The Effects of Free Trade Agreements on Product-level Trade

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Motivation

What we think we know about trade agreements and trade costs

- Trade liberalization increases trade for all products, to varying degrees
- Changes in technological comparative advantage are independent of changes in trade costs
- Gravity estimates of FTA effects using aggregate trade data reflect changes in aggregate trade costs

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What I'm going to try to convince you of

- Virtually all trade creation following FTAs comes from products that were relatively less traded ex ante
- It's possible that, for a sizeable share of products, trade actually decreases
- A significant portion of our aggregate FTA estimate reflects changes in bilateral comparative advantages, *not* changes in trade costs.

Motivation

Two provocative findings that serve as our inspiration

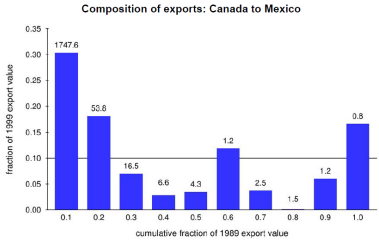
1. Baier and Bergstrand (2007): average trade creation effects of FTAs too large to be explained by tariffs

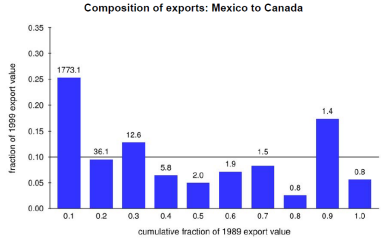
2. Kehoe and Ruhl (2013) critique of CGE model predictions:
   - ◇ Models tended to underpredict trade creation for products that are only lightly-traded *ex ante*

   ⇒ 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 from Kehoe and Ruhl (2013)





- 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 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:

- tend to 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)
- Comment: 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

  e.g., Hummels and Klenow (2005), Arkolakis et al. (2008), Baier et al. (2014)
- Comment: 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 statistically significant avg. trade growth, across many different specifications.
- For higher deciles (above 40%), trade growth is always negative (!) and significant.
- Mean reversion! Irrespective of FTAs, product-level trade costs generally fall faster for less-traded products vs. more traded products
- 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. (2019); Weidner and Zylkin (2021)

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, 2021)

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:

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

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

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

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

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\psi_{jt}: &\quad \sum_{i} X_{ijt} - \exp\left[\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right] = 0 \\
\eta_{ij}: &\quad \sum_{t} X_{ijt} - \exp\left[\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right] = 0 \\
\beta: &\quad \sum_{\mathbf{FTA}=1} X_{ijt} - \exp\left[\delta_{it} + \psi_{jt} + \eta_{ij} + \beta \mathbf{FTA}_{ijt}\right] = 0,
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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. more
- 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	x	x	x	x	x	x	x	x
Importer-time FEs	x	x	x	x	x	x	x	x
Pair FEs	x	x	x	x	x	x	x	x
"Zeroes"	x	x	x	x	x	x		
Observations	60614	60614	60614	60614	60614	60614	56201	56201

Uncorrected PPML estimates for 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 clustered by pair. * $p < 0.10$, ** $p < .05$, *** $p < .01$.

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	x	x	x	x	x	x	x	x	x
Importer-time FEs	x	x	x	x	x	x	x	x	x
Pair FEs	x	x	x	x	x	x	x	x	x
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 (bilateral) comparative advantage products to increase after trade liberalization occurs

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***		-0.104***	-0.045**		-0.107***	-0.102**	-0.028
	(0.020)	(0.019)		(0.023)	(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 $\times \mathbf{1}_{k \notin \Omega^*_{ij}}$				0.741***	0.599***		0.656***	1.163***	0.379***
				(0.038)	(0.036)		(0.027)	(0.068)	(0.025)
All FTAs$_{t-4} \times \mathbf{1}_{k \notin \Omega^*_{ij}}$					0.284***				
					(0.023)				
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								
$\left[X_{ijk1} < \text{10th perc.}\right] \times$ (year−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***	-0.104***	-0.074***	-0.112***	-0.081***	-0.036*	-0.250***
	(0.020)	(0.018)	(0.023)	(0.021)	(0.021)	(0.019)	(0.020)	(0.046)
$\times \left[\overline{X}_{ijk} < \text{10th perc.}\right]$			0.741***	0.628***	0.788***	0.697***	0.489***	0.864***
			(0.038)	(0.038)	(0.038)	(0.035)	(0.036)	(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$_{t+4}$					0.018	0.014		
					(0.021)	(0.021)		
$\times \left[\overline{X}_{ijk} < \text{10th perc.}\right]$					-0.089***	-0.129***		
					(0.030)	(0.032)		
All FTAs$_{t-4}$							-0.069***	
							(0.015)	
$\times \left[\overline{X}_{ijk} < \text{10th perc.}\right]$							0.192***	
							(0.022)	
Total FTA Effects (main effect + 4 year lag)								
Total All FTAs							-0.105***	
$\times \left[\overline{X}_{ijk} < \text{10th perc.}\right]$							0.681***	
ikt, *jkt* and *ijk* FEs	x	x	x	x	x	x	x	x
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)
$\times \left[\overline{X}_{ijk} < \text{10th perc.}\right]$	0.383***	0.497***	0.497***	0.593***	0.629***	0.771***
	(0.038)	(0.050)	(0.038)	(0.051)	(0.038)	(0.050)
$\times \left[\text{10th perc.} \leq \overline{X}_{ijk} < \text{40th perc.}\right]$		0.181***		0.169***		0.213***
		(0.032)		(0.033)		(0.029)
$\times \left[\text{40th perc.} \leq \overline{X}_{ijk} < \text{70th perc.}\right]$		0.053*		0.023		0.077***
		(0.032)		(0.029)		(0.024)
ikt, *jkt* and *ijk* FEs	x	x	x	x	x	x
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.

Some thoughts on theoretical explanations

What model features could explain these patterns? Some ideas:

- *Within-origin substitutability*: purchasers in the destination balance purchases of products from each origin against other products from the same origin.
  - Crowley, Han, and Prayer (2022)
- *Link-specific capital*: scarcity of trade-specific capital leads to higher trade costs for large exporters when new exporters enter.
  - Bergin and Lin (2012); Feng, Li, and Swenson (2016); Bergin, Feng, and Lin (2018)

Summary

In brief: We us product-level gravity to test some influential 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?
  - Scarcity of trade-specific capital?
  - Substitutability between products from the same origin?
  - Within-pair product cycles?
- Role of product-level tariffs / elasticities.
- Crisper characterization of changing comparative advantages following FTAs + implications for welfare
- Bias corrections for PPML estimates

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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

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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)

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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 combine trade data for each product from all years before the agreement
  - we also use combined trade data from 3 to 5 years before the agreement and find similar results
  - we also find similar results regardless if we use raw trade amounts vs. relative amounts (relative to total world trade in that product)

back

Data - how and why we took care

From Kehoe and Ruhl (2013)'s appendix:

> *"Unfortunately, the adoption of the Harmonized System—which took place in many countries in 1988 and in the United States in 1989—was accompanied by a significant change in the codes that are reported as traded."*
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> *"These problems seem less severe at more aggregate classifications; analysis at the two-digit level... may not be severely affected."*
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> *"It is worth noting that for both trade flows, the importing country seems to be less affected by the change in classification."*

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> *"It is worth noting that for both trade flows, the importing country seems to be less affected by the change in classification."*

What we did in response:

- We only used trade reported by the importing country
- We only included a country as an importer after they adopted SITC Rev. 3
  - SITC rev 3 adoption coincides with or follows HS adoption
- We did robustness for 4 digit-, 3 digit- and 2 digit-level aggregation levels

back

Data - countries included by year

year	number of countries
1991	58
1995	87
1999	95
2003	106
2007	107
2010	103
2015	99
Total number of countries	116

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
- $P_{jk}^{1-\xi^k} \equiv \sum_i T_{ik} \left(c_{ik} d_{ijk}\right)^{1-\xi^k}$ 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

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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:

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

→ 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)

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

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

where:

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

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*

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where:

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

→ 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. back