The Effects of Free Trade Agreements on Product-level Trade
(preliminary)

Scott French
UNSW

Thomas Zylkin
Richmond

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Motivation

Two provocative findings that illustrate limits of our knowledge about **free trade agreements**:

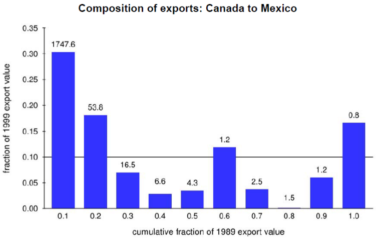
1. Baier and Bergstrand (2007): average trade creation effects of FTAs too large to be explained by tariffs

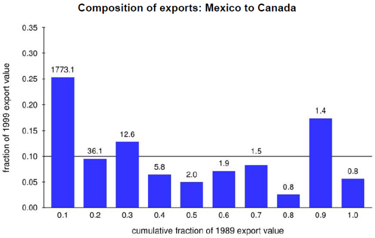
2. Kehoe and Ruhl (2013) critique of CGE model predictions:
    - ⋄ Models tended to underpredict trade creation for products that are only lightly-traded *ex ante*

    ⇒ Hypothesis: prevalence of non-traded/lightly trade products creates potential for "explosive trade creation" *ex post*

Surprisingly little work has been done to synthesize these observations

NAFTA Example





- Figures show concentration of Mexico-Canada post-NAFTA trade growth in "least-traded" products (LTPs)
- Taken from Kehoe and Ruhl (2013)

Our Objectives (3)

1. **Construct new estimates of the *aggregate* effects of FTAs on trade using *product-level* data**
   - Exploit "adding up" properties of PPML to reconcile product-level and aggregate-level estimates.
   - Addresses micro-level "composition bias" in standard estimates using aggregate data
   - Allows us to assess which subsets of products have grown faster than others
2. **Test "less-traded products" = "explosive trade growth" story**
   - Data: product-level (5 digit SITC rev 3) trade between 116 countries observed between 1991 and 2015
3. **Establish new facts about how FTAs affect product-level changes in trade**:
   - Demonstrate aggregation bias in standard estimates based on aggregate data
   - Can isolate how much of trade growth is due to least-traded products vs. moderately and heavily traded products

What's New?

The related literature generally takes one of two approaches

"Event study" approach:

- focus on two-country settings and/or specific agreements

  e.g., Kehoe and Ruhl (2013), Kehoe et al. (2015), Ruhl and Willis (2017), Kohn et al. (2016)
- Disadvantage: cannot disentangle (bilateral) effects of FTA from (multilateral) effects of technological change, comparative advantage, local market conditions, multilateral resistance, exchange rate changes, etc.

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"Margin decomposition":

- decompose aggregate trade growth into extensive / intensive margins

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- Disadvantage: once a least-traded product is no longer "least-traded", it no longer contributes to extensive margin growth, no matter how fast trade grows for that product.

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Our approach: ***Pooled, product-level* gravity estimation.**

- Allows us to extract overall "average partial effects" of FTAs which:
  i. account for product-level multilateral effects;
  ii. allow decompositions of trade growth at the product level;
  iii. address "aggregation bias" in aggregate estimates

Results

Main result: We confirm less-intensively traded products (LTPs) experience relatively faster rates of trade creation after liberalization.

Details:

- LTPs contribute ~100% of trade growth following liberalization.
- The LTP decile (bottom 10%) is the only decile with significant avg. trade growth, across many different specifications.
- For higher deciles (above 40%), trade growth is always negative (!) and significant.
- Trade costs are generally falling faster for less-traded products relative to more traded products; matters somewhat for aggregate estimates
- Product-level FTA estimates suggest upward bias in aggregate estimates of trade cost reduction effects of FTAs
  - Suggests additional channel for FTA trade creation effects: strengthening in bilateral comparative advantages that otherwise would be measured as trade cost reductions.

Related literature

Estimating the effects of FTAs using panel data:

Baier and Bergstrand (2007); Yotov et al. (2016); Larch et al. (2017); Weidner and Zylkin (2019)

Product-level gravity and aggregation bias in aggregate-level estimates:

French (2016, 2017)

The "extensive margin" of trade:

Hummels and Klenow (2005); Arkolakis et al. (2008); Besedeš and Prusa (2011)

Trade growth in new products following FTAs:

Arkolakis (2010); Kehoe and Ruhl (2013); Baier et al. (2014); Kehoe et al. (2015); Besedeš et al. (2015); Kohn et al. (2016); Ruhl and Willis (2017)

Aggregate-level Gravity

For *aggregate*-level trade data, the standard gravity equation for estimating FTA effects is well-known:

$$X_{ijt} = \exp\left(\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right) + \varepsilon_{ijt}. \tag{1}$$

- $\mathbf{FTA}_{ijt}$: a set of (time-varying) dummies for the presence of a bilateral trade agreement.
- δ_{it} and ψ_{jt}: *exporter-time* and *importer-time* FEs to account for GE terms
- η_{ij}: *time-invariant* bilateral FE to absorb ex ante trade frictions
- PPML leads to consistent estimates (Santos Silva and Tenreyro, 2006; Weidner and Zylkin, 2019)

Baseline objective: estimate β, the "average partial effect" of signing a trade agreement.

Pooled, Product-level Gravity

To account for aggregation bias, our proposed alternative is *pooled*, *product-level* gravity

$$X_{ijkt} = \exp\left(\delta_{ikt} + \psi_{jkt} + \eta_{ijk} + \beta \mathbf{FTA}_{ijt}\right) + \varepsilon_{ijkt}. \tag{2}$$

- δ_{ikt}, ψ_{jkt}: *exp-product-time* and *imp-product-time* FEs to account for changes in comp. advantage, demand patterns
- η_{ikj}: time-invariant *product-pair* FE to account for product-level heterogeneity in ex ante trade barriers

Baseline objective remains the same:

Estimate the "average partial effect" of signing a trade agreement on *aggregate* trade flows, only now pooling across product-level trade flows.

LTPs

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$$X_{ijkt} = \exp\left(\delta_{ikt} + \psi_{jkt} + \eta_{ijk} + \beta \mathbf{FTA}_{ijt}\right) + \varepsilon_{ijkt}. \tag{2}$$

To test if least-traded products grow faster than other products, we use

$$X_{ijkt} = \exp\left(\delta_{ikt} + \psi_{jkt} + \eta_{ijk} + \beta_1 \mathbf{FTA}_{ijt} + \beta_2 \mathbf{FTA}_{ijt} \times \mathbf{1}_{k \notin \Omega^*_{ij}}\right) + \varepsilon_{ijkt}, \tag{3}$$

where $\mathbf{1}_{k \notin \Omega^*_{ij}}$ equals 1 if k was a "least traded product" before i and j' s agreement

▸ LTPs

PPML and Consistent Aggregation Across Products

It adds up! The product-level PPML model nests the aggregate model as special case:

$$
\begin{aligned}
\delta_{it} &: \quad \sum_j \sum_k X_{ijkt} - \exp\left[\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right] = 0 \\
\psi_{jt} &: \quad \sum_i \sum_k X_{ijkt} - \exp\left[\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right] = 0 \\
\eta_{ij} &: \quad \sum_t \sum_k X_{ijkt} - \exp\left[\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right] = 0 \\
\beta &: \quad \sum_{\mathbf{FTA}=\mathbf{1}} \sum_k X_{ijkt} - \exp\left[\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right] = 0,
\end{aligned}
$$

$\sum_k X_{ijkt} = X_{ijt}$ ensures FOCs consistently aggregate if $\delta_{ikt} = \delta_{it}$; $\psi_{jkt} = \psi_{jt}$; $\eta_{ijk} = \eta_{ij}$.

$\Longrightarrow$ product-level estimates should be directly comparable with aggregate estimates

$\Longrightarrow$ enables us to explicitly assess product-level heterogeneity, differential rates of trade growth.

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\psi_{jt}: &\quad \sum_i X_{ijkt} - \exp\left[\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right] = 0 \\
\eta_{ij}: &\quad \sum_t X_{ijkt} - \exp\left[\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right] = 0 \\
\beta: &\quad \sum_{\mathbf{FTA}=1} X_{ijkt} - \exp\left[\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right] = 0,
\end{aligned}$$

$\sum_k X_{ijkt} = X_{ijt}$ ensures FOCs consistently aggregate if $\delta_{ikt} = \delta_{it}$; $\psi_{jkt} = \psi_{jt}$; $\eta_{ijk} = \eta_{ij}$.

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Data Sources

Trade data: UN COMTRADE (5 digit SITC sitc rev3, 1991-2015, manufacturing only)

- The most disaggregated level for SITC trade (2,771 manufacturing products)
- Due to switches in code assignments from SITC rev. 2 to HS/SITC rev. 3, we only include countries after they adopt SITC rev. 3.
- 116 largest countries by average annual trade volume, every 4 years
- Product-level model involves 3 million - 10 million FEs, depending on specification

Preferential trade agreements

- FTAs from NSF-Kellogg Database (Baier et al., 2014), which we extend ourselves to 2015
- Breaks out PTAs/FTAs into multiple categories based on depth of liberalization

▸ countries ▸ FTAs

Aggregate-level Results

	Dependent variable: Aggregate Manufacturing Flows, 1991-2015							
	PPML							*OLS*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All FTAs	0.113***			-0.021	0.157***			
	(0.034)			(0.046)	(0.033)			
All FTAs, 4 yr lag				0.142***				
				(0.043)				
All FTAs, lead					-0.051			
					(0.037)			
Regular FTAs		0.112***	0.102***			-0.030	0.110***	0.144***
		(0.034)	(0.039)			(0.046)	(0.034)	(0.031)
Regular FTAs, 4 yr lag						0.150***		
						(0.043)		
Deep FTAs		0.155***	0.141**			0.125	0.149***	0.314***
		(0.054)	(0.058)			(0.086)	(0.053)	(0.053)
Deep FTAs, 4 yr lag						0.035		
						(0.077)		
GSP			-0.007					
			(0.046)					
Non-FTA PTAs			-0.043					
			(0.048)					
Total FTA Effects (main effect + 4 year lag)								
All FTAs, total				0.121***				
				(0.034)				
Regular FTAs, total						0.120***		
						(0.034)		
Deep FTAs, total						0.161***		
						(0.054)		
Exporter-time FEs	×	×	×	×	×	×	×	×
Importer-time FEs	×	×	×	×	×	×	×	×
Pair FEs	×	×	×	×	×	×	×	×
"Zeroes"	×	×	×	×	×	×		
Observations	60614	60614	60614	60614	60614	60614	56201	56201

Bilateral manufacturing trade flows between 116 countries over the period 1991-2015, using every 4 years. "Deep" FTA refers to customs unions and/or common markets. Standard errors, which appear in parentheses, are multi-way clustered by source, destination, and year. * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Extensive Margin / Intensive Margin Decomposition

As in Baier et al. (2014), we can use a Hummels and Klenow (2005) decomposition of aggregate trade flows to measure to what extent FTAs promote trade in more products (*extensive margin*) vs. more trade in products that are already traded (*intensive margin*):

- Extensive margin ("*EM*"): # of products traded (weighted by share of imports from all partners)

$$EM_{ijt} = \frac{\sum_{k \in \Omega_{ij}} X_{Wjkt}}{\sum_{k \in \Omega_{Wj}} X_{Wjkt}}.$$

- Intensive margin ("*IM*"): i's market share in j's import market, for the goods that i exports to j

$$IM_{ijt} = \frac{\sum_{k \in \Omega_{ij}} X_{ijkt}}{\sum_{k \in \Omega_{ij}} X_{Wjkt}}.$$

- Note that

$$\ln EM_{ijt} + \ln IM_{ijt} = \ln \sum_{k \in \Omega_{ij}} X_{ijkt} - \ln \sum_{k \in \Omega_{Wj}} X_{Wjkt} = \ln X_{ijt} / X_{Wjt},$$

which allows for an intuitive decomposition of aggregate trade.

“Extensive Margin” vs. “Intensive Margin” (OLS)

	Dependent variables (based on Aggregate Manufacturing Trade)								
	ln *Trade*	ln *EM*	ln *IM*	ln *Trade*	ln *EM*	ln *IM*	ln *Trade*	ln *EM*	ln *IM*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
All FTAs	0.149***	0.056**	0.087***	0.071	0.243***	-0.192***			
	(0.031)	(0.023)	(0.027)	(0.052)	(0.044)	(0.052)			
All FTAs, 4 yr lag				0.082	-0.198***	0.295***			
				(0.051)	(0.041)	(0.050)			
Regular FTAs							0.144***	0.053**	0.085***
							(0.031)	(0.023)	(0.027)
Deep FTAs							0.314***	0.180***	0.153***
							(0.053)	(0.044)	(0.050)
Total FTA Effects (main effect + 4 year lag)									
All FTAs, total				0.153***	0.046*	0.103***			
				(0.032)	(0.023)	(0.027)			
Exporter-time FEs	×	×	×	×	×	×	×	×	×
Importer-time FEs	×	×	×	×	×	×	×	×	×
Pair FEs	×	×	×	×	×	×	×	×	×
Observations	56201	54169	53924	56201	54169	53924	56201	54169	53924

Aggregate bilateral trade flows between 116 countries over the period 1991-2015, using every 4 years. “Deep” FTA refers to customs unions and/or common markets. Standard errors, which appear in parentheses, are clustered by pair. * $p < 0.10$, ** $p < .05$, *** $p < .01$.

- These results create the impression that most of the effect of FTAs on trade is through the *intensive* margin.

Product-level Results (Reveals aggregation bias)

	Dependent variable: SITC3 *5 digit* Trade Flows 1991-2015						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All FTAs	0.113***						
	(0.034)						
All FTAs, 4 yr lag							
All FTAs, 4 yr lead							
Regular FTAs							
Deep FTAs							
Total FTA Effects (main effect + 4 year lag)							
All FTAs, total							
Exporter-time FEs	x						
Importer-time FEs	x						
Pair FEs	x						
Exporter-product-time FEs							
Importer-product-time FEs							
Product-pair FEs							
Observations	42,721,982						

Pooled, unbalanced sample of 5 digit SITC3 bilateral trade flows for 2,771 product categories between 116 countries over the period 1991-2015, using every 4 years. Standard errors are clustered by pair . * $p < 0.10$, ** $p < .05$, *** $p < .01$.

If we keep the FEs the same, pooling across disaggregated products leads to the *exact same estimates* we found for aggregate data. This is due to the special properties of PPML.

Product-level Results (Reveals aggregation bias)

	Dependent variable: SITC3 *5 digit* Trade Flows 1991-2015						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All FTAs	0.113***	0.069***	0.114***	0.054***			
	(0.034)	(0.022)	(0.034)	(0.020)			
All FTAs, 4 yr lag							
All FTAs, 4 yr lead							
Regular FTAs							
Deep FTAs							
Total FTA Effects (main effect + 4 year lag)							
All FTAs, total							
Exporter-time FEs	x		x				
Importer-time FEs	x		x				
Pair FEs	x	x					
Exporter-product-time FEs		x		x			
Importer-product-time FEs		x		x			
Product-pair FEs			x	x			
Observations	42,721,982	39,769,036	42,692,796	39,663,541			

Pooled, unbalanced sample of 5 digit SITC3 bilateral trade flows for 2,771 product categories between 116 countries over the period 1991-2015, using every 4 years. Standard errors are clustered by pair . * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Interacting the different fixed effects with the product dimension then isolates different sources of aggregation bias.

Product-level Results (Reveals aggregation bias)

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All FTAs	0.113***	0.069***	0.114***	0.054***		0.061***	0.055***
	(0.034)	(0.022)	(0.034)	(0.020)		(0.019)	(0.017)
All FTAs, 4 yr lag						-0.020	
						(0.015)	
All FTAs, 4 yr lead							-0.001
							(0.020)
Regular FTAs					0.052***		
					(0.020)		
Deep FTAs					0.153***		
					(0.040)		
Total FTA Effects (main effect + 4 year lag)							
All FTAs, total						0.040	
						(0.025)	
Exporter-time FEs	x		x				
Importer-time FEs	x		x				
Pair FEs	x	x					
Exporter-product-time FEs		x		x	x	x	x
Importer-product-time FEs		x		x	x	x	x
Product-pair FEs			x	x	x	x	x
Observations	42,721,982	39,769,036	42,692,796	39,663,541	39,663,541	39,663,541	38,216,197

Pooled, unbalanced sample of 5 digit SITC3 bilateral trade flows for 2,771 product categories between 116 countries over the period 1991-2015, using every 4 years. Standard errors are clustered by pair . * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Other specifications yield different conclusions than what we saw w/ aggregate data. Column 5 shows Deep FTAs have much larger effects than other FTAs. Column 6 fails to find lagged effects of FTAs.

More Disaggregated Results

	Dependent variable: SITC3 Manufacturing Trade 1991-2015					
	Aggregate	*1 digit SITC*	*2 digit SITC*	*3 digit SITC*	*4 digit SITC*	*5 digit SITC*
	(1)	(2)	(3)	(4)	(5)	(6)
All FTAs	0.113***	0.075***	0.058***	0.057***	0.057***	0.054***
	(0.034)	(0.025)	(0.021)	(0.020)	(0.019)	(0.020)
# products / industries	1	10	63	231	895	2,771
Observations	60,614	449,390	2,295,015	6,743,206	18,795,101	39,663,541

Pooled, unbalanced sample of SITC3 bilateral trade flows between 116 countries over the period 1991-2015, using every 4 years. All estimates include exporter-(SITC)-time, importer-(SITC)-time, and exporter-importer-(SITC) FEs. Standard errors are clustered by pair. * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Sidebar: why are product-level results and aggregate results different?

Using the model from French (2016), the elasticity of aggregate trade with respect to trade barriers is

$$\varepsilon_{ij} = -\theta + \frac{\partial \left(\widetilde{T}_{ij} / \widetilde{T}_{jj} \right)}{\partial \ln d_{ij}}$$

where

- θ: typical trade elasticity parameter (think Frechet disp. parameter from an Eaton-Kortum model)
- $\widetilde{T}_{ij} / \widetilde{T}_{jj}$ captures "product-level comparative advantage" between i and j

$$\widetilde{T}_{ij} := \sum_k \left(\frac{P_{jk}}{P_j} \right)^{\theta-(\sigma-1)} \frac{T_{ik}}{T_i}$$

  - T_{ik} is i's technology level for good k; T_i is i's aggregate technology level
  - P_{jk} is the price of good k in j; P_j is the aggregate price level in j.
  - $\sigma < \theta + 1$ is the elasticity of substitution across products

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where

- θ: typical trade elasticity parameter (think Frechet disp. parameter from an Eaton-Kortum model)
- $\widetilde{T}_{ij} / \widetilde{T}_{jj}$ captures "product-level comparative advantage" between i and j.

If T_{ik}'s are fixed, one can show that $\frac{\partial \left(\widetilde{T}_{ij} / \widetilde{T}_{jj} \right)}{\partial \ln d_{ij}} > 0$.

Thus, for aggregate estimates of θ to be *upward*-biased, one would need T_{ik}'s for each country's comparative advantage products to increase after trade liberalization occurs (stronger technological CA)

Table: Effects of FTAs on "Least-traded" Products - Pooled PPML

	Dependent variable: SITC3 5 digit Trade Flows 1991-2015								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pooled FTA Effects across all products									
All FTAs	0.054***	0.061***		-0.098***	-0.046**		-0.107***	-0.102**	-0.028
	(0.020)	(0.019)		(0.022)	(0.021)		(0.025)	(0.045)	(0.025)
All FTAs$_{t-4}$		-0.020			-0.139***				
		(0.015)			(0.017)				
Reg. FTAs			0.052***			-0.075***			
			(0.020)			(0.022)			
Deep FTAs			0.153***			0.193***			
			(0.040)			(0.044)			
FTA Effects for LTPs									
All FTAs $\times \mathbf{1}_{k \notin \Omega^*_{ij}}$				0.703***	0.599***		0.656***	1.162***	0.379***
				(0.033)	(0.035)		(0.027)	(0.067)	(0.025)
All FTAs$_{t-4} \times \mathbf{1}_{k \notin \Omega^*_{ij}}$					0.284***				
					(0.022)				
Reg. FTAs $\times \mathbf{1}_{k \notin \Omega^*_{ij}}$						0.541***			
						(0.029)			
Deep FTAs $\times \mathbf{1}_{k \notin \Omega^*_{ij}}$						1.190***			
						(0.037)			
Total FTA Effects (main effect + 4 year lag)									
Total All FTAs		0.040			-0.184***				
Total All FTAs $\times \mathbf{1}_{k \notin \Omega^*_{ij}}$					0.882***				
ikt and *jkt* FEs	x	x	x	x	x	x	x		x
it and *jt* FEs								x	
ijk FEs	x	x	x	x	x	x	x	x	x
Percentile definition	-	-	-	raw	raw	raw	relative	raw	Kehoe-Ruhl
Observations	39,663,541	39,663,541	39,663,541	39,663,541	39,663,541	39,663,541	39,663,541	42,692,796	42,692,796

Pooled sample of 5 digit SITC3 trade flows between 116 countries over the period 1991-2015, every 4 years. $\mathbf{1}_{k \notin \Omega^*_{ij}}$ is indicator equal to 1 if trade in product k was not intensively traded in years preceding FTA. Columns 5, 6, 7, and 9 compute this measure using raw percentiles, whereas column 9 uses relative percentiles, relative to each product's contribution to world trade. Column 9 uses the average of 2-4 years before the FTA. Standard errors are clustered by pair. * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Table: "Least-traded" Products - more results

	Dependent variable: SITC3 5 digit Trade Flows 1991-2015							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control for if trade in LTPs generally grows faster than trade in other products for all pairs								
$\left[X_{ijk1} < \text{10th perc.}\right] \times (\text{year}-\text{first year})$		0.046***		0.044***		0.044***	0.044***	
		(0.001)		(0.001)		(0.001)	(0.001)	
Pooled FTA Effects across all products								
All FTAs	0.054***	0.060***	-0.107***	-0.067***	-0.097***	-0.064***	-0.037*	-0.250***
	(0.020)	(0.018)	(0.025)	(0.020)	(0.020)	(0.019)	(0.019)	(0.046)
$\times \left[\overline{X}_{ijk} < \text{10th perc.}\right]$			0.656***	0.585***	0.687***	0.601***	0.517***	0.864***
			(0.027)	(0.027)	(0.034)	(0.027)	(0.035)	(0.058)
$\times \left[\text{10th perc.} \leq \overline{X}_{ijk} < \text{40th perc.}\right]$								0.231***
								(0.047)
$\times \left[\text{40th perc.} \leq \overline{X}_{ijk} < \text{70th perc.}\right]$								0.099**
								(0.041)
All FTAs_{t+4}					-0.003	-0.003		
					(0.021)	(0.020)		
$\times \left[\overline{X}_{ijk} < \text{10th perc.}\right]$					0.026	-0.033		
					(0.019)	(0.019)		
All FTAs_{t-4}							-0.089***	
							(0.015)	
$\times \left[\overline{X}_{ijk} < \text{10th perc.}\right]$							0.223***	
							(0.022)	
Total FTA Effects (main effect + 4 year lag)								
Total All FTAs							-0.126***	
$\times \left[\overline{X}_{ijk} < \text{10th perc.}\right]$							0.793***	
ikt, *jkt* and *ijk* FEs	×	×	×	×	×	×	×	×
Observations	39,663,541	39,663,541	39,663,541	39,663,541	38,216,197	38,216,197	39,663,541	39,663,541

Pooled sample of 5 digit SITC3 trade flows between 116 countries over the period 1991-2015, every 4 years. $\overline{X}_{ijk}$ is the average trade flow for product k for years before i and j sign an FTA. X_{ij1} is the trade flow from the first year pair ij appears in the data. Standard errors are clustered by pair. * $p < 0.10$, ** $p < .05$, *** $p < .01$.

Interestingly, trade in LTPs is generally growing relative to trade in other products over time. FTAs are shown to accelerate this process.

Results from higher levels of aggregation

Table: "Least-traded" Products - more results

	Dependent variable: SITC3 5 digit Trade Flows 1991-2015					
	2 digit SITC		*3 digit SITC*		*4 digit SITC*	
Pooled FTA Effects across all products						
All FTAs	-0.006	-0.111***	-0.030	-0.117***	-0.066***	-0.199***
	(0.022)	(0.019)	(0.022)	(0.019)	(0.022)	(0.033)
$\times \left[\overline{X}_{ijk} < 10\text{th perc.}\right]$	0.383***	0.497***	0.497***	0.593***	0.629***	0.771***
	(0.038)	(0.050)	(0.038)	(0.051)	(0.038)	(0.050)
$\times \left[10\text{th perc.} \leq \overline{X}_{ijk} < 40\text{th perc.}\right]$		0.181***		0.169***		0.213***
		(0.032)		(0.033)		(0.029)
$\times \left[40\text{th perc.} \leq \overline{X}_{ijk} < 70\text{th perc.}\right]$		0.053*		0.023		0.077***
		(0.032)		(0.029)		(0.024)
ikt, *jkt* and *ijk* FEs	×	×	×	×	×	×
Observations	2,295,015	2,295,015	6,743,206	6,743,206	18,795,101	18,795,101

Pooled sample of SITC3 trade flows between 116 countries over the period 1991-2015 at different levels of disaggregation, every 4 years. $\overline{X}_{ijk}$ is the average trade flow for product k for years before i and j sign an FTA. Standard errors are clustered by pair.
* $p < 0.10$, ** $p < .05$, *** $p < .01$.

Even for relatively aggregated (2 digit) data, trade actually *decreases* for the goods that lie above the 40% percentile.

Summary

In brief: We provide the first systematic test of an influential series of observations by Kehoe and Ruhl (2013) regarding trade growth in "less-traded products" following liberalization.

Some takeaways:

- We confirm trade in less-traded and newly traded products grows much faster than trade in other products following trade liberalization, after taking into account technological change, multilateral resistance, and aggregation bias
- **Puzzle**: do not find other deciles contribute to aggregate trade growth; LTPs completely explain all aggregate trade growth
- We find increases in bilateral trade are generally biased towards less-traded products, even independently of FTAs
- Product-level results generally indicate upward bias in aggregate estimates

Next steps...

- Different paths to pursue from here:
  - ◇ What drives stark difference between effects of FTAs on less-traded products versus more traded products?
    - Multi-product firms / cannibalization?
    - Lower FDI / direct sales costs for products that are already intensively traded?
  - ◇ Add product-level tariffs / elasticities.
  - ◇ Crisper characterization of changing comparative advantages following FTAs + implications for welfare

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Other cases which aggregate consistently

Eaton-Kortum model. suppose:

i. $\sigma_k = \infty, \forall k$ (no national product differentiation)

ii. T_{ik}'s $\sim$ Frechet(T_i^*, θ) (EK technology dispersion assumption)

iii. $d_{ijk} = d_{ij}$ (same bilateral trade friction for all products)

back

Other cases which aggregate consistently

Eaton-Kortum model. suppose:

i. $\sigma_k = \infty, \forall k$ (no national product differentiation)

ii. T_{ik}'s $\sim$ Frechet(T_i^*, θ) (EK technology dispersion assumption)

iii. $d_{ijk} = d_{ij}$ (same bilateral trade friction for all products)

Then the aggregate-level trade share is given by

$$\pi_{ij} = \Gamma \frac{T_i^* \left(w_i d_{ij}\right)^{-\theta}}{P_j^{*-\theta}}$$

where:

$$\Gamma \equiv \Gamma(\theta, \rho) \qquad P_j^{*-\theta} = \Gamma^{-1} \sum_i T_i^* \left(w_i d_{ij}^*\right)^{-\theta}$$

The Frechet parameters T_i^* and θ now provide technology levels and the trade elasticity.

back

Other cases which aggregate consistently

No Comparative Advantage. suppose:

i. $\sigma_k = \sigma, \forall k$ (common trade elasticity across products)

ii. $T_{ik} = T_i^*, \forall k$ (no comparative advantage across products)

iii. $d_{ijk} \neq d_{ij}$ (trade frictions need not be uniform across products)

back

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Then the *aggregate*-level trade share is given by

$$\pi_{ij} = \frac{T_i^* \left(w_i d_{ij}^*\right)^{1-\sigma}}{P_j^{*1-\sigma}}$$

where:

$$\tau_{ij}^{*1-\sigma} = \sum_k d_{ijk}^{1-\sigma} \qquad P_j^{*1-\sigma} = \sum_i T_i^* \left(w_i d_{ij}^*\right)^{1-\sigma}$$

back

Gravity and the Different "Margins" of Trade

Following Hummels and Klenow (2005), the extensive margin ("EM") may then be computed as

$$EM_{ijt} = \frac{\sum_{k \in \Omega_{ij}} X_{Wjkt}}{\sum_{k \in \Omega_{Wj}} X_{Wjkt}}. \tag{4}$$

where

- The "traded goods" set Ω_{ij} is the set of products that lie above the 10th percentile when products are sorted by trade volume (as in Kehoe and Ruhl, 2013)
- Goods that fall below the 10th percentile are considered "least-traded"
- For ex ante measures, we always use (combined) trade data from 3 to 5 years before the agreement.

back

Model: General Framework

Utility is derived from CES preferences across a (discrete) large number of products:

$$U_i = \left[\sum_{k=1}^{K} \left(q_i^k \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

where each q_i^k is a CES (Armington) aggregate across nationally differentiated varieties:

$$q_i^k = \left[\sum_{i}^{N} \left(q_i^k \right)^{\frac{\xi^k-1}{\xi^k}} \right]^{\frac{\xi^k}{\xi^k-1}}$$

Note: ξ^k may vary by product, σ is global

Model: Product-level Trade Shares

A generalized product-level gravity equation for country j's trade share wrt origin i, product k:

$$\pi_{ijk} = \frac{T_{ik}\left(w_i d_{ijk}\right)^{1-\xi^k}}{P_{jk}^{1-\xi^k}}$$

with:

- T_{ik}: technology level
- w_i: production cost
- d_{ijk}: iceberg trade cost
- $P_{jk}^{1\text{-}\xi^k} \equiv \sum_i T_{ik}\left(c_{ik} d_{ijk}\right)^{1\text{-}\xi^k}$ denotes the usual CES price index

  (a.k.a. "inward multilateral resistance")

Model: Conditions needed for *Aggregation*

Special case. suppose:

i. $\xi^k = \xi$ (common trade elasticity across products)

ii. $\xi = \sigma$ (same substitutability across vs. within product categories)

iii. $d_{ijk} = d_{ij}$ (same bilateral trade friction for all products)

other cases

Model: Conditions needed for *Aggregation*

Special case. suppose:

i. $\xi^k = \xi$ (common trade elasticity across products)

ii. $\xi = \sigma$ (same substitutability across vs. within product categories)

iii. $d_{ijk} = d_{ij}$ (same bilateral trade friction for all products)

Then the *aggregate*-level trade share is given by

$$\pi_{ij} = \frac{T_i^* \left(w_i d_{ij}\right)^{1-\sigma}}{P_j^{*1-\sigma}}$$

where:

$$T_i^* = \sum_k T_{ik}; \qquad P_j^{*1-\sigma} = \sum_i T_i^* \left(w_i d_{ij}\right)^{1-\sigma}$$

$\longrightarrow$ In this special case, product-level gravity aggregates consistently to aggregate gravity.

other cases

Model: Conditions needed for *Aggregation*

More general cases. suppose:

i. $\xi^k = \xi$ (common trade elasticity across products)

ii. $\sigma < \xi$ (varieties are more substitutable within product categories than across categories)

iii. $d_{ijk} = d_{ij}$ (same bilateral trade friction for all products)

Model: Conditions needed for *Aggregation*

More general cases. suppose:

i. $\xi^k = \xi$ (common trade elasticity across products)

ii. $\sigma < \xi$ (varieties are more substitutable within product categories than across categories)

iii. $d_{ijk} = d_{ij}$ (same bilateral trade friction for all products)

Then the *aggregate*-level trade share is given by

$$\pi_{ij} = \frac{T_i^* \left(w_i d_{ij}\right)^{1-\xi}}{P_j^{*1-\xi}} \times Z_{ij}$$

where:

$$Z_{ij} = \left\{ \sum_k \left(\frac{d_{ik}}{d_i^*}\right) \left(\frac{P_{jk}}{P_j^*}\right)^{\xi-\sigma} \right\}$$

is a non-trivial bilateral term reflecting product-level comparative advantage, such that estimates of τ_{ij} will be suffer from aggregation bias. (French, 2016)

Model: Conditions needed for *Aggregation*

More general cases. suppose:

i. $\xi^k = \xi$ (common trade elasticity across products)

ii. $\sigma = \xi$ (same substitutability across vs. within product categories)

iii. $d_{ijk} \neq d_{ij}$ (non-uniform trade friction for all products)

other cases

Model: Conditions needed for *Aggregation*

More general cases. suppose:

i. $\xi^k = \xi$ (common trade elasticity across products)

ii. $\sigma = \xi$ (same substitutability across vs. within product categories)

iii. $d_{ijk} \neq d_{ij}$ (non-uniform trade friction for all products)

Then the *aggregate*-level trade share is given by

$$\pi_{ij} = \frac{T_i^* \left(w_i d_{ij}^* \right)^{1-\sigma}}{P_j^{*1-\sigma}}$$

where:

$$T_i^* = \sum_k T_{ik}; \qquad d_{ij}^{*1-\sigma} = \sum_k \frac{T_{ik}}{T_i^*} d_{ijk}^{1-\sigma} \qquad P_j^{*1-\sigma} = \sum_i T_i^* \left(w_i d_{ij}^* \right)^{1-\sigma}$$

$\rightarrow$ Again, the bilateral term is inseperable from product-level comparative advantage.

▸ other cases

FTA Depth

Using BBF's classifications of agreement "depth" we can include 4 different PTA/FTA types:

- **One-way PTAs**: e.g., GSP and other non-reciprocal preference arrangements
- **Two-way PTAs**: Reciprocal trade agreements that stop short of completely eliminating barriers to trade
- **Free Trade Agreements**: Agreements explicitly committed to free trade
- **Economic Integration Agreements**: "Deeper" agreements with commitments that go beyond free trade
  - e.g., Customs Unions, Common Markets

Note: We generally find the first two categories do not have significant effects on trade on average; we thus mainly focus on the two "deepest" categories.

Product-level GE model

Assumptions and notation:

- Assign product-level output values using export shares: $Y_{ik} = (X_{ik}/X_i) \times Y_i$, where Y_i is manufacturing output
- Consumer preferences are CES across products
  - σ: elasticity of substitution
  - χ_{jk}: is a CES preference share parameter determining country j's expenditure share on product k
- Product-level trade flows are also "CES-like" a la Eaton-Kortum:

$$X_{ijk} = \frac{T_{ik} w_i^{-\theta} d_{ijk}^{-\theta}}{P_{jk}^{-\theta}} E_{jk},$$

  where θ reflects (inverse) dispersion in productivity draws from a Frechet distribution.
- Trade balances are treated as exogenous transfers: $D_i = E_i - Y_i$, with $\sum_i D_i = 0$.

Product-level GE model (equilibrium conditions)

Product-level Output

$$Y_{ik} = \sum_j X_{ijk} = \sum_j \frac{T_{ik} w_i^{-\theta} d_{ijk}^{-\theta}}{P_{jk}^{-\theta}} E_{jk}$$

Local Price Levels

$$P_{jk} = \left[\sum_i T_{ik} w_i^{-\theta} d_{ijk}^{-\theta} \right]^{-1/\theta}$$

Product-level Expenditure

$$E_{jk} = \chi_{jk} \frac{P_{jk}^{1-\sigma}}{P_j^{1-\sigma}} E_j \qquad \textit{where} \qquad P_j := \left[\sum_k \chi_{jk} P_{jk}^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$

Trade Balance and Labor Market Clearing

$$w_i L_i = Y_i := \sum_k Y_{ik} \qquad\qquad E_i := \sum_k E_{ik} = Y_i + D_i$$

Product-level GE model (equilibrium in changes I)

"Exact hat algebra"

- As in Dekle, Eaton, and Kortum, one can solve for counterfactuals without knowledge of technologies (T_i), initial trade barriers (d_{ijk}), preference share parameters (χ_{jk}), wages (w_i), labor endowments (L_i), or price levels (P_i)
- To do so, let x'denote the new value taken by variable x_i in the counterfactual and let $\widehat{x}_i := x'/x$.
- Also let $\pi_{ijk} := \frac{X_{ijk}}{E_{jk}}$ (bilateral trade share) and let $\zeta_{jk} := \frac{E_{jk}}{E_j}$ (within-country expenditure share)
- Solve for new aggregate trade flows ($X'_{ij} = \sum_k X'_{ijk}$) as a result of FTA formation ($\widehat{d}_{ijk}^{-\theta} = e^{\beta FTA}$)

Product-level GE model (solving the model)

Counterfactual output

$$Y'_{ik} = \sum_j X'_{ijk} = \widehat{w}_i^{-\theta} \sum_j \pi_{ijk} \widehat{d}_{ijk}^{-\theta} \frac{E'_{jk}}{\widehat{P}_{jk}^{-\theta}}$$

Counterfactual Price Levels

$$\widehat{P}_{jk}^{-\theta} = \sum_i \pi_{ijk} \widehat{w}_i^{-\theta} \widehat{d}_{ijk}^{-\theta}$$

Counterfactual expenditure

$$E'_{jk} = \zeta_{jk} \frac{\widehat{P}_{jk}^{1-\sigma}}{\widehat{P}_j^{1-\sigma}} E'_j \qquad \textit{where} \qquad \widehat{P}_j^{1-\sigma} := \left[\sum_k \zeta_{jk} \widehat{P}_{jk}^{1-\sigma} \right]$$

Counterfactual wages and national expenditure

$$\widehat{w}_i = \frac{\sum_k Y'_{ik}}{\sum_k Y_{ik}} \qquad\qquad E'_i := \sum_k Y'_{ik} + D_i$$

Table: OLD TABLE: Effects of FTAs on "Least-traded" Products - Pooled PPML

	Dependent variable: SITC3 5 digit Trade Flows 1991-2015								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pooled FTA Effects across all products									
All FTAs	xxxx	xxxx			xxxx	xxxx			xxxx
	xxxx	xxxx			xxxx	xxxx			xxxx
All FTAs$_{t-4}$		xxxx				xxxx			
		xxxx				xxxx			
Reg. FTAs			xxxx	xxxx			xxxx	xxxx	
			xxxx	xxxx			xxxx	xxxx	
Reg. FTAs$_{t-4}$				xxxx				xxxx	
				xxxx				xxxx	
Deep FTAs			xxxx	xxxx			xxxx	xxxx	
			xxxx	xxxx			xxxx	xxxx	
Deep FTAs$_{t-4}$				xxxx				xxxx	
				xxxx				xxxx	
FTA Effects for LTPs									
All FTAs $\times \mathbf{1}_{k\notin\Omega^*_{ij}}$					xxxx	xxxx			xxxx
					xxxx	xxxx			xxxx
All FTAs$_{t-4} \times \mathbf{1}_{k\notin\Omega^*_{ij}}$						xxxx			
						xxxx			
Reg. FTAs $\times \mathbf{1}_{k\notin\Omega^*_{ij}}$							xxxx	xxxx	
							xxxx	xxxx	
Reg. FTAs$_{t-4} \times \mathbf{1}_{k\notin\Omega^*_{ij}}$								xxxx	
								xxxx	
Deep FTAs $\times \mathbf{1}_{k\notin\Omega^*_{ij}}$							xxxx	xxxx	
							xxxx	xxxx	
Deep FTAs$_{t-4} \times \mathbf{1}_{k\notin\Omega^*_{ij}}$								xxxx	
								xxxx	
Total FTA Effects (main effect + 4 year lag)									
Total All FTAs		xxxx				xxxx			
Total Reg. FTAs				xxxx				xxxx	
Total Deep FTAs				xxxx				xxxx	
Total All FTAs $\times \mathbf{1}_{k\notin\Omega^*_{ij}}$						xxxx			
Total Reg. FTAs $\times \mathbf{1}_{k\notin\Omega^*_{ij}}$								xxxx	
Total Deep FTAs $\times \mathbf{1}_{k\notin\Omega^*_{ij}}$								xxxx	
ikt and *jkt* FEs	x	x	x	x	x	x	x	x	x
it and *jt* FEs	x	x	x	x	x	x	x	x	x
ijk FEs	x	x	x	x	x	x	x	x	x
Percentile definition	-	-	-	-	raw	raw	raw	raw	relative
Observations	41,758,437	41,758,437	41,758,437	41,758,437	41,758,437	41,758,437	41,758,437	41,758,437	41,758,437

Pooled sample of 5 digit SITC3 trade flows between 116 countries over the period 1991-2015, every 4 years. $\mathbf{1}_{k\notin\Omega^*_{ij}}$ is indicator equal to 1 if k was not intensively traded in years preceding FTA. Columns 5 to 8 compute this measure using raw percentiles, whereas column 9 uses relative percentiles, relative to each product's