

Exchange Rate Pass-Through, Currency Invoicing and Trade Partners

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- Numerous papers have found that exchange rate pass-through (ERPT) into import prices is incomplete
- Latest research on ERPT has used micro data (firm- and product-level data) to explore reasons behind incomplete pass-through
- Main findings: ERPT depends on currency of invoicing, frequency of price adjustment, competitor producer exchange rates, competition in local markets

This paper:

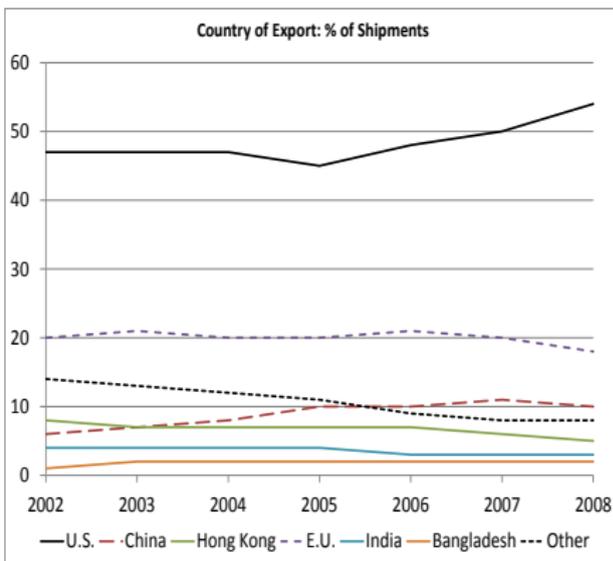
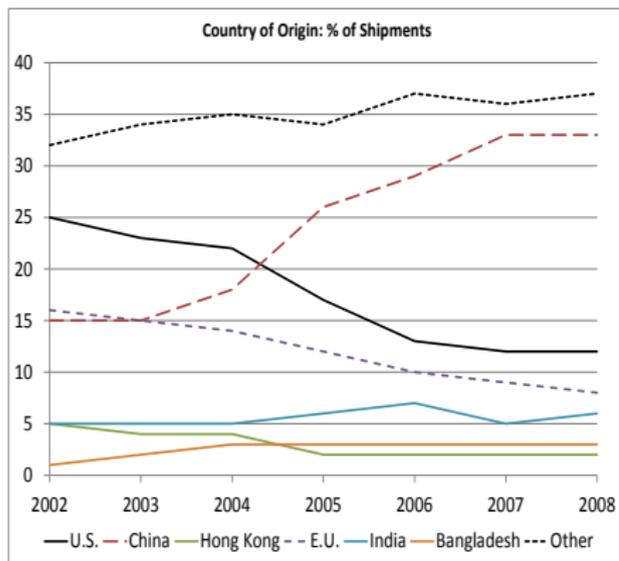
- Adds to the literature on the role of currency choice in ERPT
- Also explores the role of direct versus indirect trade

- The nature of trade changed fundamentally in the last decade
 - Failure of the Doha Round of multilateral negotiations and the proliferation of bilateral and plurilateral trade agreements
 - Rise of China and India (among others) as major producers and exporters
- In response, the way firms thought about trade had to adjust
 - Larger choice set of trade partners available
 - New trade networks needed to be established
- Importance of understanding the effects of these changes on ERPT
 - Overall trends in pass-through
 - Who bears the cost of exchange rate fluctuations?
 - Separating price from quantity effects in understanding trade flows
 - Inflation pressure

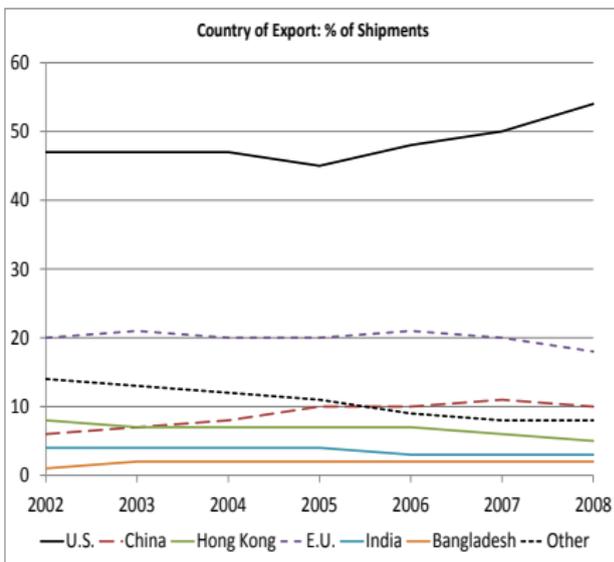
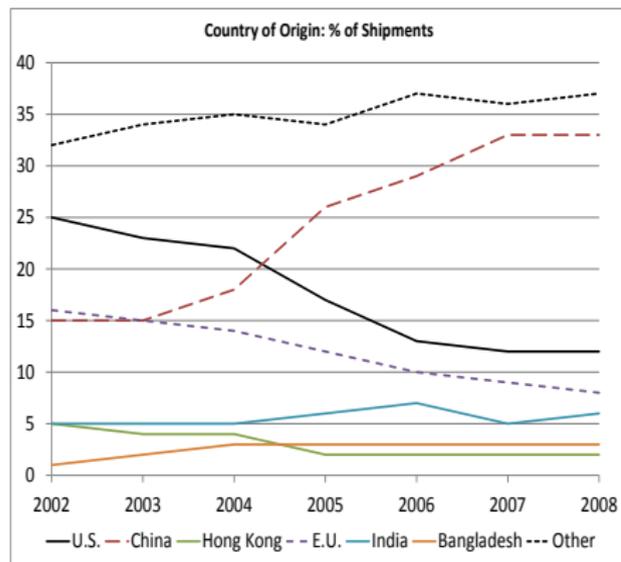
Data Preview: Apparel Imports

- Current paper focuses on Canadian apparel imports using highly disaggregated shipment data (the set of products included in the analysis will be expanded)
- We observe all shipments into Canada from 2002 to 2008
- Apparel industry characteristics:
 - Particularly affected by the increase in Chinese manufacturers and exporters
 - Many different currencies used in the apparel trade
 - Complex trade networks

Trade Patterns: Country of Origin and Export

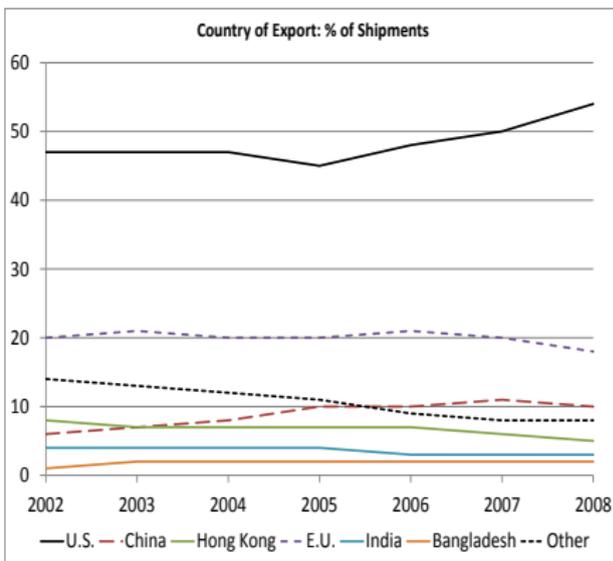
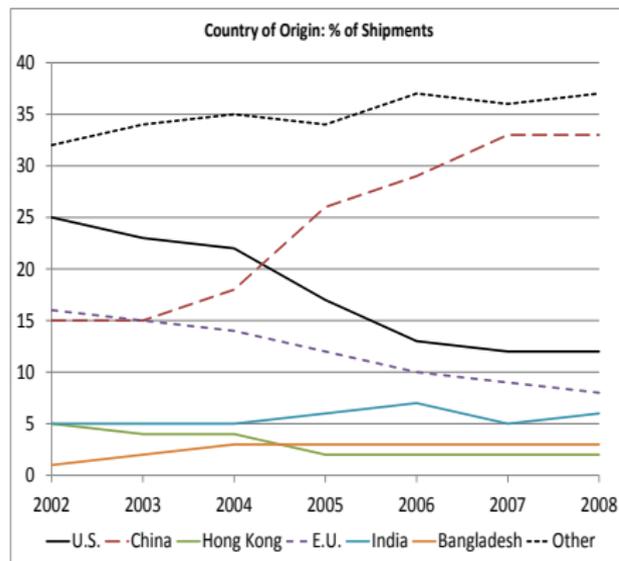


Trade Patterns: Country of Origin and Export



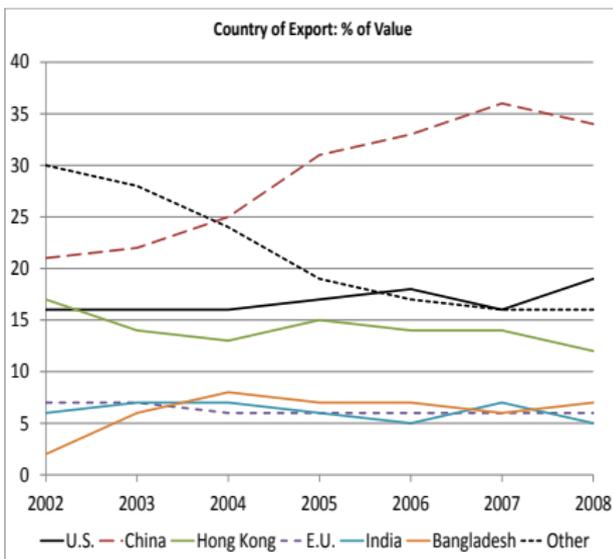
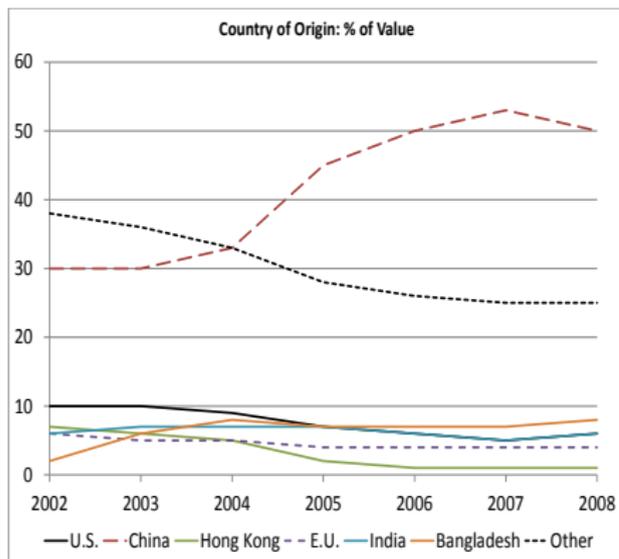
- Origin: dramatic rise in China as a producer

Trade Patterns: Country of Origin and Export

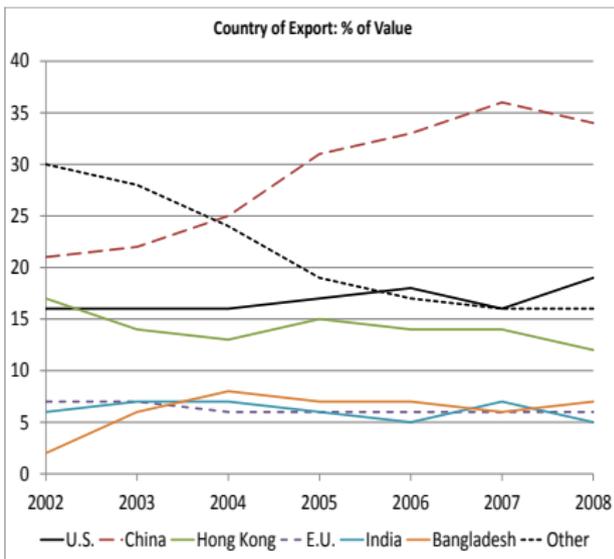
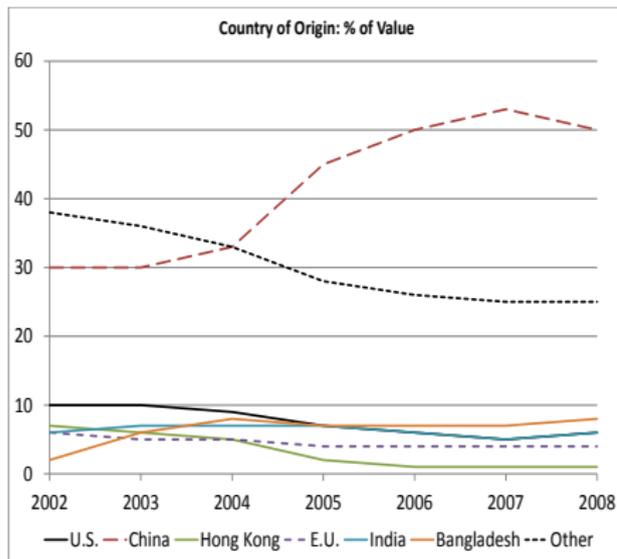


- Origin: dramatic rise in China as a producer
- Exporter: little change in export country, suggesting increase in indirect trade

Trade Patterns: Country of Origin and Export (Value)

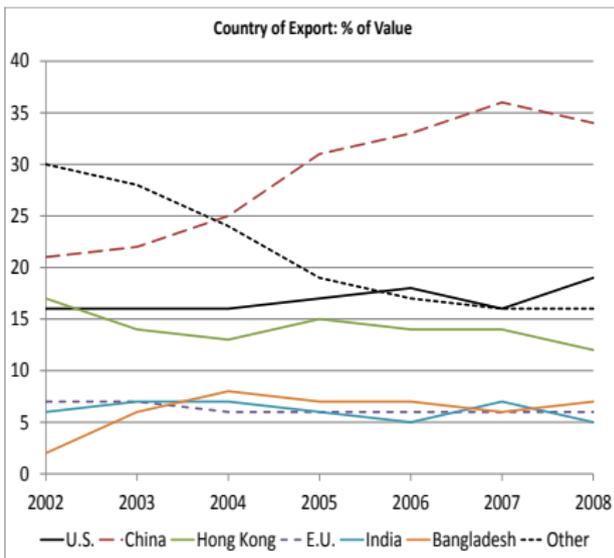
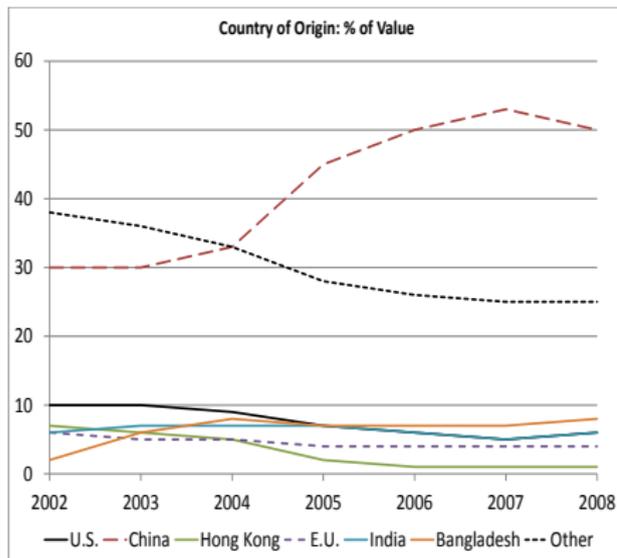


Trade Patterns: Country of Origin and Export (Value)



- Origin: rise of China as a producer is still apparent

Trade Patterns: Country of Origin and Export (Value)



- Origin: rise of China as a producer is still apparent
- Exporter: increase in China as country of export, but 15pp gap still exists

- Build a simple model to help us think about the role of currency choice and trade routes in price adjustment
- Get reduced-form pass-through estimates for Canadian imports by country of origin and export, and by currency
- Explore the implications of the results given the changes in the nature of trade over in the last decade

Pass-through to import price:

- Campa and Goldberg (2005), Bouakez and Rebei (2008), Burstein and Gopinath (2013)

Currency choice and pass-through:

- Engel (2006), Gopinath, Itskhoki and Rigobon (2010), Cao, Dong and Tomlin (2012), Fitzgerald and Haller (2012)
- Goldberg and Tille (2009)

Pass-through using micro pricing data:

- Gopinath and Itskhoki (2010), Amiti, Itskhoki and Konings (2012), Auer and Schoenle (2012), Pennings (2012)

- 1 Model of firm pricing and international trade
- 2 Data and stylized facts
- 3 Empirical model and results
- 4 Conclusions

Theoretical Discussion

- Simple model of monopolistic competition to highlight the mechanisms at play
- Borrows from Burstein and Gopinath (2013), Amiti et al. (2013), Gopinath et al. (2010) and Hong and Li (2013)
- Firm CES demand schedule:

$$x_{ik} = p_{ik}^{-\rho} p_k^{\rho-\eta} X$$

- Sectoral price and demand:

$$p_k = \left[\sum_{i=1}^N p_{ik}^{1-\rho} \right]^{\left(\frac{1}{1-\rho}\right)}$$

$$x_k = p_k^{-\eta} X$$

- Production process has both domestic and foreign content:

$$x = \left[a^{\frac{1}{\gamma}} F_x^{1-\frac{1}{\gamma}} + (1-a)^{\frac{1}{\gamma}} N_x^{1-\frac{1}{\gamma}} \right]$$

- Domestic production:

$$F_x = L_x^\alpha I_x^{1-\alpha}$$

- Assume price of imported input and local distribution cost are equal to one:

$$c(w, s_f, s, x) = \left[a w^\alpha \left(\frac{1}{s_f} \right)^{1-\alpha} + (1-a) \frac{1}{s} \right] x$$

- Exporter profits (set in local currency):

$$p_{ik}x_{ik} - SC(w, s_f, s, x)$$

- Profit maximizing price:

$$p_{ik} = \frac{\epsilon_{ik}}{\epsilon_{ik} - 1} s \left[aw^\alpha s_f^{1-\alpha} + (1-a)\frac{1}{s} \right]$$

- Firm's demand elasticity:

$$\epsilon(\theta_{ik}) = \rho - (\rho - \eta)\theta_{ik}$$

ERPT with Flexible Prices (II)

- Pass-through (log approx. around initial equilibrium):

$$\frac{d \log p_{ik}}{d \log s} = \frac{a}{1 + \omega}$$

- 1 Direct effect of exchange rate on home currency prices, adjusted for local content in production and impact of price on firm's markup through change in market share (ω = elasticity of firm markup to price)

$$\omega = \frac{(\rho - \eta)(\rho - 1)\theta_{ik}(1 - \theta_{ik})}{\epsilon(\theta_{ik})(\epsilon(\theta_{ik}) - 1)}$$

ERPT with Flexible Prices (II)

- Pass-through (log approx. around initial equilibrium):

$$\frac{d \log p_{ik}}{d \log s} = \frac{a}{1 + \omega} + \frac{\omega}{(1 + \omega)(1 - \theta_{ik})} \sum_{j \neq i} \theta_{jk} \frac{d \log p_{jk}}{d \log s}$$

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- 2 Indirect effect on firm markup due to competitor price adjustment

ERPT with Flexible Prices (II)

- Pass-through (log approx. around initial equilibrium):

$$\frac{d \log p_{ik}}{d \log s} = \frac{a}{1 + \omega} + \frac{\omega}{(1 + \omega)(1 - \theta_{ik})} \sum_{j \neq i} \theta_{jk} \frac{d \log p_{jk}}{d \log s} + \frac{a}{1 + \omega} \left[\alpha \frac{d \log w}{d \log s} - (1 - \alpha) \frac{d \log s_f}{d \log s} \right]$$

- 1 Direct effect of exchange rate on home currency prices, adjusted for local content in production and impact of price on firm's markup through change in market share (ω = elasticity of firm markup to price)

$$\omega = \frac{(\rho - \eta)(\rho - 1)\theta_{ik}(1 - \theta_{ik})}{\epsilon(\theta_{ik})(\epsilon(\theta_{ik}) - 1)}$$

- 2 Indirect effect on firm markup due to competitor price adjustment
- 3 Proportional impact on domestic costs and imported inputs

Sticky Prices and Currency Choice

- Optimal (Calvo model) price in local currency for a firm that resets its price with probability $1 - \kappa$:

$$p_t^{LCP} = (1 - \beta\kappa) E_t \sum_{j=0}^{\infty} (\beta\kappa)^j \tilde{p}_{t+j}$$

- Optimal price with producer currency pricing:

$$p_t^{PCP} = (1 - \beta\kappa) E_t \sum_{j=0}^{\infty} (\beta\kappa)^j (\tilde{p}_{t+j}^* - s_{t+j}) = (1 - \beta\kappa) E_t \sum_{j=0}^{\infty} (\beta\kappa)^j (\tilde{p}_{t+j} - s_{t+j})$$

- Gopinath, Itskhoki and Rigobon (2010): firms self-select into LCP or PCP based on desired medium-run pass-through

- So far: model of direct trade with currency choice
- Our data distinguishes between country of origin and country of export
- Working on a model to help us understand fractionalization in supply chains (indirect trade):
 - How should we expect prices to adjusted to exchange rate movements in an environment with double marginalization?
 - This remains a work in progress

Canadian Border Services Agency (CBSA) Customs Database

- Data on every shipment into Canada from July 2002 to August 2008
- Organized at the Harmonized Commodity Description and Coding System (HS) 10 level (very precise product definition)
- Information on total shipment value and number of units—can back out unit prices for most goods
- Identifies the currency of invoice and provides shipment value in the currency of invoice and Canada dollars (CAD)
 - Can back out implied exchange rate or use noon spot rate
- Provides information on country of origin and export
- Importing firm identifier (scrambled) allows for the creation of firm/product-level panel

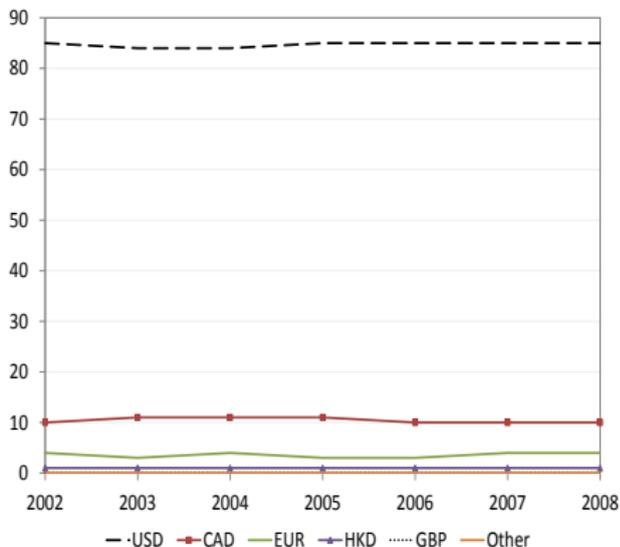
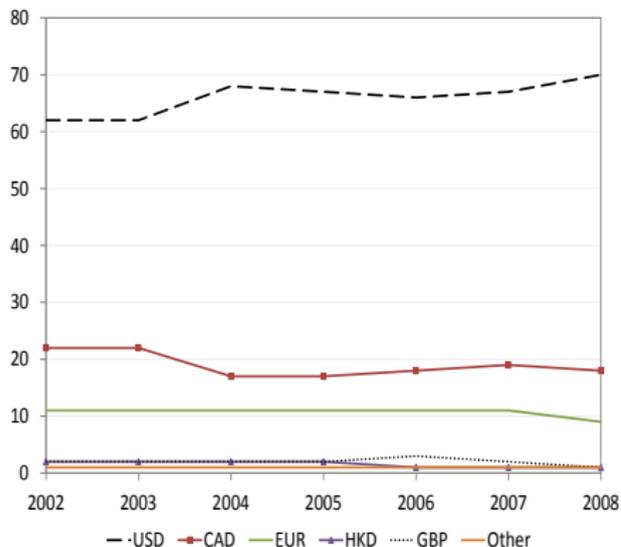
- HS2 61 (knitted) and 62 (non-knitted)
- Most shipments reported in "numbers"
- Can back out unit prices for 93% of observations
- Drop observations of trade among affiliates (about 16% of observations)
- 6.7 million shipment observations over 74 months

- HS 6109: T-shirts, singlets and other vests
 - 6109.10.00.00: Of cotton
 - 6109.90.00.00: Of other materials

- HS 6204: Women's or girls' suits, jackets, blazers, dresses, skirts, trousers, overalls, breeches and shorts
 - 6204.33.00.10: Jackets and blazers, synthetic fiber, containing 85% or more by weight of polyester
 - 6204.33.00.20 or 30 or 90: Other synthetic mixes

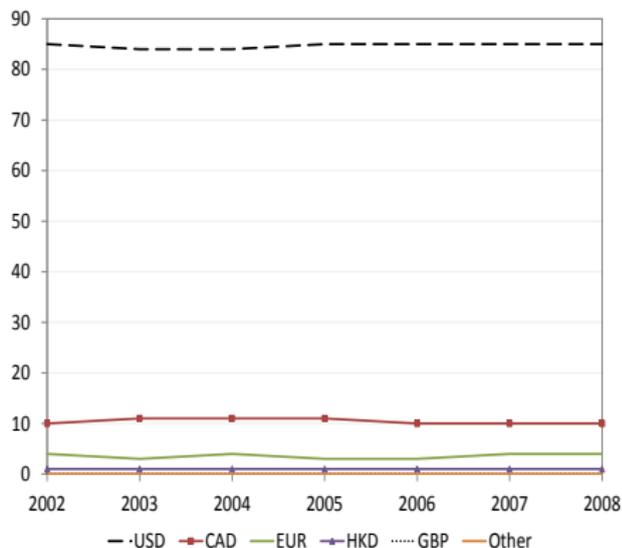
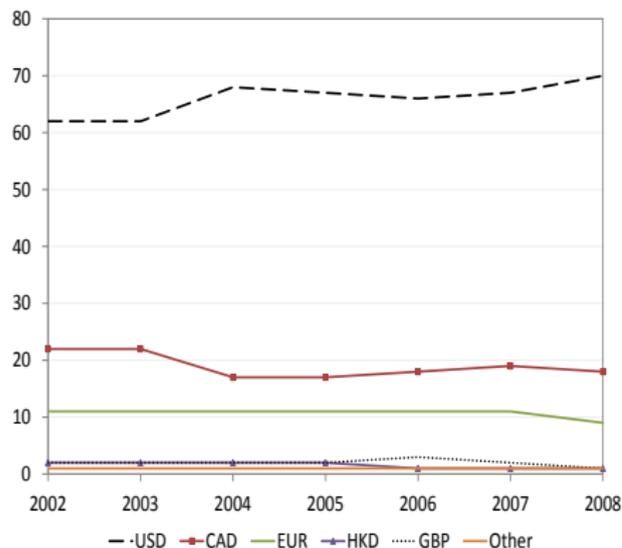
Data: Currency of Invoice

% of imports by shipments (LHS) and value (RHS) by currency



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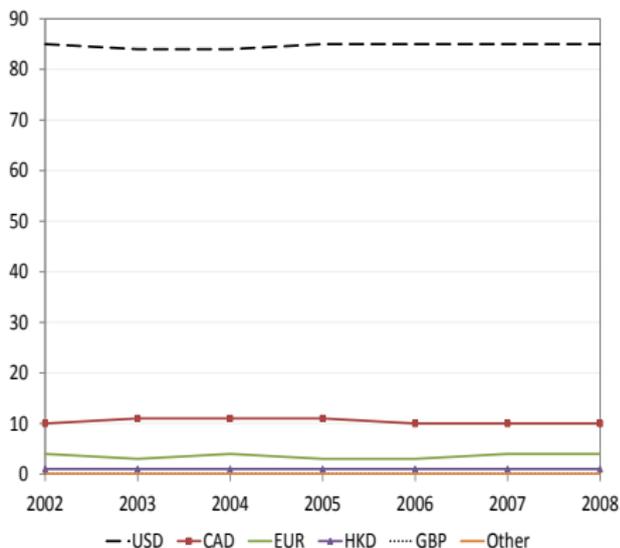
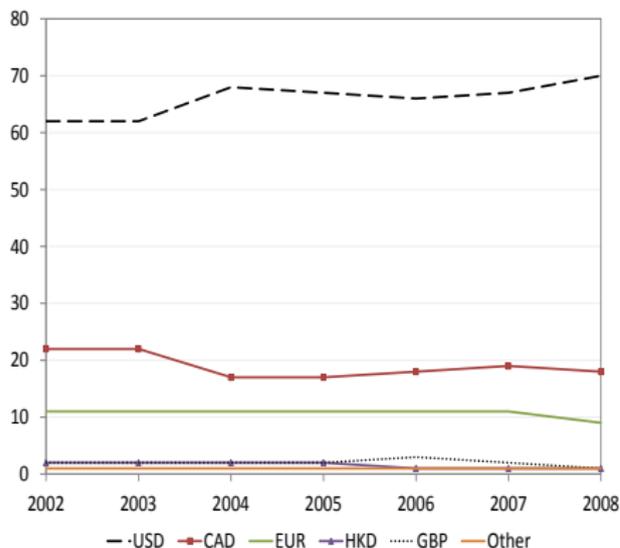
% of imports by shipments (LHS) and value (RHS) by currency



- In terms of shipments, mainly USD, CAD and EUR

Data: Currency of Invoice

% of imports by shipments (LHS) and value (RHS) by currency



- In terms of shipments, mainly USD, CAD and EUR
- In terms of value, USD dominates (used as vehicle currency)

COO = COE

- Direct shipment: good is shipped directly from country of origin to the destination market
- Transshipment: good is shipped from origin to destination via another country (and meets transshipment rules)

Determination of the Country of Origin and Export

COO = COE

- Direct shipment: good is shipped directly from country of origin to the destination market
- Transshipment: good is shipped from origin to destination via another country (and meets transshipment rules)

COO \neq COE

- Indirect trade: goods shipped from origin to destination via another country where the good “enters the economy” of the intermediary country, e.g.:
 - extended warehousing in intermediary
 - use of customs brokerage located in intermediary
- Value added: value is added to the product during the transportation process, but not enough to change the country of origin (based on Rules of Origin regulations)

Prices are proxied by unit prices:

$$P_i \equiv \left(\frac{\text{Shipment value}_i}{\text{Shipment quantity}_i} \right)$$

Issues with using unit prices:

- Not all HS 10 codes are precise – there may be more than one distinct product in each code
- Price changes may be due to compositional changes within HS 10 codes
- There can be errors in measuring quantities (number of units is the case of apparel)

Partial solution:

- Define a HS 10 product as firm, COO, COE and currency of invoice specific

- Convert all transaction unit prices into a single currency (CAD) using exchange rate
- Define a price that is importing firm (f), HS10 product (p), country of origin (o), country of export (e), currency (c) and month (t) specific (let $s = \{f, p, o, e, c\}$):

$$P_{st} = \sum_{i=1}^n (\alpha_{ist} \cdot P_{ist})$$

where

$$\alpha_{ist} = \frac{Shipsize_{ist}}{\sum_{j=1}^n Shipsize_{jst}}$$

- This creates a “collapsed” or “condensed” data set — reduced data by over 66%

- Regression framework examines cumulative pass-through over period between *fpoect*-price observations:

$$\Delta_{\tau} p_{st} = \beta \Delta_{\tau} ex_{st} + \Delta_{\tau} MU'_{st} \gamma + \Delta_{\tau} MC'_{st} \sigma + \gamma + \epsilon_{st}$$

where:

- $\Delta_{\tau} p_{st} = \ln(P_{st}) - \ln(P_{s\tau})$ and τ is that last period before t in which this product s was imported
 - Similar methodology as P_{st} used to create a *fpoect*-specific exchange rate, Ex_{st}
 - MU = markup; MC = marginal cost; γ = fixed effects
- Use sample restriction to explore the role of currency invoicing and direct versus indirect trade in $\hat{\beta}$

Shipment Frequency

Time between shipment of *fpoec* product

Δ_τ	Percent	Cumul. %
1	44.5	44.5
2	13.1	57.6
3	7.4	65.0
4	5.5	70.5
5	5.0	75.5
6	4.4	79.9
7	2.8	82.6
8	1.8	84.5
9	1.6	86.1
10	1.6	87.6
10+	12.4	100.0

- A large proportion of products are imported in consecutive months
- There remain a number of products that are imported infrequently

$$\Delta_{\tau} p_{st} = \beta \Delta_{\tau} ex_{st} + \Delta_{\tau} MU'_{ot} \gamma + \Delta_{\tau} MC'_{ot} \sigma + \gamma_p + \epsilon_{st}$$

- MU and MC proxies (depends on data availability)
 - MU: Export country market shares (at HS6 level), large importer indicator (single shipment in top 5% in a month at HS4 level)
 - MC: COO country CPI, U.S. PPI, U.S. nominal GDP, COO wages
- Current specification uses product fixed effects (results robust to other fixed effect specifications)

Baseline Results: All Imports

All available data, dependent variable: $\Delta_{\tau} p_{st}$

	(1)	(2)	(3)	(4)
$\Delta_{\tau} e_{st}$	0.531*** (0.010)			
$\Delta_{\tau} CPI_{st}$	-0.149*** (0.024)			
$\Delta_{\tau} PPI_{st}$				
$\Delta_{\tau} GDP_{st}$				
$\Delta_{\tau} W_{st}$				
$\Delta_{\tau} Exportershare_{st}$	0.024*** (0.000)			
$Largestimporter_{st}$	-0.004*** (0.001)			
Obs.	2,080,350			

Baseline Results: All Imports

All available data, dependent variable: $\Delta_{\tau} p_{st}$

	(1)	(2)	(3)	(4)
$\Delta_{\tau} e_{st}$	0.531*** (0.010)	0.524*** (0.011)		
$\Delta_{\tau} CPI_{st}$	-0.149*** (0.024)			
$\Delta_{\tau} PPI_{st}$		-0.026*** (0.022)		
$\Delta_{\tau} GDP_{st}$				
$\Delta_{\tau} W_{st}$				
$\Delta_{\tau} Exporters_{share}_{st}$	0.024*** (0.000)	0.023*** (0.000)		
$Largest_{importer}_{st}$	-0.004*** (0.001)	-0.004*** (0.001)		
Obs.	2,080,350	2,138,512		

Baseline Results: All Imports

All available data, dependent variable: $\Delta_{\tau} p_{st}$

	(1)	(2)	(3)	(4)
$\Delta_{\tau} e_{st}$	0.531*** (0.010)	0.524*** (0.011)	0.547*** (0.010)	
$\Delta_{\tau} CPI_{st}$	-0.149*** (0.024)			
$\Delta_{\tau} PPI_{st}$		-0.026*** (0.022)		
$\Delta_{\tau} GDP_{st}$			0.033*** (0.018)	
$\Delta_{\tau} W_{st}$				
$\Delta_{\tau} Exportershare_{st}$	0.024*** (0.000)	0.023*** (0.000)	0.023*** (0.000)	
$Largestimporter_{st}$	-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)	
Obs.	2,080,350	2,138,512	2,163,178	

Baseline Results: All Imports

All available data, dependent variable: $\Delta_{\tau} p_{st}$

	(1)	(2)	(3)	(4)
$\Delta_{\tau} e_{st}$	0.531*** (0.010)	0.524*** (0.011)	0.547*** (0.010)	0.589*** (0.027)
$\Delta_{\tau} CPI_{st}$	-0.149*** (0.024)			
$\Delta_{\tau} PPI_{st}$		-0.026*** (0.022)		
$\Delta_{\tau} GDP_{st}$			0.033*** (0.018)	
$\Delta_{\tau} W_{st}$				0.902*** (0.079)
$\Delta_{\tau} Exportershare_{st}$	0.024*** (0.000)	0.023*** (0.000)	0.023*** (0.000)	0.026*** (0.001)
$Largestimporter_{st}$	-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)	-0.008 (0.004)
Obs.	2,080,350	2,138,512	2,163,178	400,430

Baseline Results: COO = US & COE = US

U.S. imports only, dependent variable: $\Delta_{\tau} p_{st}$

	(1)	(2)	(3)	(4)
$\Delta_{\tau} e_{st}$	0.646*** (0.032)	0.634*** (0.033)	0.771*** (0.035)	0.718*** (0.032)
$\Delta_{\tau} CPI_{st}$	0.860*** (0.095)			
$\Delta_{\tau} PPI_{st}$		0.555*** (0.072)		
$\Delta_{\tau} GDP_{st}$			0.745*** (0.059)	
$\Delta_{\tau} W_{st}$				1.161*** (0.092)
$\Delta_{\tau} Exportershare_{st}$	0.010*** (0.002)	0.010*** (0.002)	0.012*** (0.002)	0.011*** (0.002)
$Largestimporter_{st}$	-0.007 (0.005)	-0.007 (0.005)	-0.006 (0.005)	-0.006 (0.005)
Obs.	339,881	335,323	339,881	339,881

Results: COO, COE and Currency Type

Subsamples, dependent variable: $\Delta_{\tau} p_{st}$

COO	$\hat{\beta}$	COE	$\hat{\beta}$	CUR	$\hat{\beta}$
US	0.644***	US		USD	
China	0.655***	China		CAD	
EU	0.162***	EU		EUR	
Hong Kong	0.581***	Hong Kong		Other	
India	0.682***	India			
Bangladesh	0.335***	Bangladesh			
Other	0.526***	Other			

Results: COO, COE and Currency Type

Subsamples, dependent variable: $\Delta_{\tau} p_{st}$

COO	$\hat{\beta}$	COE	$\hat{\beta}$	CUR	$\hat{\beta}$
US	0.644***	US	0.524***	USD	
China	0.655***	China	0.706***	CAD	
EU	0.162***	EU	0.226***	EUR	
Hong Kong	0.581***	Hong Kong	0.761***	Other	
India	0.682***	India	0.797***		
Bangladesh	0.335***	Bangladesh	0.344***		
Other	0.526***	Other	0.416***		

Results: COO, COE and Currency Type

Subsamples, dependent variable: $\Delta_{\tau} p_{st}$

COO	$\hat{\beta}$	COE	$\hat{\beta}$	CUR	$\hat{\beta}$
US	0.644***	US	0.524***	USD	0.554***
China	0.655***	China	0.706***	CAD	0.270***
EU	0.162***	EU	0.226***	EUR	0.242***
Hong Kong	0.581***	Hong Kong	0.761***	Other	0.598***
India	0.682***	India	0.797***		
Bangladesh	0.335***	Bangladesh	0.344***		
Other	0.526***	Other	0.416***		

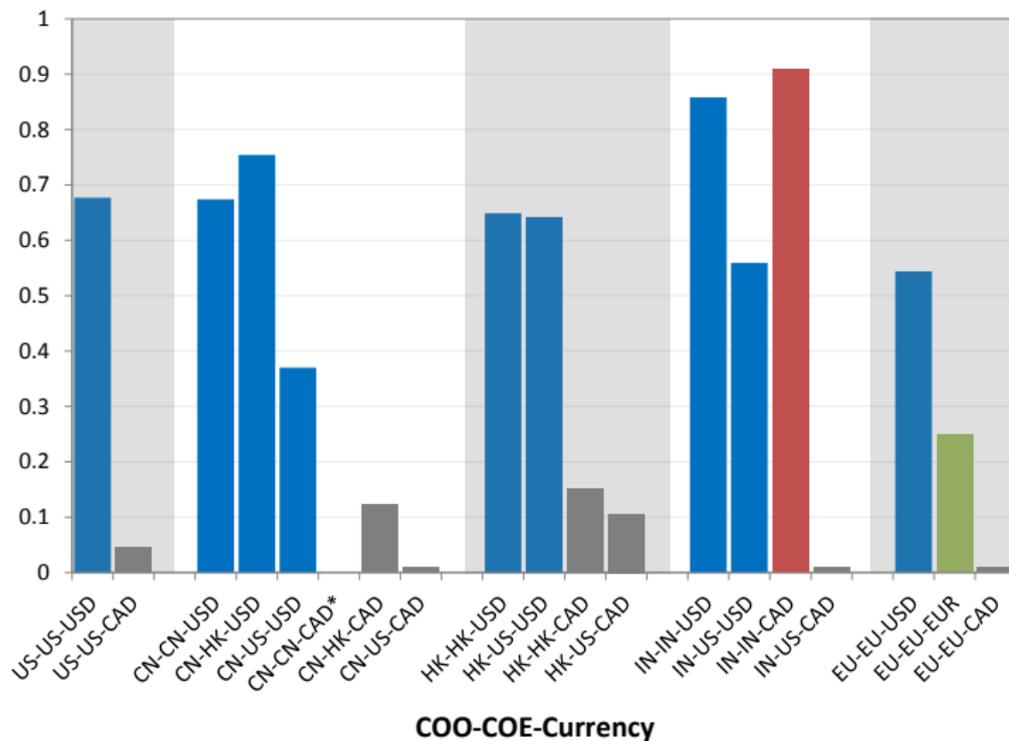
Results: COO/COE/Currency Type

Dependent variable: $\Delta_{\tau} \rho_{St}$

COO	COE	CUR	β	obs.
US	US	USD	0.677***	315,996
US	US	CAD	0.046	23,849
EU	EU	USD	0.544***	15,089
EU	EU	CAD	-0.176	53,980
EU	EU	EUR	0.248***	203,717
China	China	USD	0.674***	256,929
China	China	CAD	1.670***	8,354
China	Hong Kong	USD	0.754***	117,614
China	Hong Kong	CAD	0.123	8,184
China	US	USD	0.370***	136,861
China	US	CAD	-0.448*	7,615
Hong Kong	Hong Kong	USD	0.649***	25,552
Hong Kong	Hong Kong	CAD	0.151	1,996
Hong Kong	US	USD	0.642***	15,685
Hong Kong	US	CAD	0.106	1,089
India	India	USD	0.858***	72,858
India	India	CAD	0.908***	26,337
India	US	USD	0.559***	19,597
India	US	CAD	-0.283	1,313

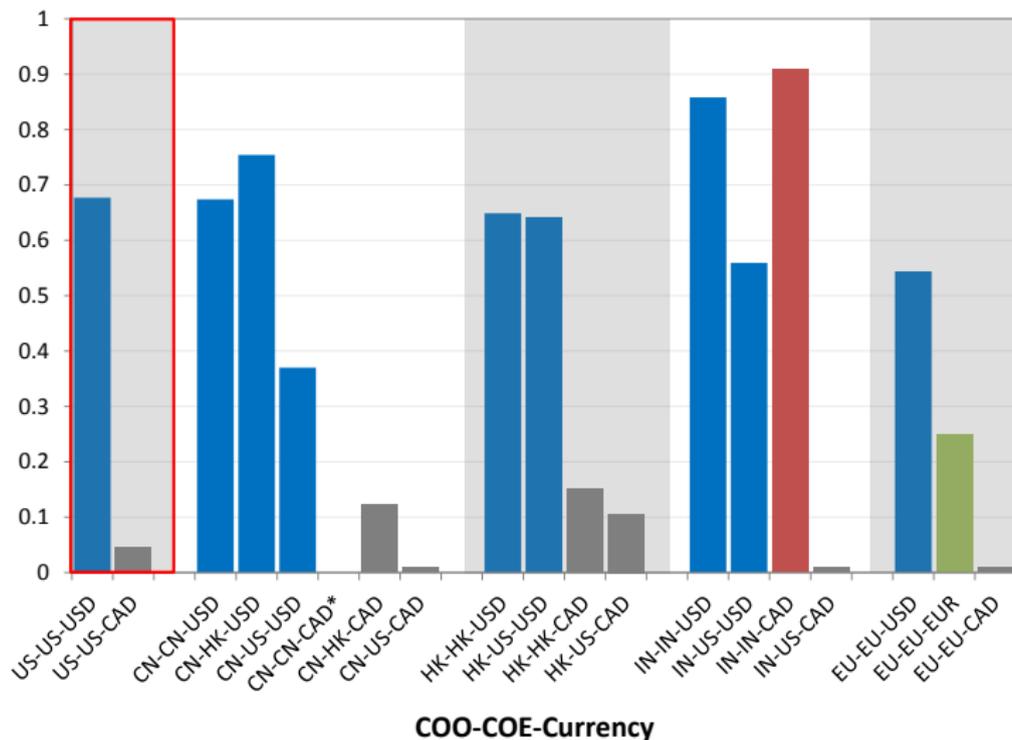
Results: COO/COE/Currency Type

Exchange rate pass-through coefficient by COO-COE-Currency



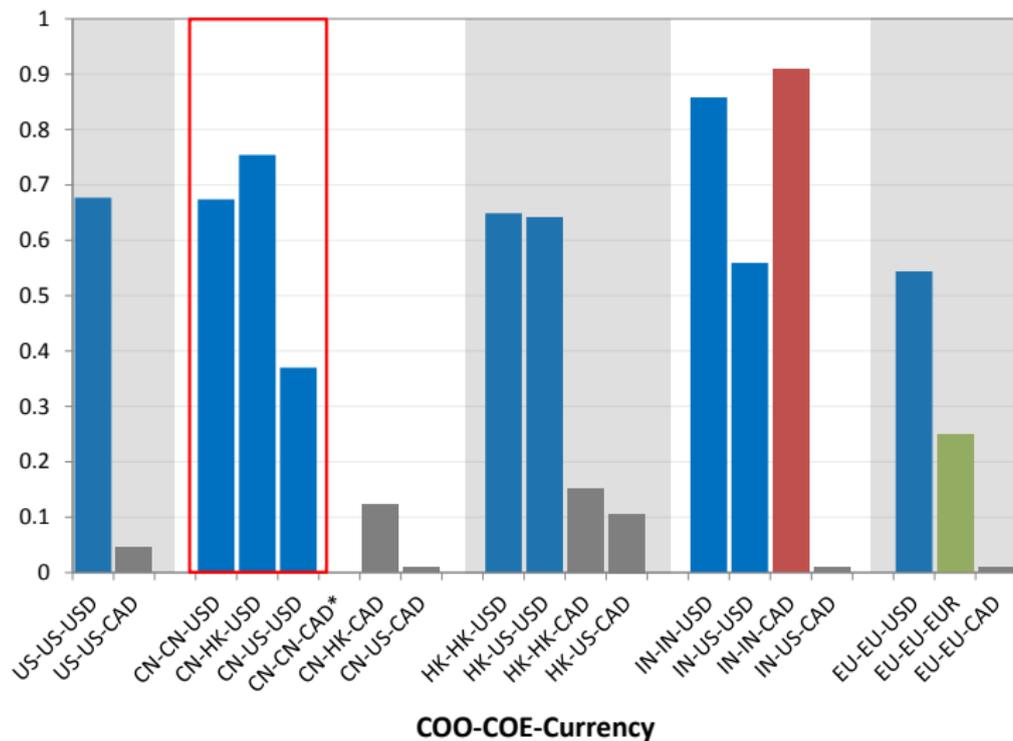
Results: COO/COE/Currency Type

Exchange rate pass-through coefficient by COO-COE-Currency



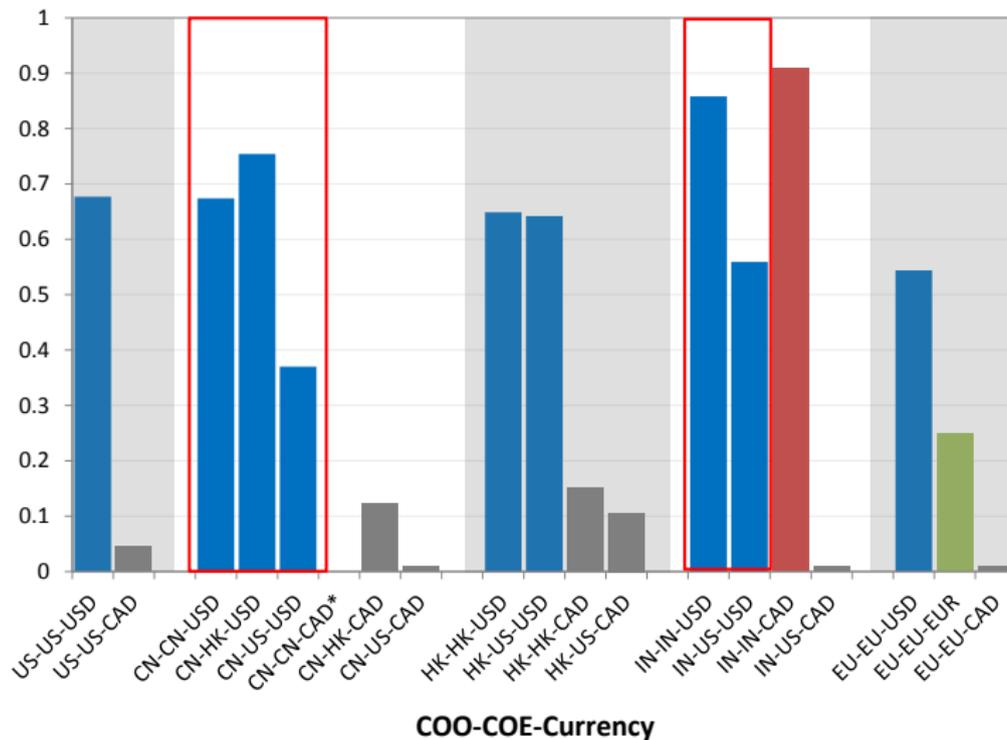
Results: COO/COE/Currency Type

Exchange rate pass-through coefficient by COO-COE-Currency



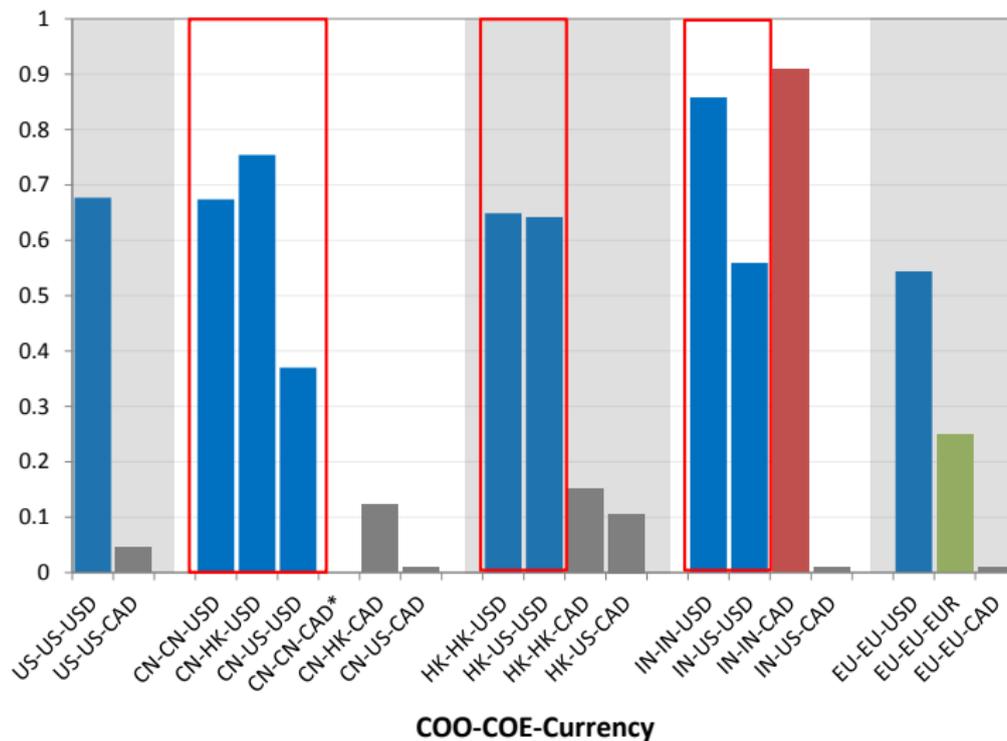
Results: COO/COE/Currency Type

Exchange rate pass-through coefficient by COO-COE-Currency



Results: COO/COE/Currency Type

Exchange rate pass-through coefficient by COO-COE-Currency



Possible Explanations for ERPT Differentials

- Different products being shipped along different routes
 - This does not seem to be the case – analysis of product types does not vary too much by trade route
- Types of product being shipped is changing over time
 - Not much change in the composition of products over time
 - Product quality is unobservable and this might be playing a role
- Double marginalization in indirect trade
 - This is a possibility and being explored in the model we are developing
- Size and sophistication of domestic firms

Findings so far:

- Currency and trade routes appear to play an important role in pass-through to Canadian import prices in the apparel industry
- Implication of this could be that pass-through changes over time

Future work:

- Further develop a model that incorporates currency choice and different trade patterns
- Extend the set of products being examined for universality of results (the analysis of consumer electronics is almost complete)