Trade Disruptions and Reshoring

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Background

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How firms withstand such shocks (do they reorient trade to mitigate losses?)

Question

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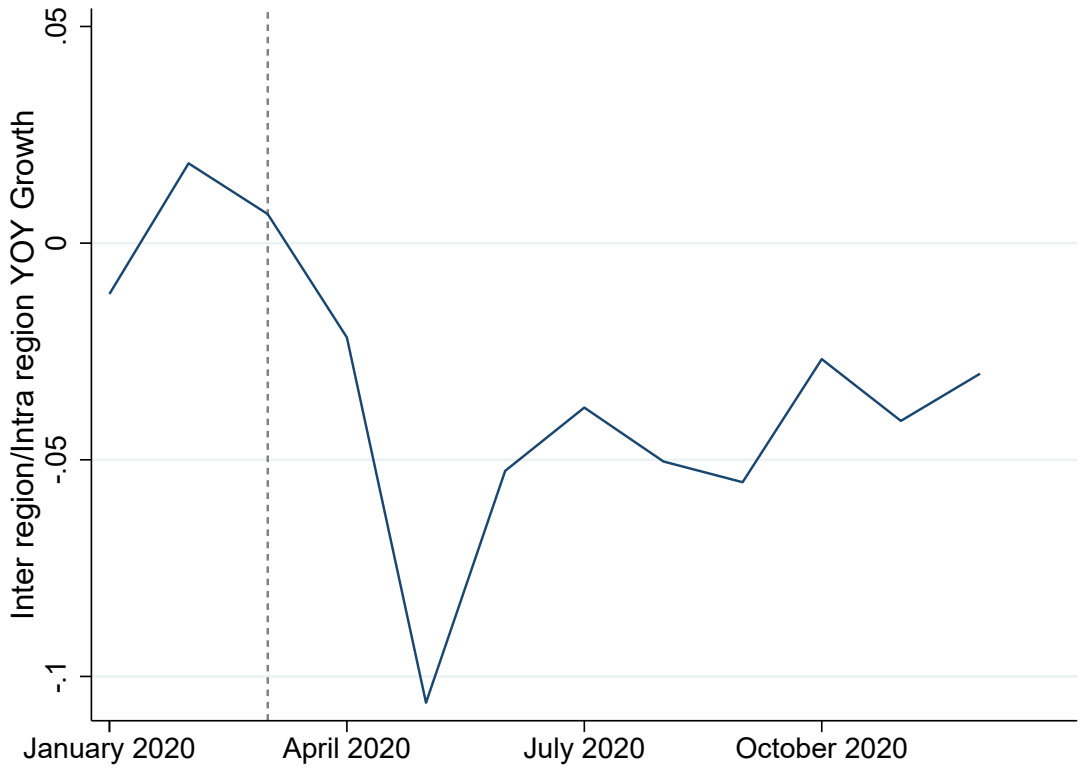
Setting: Domestic trade across 35 regions within a country (India)

- Intra-country trade costs as high as inter-country trade costs (Atkin & Donaldson 2015)

Shock: COVID-19 National Lockdown India (March 2020)

Domestic Trade Collapse in India: Post COVID-19 Lockdown

Figure: Inter-State Sales to Intra-State Sales Ratio Growth (YoY)



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Reshoring Channel of Trade Collapse

- Plants selling more outside pre-pandemic switch to intra-state sales
- One s.d. increase in inter-state dependence $\Rightarrow$ 8% (6%) higher (lower) intra-state (inter-state) sales
- Similar results for inputs
- Reshoring accounts for 7.6% growth in sales in Oct-Dec 2020

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Why reshoring?

- Uncertainty about state border closure
- Scope for home expansion (local demand + local production)

Data

Electronic-way (E-way) Bills collected by the Goods and Services Tax Network (GSTN) in India

Legal requirement to generate an E-way bill before transporting goods above INR 50,000 USD 700 (not services)

Period: January 2019–December 2020

Two unique administrative datasets at state level

- Plant Data
- Product Data

Plant Data

Monthly Sales Data (B2B+B2C):

- Two distinct datasets: inter-state and intra-state sales
- Top 1000 plants at state month level
- Unique plant identity: match over month or type of sales
- Top 1000 plants constitute 60 percent to the total state level sales

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Similar datasets on the input (B2B) side (inter- and intra-state inputs)

Keep balanced set of plants for which we observe total sales for all 24 months

Plant Data: Summary Stats

Monthly plant sales and inputs

Plant Data (Sales and Receipts, INR million)						
	2019			2020		
	Obs.	Mean	S.D.	Obs.	Mean	S.D.
(1) Number of plants (Sales data)	408	272.1	151.9	408	272.1	151.9
(2) Total Sales	111024	355.8	1342.6	111024	337.1	1410.3
(3) Inter-state Sales	81092	309	1238.5	81983	285.4	1368.5
(4) Intra-state Sales	80685	179.1	493.9	81041	173.1	460.1
(5) Number of plants (Inputs data)	408	265.6	85.1	408	265.6	85.1
(6) Total Inputs	108348	223.9	802.6	108348	212.2	982.4
(7) Inter-state Inputs	81883	200.8	597.3	83113	187.2	913.1
(8) Intra-state Inputs	65204	120.0	589.9	64715	115.0	547.0

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Product Data

January 2019–December 2020, product inter-state sales, intra-state sales and inter-state receivables (HSN 4-digit level)

Monthly data for the top 1000 products in each of the three

Summary statistics for a balanced set of products: total production (sales) data (*Intra-state Sales*+*Inter-state Sales*)

Timeline: COVID-19 and Policy response in 2020

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May 17: inter-state transportation easing began

By July: All restrictions on transportation lifted

By September, economic indices back to the pre-pandemic level

Timeline: Active COVID cases

Empirical Strategy: Inter-state dependence

Using Gopinath and Neiman (2014) framework show that rms more expos to inter-state trade are likely to shift sourcing from inter to intra state

Measure Pre-pandemic Inter-state dependence (using 2019 data):

$$f_{ir}^{c} = \frac{c_{ir}^{inter}}{c_{ir}^{inter} + c_{ir}^{intra}}$$

f_{ir}^{c}: fraction of inter-state sales (input) over total sales (input) for a given categoryc 2 f sales; inputg in 2019.

High f_{ir}^{c} ! higher likelihood to shift to intra-state sales

Inter-State Dependence (2019)

	Obs.	Mean	Median	S.D.	Min	Max
(1) Plants: Inter-state Sales Fraction	9252	0.53	0.59	0.40	0.00	1.00
(2) Plants: Inter-state Inputs Fraction	9029	0.64	0.84	0.40	0.00	1.00

Reshoring: Empirical strategy

$$\ln(z^{c}_{ijr;my}) = \beta^{c}_{0} + \sum_{2(m2020)} \beta^{;c}_{1}(1_m \quad 1_{2020}) + \sum_{2(m2020)} \beta^{;c}_{2}(1_m \quad 1_{2020} \quad f^{c}_{ir})$$

$$+ \quad 1_{2020} \quad f^{c}_{ir} + 1_{2020} + \quad \alpha^{c}_{ir;m} + \quad \alpha^{c}_{j;my} + X^{c}_{ir;my}\beta + \varepsilon^{c}_{ijr;my}$$

$z^{c}_{ijr;my}$: outcome variable for a plant i belonging to sector j in state r in month m and year y and category $c \in$ {Sales, Inputs}.

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$X^{c}_{ir;my}$: Other controls ($\sum_{2(m2020)} \beta^{;c}(1_m \quad 1_{2020} \quad X^{c}_{ir})$ and the relevant double interactions)

Reshoring: Empirical strategy

$$\ln(z^{c}_{ijr;my}) = \beta^{c}_{0} + \sum_{2(m2020)} \beta_{1}; {}^{c}(1_{m} \quad 1_{2020}) + \sum_{2(m2020)} \beta_{2}; {}^{c}(1_{m} \quad 1_{2020} \quad f^{c}_{ir})$$

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For c = Sales, z=Inter-state

${}_{2}{}^{;sales}$: Impact of inter-state sales dependence on plant inter-state sales in month m in 2020 (Heterogeneous DID treatment e ects)

Change in plant inter-state sales in month m in year 2020 relative to January 2020, over and above the change in inter-state sales between month m in 2019 and January 2019, as a function of plants' inter-state sales dependence

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For Reshoring: ${}_{2}^{;sales}$ negative for inter and positive for intra-state sales

Results: Reshoring (Sales)

Impact on Inter- and Intra-state Sales

Dependent Variable: Inter-state Sales,
Heterogeneity: By Sales Fraction

Dependent Variable: Intra-state Sales,
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Results: Reshoring (Inputs)

Impact on Inter- and Intra-state Inputs

Dependent Variable: Inter-state Inputs,
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Heterogeneity: By Inputs Fraction

Results: Plants' Financial Condition do not Matter

Dependent Variable: Sales,
Heterogeneity: By Cash to Assets Ratio

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Other tests

Plants that su er more in total output post-lockdown reshore their sales or inputs home-ward Click

Decline in Quantity: Count of E-way Bills as proxy

Similar reshoring in product-level data

Robustness

- Longer pre-trends when not controlling for plant-monthly seasonality
- Alternate Plant Sample { unbalanced sample
- District level Variation in lockdown Stringency
- Remove plants that engage in international trade

What explains reshoring? Salience of State Administrat Border

Reshoring is similar for border and inland plants

Sales: By Inter-state Sales Fraction Border

Inputs: By Inter-state Inputs Fraction Border

Product data: Scope for Home Expansion (SHE)

Which products undergo the most reshoring?

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Which products undergo the most reshoring?

Scope for expanding in the home state for product k in state r given by:

$$SHE_{kr} = \min\left[\frac{Receipts_{kr}^{inter}}{Receipts_{kr}^{inter} + Sales_{kr}^{intra}} ; \frac{Sales_{kr}^{inter}}{Sales_{kr}^{inter} + Sales_{kr}^{intra}}\right]$$

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When both these fractions are large, outside state receipts for product k in state r can be substituted by home productio

Grubel-Loyd Index?

Empirical Strategy: Reshoring by SHE

$$\ln(z_{kr;my}) = \beta_0 + \sum_{2(m2020)} \beta_1 (1_m \cdot 1_{2020}) + \sum_{2(m2020)} \beta_2 (1_m \cdot 1_{2020} \cdot SHE_{kr})$$

$$+ \beta_1 1_{2020} \cdot SHE_{kr} + \beta_2 1_{2020} + \alpha_{kr;m} + \alpha_{k;my} + X_{kr;my}\gamma + \varepsilon_{kr;my}$$

$z_{kr;my}$: outcome variable (Inter-state Sales, Intra-state sales) for product k produced in state r, in month m and year y

$\alpha_{kr;m}$: Product-state level unobserved heterogeneity and seasonality

$\alpha_{k;my}$: Variation over time in product demand at 4-digit HSN code level

$X_{kr;my}$: Other controls (Inter-state Receivables Fraction)

β_2: Impact of SHE on product outcomes in month m in 2020

Results: High SHE ⇒ More Reshoring

Impact on Inter- and Intra-state Sales

Dependent Variable: Inter-state Sales,
Heterogeneity: By SHE_{kr}

Dependent Variable: Intra-state Sales,
Heterogeneity: By SHE_{kr}

Summary:SHE Results

Scope for Home Expansion matters:

- Larger reduction in inter-state product sales immediately after the lockdown by 5% for one S.D. increase in SHE_{kr}
- Larger increase in intra-state product sales by 10% after the lockdow which persist at 6.5% (July-December 2020) for one S.D. increase in SHE_{kr}

Total sales recover for products with high SH ⏩ Click

Product Di erentiation: Other product attributes don't matter (Rausch classi cation)

Conclusion

Causal evidence for reshoring after a temporary trade disruption

- New channel to explain trade collapse
- Evidence for a home-ward shift at plant and product level
  - Final and intermediate goods
  - Higher for plants that were more dependent on outside state sales and inputs before the pandemic

Reshoring is:

- Salient along state administrative borders
- Dominant for products with high SHE

Reshoring can aid recovery after shocks (7.6% of the sales growth in Oct-Dec 2020)

- states exporting \less speci c" products rebound faster

APPENDIX

Theoretical Setup

Consider a home-region rm i, manufactures a unique good i using production technology:

$$Y_i = A_i L_{p;i}^{1} \quad X_i \tag{1}$$

where A_i is the productivity of rm i, $L_{p;i}$ is the labor used for production and X_i is the intermediate input.

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X_i combines intra-region inputs Z_i and inter-region inputs M_i:

$$X_i = \quad Z_i \; + \; M_i \quad ^{\frac{1}{}}: \tag{2}$$

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$$Z_i = \int_j z_{ij}\, dj \quad ^{\frac{1}{}} \quad ; \quad M_i = \int_{k2\ i} m_{ik}\, dk \quad ^{\frac{1}{}} : \tag{3}$$

Z_i and M_i aggregate intra-region and inter-region varieties; elasticity of substitution same over the bundles

z_{ij} is the set of intra-region inputs j; m_{ik} the set of inter-region inputs k.

Theoretical Setup

Firm i only imports a set $_i$ of the available inter-region varieties.

xed costs increasing in number of inter-region varieties imported:

$$F(j \quad _i j) = f j \quad _i j \tag{4}$$

where$f > 0; \quad > \quad 0;$

Theoretical Setup

Output from each firm i: final good production and intermediate input

$$Y_i = g_i + z_i = g_i + \int_j z_{ji}\, dj : \tag{5}$$

Final good $G = \left[\int_j g_i^{\frac{1}{}} \, di \right]$

Theoretical Setup

All firms monopolistically competitive and take the wages w_s, set of intra-region prices p_j, and inter-region input prices p_m

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Unit cost function of the firm:

$$C_i = \frac{1}{(1 \quad)^{(1 \quad)}} \frac{w^1 \quad P_{X_i}}{A_i}: \tag{6}$$

where P_{X_i} is the price index of the intermediates for firm i

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Unit cost function of the rm:

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where P_{X_i} is the price index of the intermediates for rm

$$P_{X_i} = \left[P_Z^{\overline{\quad 1}} + P_{M_i}^{\overline{\quad 1}} \right]^{\frac{1}{\quad}} : \tag{7}$$

Theoretical Setup

Home-region and inter-region input price indices:

$$P_Z = \left[\int_j p_i^{1-\sigma} di\right]^{\frac{1}{1-\sigma}}; \quad P_{M_i} = \left[\int_k p_m^{1-\sigma} dk\right]^{\frac{1}{1-\sigma}} = p_m \left|\Omega_i\right|^{\frac{1}{1-\sigma}}: \qquad (8)$$

P_Z same across all firms, P_{Mi} varies depending on the number of inter-region varieties $\left|\Omega_i\right|$ used by i

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Price charged: $C_i =$ and chooses the optimal $_i$ to maximize its profits.

Inter region prices $p(\phi_m)$: same for all varieties, includes iceberg trade cost and price increase to accommodate uncertainty in arrival of good

Uncertainty goes up, p_m goes up

Propositions

Proposition 1 (Trade collapse)Under certain parametric restrictions, an increase in uncertainty captured by an increase in inter-region input price p_m, increases the share of domestic inputs in total inputs for firm i ($_i$).

$$\frac{@\ln\ _i}{@\ln p_m} = \frac{(1\quad\ _i)}{1}\quad 1\quad \frac{@\ln P_Z}{@\ln p_m} + \frac{1}{\quad}\frac{@\ln\ _i}{@\ln p_m} > 0: \tag{9}$$

Propositions

Proposition 1 (Trade collapse): Under certain parametric restrictions, an increase in uncertainty captured by an increase in inter-region input price p_m, increases the share of domestic inputs in total inputs for firm i.

$$\frac{\partial \ln x_{ii}}{\partial \ln p_m} = \frac{(1-\sigma)}{1-(1-\sigma)\theta_i}\left[\frac{\partial \ln P_Z}{\partial \ln p_m} + \frac{1}{1-\sigma}\frac{\partial \ln x_{ii}}{\partial \ln p_m}\right] > 0. \quad (9)$$

Proposition 2: When trade collapse occurs, and $\partial\left(\frac{\partial \ln x_{ii}}{\partial \ln p_m}\right)/\partial \theta_i > 0$, the shift to intra-region inputs is larger for firms with a higher dependence on inter-region intermediate inputs after an increase in uncertainty $\left(\frac{\partial\left(\frac{\partial \ln x_{ii}}{\partial \ln p_m}\right)}{\partial \theta_i} < 0\right)$

Back

Appendix: Plant Inputs, Single di erence pre-trends

Inter-Region Inputs: By Inputs Fraction

Intra-Region Inputs: By Inputs Fraction

Results for Total Plant Sales and Inputs: By inter-region dependence

Dependent variable	log(Total Sales)			log(Total Inputs)		
	(1)	(2)	(3)	(4)	(5)	(6)
Reg. Dependence=	Inter-Region Sales Fraction			Inter-Region Inputs Fraction		
Feb 2020	0.01	0.00	{0.00	{0.01	{0.01	{0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Mar 2020	{0.03**	{0.04**	{0.05**	{0.05***	{0.06***	{0.02
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Apr 2020	{0.20***	{0.34***	{0.38***	{0.27***	{0.34***	{0.17***
	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.05)
May 2020	{0.13***	{0.16***	{0.17***	{0.14***	{0.19***	{0.18***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
June 2020	{0.05***	{0.05**	{0.06***	{0.07***	{0.12***	{0.11***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
July 2020	0.01	0.01	{0.00	{0.06***	{0.10***	{0.06**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Aug 2020	{0.04**	{0.04**	{0.05**	{0.04**	{0.07***	{0.04
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Sep 2020	{0.02	{0.04*	{0.05**	{0.01	{0.02	{0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Oct 2020	0.03*	0.02	0.01	{0.01	{0.02	{0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Nov 2020	{0.07***	{0.05**	{0.06**	{0.06***	{0.06***	{0.06**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Dec 2020	{0.04**	{0.03	{0.03	0.01	{0.01	{0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Fixed E ects						
Plant-Month	X	X	X	X	X	X
Sector-Month-Year		X	X		X	X
Additional Controls			X			X
N	222048	177408	164736	216696	148368	122712

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Robustness (Plants)

Alternate Plant Sample { unbalanced sample

Regional Variation in Stringency { local lockdowns

Export-import status

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Why not Grubel-Loyd Index?

For the i-th product, it is given by $GL_i = 1 - \frac{|X_i - M_i|}{X_i + M_i}$ where X and M represents export and import

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Eg 2: export-import pairs with values $f5;\ 5g$ and $f100;\ 100g$; with same intra-region sales value, say 10

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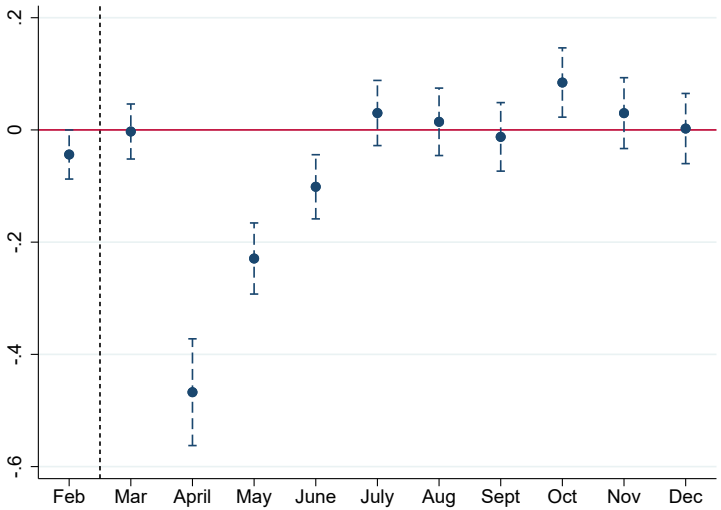
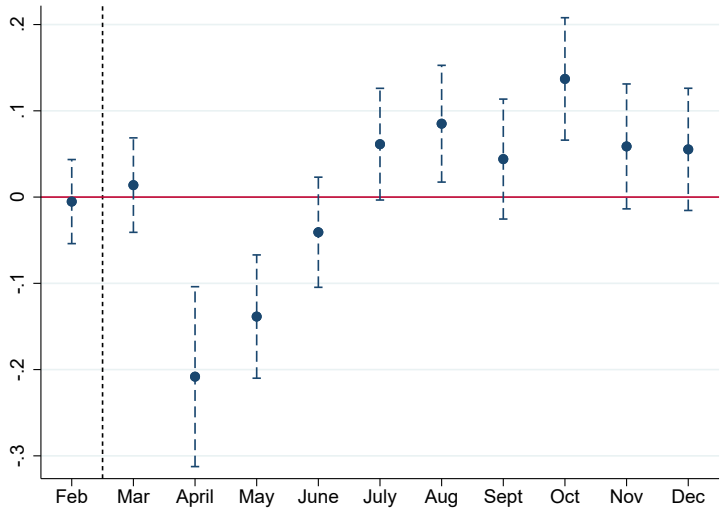
Results: Total Product Sales (By f_{kr} and SHE_{kr})

Figure: Impact on Total Product Sales

By Inter-Region Sales Fraction



By Scope for Home Expansion



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