Foreign Shocks as Granular Fluctuations

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September, 2019

International Business Cycle Shock Propagation

- Textbook: cross-country propagation through relative prices, representative firm
  - e.g. BKK (1992), Kose and Yi (2006), Johnson (2014), ...
- Data: importing and exporting i) relatively rare; ii) strongly concentrated among largest firms
  - e.g. Freund and Pierola (2015), di Giovanni et al. (2017, 2018), ...
- "Micro of Macro": role of large firms, idiosyncratic shocks in aggregate fluctuations
  - Gabaix (2011), di Giovanni et al. (2014), Carvalho an Grassi (2015), ...

A firm-level view of international shock propagation

- Foreign shocks (even purely aggregate) affect firms differentially depending on the extent and nature of their international linkages

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- Elasticity of GDP w.r.t. a foreign shock:

$$\epsilon^Y = \underbrace{\bar{\epsilon}}_{\text{Average}} + \underbrace{Cov\left(\frac{\omega_f}{\overline{\omega}}, \epsilon^f\right)}_{\substack{\text{Granular} \\ \text{Propagation}}}$$

- Foreign shocks affect predominantly the largest firms

$\Rightarrow$ Aggregate (granular) fluctuations

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⇒ Aggregate (granular) fluctuations

- This paper:
  1. Provide evidence that $Cov\left(\frac{\omega_f}{\overline{\omega}}, \epsilon^f\right) > 0$
  2. Quantify the size of the granular propagation term

This paper

- Quantitative model with heterogeneous firms, multiple countries, multiple sectors
  - Implemented directly on firm-level data
  - Census of French firms appended with WIOD (40 countries, 32 sectors)
- Simulate two types of (aggregate) shocks: A productivity shock and a preference shock w.r.t French varieties
- Granular propagation term accounts for $40 - 60\%$ of the total effect of a shock
- Individual firms' strategies on where to export / where to source inputs from have important consequences for the economy's exposure to various foreign shocks

Literature

- Micro origins of macro fluctuations
  - **Input-output networks:** Carvalho (2010), Acemoglu et al. (2012), Barrot and Sauvagnat (2016), Baqaee (2016), Carvalho et al. (2016), Atalay (2017), Baqaee and Farhi (2018), Grassi (2018), Kikkawa et al. (2018)
  - **Large firms:** Gabaix (2011), di Giovanni et al. (2014), Carvalho and Grassi (2015)
- Business cycle transmission at the firm level
  - Kleinert et al. (2015), Boehm et al. (2019), Cravino and Levchenko (2017), di Giovanni et al. (2017, 2018), Blaum (2018)
  - Ghironi and Melitz (2005), Alessandria and Choi (2007)

Data sources

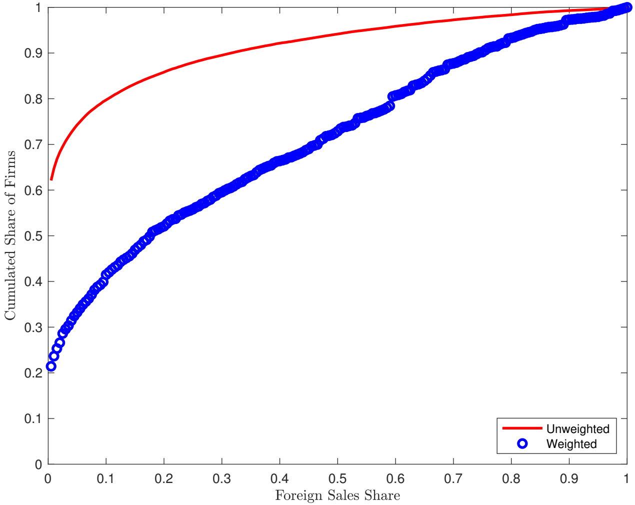
- France (firm level):
  - Fiscal administration: firm tax forms from INSEE-Ficus: value added, sales, intermediate usage, industry Statistics by sector
  - Customs: partner-country exports and imports (Trade in *goods*)
- World (sector level):
  - WIOD: global input-output matrix, 40 countries, 32 sectors
- Firm-level coefficients normalized to match WIOD at the sector level

Fact 1: Larger firms more sensitive to foreign GDP

	(1)	(2)	(3)	(4)
	Dep. Var.: Log change in firm VA			
Firm's size×World GDP growth	0.175[a]	0.173[a]	0.105[a]	0.118[a]
	(0.017)	(0.017)	(0.018)	(0.019)
Firm's size	-0.024[a]	-0.024[a]	-0.025[a]	-0.025[a]
	(0.001)	(0.001)	(0.001)	(0.001)
World GDP growth	-1.025[a]			
	(0.105)			
Firm's size×French GDP growth				-0.030[b]
				(0.014)
Observations	3,632,281	3,632,281	3,632,281	3,632,281
# years	11	11	11	11
# firms	655,596	655,596	655,596	655,596
Adjusted R^2	0.009	0.013	0.020	0.020
Fixed Effects	–	Year	Sector×Year	Sector×Year

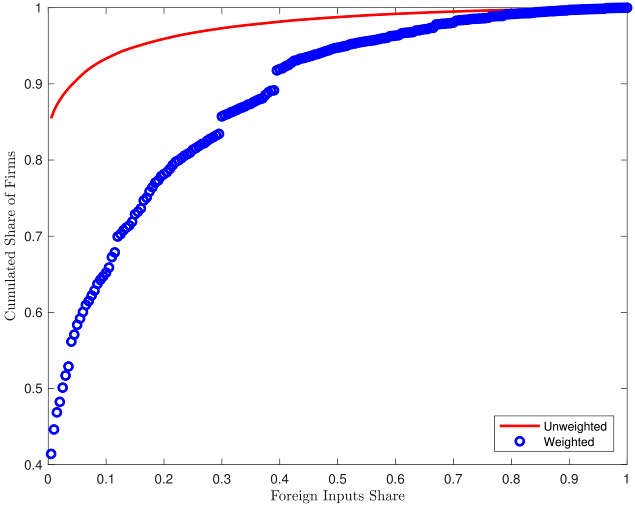
- A doubling of firm size increases the elasticity of firm growth to world GDP by about 0.12

Fact 2a: Larger firms more likely to export



Sources: French customs and balance-sheet data, for 2005. Restricted to T sectors. Foreign sales share is the share of exports in total sales

Fact 2b: Larger firms more likely to import



Sources: French customs and balance-sheet data, for 2005. Foreign inputs share is the share of foreign inputs in firms' total input expenditure

▸ Labor Share Figure

Main ingredients

- Heterogeneous-firm, multi-country, multi-sector model of trade
  - Time t, countries m, n, k, sectors i, j, firms f, g
- Rest of the world: no firm-level data $\Rightarrow$ heterogeneity within a sector assumed away (see Costinot and Rodriguez-Clare, 2014)
- France: heterogeneity in i) productivity, ii) input linkages, iii) export patterns, and iv) labor shares
- Endogenous factor supply

Households

- M countries and J sectors
- $\bar{L}_n$ households in country n (supply of primary factors)
- GHH preferences (Greenwood et al, 1988):

$$U\left(\{c_{n,t}, l_{n,t}\}_{t=0}^{\infty}\right) = \sum_{t=0}^{\infty} \delta^t \nu \left(c_{n,t} - \frac{\psi_0}{\bar{\psi}} l_{n,t}^{\bar{\psi}}\right)$$

$$c_{n,t} = \prod_j c_{n,j,t}^{\vartheta_j}$$

$$c_{n,j,t} = \left[\sum_m \mu_{mn,j}^{\frac{1}{\sigma_j}} c_{mn,j,t}{}^{\frac{\sigma_j - 1}{\sigma_j}}\right]^{\frac{\sigma_j}{\sigma_j - 1}}$$

Sectors and firms

- CES aggregate of firms from m selling to n in sector j:

$$Q_{mn,j,t} = \left[\sum_{f \in \Omega_{mn,j}} \xi_{mn,j,t}(f)^{\frac{1}{\rho_j}} Q_{mn,j,t}(f)^{\frac{\rho_j - 1}{\rho_j}} \right]^{\frac{\rho_j}{\rho_j - 1}}$$

- Demand faced by firm f, expressed in expenditures:

$$X_{mn,j,t}(f) = \underbrace{\xi_{mn,j,t}(f) \frac{p_{mn,j,t}(f)^{1-\rho_j}}{P_{mn,j,t}^{1-\rho_j}}}_{\pi_{mn,j,t}(f)} X_{mn,j,t}$$

Firms

- Monopolistically competitive
- Productivity: $a_t(f)$
- Taste shocks: $\{\xi_{mn,j,t}(f)\}_n$
- Firm-specific input bundle cost:

$$b_{m,j,t}(f) = \left[\alpha_{m,j}(f) w_{m,t}^{1-\lambda} + (1-\alpha_{m,j}(f)) \left(P_{m,j,t}^{M}(f)\right)^{1-\lambda}\right]^{\frac{1}{1-\lambda}},$$

$$P_{m,j,t}^{M}(f) = \left[\sum_{i}\sum_{k} \gamma_{km,ij}(f) P_{km,i,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}$$

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$$P_{m,j,t}^M(f) = \left[\sum_i \sum_k \gamma_{km,ij}(f) P_{km,i,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}$$

- Heterogeneity:

$$\pi_{mm,j,t}(f) = \frac{\xi_{mm,j,t}(f) a_t(f)^{1-\rho_j} \left[\alpha_{m,j}(f) w_{m,t}^{1-\lambda} + (1-\alpha_{m,j}(f)) \left(P_{m,j,t}^M(f)\right)^{1-\lambda}\right]^{\frac{1-\rho_j}{1-\lambda}}}{\sum_{g\in\Omega_{mm,j}} \xi_{mm,j,t}(g) a_t(g)^{1-\rho_j} \left[\alpha_{m,j}(g) w_{m,t}^{1-\lambda} + (1-\alpha_{m,j}(g)) \left(P_{m,j,t}^M(g)\right)^{1-\lambda}\right]^{\frac{1-\rho_j}{1-\lambda}}}$$

Equilibrium

- Goods market clearing:

$$X_{mn,j,t} = \frac{\mu_{mn,j} P_{mn,j,t}^{1-\sigma_j}}{P_{n,j,t}^{1-\sigma_j}} \vartheta_j \left[w_{n,t} \left(\frac{1}{\psi_0} \frac{w_{n,t}}{P_{n,t}} \right)^{\frac{1}{\bar{\psi}-1}} \bar{L}_n + \Pi_{n,t} + D_{n,t} \right]$$

$$+ \sum_i \sum_{f \in i} \frac{\rho_i - 1}{\rho_i} (1 - \pi^I_{n,i,t}(f)) \pi^M_{mn,ji,t}(f) \sum_k \frac{\xi_{nk,i,t}(f) \left(\frac{\rho_i}{\rho_i - 1} \tau_{nk,i} b_{n,i,t}(f) a_t(f) \right)^{1-\rho_i}}{P_{nk,i,t}^{1-\rho_i}} X_{nk,i,t}$$

Price level and input shares

- Factor market clearing:

$$\left(\frac{1}{\psi_0} \frac{w_{n,t}}{P_{n,t}} \right)^{\frac{1}{\bar{\psi}-1}} \bar{L}_n = \sum_j L_{n,j,t}$$

$$= \frac{\rho_j - 1}{\rho_j} \sum_{f \in j} \pi^I_{n,i,t}(f) \sum_k \frac{\xi_{nk,j,t}(f) \left(\frac{\rho_j}{\rho_j - 1} \tau_{nk,j} b_{n,j,t}(f) a_t(f) \right)^{1-\rho_j}}{P_{nk,j,t}^{1-\rho_j}} X_{nk,j,t}$$

The role of heterogeneity

- Aggregate and firm-level value added: ▸ GDP

$$Y_{m,t} = \sum_f Y_{m,t}(f) \qquad \rightarrow \qquad \epsilon^Y = \sum_f \omega_m(f) \epsilon^f$$

$$\epsilon^Y \quad = \quad \bar{\epsilon} + Cov\left(\frac{\omega_m(f)}{\overline{\omega}}, \epsilon^f\right)$$

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$$\epsilon^Y = \bar{\epsilon} + Cov\left(\frac{\omega_m(f)}{\overline{\omega}}, \epsilon^f\right)$$

- Firm value added growth:

$$\begin{aligned} d\ln Y_{m,j,t}(f) \quad \approx \quad & (1-\rho_j)\Big[d\ln a_t(f) + \pi^l_{m,j,t}(f) d\ln w_{m,t} + \\ & + \sum_i \sum_k (1-\pi^l_{m,j,t}(f))\pi^M_{km,ij,t}(f) d\ln P_{km,i,t}\Big] \\ & + \sum_n \widetilde{s}_{mn,j,t}(f) d\ln\left[\xi_{mn,j,t}(f)\left(\frac{\tau_{mn,j}}{P_{mn,j,t}}\right)^{1-\rho_j} X_{mn,j,t}\right] \end{aligned}$$

Calibration

- Transform model to growth rates, use sales shares data directly (Dekle, Eaton, and Kortum, 2008) DEK
- Use GDP deflator to express results in real terms
- 2 types of foreign shocks: demand ($\xi_{mn,j,t}(f)$) or productivity ($a_t(f)$); 2 foreign economies: the World or Germany

Param.	Value	Source	Related to
ρ	3	Broda and Weinstein (2006)	subst. elasticity btw. firms
σ	1.5	Feenstra et al. (2018)	Armington elasticity
η	1	standard	subst. elasticity btw. inputs
λ	1	standard	subst. elasticity btw. inputs and labor
$\overline{\psi}$	3	Chetty et al. (2012)	Frisch elasticity
$\pi^{l}_{n,i,t}(f)$, $\pi^{M}_{mn,ji,t}(f)$	}	Our calculations based on French data and WIOD	labor and intermediate shares
ϑ_j			final consumption shares
$\pi^{c}_{mn,j,t}$			final trade shares
$\pi_{nk,j,t}(f)$			intermediate use trade shares

10% world productivity shock

	ϵ^Y	$\bar{\epsilon}$	$Cov\left(\frac{\omega_{m,t}(f)}{\overline{\omega}_t}, \epsilon^f\right)$
	World Productivity Shock		
Baseline	0.374	0.145	0.229
Share:		*0.39*	*0.61*
Homogeneous firms	0.430	0.424	0.006
Share:		*0.99*	*0.01*
	German Productivity Shock		
Baseline	0.055	0.011	0.044
Share:		*0.20*	*0.80*
Homogeneous firms	0.065	0.066	-0.001
Share:		*1.02*	*-0.02*

Sector-Level Decomposition

	ϵ^Y	$\bar{\epsilon}_j$	$Cov\left(\frac{\omega_{j,t}}{\overline{\omega}_t}, \epsilon^j\right)$
	World Productivity Shock		
Baseline	0.374	0.313	0.061
Share:		*0.84*	*0.16*
	German Productivity Shock		
Baseline	0.055	0.055	0.000
Share:		*1.01*	*-0.01*

▸ ϵ^f distribution ▸ ϵ^f and firm size ▸ ϵ^f and imported input share ▸ ϵ^f and export intensity

10% world demand shock

	ϵ^Y	$\bar{\epsilon}$	$Cov\left(\frac{\omega_{m,t}(f)}{\overline{\omega}_t}, \epsilon^f\right)$
	World Demand Shock		
Baseline	0.039	0.024	0.015
Share:		*0.61*	*0.39*
Homogeneous firms	0.042	0.043	-0.001
Share:		*1.02*	*-0.02*
	German Demand Shock		
Baseline	0.006	0.003	0.003
Share:		*0.54*	*0.46*
Homogeneous firms	0.007	0.006	0.000
Share:		*0.94*	*0.06*

Sector-Level Decomposition

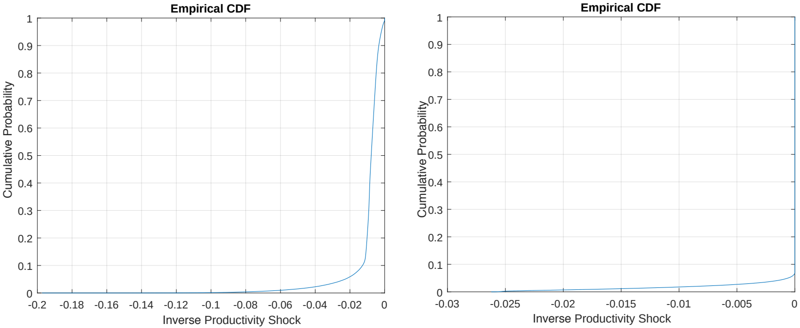
	ϵ^Y	$\bar{\epsilon}_j$	$Cov\left(\frac{\omega_{j,t}}{\overline{\omega}_t}, \epsilon^j\right)$
	World Demand Shock		
Baseline	0.039	0.064	-0.025
Share:		*1.63*	*-0.63*
	German Demand Shock		
Baseline	0.006	0.008	-0.002
Share:		*1.35*	*-0.35*

Larger firms and foreign shocks: data vs model

	(1)	(2)	(3)
	Dep. Var.: $d \ln Y_{m,j,t+1}(f)$		
	Data	Model	
		World Prod. Shock	World Pref. Shock
$\ln Y_{m,j,t}(f) \times d \ln Y_{W,t}$	0.105^a	0.020^a	0.333^a
	(0.018)	(0.0001)	(0.001)
$\ln Y_{m,j,t}(f)$	-0.025^a		
	(0.001)		
Observations	3,632,281	385,928	385,928
# years	11	1	1
# firms	655,596	385,928	385,928
Adjusted R^2	0.020	0.444	0.432
Fixed Effects	Sector×Year	Sector	Sector

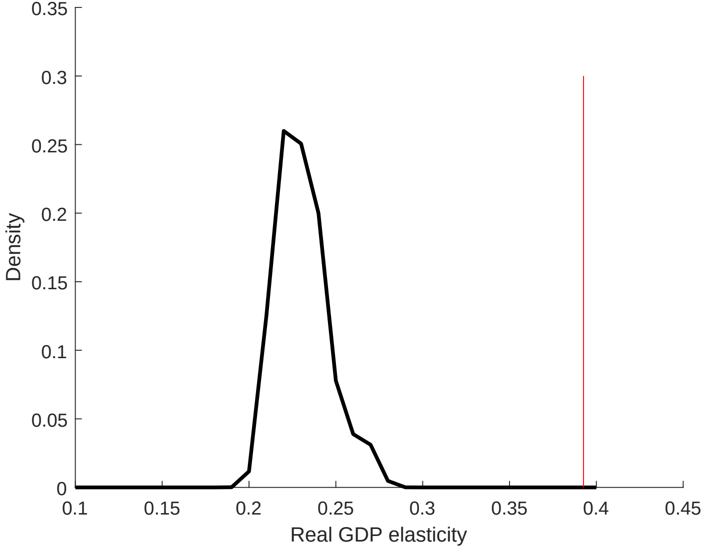
Translating foreign shocks into productivity shocks

- Thought experiment: pick firm-specific productivity shocks that replicate firm-level value added growth following the foreign shock.



Foreign Productivity   Foreign Demand

Randomizing the shocks



Conclusion

- How do foreign shocks affect the domestic economy?
- Two observations:
  1. Participation in trade highly skewed
  2. Larger firms more likely to trade
- Empirics: large firms are (1) more sensitive to foreign GDP growth, and (2) more likely to both export and import
- Quantitative assessment:
  1. Granular propagation as large as $40 - 60\%$ of aggregate impact
  2. Granular residual explains about 70% of the overall GDP impact of foreign shocks ◂ Actual Shocks

Price level and input shares

$$P_{mn,j,t} = \left[\sum_{f \in \Omega_{mn,j}} \xi_{mn,j,t}(f) \left(\frac{\rho_j}{\rho_j - 1} \tau_{mn,j} b_{m,j,t}(f) a_t(f) \right)^{1-\rho_j} \right]^{\frac{1}{1-\rho_j}}$$

$$\pi^{l}_{m,j,t}(f) = \frac{\alpha_{m,j}(f) w_{m,t}^{1-\lambda}}{\alpha_{m,j}(f) w_{m,t}^{1-\lambda} + (1 - \alpha_{m,j}(f)) \left(P^{M}_{m,j,t}(f) \right)^{1-\lambda}}$$

$$\pi^{M}_{km,ij,t}(f) = \frac{\gamma_{km,ij}(f) P_{km,i,t}^{1-\eta}}{\sum_i \sum_n \gamma_{nm,ij}(f) P_{nm,i,t}^{1-\eta}}$$

◂ Back

GDP accounting in the model

Firm value added:

$$Y^{NOM}_{mn,j,t}(f) = \frac{1 + \alpha_{m,j}(f)(\rho_j - 1)}{\rho_j} X_{mn,j,t}(f),$$
$$Y^{NOM}_{m,j,t}(f) = \frac{1 + \alpha_{m,j}(f)(\rho_j - 1)}{\rho_j} \sum_n X_{mn,j,t}(f),$$

Nominal GDP:

$$\widehat{Y}^{NOM}_{m,t+1} = \sum_f \sum_n \omega_{m,j,t}(f) \widetilde{s}_{mn,j,t}(f) \widehat{X}_{mn,j,t+1}(f),$$

Real GDP (deflated by GDP deflator):

$$\widehat{Y}_{m,t} = \frac{\widehat{Y}^{NOM}_{m,t+1}}{\widehat{P}^{G}_{m,t+1}}.$$

Back

DEK (2008) formulation

$$\widehat{X}_{mn,j,t+1}X_{mn,j,t} = \pi^{c}_{mn,j,t+1}\pi^{c}_{n,j,t+1}\left[\widehat{w}_{n,t+1}\left(\frac{\widehat{w}_{n,t+1}}{\widehat{P}_{n,t+1}}\right)^{\frac{1}{\bar{\psi}-1}} s^{L}_{n,t} + \widehat{\Pi}_{n,t+1}s^{\Pi}_{n,t} + \widehat{D}_{n,t+1}s^{D}_{n,t}\right]P_{n,t}C_{n,t}$$

$$+\sum_{i}\frac{\rho_i - 1}{\rho_i}\sum_{f\in i}(1-\pi^{I}_{n,i,t+1}(f))\pi^{M}_{mn,ji,t+1}(f)\sum_{k}\pi_{nk,i,t+1}(f)\widehat{X}_{nk,i,t+1}X_{nk,i,t}$$

$$\pi^{c}_{mn,j,t+1} = \frac{\widehat{P}^{1-\sigma_j}_{mn,j,t+1}\pi^{c}_{mn,j,t}}{\sum_k \widehat{P}^{1-\sigma_j}_{kn,j,t+1}\pi^{c}_{kn,j,t}}$$

$$\pi_{nk,j,t+1}(f) = \frac{\widehat{\xi}_{nk,j,t+1}(f)\left(\widehat{b}_{n,j,t+1}(f)\widehat{a}_{t+1}(f)\right)^{1-\rho_j}\pi_{nk,j,t}(f)}{\sum_{g\in\Omega_{nk,j}}\widehat{\xi}_{nk,j,t+1}(g)\left(\widehat{b}_{n,j,t+1}(g)\widehat{a}_{t+1}(g)\right)^{1-\rho_j}\pi_{nk,j,t}(g)}$$

$$\widehat{b}_{m,j,t+1}(f) = \left[\pi^{I}_{m,j,t}(f)\widehat{w}^{1-\lambda}_{m,t+1} + (1-\pi^{I}_{m,j,t}(f))\left(\widehat{P}^{M}_{m,j,t+1}(f)\right)^{1-\lambda}\right]^{\frac{1}{1-\lambda}}$$

$$\widehat{P}^{M}_{m,j,t+1}(f) = \left[\sum_{i}\sum_{k}\pi^{M}_{km,ij,t}(f)\widehat{P}^{1-\eta}_{km,i,t+1}\right]^{\frac{1}{1-\eta}}$$

$$\pi^{I}_{m,j,t+1}(f) = \frac{\pi^{I}_{m,j,t}(f)\widehat{w}^{1-\lambda}_{m,t+1}}{\pi^{I}_{m,j,t}(f)\widehat{w}^{1-\lambda}_{m,t+1} + (1-\pi^{I}_{m,j,t}(f))\left(\widehat{P}^{M}_{m,j,t+1}(f)\right)^{1-\lambda}}; \quad \pi^{M}_{km,ij,t+1}(f) = \frac{\pi^{M}_{km,ij,t}(f)\widehat{P}^{1-\eta}_{km,i,t+1}}{\sum_i\sum_n \pi^{M}_{nm,ij,t}(f)\widehat{P}^{1-\eta}_{nm,i,t+1}}$$

$$\sum_{j}\sum_{f\in j}\sum_{k}\frac{\rho_j - 1}{\rho_j}\pi^{I}_{n,j,t}(f)\pi_{nk,j,t}(f)X_{nk,j,t}\left[\widehat{\pi}^{I}_{n,j,t+1}(f)\widehat{\pi}_{nk,j,t+1}(f)\widehat{X}_{nk,j,t+1} - \widehat{w}^{\frac{\bar{\psi}}{\bar{\psi}-1}}_{n,t+1}\widehat{P}^{\frac{1}{1-\bar{\psi}}}_{n,t+1}\right] = 0$$

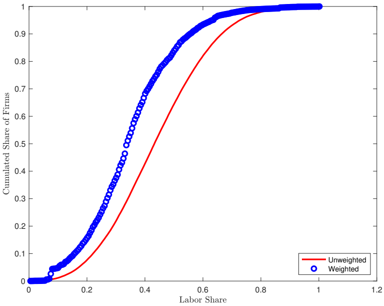
◂ Back

Summary statistics by sector (2005 data)

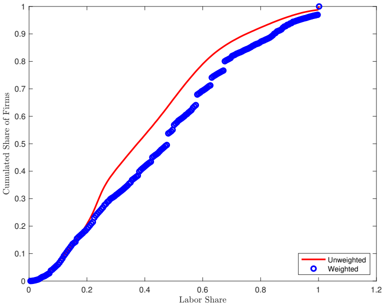
WIOT sector	# firms	Share VA	Traded/ non-traded
Agriculture, Hunting, Forestry, Fishing	7,718	.0067	T
Mining, Quarrying	1,022	.0041	T
Food, Beverages, Tobacco	10,883	.0354	T
Textile Products	1,684	.0039	T
Leather, Footwear	2,501	.0058	T
Wood Products	3,045	.0044	T
Pulp, Paper, Publishing	7,721	.0202	T
Coke, Refined Petroleum, Nuclear Fuel	50	.0056	T
Chemical Products	2,051	.0358	T
Rubber and Plastics	2,992	.0155	T
Other Non-Metallic Minerals	2,607	.0127	T
Basic and Fabricated Metals	14,561	.0373	T
Machinery n.e.c.	6,442	.0243	T
Electrical, Optical Equipment	6,599	.0288	T
Transport Equipment	1,804	.0315	T
Manufacturing n.e.c.	4,946	.0086	T
Electricity, Gas, Water Supply	321	.0364	NT
Construction	54,428	.0664	NT
Wholesale and Retail Motor Vehicles and Fuel	25,975	.0218	NT
Wholesale Trade	49,166	.0867	NT
Retail Trade	76,069	.0739	NT
Hotels and restaurants	29,135	.0259	NT
Inland Transport	9,244	.0401	NT
Water Transport	171	.0017	NT
Air Transport	66	.0085	NT
Other Transport Activities	2,068	.0256	NT
Post and Telecommunications	276	.0488	NT
Real Estate	7,726	.0425	NT
Business Activities	31,605	.1849	NT
Education	1,569	.0037	NT
Health and Social Work	6,200	.0200	NT
Other Personal Services	15,283	.0324	NT
Total	385,928	1.000	

Back

Distribution of labor shares across French firms



Tradable Sectors



Non-tradable Sectors

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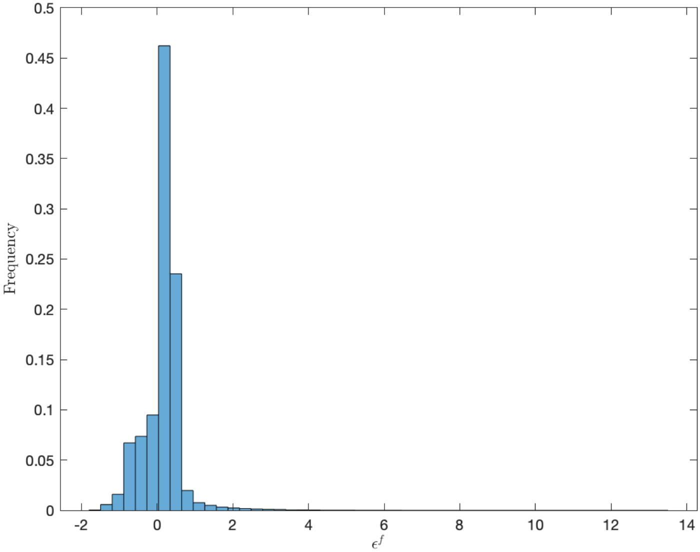
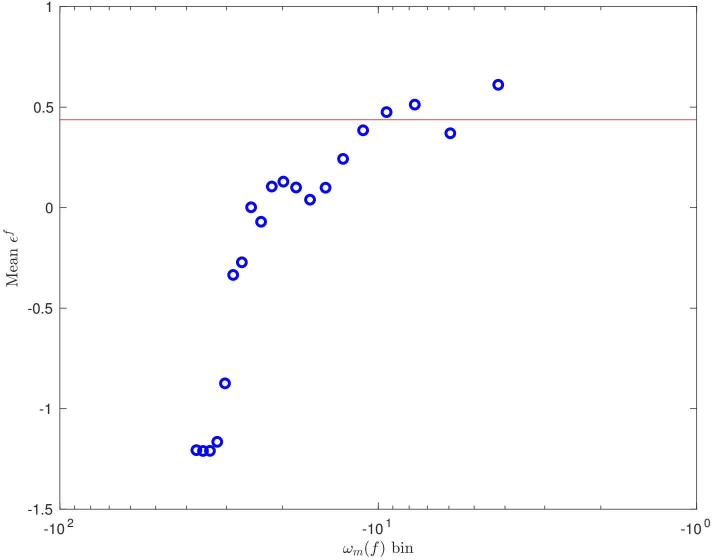
Distribution of ϵ^f



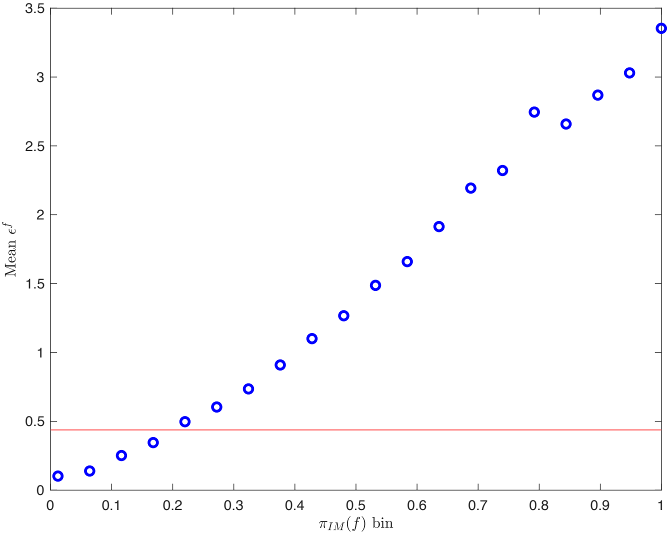
Back

ϵ^f and firm size



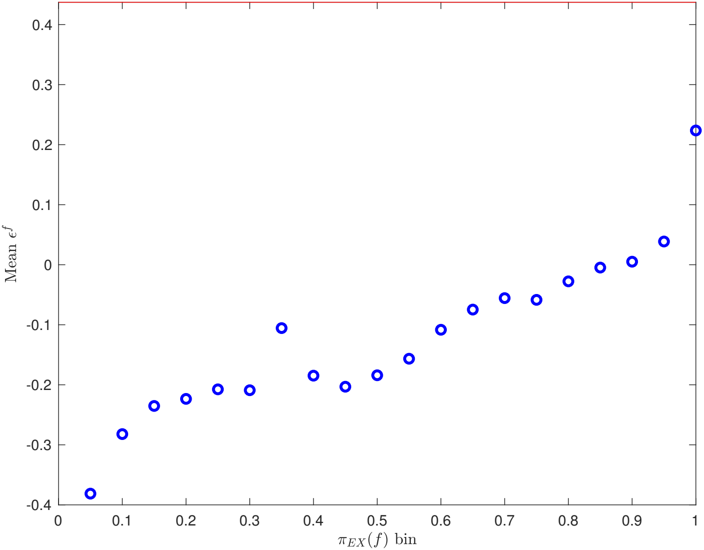
Note: red horizontal line indicates baseline value of ϵ^Y; x-axis is log-scale Back

ϵ^f and imported input share



Notes: red horizontal line indicates baseline value of ϵ^Y Back

ϵ^f and export intensity



Note: red horizontal line indicates baseline value of ϵ^Y Back

Contribution of foreign shocks to the granular residual I

- Elasticity of output of firm f to prod. shock in country n:

$$\epsilon_n^f \equiv d \ln Y_{m,t}(f) / d \ln a_{n,t}$$

- f's real value added growth rate due to the foreign shocks:

$$d \ln Y_{m,t}(f) = \sum_n \epsilon_n^f d \ln a_{n,t}$$

- Change in French GDP due to foreign shocks:

$$d \ln Y_{m,t}^F = \sum_f \omega_{m,t-1}(f) d \ln Y_{m,t}^F(f)$$

Contribution of foreign shocks to the granular residual II

- Define the *foreign granular residual* as the size-weighted firm deviation from the unweighted average (Gabaix, 2011):

$$\Gamma^F_{m,t} = \sum_f \omega_{m,t-1}(f) d \ln Y^F_{m,t}(f) - \frac{1}{N} \sum_f d \ln Y^F_{m,t}(f)$$

Contribution of foreign shocks to the granular residual II

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- Then overall change in the French GDP due to foreign shocks is

$$d \ln Y^F_{m,t} = \Gamma^F_{m,t} + E^F_{m,t},$$

where

$$E^F_{m,t} = \frac{1}{N} \sum_f d \ln Y^F_{m,t}$$

is the simple mean of the value added change across all French firms due to foreign shocks

Volatility of actual and foreign-induced GDP growth

Period	Standard deviation (% points)							
	Data		Foreign TFP			Foreign GDP		
	$d \ln Y_{m,t}$	$\Gamma_{m,t}$	$d \ln Y^F_{m,t}$	$\Gamma^F_{m,t}$	$E^F_{m,t}$	$d \ln Y^F_{m,t}$	$\Gamma^F_{m,t}$	$E^F_{m,t}$
1975-2014	1.54		0.38	0.26	0.12	0.16	0.11	0.05
1991-2007	1.11	0.96	0.37	0.25	0.13	0.11	0.07	0.04

Notes: This table reports the standard deviations of actual French GDP growth ($d \ln Y_{m,t}$), the actual French granular residual ($\Gamma_{m,t}$) and each component of $d \ln Y^F_{m,t}$

Data sources:

- French granular residual ($\Gamma_{m,t}$): di Giovanni et al. (2014)
- Foreign TFP: PWT v.9
- Foreign GDP: WDI

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