Product Mix and Firm Productivity Responses to Trade Competition

Thierry Mayer
Sciences-Po

Marc J. Melitz
Harvard University

Gianmarco I.P. Ottaviano
London School of Economics

Motivation: Trade, Reallocations, and Productivity

- Trade induces many different reallocations across firms and products:
  - Selection effects:
    - Which products are sold where (across domestic and export markets)
    - Which firms survive; which firms export (and where)
  - But also competition effects:
    - Conditional on selection (same products sold in a given market) – trade affects the relative market shares of those products
- These reallocations generate (endogenous) productivity changes that are independent of "technology"
  - ... which are reflected in additional aggregate welfare gains from trade (over and above gains from other channels, e.g. product variety, returns to scale, ...)

Outline

1. Measuring the reallocation effects of trade using multi-product firms
   $\longrightarrow$ Changes in the firm's product mix
2. What modeling "ingredients" are needed to explain these reallocations?
   - Theoretical model of multi-product firms – emphasizing demand conditions consistent with reallocations
   - Highlight link: Demand shocks in export markets $\longrightarrow$ Increased competition $\longrightarrow$ Product-mix reallocations $\longrightarrow$ Firm Productivity
3. Measure the impact of trade shocks on firm productivity
   - Highlight empirical relevance of product reallocation channel

Measuring the Reallocation Effects of Trade

- It is very hard to measure the reallocation effects across firms at the country/industry level:
  - Shocks that affect trade (institutions, technology, ...) are also likely to affect the distribution of market shares across firms
- Recent theoretical models of multi-product firms highlight how trade induces a similar pattern of reallocations within firms as it does across firms
- When measuring reallocations within multi-product firms, can:
  - Isolate trade shocks that are exogenous to individual firms – controlling for country/industry effects
  - Control for firm-level technology changes
  - Look at same set of (narrowly defined products) sold by same firm across destinations or time

Why Focus on Multi-Product Firms?

Table 3: Distribution of French exporters over products and markets[9]

Share of French exporters in 2003 (total number exporters: 99259)

	Number of countries			
No. of products	**1**	**5**	**10+**	**Total**
1	29.61	0.36	0.22	34.98
5	0.76	0.45	0.62	4.73
10+	0.95	0.89	10.72	18.57
Total	42.59	4.12	15.54	100

Share of French exports in 2003 (total exports: 314.3 billion €)

	Number of countries			
No. of products	**1**	**5**	**10+**	**Total**
1	0.7	0.08	0.38	1.86
5	0.3	0.08	1.06	1.97
10+	0.28	0.45	76.3	81.36
Total	2.85	1.55	85.44	100

Source: EFIM.

Measuring Product Mix Reallocations Within Multi-Product Firms

Similar Reallocations Across Firms and Within Multi-Product Firms

Firms

- Stable performance ranking for firms based on performance in any given market (including domestic market) or worldwide sales
- Better performing firms export to more destinations
- Worse performing firms are most likely to exit (overall, or from any given export market)

Products within Firms

- Stable performance ranking across destinations (and for worldwide sales)
- Better performing products are sold in more destinations
- Worse performing products are most likely to be dropped from any given market

Prices, Markups, and Pass-Through

Firms

- Larger, better perfoming firms set higher markups
- Incomplete pass-through of cost shocks to prices
  - 'More' incomplete for larger, better performing firms (Berman et al, 2012)

Products within Firms

- Similar pattern for multi-product Indian firms (Goldberg et al, 2012)

Data on French Multi-Product Exporters

- Comprehensive customs data for firm-product exports to 229 destinations (d) for 1995-2005 (t)
- Exclude service and wholesale/distribution firms (keep manufacturing and agriculture)
- Products recorded at 8-digit level (over 10,000 product codes)

Also country, sector (ISIC-3), and product (HS6) level trade for those destinations:

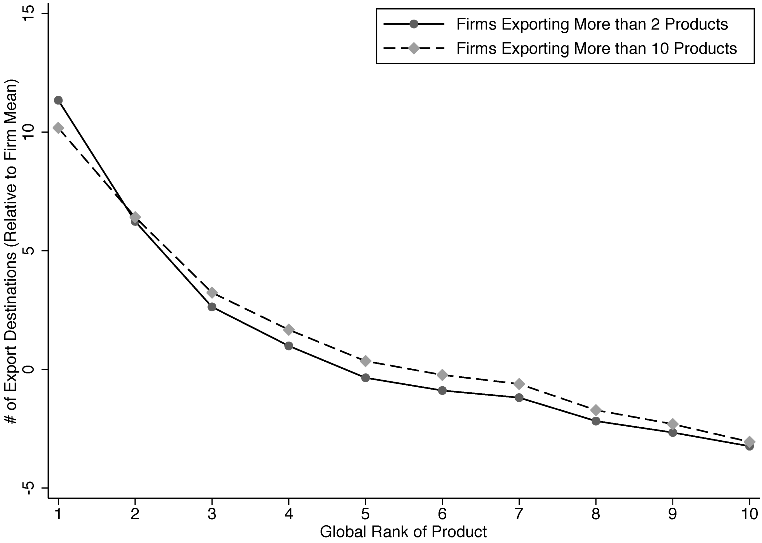
- GDP and other country level variables
- Imports by destination (d) at ISIC3 $(M^I_{d,t})$ and HS6 $(M^s_{d,t})$ level

Correlations Between Local and Global Rankings

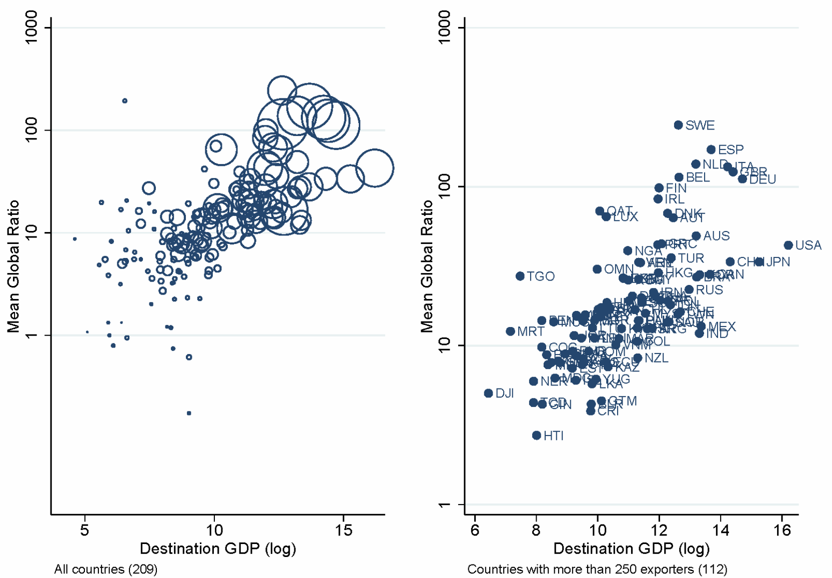
Table 1: Spearman Correlations Between Global and Local Rankings

Firms exporting at least:	# products				
to # countries	1	2	5	10	50
1	67.93%	67.78%	67.27%	66.26%	59.39%
2	67.82%	67.74%	67.28%	66.28%	59.39%
5	67.55%	67.51%	67.2%	66.3%	59.43%
10	67.02%	67%	66.82%	66.12%	59.46%
50	61.66%	61.66%	61.64%	61.53%	58.05%

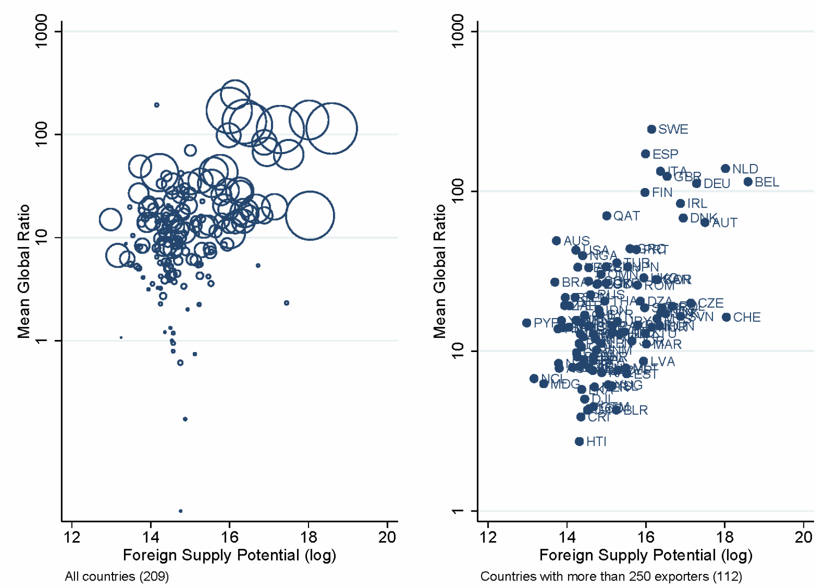
Global Ranking and Selection Into the Local Ranking



Mean Global Sales Ratio and Destination Market Size



Mean Global Sales Ratio and Foreign Supply Potential



Reallocations Over Time

Reallocations Over Time: Measuring Trade Shocks

- Changes in the destination markets over time also induce similar pattern of reallocations
- For all firms exporting to destination d, can measure change in
  - $\log GDP_{d,t}$
  - Total imports into d (in ISIC I) excluding French exports: $\log M^I_{d,t}$
  - Both capture demand shocks for French exporters to d (trade-induced for the case of $\log M^I_{d,t}$)

Reallocations Over Time: Measuring Trade Shocks

- Changes in the destination markets over time also induce similar pattern of reallocations
- For all firms exporting to destination d, can measure change in
  - $\log GDP_{d,t}$
  - Total imports into d (in ISIC I) excluding French exports: $\log M^{I}_{d,t}$
  - Both capture demand shocks for French exporters to d (trade-induced for the case of $\log M^{I}_{d,t}$)
- ... but we can also construct a firm i-specific measure of the trade-induced demand shock:

$$\text{shock}^{I}_{i,d,t} \equiv \overline{\log M^{s}_{d,t}} \quad \forall \text{ products } s \in I \text{ exported by firm } i \text{ to } d \text{ in } t_0$$

Reallocations Over Time: Measuring Trade Shocks

- Changes in the destination markets over time also induce similar pattern of reallocations
- For all firms exporting to destination d, can measure change in
  - $\log GDP_{d,t}$
  - Total imports into d (in ISIC I) excluding French exports: $\log M^{I}_{d,t}$
  - Both capture demand shocks for French exporters to d (trade-induced for the case of $\log M^{I}_{d,t}$)
- ... but we can also construct a firm i-specific measure of the trade-induced demand shock:

$$\text{shock}^{I}_{i,d,t} \equiv \overline{\log M^{s}_{d,t}} \quad \forall \text{ products } s \in I \text{ exported by firm } i \text{ to } d \text{ in } t_0$$

- For all of these demand shocks $X_t = GDP_{d,t}, M^{I}_{d,t}, M^{s}_{d,t}$, we compute the first difference as the Davis-Haltiwanger growth rate:

$$\tilde{\Delta} X_t \equiv \left(X_t - X_{t-1}\right) / \left(.5X_t + .5X_{t-1}\right).$$

$\longrightarrow$ Shocks in first differences: $\tilde{\Delta} GDP_{d,t}$, $\tilde{\Delta} M^{I}_{d,t}$, $\overline{\tilde{\Delta} M^{s}_{d,t}}$

Reallocations Over Time: Impact of Trade Shocks on Intensive and Extensive Margins of Firm Export

Dependent Variable	Δ log Exports per Product			Δ log # Products Exported		
$\tilde{\Delta}$ GDP Shock	0.486[a]			0.147[a]		
	(0.046)			(0.016)		
$\tilde{\Delta}$ Trade Shock		0.273[a]			0.075[a]	
		(0.009)			(0.004)	
$\tilde{\Delta}$ Trade Shock - ISIC			0.038[a]			0.014[a]
			(0.005)			(0.002)
Observations	396740	402522	402522	396740	402522	402522

Standard errors in parentheses: $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$

Reallocations Over Time: Skewness of Product Mix

Dependent Variable	$T^{I}_{i,d,t}$	$\Delta T^{I}_{i,d,t}$		$\Delta T^{I,\text{const}}_{i,d,t}$	
Specification	FE	FD	FD-FE	FD	FD-FE
GDP Shock	0.076^{a}				
	(0.016)				
Trade Shock	0.047^{a}				
	(0.005)				
Trade Shock - ISIC	0.002^{a}				
	(0.000)				
$\tilde{\Delta}$ GDP Shock		0.067^{a}	0.068^{a}	-0.005	-0.004
		(0.012)	(0.016)	(0.008)	(0.009)
$\tilde{\Delta}$ Trade Shock		0.036^{a}	0.032^{a}	0.012^{a}	0.012^{a}
		(0.005)	(0.006)	(0.003)	(0.003)
$\tilde{\Delta}$ Trade Shock - ISIC		0.006^{a}	0.004	0.002	0.004^{b}
		(0.002)	(0.003)	(0.001)	(0.002)
Observations	474506	396740	396740	437626	437626

Standard errors in parentheses: $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$

Theory: Reallocations and Structure of Demand

Motivation

- Demand shocks in a destination (in both cross-section and over time) affect the extensive margin of trade into that destination
- ... but also – for a fixed set of products exported to that destination – the shocks increase the relative market share of better performing products (product mix/intensive margin effect)
- The latter cannot be explained by C.E.S. preferences
- What demand and cost conditions are needed to deliver these reallocation results?

Motivation

- Demand shocks in a destination (in both cross-section and over time) affect the extensive margin of trade into that destination
- ... but also – for a fixed set of products exported to that destination – the shocks increase the relative market share of better performing products (product mix/intensive margin effect)
- The latter cannot be explained by C.E.S. preferences
- What demand and cost conditions are needed to deliver these reallocation results?
- Start with closed economy setup to emphasize demand structure and impact of demand shocks

Structure of Model: Consumers and Demand

- L^w unit of (homogeneous) workers representing $L^c \equiv \eta L^w$ consumers
    - Increase in demand: $L^w \nearrow$ (long run); $\eta \nearrow$ (short run)
- Preferences represented by additive separable utility over a continuum of imperfectly substitutable products. Each consumer solves:

$$\max_{x_i \geq 0} \int_0^M u(x_i) di \ s.t. \ \int_0^M p_i x_i di = 1$$

where $u(0) = 0$, $u(x_i) \geq 0$, $u'(x_i) > 0$, and $u''(x_i) < 0$
- This defines inverse demand $p(x_v)$ and the (inverse) price elasticity $\varepsilon_p(x_v)$
- Along with associated marginal revenue curve $r(x_v)$ and its elasticity $\varepsilon_r(x_v)$

Structure of Model: Firms and Products

- Continuum of firms with core cost competency c
- Each firm can produce a countable number of products $M(c)$
  - Products $m = 0, 1, 2, \ldots$ produced with marginal cost $v(m, c) = cz(m)$ with $z(0) = 1$ and $z'(m) > 0$
    $\longrightarrow$ This generates stable product ladder (also across destinations in open economy)
    - c and $z(m)$ summarize firm's technology
  - Along with overhead fixed cost f per product

Structure of Model: Firms and Products

- Continuum of firms with core cost competency c
- Each firm can produce a countable number of products $M(c)$
  - Products $m = 0, 1, 2, ...$ produced with marginal cost $v(m, c) = cz(m)$ with $z(0) = 1$ and $z'(m) > 0$
    $\longrightarrow$ This generates stable product ladder (also across destinations in open economy)
    - c and $z(m)$ summarize firm's technology
  - Along with overhead fixed cost f per product
- Optimization at product level given marginal cost v
  - Generates optimized choice of output x_v and price $p(x_v)$
  - and maximized operating profit $\pi^*(v, \lambda)$, where λ is marginal utility of income
- Zero-cutoff profit condition yields firm/product cost cutoff $\hat{c} = \hat{v}$: $\pi^*(\hat{c}, \lambda)L^c = f$

Structure of Model: Firm Entry

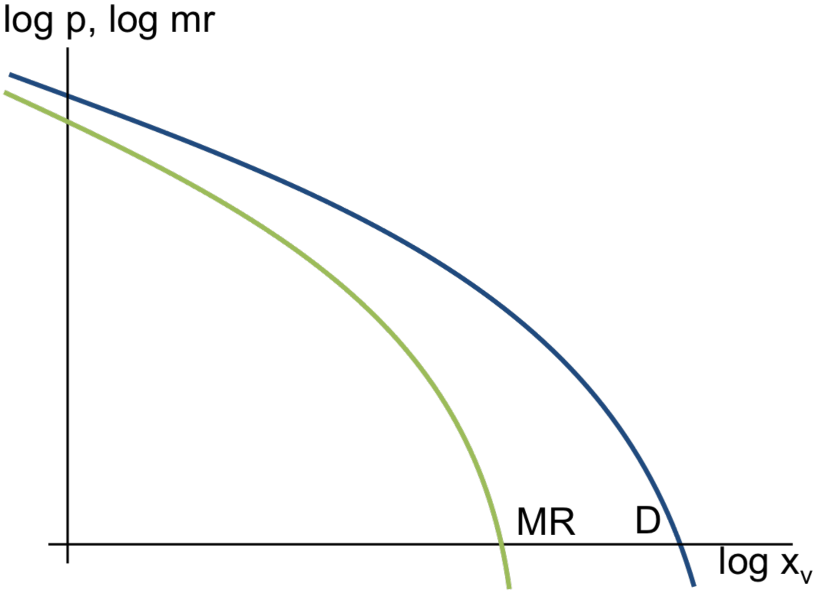
- Sunk entry cost f^e
- Ex-ante identical firms receive core competency draw c post-entry
  - Distribution $\Gamma(c)$
- Free entry condition equates expected firm (across product range) profit with sunk entry cost

$$\sum_{m=0}^{\infty} \left[\int_0^{\widehat{c}/z(m)} \left[\pi^* \left(cz(m), \lambda \right) \eta L^w - f \right] d\Gamma(c) \right] = f^e$$

Preferences and Reallocations

- In order to explain the empirical evidence on reallocations, the following additional assumptions for demand are needed:
  - The (inverse) price elasticity $\varepsilon_p(x_v)$ increases with output x_v
    - $\longrightarrow$ Higher markups on better performing products
  - The elasticity of marginal revenue $\varepsilon_r(x_v)$ increases with output x_v
  - $\longrightarrow$ Pass-through cannot be substantially higher for better performing products

Residual Demand and Marginal Revenue



Impact of Demand Shocks

Under those assumptions for residual demand, increases in demand ($L^w \nearrow$ in long run or $L^c \nearrow$ short run) lead to:

- Tougher competition:
  - Touhger selection for survival ($\hat{v} = \hat{c} \searrow$) and lower markups for all products (given cost v)

Impact of Demand Shocks

Under those assumptions for residual demand, increases in demand ($L^w \nearrow$ in long run or $L^c \nearrow$ short run) lead to:

- Tougher competition:
  - Touhger selection for survival ($\hat{v} = \hat{c} \searrow$) and lower markups for all products (given cost v)
- Higher relative sales (quantity and revenue) for better performing products
  - In levels: best performing products increase market share and profits whereas worse products experience declines in both

Impact of Demand Shocks

Under those assumptions for residual demand, increases in demand ($L^w \nearrow$ in long run or $L^c \nearrow$ short run) lead to:

- Tougher competition:
  - Touhger selection for survival ($\hat{v} = \hat{c} \searrow$) and lower markups for all products (given cost v)
- Higher relative sales (quantity and revenue) for better performing products
  - In levels: best performing products increase market share and profits whereas worse products experience declines in both
- Consequences for productivity:
  - So long as better performing products feature higher employment (MR not too steep), then the reallocations induced by the demand shock will increase firm productivity

The Model: Utility and Profit Maximization

- L^w identical households, each consisting of η workers
  - Each worker supplies $1/\eta$ efficiency units of labor inelastically: labor supply equals L^w while the total number of consumers equals $L^c = \eta L^w$
  - Efficiency units of labor per worker are chosen as numeraire: each consumer earns unit wage (and household income is η).
- Utility maximization problem:

$$\max_{x_i \geq 0} \int_0^M u(x_i) di \text{ s.t. } \int_0^M p_i x_i di = 1$$

- Profit maximization problem:

$$\max_{q_i \geq 0} \pi(q_i) = p_i q_i - v q_i - f$$

- Necessary and sufficient conditions for these problems are:
  - **(A1)** $u(x_i) \geq 0$ with $u(0) = 0$; $u'(x_i) > 0$ and $u''(x_i) < 0$ for $x_i \geq 0$
  - **(A2)** $\varepsilon_p(x_v) < 1$
  - **(A3)** $\varepsilon_r(x_v) > 0$
  - i.f.f. (A1), (A2) and (A3) hold there exists a unique output and price level for all varieties $x_v > 0$ and $p(x_v) > 0$, and for any given $\lambda > 0$

The Model: Conditions for Empirical Consistency

- De Loecker, Goldberg, Pavcnik and Khandelwal (NBER 2012) find that lower costs are associated with larger markups so that cost advantages are not fully passed through to prices
  - $\longrightarrow$ A necessary and sufficient condition for this is

$$\textbf{(B1)}\ \varepsilon_p'(x_v) > 0$$

- Berman, Martin and Mayer (QJE 2012) find that high-performance firms react to a real exchange depreciation by increasing significantly more their markup
  - $\longrightarrow$ Given (B1), a necessary and sufficient condition for this is

$$\textbf{(B2)}\ \frac{\varepsilon_p'(x_v)x_v}{\varepsilon_p(x_v)} < \frac{\varepsilon_r'(x_v)x_v}{\varepsilon_r(x_v)}$$

- Empirically lower cost firms/products are associated with larger employment
  - $\longrightarrow$ A necessary and sufficient condition for this is

$$\textbf{(B3)}\ \varepsilon_r(x_v) < 1$$

The Model: Effects of a Demand Shock

- Consider an additive separable utility function satisfying (A1)-(A3)
- Define a 'positive demand shock' as larger L^c due to larger η for given L^w
- Then:
  - **Lemma 1.** A positive demand shock increases the marginal utility of income.
  - **Proposition 1 - Extensive margin adjustment.** *(B1) is necessary and sufficient for a positive demand shock to reduce the cost cutoff*, thus increasing multi-product firm productivity through extensive margin adjustment. (B1) is also necessary and sufficient for a positive demand shock to increase (decrease) profit for low (high) cost products.
  - **Proposition 2 - Intensive margin adjustment.** (B1) and (B2) are sufficient for a positive demand shock to reallocate output and revenue from higher to lower cost products. *As long as (B3) holds, assumptions (B1) and (B2) are* also *sufficient for a positive demand shock to reallocate employment from higher to lower cost products*, thus increasing multi-product firm productivity through intensive margin adjustment.

Open Economy Model

- 3 countries: destination D, France F, and W (ROW)
- Per unit trade costs τ and fixed export costs f_X
- In order to focus on trade shocks and competition in D:
  - Assume that D is small relative to F and W
    $\longrightarrow$ Demand shocks in D do not affect country-wide equilibrium variables in F or W (Apart from those related to exports to D)
  - Do not model any feedback loop from changes in exports from D
- $\longrightarrow$ Focus on equilibrium response in D

Open Economy: Impact of Demand Shock in D

- In both the short run ($\eta \nearrow$) and long run ($L^w \nearrow$):
- Tougher competition in D: for survival $\hat{v}_{DD} = \hat{c}_{DD} \searrow$ and lower markups for all products (given cost v)
- For all sellers in D:
  - Higher relative sales for better performing products
    - In levels: best performing products increase market share and profits whereas worse products experience declines in both

Open Economy: Impact of Demand Shock in D

- In both the short run ($\eta \nearrow$) and long run ($L^w \nearrow$):
- Tougher competition in D: for survival $\hat{v}_{DD} = \hat{c}_{DD} \searrow$ and lower markups for all products (given cost v)
- For all sellers in D:
  - Higher relative sales for better performing products
    - In levels: best performing products increase market share and profits whereas worse products experience declines in both
- Consequences for productivity: For given set of products sold in D, productivity increases for that exported bundle

Open Economy: Impact of Demand Shock in D

- In both the short run ($\eta \nearrow$) and long run ($L^w \nearrow$):
- Tougher competition in D: for survival $\hat{v}_{DD} = \hat{c}_{DD} \searrow$ and lower markups for all products (given cost v)
- For all sellers in D:
    - Higher relative sales for better performing products
        - In levels: best performing products increase market share and profits whereas worse products experience declines in both
- Consequences for productivity: For given set of products sold in D, productivity increases for that exported bundle
- Selection: If f_X is high enough, then selection for exported products goes in opposite direction than domestic selection
    - Export cutoff $\hat{v}_{XD} = \hat{c}_{XD} \nearrow$ generates entry of new exported products (and new exporters)
    - Increase in intensive margin of exports to D for all products
    - $\longrightarrow$ Increase in overall firm exports to D and aggregate exports from F and W to D

Impact of Trade Shocks on Firm Productivity

New Data and Productivity

- Merge trade data with production data (comprehensive annual census)
  - Adds firm level variables (by year) for input and output use
- Measure productivity as deflated value-added per worker

New Data and Productivity

- Merge trade data with production data (comprehensive annual census)
  - Adds firm level variables (by year) for input and output use
- Measure productivity as deflated value-added per worker
  - Aggregates (using firm labor shares) to welfare-relevant real value-added per worker for French manufacturing (so long as industry price deflators are accurately measured)

Aggregating Destination Demand Shocks to Firm-Level

- Main idea: Use firm/destination specific trade shocks to create exogenous (to the firm) measure of trade exposure over time
- Aggregate destination-level trade shock to the firm-level:

$$\text{shock}_{i,t} = \sum_{d,I} s^{I}_{i,d,t_0} \cdot \text{shock}^{I}_{i,d,t} \quad \text{and} \quad \tilde{\Delta}\text{shock}_{i,t} = \sum_{d,I} s^{I}_{i,d,t-1} \cdot \tilde{\Delta}\text{shock}^{I}_{i,d,t}$$

Aggregating Destination Demand Shocks to Firm-Level

- Main idea: Use firm/destination specific trade shocks to create exogenous (to the firm) measure of trade exposure over time
- Aggregate destination-level trade shock to the firm-level:

$$\text{shock}_{i,t} = \sum_{d,I} s^I_{i,d,t_0} \cdot \text{shock}^I_{i,d,t} \quad \text{and} \quad \tilde{\Delta}\text{shock}_{i,t} = \sum_{d,I} s^I_{i,d,t-1} \cdot \tilde{\Delta}\text{shock}^I_{i,d,t}$$

- This aggregation only includes shocks for export market (but not for domestic market)
- Since cannot measure exogenous shocks for domestic market, adjust shock to reflect export intensity (i.e. adjust market shares $s_{i,d}$ to reflect sales in domestic market)

$$\text{shock}_{i,t} \times \text{export intensity}_{i,t_0} \quad \text{and} \quad \tilde{\Delta}\text{shock}_{i,t} \times \text{export intensity}_{i,t-1}$$

Aggregating Destination Demand Shocks to Firm-Level

- Main idea: Use firm/destination specific trade shocks to create exogenous (to the firm) measure of trade exposure over time
- Aggregate destination-level trade shock to the firm-level:

$$\text{shock}_{i,t} = \sum_{d,l} s^{l}_{i,d,t_0} \cdot \text{shock}^{l}_{i,d,t} \quad \text{and} \quad \tilde{\Delta}\text{shock}_{i,t} = \sum_{d,l} s^{l}_{i,d,t-1} \cdot \tilde{\Delta}\text{shock}^{l}_{i,d,t}$$

- This aggregation only includes shocks for export market (but not for domestic market)
- Since cannot measure exogenous shocks for domestic market, adjust shock to reflect export intensity (i.e. adjust market shares $s_{i,d}$ to reflect sales in domestic market)

$$\text{shock}_{i,t} \times \text{export intensity}_{i,t_0} \quad \text{and} \quad \tilde{\Delta}\text{shock}_{i,t} \times \text{export intensity}_{i,t-1}$$

- Note: Use t_0 for levels and $t-1$ for first difference: shocks are exogenous to firm decisions in $t > t_0$ (levels) or firm level changes Δ_t (FD)
  $\longrightarrow$ Changes in the set of exported products or exported market shares are not reflected in shock

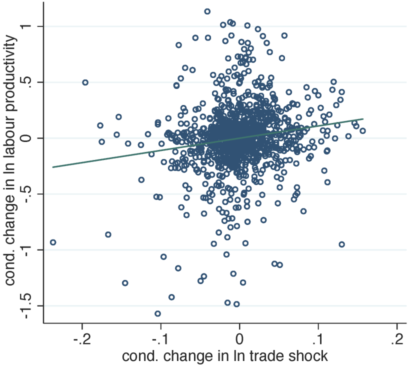
Impact of Demand Shocks on Firm Productivity

Dependent Variable	log prod.	Δ log prod.		log prod.	Δ log prod.	
Specification	FE	FD	FD-FE	FE	FD	FD-FE
log (shock×exp intens)	0.094^a			0.073^a		
	(0.019)			(0.018)		
$\tilde{\Delta}$ (shock×exp intens)		0.134^a	0.116^a		0.108^a	0.096^a
		(0.024)	(0.028)		(0.024)	(0.028)
log K/L				0.228^a		
				(0.007)		
log raw materials				0.091^a		
				(0.004)		
Δ log K/L					0.327^a	0.358^a
					(0.008)	(0.009)
Δ log raw materials					0.100^a	0.093^a
					(0.004)	(0.004)
Observations	213877	188328	188328	201627	174931	174931

Standard errors in parentheses: $^c < 0.1$, $^b < 0.05$, $^a < 0.01$

Impact of Demand Shocks on Firm Productivity: Largest French Exporters

regression line: coef = .783, se = .198, N = 1063
sample: 167 firms representing 50% of French exports in 1996



regression line: coef = 1.094, se = .263, N = 1040
sample: 167 firms representing 50% of French exports in 1996
standard errors clustered by firm

Robustness – No Reponse of Investment

Dependent Variable	ln K/L	Δ ln K/L	Δ ln K/L
Specification	FE	FD	FD-FE
log (trade shock $\times$ export intens.)	-0.018		
	(0.018)		
$\tilde{\Delta}$ (trade shock $\times$ export intens.)		-0.003	-0.005
		(0.017)	(0.020)
Observations	212745	186171	186171

Standard errors in parentheses: $^{c} < 0.1$, $^{b} < 0.05$, $^{a} < 0.01$

Robustness – Returns to Scale

Sample	Employment Increase	Employment Decrease
Dependent Variable	Δ log productivity	Δ log productivity
Specification	FD	FD
$\tilde{\Delta}$ (trade shock $\times$ export intens.)	0.135^a	0.156^a
	(0.035)	(0.045)
Δ log capital stock per worker	0.288^a	0.332^a
	(0.012)	(0.013)
Δ log raw materials	0.091^a	0.097^a
	(0.005)	(0.005)
Observations	69642	65268

Standard errors in parentheses: $^c < 0.1$, $^b < 0.05$, $^a < 0.01$

Robustness – Single Product Firms

Sample	Single Product Firms		
Dependent Variable	log prod.	Δ log prod.	
Specification	FE	FD	FD-FE
log (trade shock × export intens.)	0.005		
	(0.050)		
log capital stock per worker	0.269[a]		
	(0.016)		
log raw materials	0.101[a]		
	(0.010)		
$\tilde{\Delta}$ (trade shock × export intens.)		-0.021	-0.138[c]
		(0.062)	(0.079)
Δ log capital stock per worker		0.368[a]	0.415[a]
		(0.020)	(0.028)
Δ log raw materials		0.114[a]	0.090[a]
		(0.010)	(0.013)
Observations	32870	25330	25330

Robustness – Low/High Export Intensity

Sample	exp. intens. quartile # 1			exp. intens. quartile # 4		
Dependent Variable	log prod.	Δ log prod.		log prod.	Δ log prod.	
Specification	FE	FD	FD-FE	FE	FD	FD-FE
log trade shock	0.009			0.068[a]		
	(0.006)			(0.014)		
log K/L	0.278[a]			0.217[a]		
	(0.022)			(0.015)		
log raw materials	0.070[a]			0.128[a]		
	(0.006)			(0.010)		
$\tilde{\Delta}$ trade shock		0.000	-0.002		0.096[a]	0.100[a]
		(0.007)	(0.009)		(0.017)	(0.021)
Δ log K/L		0.323[a]	0.367[a]		0.325[a]	0.368[a]
		(0.016)	(0.020)		(0.014)	(0.016)
Δ log raw materials		0.070[a]	0.057[a]		0.129[a]	0.123[a]
		(0.006)	(0.006)		(0.008)	(0.010)
Observations	49227	38894	38894	53125	46347	46347

Reallocation Channel? Aggregating from Destination Level to Firm Level

- Trade shocks affect reallocations at destination level
- Effects of reallocations on productivity should come through global sales (i.e. overall production)
- Can aggregation of skewness responses at destination level be used to predict skewness of global sales?

Reallocation Channel? Aggregating from Destination Level to Firm Level

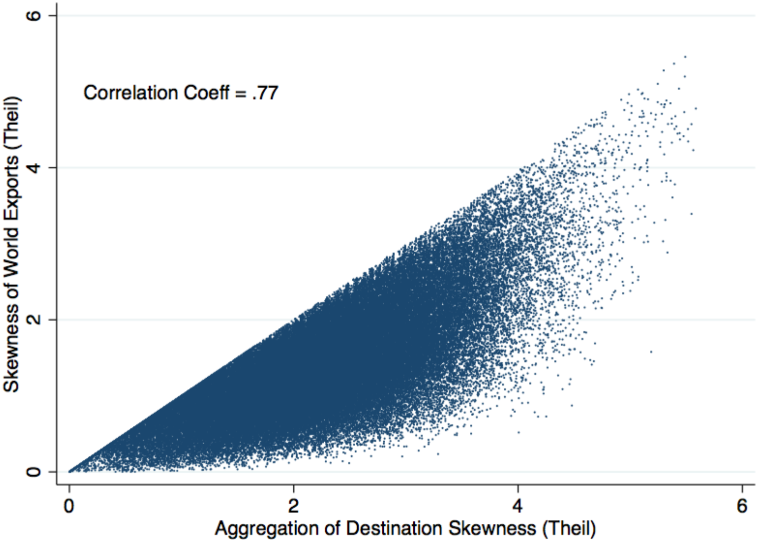
- Trade shocks affect reallocations at destination level
- Effects of reallocations on productivity should come through global sales (i.e. overall production)
- Can aggregation of skewness responses at destination level be used to predict skewness of global sales?
- Yes: If skewness is measured using Theil index
  - Can write skewness of global export as aggregation of destination skewness:

$$T_{i,t} = \sum_d s_{d,i,t} T_{idt} - \text{Between Theil (across } d\text{)}$$

  - Skewness of global production (including domestic sales) is then

$$\text{export intensity}_{i,t} \times T_{i,t} - \text{Between Theil (across export-domestic sales)}$$

Aggregating Product Skewness



Effect of Firm-Level Trade Shocks on Global Skewness

Dependent Variable	$T_{i,t}$	$\Delta T_{i,t}$		Exp. Intens$_{i,t}$	Δ Exp. Intens$_{i,t}$	
Specification	FE	FD	FD-FE	FE	FD	FD-FE
log GDP shock	-0.001			0.003[a]		
	(0.004)			(0.001)		
log trade shock	0.045[a]			0.014[a]		
	(0.009)			(0.003)		
log trade shock - ISIC	-0.001			0.000		
	(0.001)			(0.000)		
$\tilde{\Delta}$ GDP shock		0.118[a]	0.107[a]		0.032[a]	0.035[a]
		(0.031)	(0.038)		(0.010)	(0.012)
$\tilde{\Delta}$ trade shock		0.057[a]	0.050[a]		0.019[a]	0.016[a]
		(0.011)	(0.013)		(0.003)	(0.004)
$\tilde{\Delta}$ trade shock - ISIC		-0.003	-0.010		0.002	0.000
		(0.005)	(0.007)		(0.002)	(0.002)
	(0.110)	(0.004)	(0.004)	(0.030)	(0.001)	(0.001)
Observations	117851	117851	117851	110565	107283	107283

Impact of Global Skewness on Firm Productivity

	OLS			IV – 2SLS		
Dependent Variable	log prod.	Δ log productivity		log prod.	Δ log productivity	
Specification	FE	FD	FD-FE	FE	FD	FD-FE
$T_{i,t}$ × export intens.	0.114^a			0.709^a		
	(0.009)			(0.226)		
log K/L	0.217^a			0.218^a		
	(0.010)			(0.010)		
log raw materials	0.088^a			0.062^a		
	(0.004)			(0.011)		
$\tilde{\Delta}$ $T_{i,t}$ × export intens.		0.095^a	0.091^a		1.167^a	0.996^a
		(0.008)	(0.009)		(0.170)	(0.202)
Δ log K/L		0.317^a	0.351^a		0.317^a	0.351^a
		(0.012)	(0.014)		(0.013)	(0.015)
Δ log raw materials		0.089^a	0.088^a		0.065^a	0.071^a
		(0.005)	(0.005)		(0.006)	(0.007)
	(0.056)	(0.003)	(0.004)		(0.004)	
Observations	131047	99490	99490	126367	99490	95895

Conclusion

- Demand shocks in export markets lead French multi-product exporters to reallocate sales towards their best performing products in those markets
- The best performing products in each market are also the firm's best performing global products – so the demand shocks lead to a reallocation of overall production towards better performing products
- Our theoretical model derives the demand and cost conditions that are needed to generate these reallocations
  - ... and highlights the associated increase in competition associated with the demand shocks
- Empirically, we find that the demand shocks induce large and substantial productivity responses for multi-product French exporters