ to a one-time s_{jt} while varying input shares in the IO matrix
- ▶ Two scenarios: no communication $\mathcal{C} = I$ and even communication $\mathcal{C} = \mathbf{1}_{3 \times 3}/3$

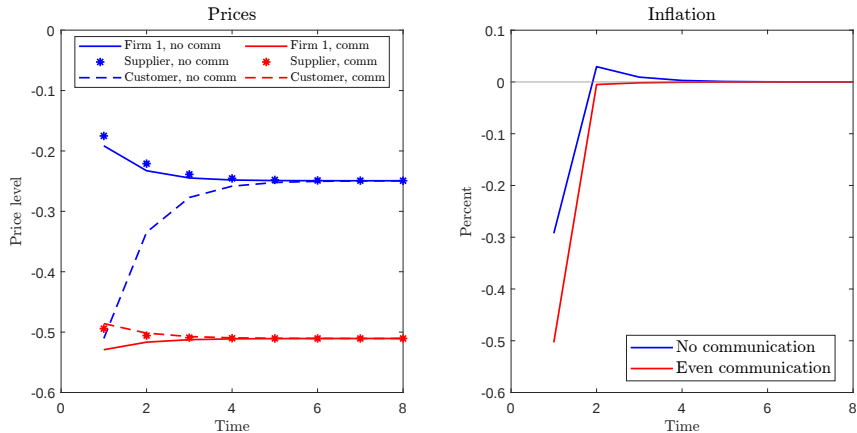
Parameterization

Distribution of Initial Price Responses to Output Uncertainty



- Communication: symmetric upstream vs downstream transmission of uncertainty.
- Communication reduces the dispersion of price responses to a treatment.

Evolution of Prices and Inflation when Treating Customer Firms



- Communication: bigger response of the aggregate price level but less dispersion.
- $\Rightarrow$ higher inflation response on impact, but less inflation persistence.

Macroeconomic Implications & Food for Thought

- ▶ Communication symmetrizes the transmission of uncertainty shocks upstream and downstream.
- ▶ Communication can amplify the impact of firm-specific shocks about macro uncertainty on inflation but also reduce its persistence.
- ▶ Accounting for firms' inflation expectations becomes particularly important when estimating structural parameters, such as the Phillips curve slope.
- ▶ Inter-firm communication is a key channel through which firms' beliefs propagate can help policymakers design alternative policy communication strategies.

Concluding Remarks

- ▶ We quantify the spillover effects of macroeconomic expectations and uncertainty in the context of production networks.
 - ▶ Spillover effects of uncertainty are particularly strong.
- ▶ Higher aggregate uncertainty of an individual firm induces higher aggregate uncertainty for its trading partners, too
 - ▶ $\Rightarrow$ lower prices, lower investment, lower employment.
- ▶ Communication between trading partners is a key mechanism for the transmission of macro expectations and uncertainty. It...
 - ▶ symmetrizes the transmission of uncertainty shocks upstream and downstream;
 - ▶ amplifies the impact of macro uncertainty on inflation, but it reduces inflation persistence.

Summary Statistics

	5 or less Workers		6–19 Workers		20–49 Workers		50+ Workers		Totals	
	Number	%	Number	%	Number	%	Number	%	Number	%

Panel A: Stats NZ Records

Manufacturing	5286	48	3663	33	1239	11	771	7	10959	100
Wholesale Trade	4107	54	2328	31	705	9	396	5	7536	100
Retail Trade	7317	58	3945	31	735	6	618	5	12615	100
Totals	16710	54	9936	32	2679	9	1785	6	31110	100

Panel B: Firms Approached

Manufacturing	2610	46	1934	34	729	13	347	6	5620	51
Wholesale Trade	2451	51	1622	34	433	9	307	6	4813	64
Retail Trade	3122	54	1996	35	295	5	364	6	5777	46
Totals	8183	50	5552	34	1457	9	1018	6	16210	52

Panel C: Main Wave Firms Sample

Manufacturing	70	3	444	23	362	50	251	72	1127	20
Wholesale Trade	45	2	212	13	157	36	99	32	513	11
Retail Trade	95	3	195	10	175	59	43	12	508	9
Totals	210	3	851	15	694	48	393	39	2148	13

Panel D: Follow-up Firms Sample

Manufacturing	31	44	230	52	198	55	130	52	589	52
Wholesale Trade	18	40	111	52	72	46	47	47	248	48
Retail Trade	33	35	109	56	73	42	26	60	241	47
Totals	82	39	450	53	343	49	203	52	1078	50

Back

Prior Expectations and Plans

1. **What do you think will be the annual growth rate of real GDP in New Zealand in twelve months? _____ % per year.**
2. **Could you provide us with an approximate range of what you think annualized real GDP growth in New Zealand will be over the next 12 months?**
Between ____ % per year (lowest forecast) and ____ % per year (highest forecast).
3. **Over the next 3 months, by how much (in % changes relative to current level) do you expect to change:**
 - ▶ The price of your main product: _____ %
 - ▶ Investment in capital goods: _____ %
 - ▶ Employment at your firm: _____ %
 - ▶ Average wages: _____ %

Information Treatments

0. **Control:** No information. (300-400 pairs)
1. **Mean treatment:** *We are going to give you information from a group of leading experts about the New Zealand economy. According to Consensus Economics, a leading professional forecaster, the **average prediction among professional forecasters is that the real GDP will grow** by 2.3 percent in 2025.* (300-400 pairs)
2. **Uncertainty Treatment:** *We are going to give you information from a group of leading experts about the New Zealand economy. According to Consensus Economics, a leading professional forecaster, the **difference between the lowest and highest predictions of real GDP growth** is 2.2 percentage points for 2025.* (300-400 pairs)

Posterior Expectations and Actions

1. **Please let me know what you perceive as the most pessimistic, the most likely, and most optimistic real GDP growth rate for New Zealand over the next 12 months.** What do you think the lowest annualized real GDP growth rate might be for this time period, what do you think the most likely might be, and what do you think the highest might be? (please provide an answer as % per year).

– surveyed in first and second waves.

2. **Over the last 3 months, by how much (in % changes) did you change:**

- ▶ The price of your main product:_____ %
- ▶ Investment in capital goods:_____ %
- ▶ Employment at your firm:_____ %
- ▶ Average wages:_____ %

– surveyed in second wave.

List of Questions on Communication

1. **In general, how often do you communicate with your customer/main supplier firm XXX?**
 - ▶ About your product transactions
 - ▶ About industry trends and conditions
 - ▶ About economic trends and conditions
2. **Over the last three months, how many times did you communicate with your customer/main supplier firm XXX about GDP?** Answer: _____
times over the last three months.

Back

List of Questions on Communication

- ▶ **In general, how often do you communicate with your customer/main supplier firm XXX?**
 - ▶ About your product transactions
 - ▶ About industry trends and conditions
 - ▶ About economic trends and conditions
 - i Daily
 - ii Weekly
 - iii Monthly
 - iv Quarterly
 - v Semi-annually
 - vi Annually
 - vii Less frequently than annually

Back

List of Questions on Communication

- ▶ **In general, if you had to place a dollar value on the information that you acquire from your customer/main supplier firm XXX about product transactions, industry trends and conditions and economic trends and conditions each year, how much do you think that \$ value would be? Please use minimum as \$0 and maximum as \$1000.**
 1. _____ \$ per year for information on product transactions
 2. _____ \$ per year for information on industry trends and conditions
 3. _____ \$ per year for information on economic trends and conditions

- ▶ **Over the last three months, how many times did you communicate with your customer/main supplier firm XXX about GDP? Answer: _____ times over the last three months.**

Back

List of Questions on Communication

- **What are the primary reasons you would share information about GDP growth and uncertainty with your customer/main supplier firm XXX?**

Multiple answers are allowed.

1. To reduce operational costs
2. To comply with legal requirements
3. To foster innovation and collaboration
4. To gain a competitive advantage
5. To foster trust
6. To address common sectoral challenges
7. I do not share information about GDP growth or uncertainty with my customer/main supplier firm XXX.
8. Other: Please specify _____

Back

Treatments Affect Expectations of Treated and Connected Firms

	(1)	(2)	(3)	(4)
$Prior^{mean}$	0.972*** (0.023)	0.964*** (0.016)	0.945*** (0.020)	0.938*** (0.013)
T_1	1.799*** (0.068)	-0.063 (0.044)	1.787*** (0.070)	1.772*** (0.112)
T_2	1.567*** (0.068)	-0.040 (0.045)	1.773*** (0.095)	1.433*** (0.147)
$T_1 \times Prior^{mean}$	-0.723*** (0.032)	0.017 (0.019)	-0.603*** (0.032)	-0.586*** (0.046)
$T_2 \times Prior^{mean}$	-0.492*** (0.032)	0.006 (0.018)	-0.503*** (0.046)	-0.502*** (0.061)
Constant	0.025 (0.048)	0.062 (0.043)	0.080 (0.047)	0.120** (0.036)
Period Posterior	Baseline	Baseline	Follow-Up	Follow-Up
Type of firm	Main	Connected	Main	Connected
Observations	999	1020	510	505
R-squared	0.739	0.955	0.760	0.743

Treatments Affect Uncertainty of Treated and Connected Firms

	(1)	(2)	(3)	(4)
$Prior^{Uncertainty}$	0.960*** (0.019)	0.993*** (0.010)	0.978*** (0.019)	0.974*** (0.018)
T_1	1.395*** (0.198)	0.025 (0.084)	1.310*** (0.302)	2.044*** (0.328)
T_2	1.145*** (0.163)	-0.015 (0.083)	1.142*** (0.264)	1.139*** (0.267)
$T_1 \times Prior^{Uncertainty}$	-0.766*** (0.033)	-0.008 (0.013)	-0.717*** (0.042)	-0.761*** (0.046)
$T_2 \times Prior^{Uncertainty}$	-0.720*** (0.031)	-0.008 (0.014)	-0.689*** (0.042)	-0.610*** (0.045)
Constant	0.220* (0.095)	0.067 (0.070)	0.187* (0.090)	0.276* (0.122)
Posterior Period	Baseline	Baseline	Follow-Up	Follow-Up
Firm Type	Main	Connected	Main	Connected
Observations	1012	1022	514	513
R-squared	0.835	0.973	0.809	0.700

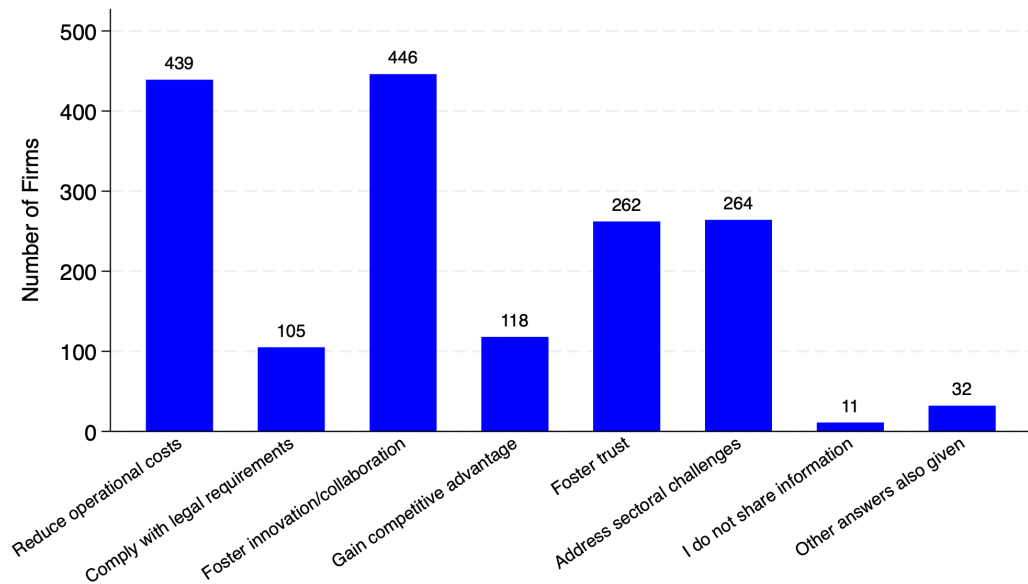
Effects of Treatments on Actions

	Price		Investment		Employment		Wage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Plan</i>	1.006*** (0.009)	1.012*** (0.011)	0.975*** (0.018)	0.979*** (0.019)	1.014*** (0.020)	1.017*** (0.012)	0.995*** (0.015)	0.998*** (0.019)
T_1	1.583*** (0.136)	1.841*** (0.136)	3.448*** (0.199)	3.128*** (0.205)	2.837*** (0.540)	2.291*** (0.498)	-0.024 (0.019)	0.011 (0.041)
T_2	1.722*** (0.125)	1.815*** (0.125)	2.819*** (0.190)	2.552*** (0.167)	3.388*** (0.568)	2.883*** (0.472)	-0.016 (0.016)	-0.028 (0.028)
$T_1 \times Plan$	-0.323*** (0.089)	-0.401*** (0.080)	-0.679*** (0.092)	-0.625*** (0.096)	-0.741*** (0.178)	-0.491*** (0.145)	0.005 (0.017)	-0.040 (0.033)
$T_2 \times Plan$	-0.381*** (0.068)	-0.533*** (0.081)	-0.483*** (0.081)	-0.366*** (0.069)	-1.017*** (0.196)	-0.845*** (0.181)	-0.001 (0.021)	-0.005 (0.023)
Constant	-0.013 (0.022)	-0.041 (0.026)	-0.002 (0.030)	-0.012 (0.029)	-0.050 (0.074)	0.009 (0.047)	0.012 (0.011)	0.030 (0.028)
Firm Type	Main	Connected	Main	Connected	Main	Connected	Main	Connected
Observations	512	506	505	512	508	511	505	511
R-squared	0.715	0.629	0.577	0.586	0.324	0.438	0.980	0.981

Similar outcomes when controlling for firm characteristics

Back

Reasons Why Main and Connected Firms Share Info about Output Growth



Treatment Effects Do Not Depend on The Strength of Relationship

	(1) GDP	(2) Wage	(3) Employment	(4) Investment	(5) Price
Prior	0.929*** (0.016)	0.999*** (0.035)	1.042*** (0.026)	0.966*** (0.023)	1.001*** (0.013)
T_1	1.720*** (0.141)	-0.000 (0.059)	1.846*** (0.628)	2.776*** (0.226)	1.800*** (0.155)
T_2	1.413*** (0.208)	-0.045 (0.048)	2.041*** (0.739)	2.398*** (0.222)	1.580*** (0.207)
$T_1 \times \text{Prior}$	-0.566*** (0.061)	-0.042 (0.047)	-0.533** (0.228)	-0.662*** (0.117)	-0.470*** (0.099)
$T_2 \times \text{Prior}$	-0.553*** (0.088)	0.007 (0.036)	-1.154*** (0.260)	-0.410*** (0.098)	-0.548*** (0.133)
$T_1 \times \text{Prior} \times \text{Share}$	0.001 (0.003)	-0.001 (0.002)	0.023* (0.012)	-0.012 (0.009)	0.002 (0.009)
$T_2 \times \text{Prior} \times \text{Share}$	0.002 (0.004)	0.001 (0.002)	0.015 (0.020)	-0.009 (0.010)	0.002 (0.019)
Constant and share	✓	✓	✓	✓	✓
Observations	334	335	341	341	314
R-squared	0.755	0.985	0.413	0.556	0.580

Back

Knightian Uncertainty

- ▶ Firms cannot distinguish the two components of growth; perceive $y_{t+1} = \mu_{jt} + \epsilon_{j,t+1}$
- ▶ $\mu_{jt} \in [\underline{\mu}_{jt}, \bar{\mu}_{jt}]$ but with unknown pdf (**Knightian uncertainty**)
 - ▶ Higher uncertainty $\Rightarrow$ lower $\underline{\mu}_{jt}$
- ▶ **Ambiguity aversion:** $\tilde{\mathbb{E}}_{jt}^{prior} = \underline{\mu}_{jt}$
Epstein and Wang (1994), Ilut and Schneider (2014)

Back

Parameterization

- ▶ Input-output matrix

$$IO = \begin{bmatrix} 0 & 0 & 0 \\ \iota_{21} & \iota_{22} & 0 \\ \iota_{31} & \iota_{32} & \iota_{33} \end{bmatrix}$$

- ▶ Fix $\iota_{31} = 0.15$.
 - ▶ $\iota_{21} \in \{0.1, 0.2, \dots, 1\}$
 - ▶ $\iota_{32} \in \{0.1, 0.2, \dots, 1 - \alpha_3\}$
 - ▶ $\alpha_1 = 1$; $\alpha_2 = 1 - \iota_{21}$, $\alpha_3 = 1 - \iota_{32} - \alpha_3$
-
- ▶ Discount factor $\beta = 0.9975$.
-
- ▶ $\phi_1 = 0.61$; $\phi_2 = 0.63$; $\phi_3 = 0.66$.
-
- ▶ $g_j \approx 0.7$ for any firm j that is treated.

Distribution of Within-Network Prices

