Market Structure and Exchange Rate Pass-Through

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Research Question

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How do movements of the exchange rate affect "market toughness," and to what extent can this explain incomplete pass-through?

Motivation I

Why do we care?

- Strategic price complementarities: Melitz and Ottaviano (2008), Atkeson and Burstein (2008), Gust et al. (2010 and 2011), Gopinath and Itskhoki (2010)
- If exchange rate moves "market toughness", it leads to a firm's optimal price not commoving 1-1 with exchange rate
- Can the incompleteness of long-run pass-through (e.g. Nakamura and Steinsson (2008)) be explained by such real rigidities?

Motivation II

Understanding the importance of strategic price complementarities is of interest because:

- It guides key modeling choices, also in the closed economy literature: already small menu costs have large effects if complementarities matter.
- It has direct relevance for monetary policy as we can understand how exchange rate affects inflation:
  - What does a global "demise of the dollar" mean for US import inflation?
  - What is the effect of a large trade-partner appreciation (China?) on the US?
  - Can the changing structure of trade explain the decline in US PT? (see Marazzi and Sheets (2007))

Outline

1. Decomposing the Exchange Rate
   - PT rate following broad USD movements.
   - PT rate following idiosyncratic Trade Partner Currency (TPC) movements.

2. Decomposed Exchange Rate Shocks and Relevant Market Share:
   - Does TPC PT depend on the trade partner‘s market share?
   - Does USD PT depend on the market share of domestic producers?

3. To what extent can a simple model of price complementarities explain PT rates when calibrated using our exchange rate decomposition, market share and other sector information?

Trade-Partner Currency vs USD Movements

Part I

Decomposing the exchange rate and PT

Trade-Partner Currency vs USD Movements

Idea:
Building on Gopinath and Itskhoki (2010), Glick and Rogoff (1995), we decompose the nominal exchange rate into two components:

- Global movements of the US: USD movements
- Trade-partner specific currency movements: TPC movements

Why do we decompose the exchange rate?

- Idiosyncratic country movements affect only few firms
- Common movements affect all importers

Trade-Partner Currency vs USD Movements

How do we decompose exchange rate movements?

Think about three currency movements: US, TP, rest of the world (ROW). Define global USD movement:

$$\Delta USD_{ROW-TP,t} \equiv \sum_{c \epsilon (C \supset \{TP, USA\})} \omega_{c,t} \Delta USD_{c,t} \tag{1}$$

then,

$$\Delta TPC_{TP,t} \equiv \Delta USD_{TP,t} - \Delta USD_{ROW-TP,t} \tag{2}$$

where

- Note: the ROW is the anchor that tells us whether the USD appreciated or the TPC depreciated
- Also, ROW is different for each TP

Trade-Partner Currency vs USD Movements

Example 1: How do we calculate USD and TPC movements?

- Suppose there are 3 equally large US trade partners in the world: China, Canada, Mexico
- Exchange rate movements are:
  - USD/CNY: +10%
  - USD/MXN 0%
  - USD/CAD 0%
- Consider China as TP.
- ROW: Canada and Mexico.

Standard all-country, trade-weighted (TW) definition:

- TW movement: 0.33*(10%+0% +0%) = 3.33%

Our definition:

- USD movement: 0.5*(0% +0%) = 0%
- TPC movement: 10% - 0% = 10%

Trade-Partner Currency vs USD Movements

Example 2: Do we address the correlation structure of XRs?

- Now, exchange rate movements are:
  - USD/CNY: +5%
  - USD/MXN -5%
  - USD/CAD -5%
- Consider China as TP.
- ROW: Canada and Mexico.

Standard all-country, trade-weighted (TW) definition:

- TW movement: 0.33*(5% -5% -5%) = -5%/3

Our definition:

- USD movement: 0.5*(-5% -5%) = -5%
- TPC movement: 5% - (-5%) = 10%

⇒Correlation structure does not affect decomposition

Estimating Pass-Through

How do we estimate PT?

Estimate standard unconditional PT regression at n-month horizons for each exchange rate measure:

$$\Delta p_{c,t} = \alpha_c + \sum_{j=0}^{n} \beta_j \Delta e_{c,t-j} + \sum_{j=0}^{n} \theta_j \Delta \pi_{c,t-j} + \gamma Z_t + \epsilon_{c,t} \qquad (3)$$

where

- c is a country
- e the log of one exchange rate measure
- n$= 1, 2, ..., 25$
- controls Z_t

PT at horizon n is the sum of β_j up to $j = n$.

Estimating Pass-Through

What is the data?

BLS micro price data:

- Data underlying U.S. IPP (import price index)
- Monthly transaction prices - Stigler and Kindahl (1970)
- Prices exclude intra-firm prices ("transfer pricing")
- Prices exclude 'lumpy trade' prices
- Individual "items" such as "Rug; 100% New Zealand wool; hand-tufted; hand-hooked; style name: XXX"
- Time frame: 1994-2005

Exchange rate data from IMF.

Estimating Pass-Through

Countries included:

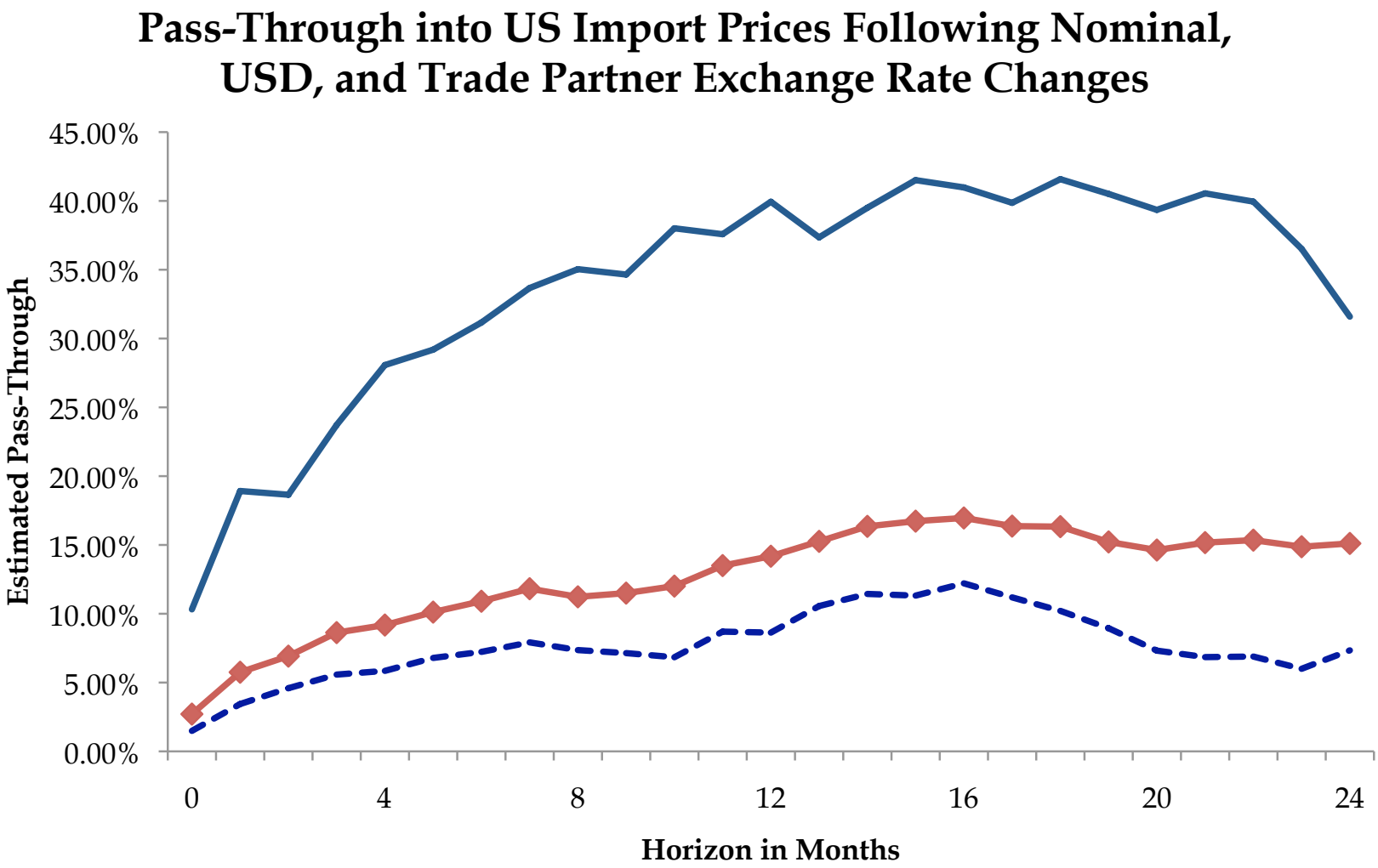
- Major trade partners: China, Canada, Mexico, Japan, Germany, South Korea, United Kingdom, Taiwan, France, Ireland
- Minor trade partners: Austria, Denmark, Czech Republic, Finland, Greece, Hungary, Italy, Netherlands, Norway, Portugal, Singapore, Spain, Sweden, Switzerland

Results

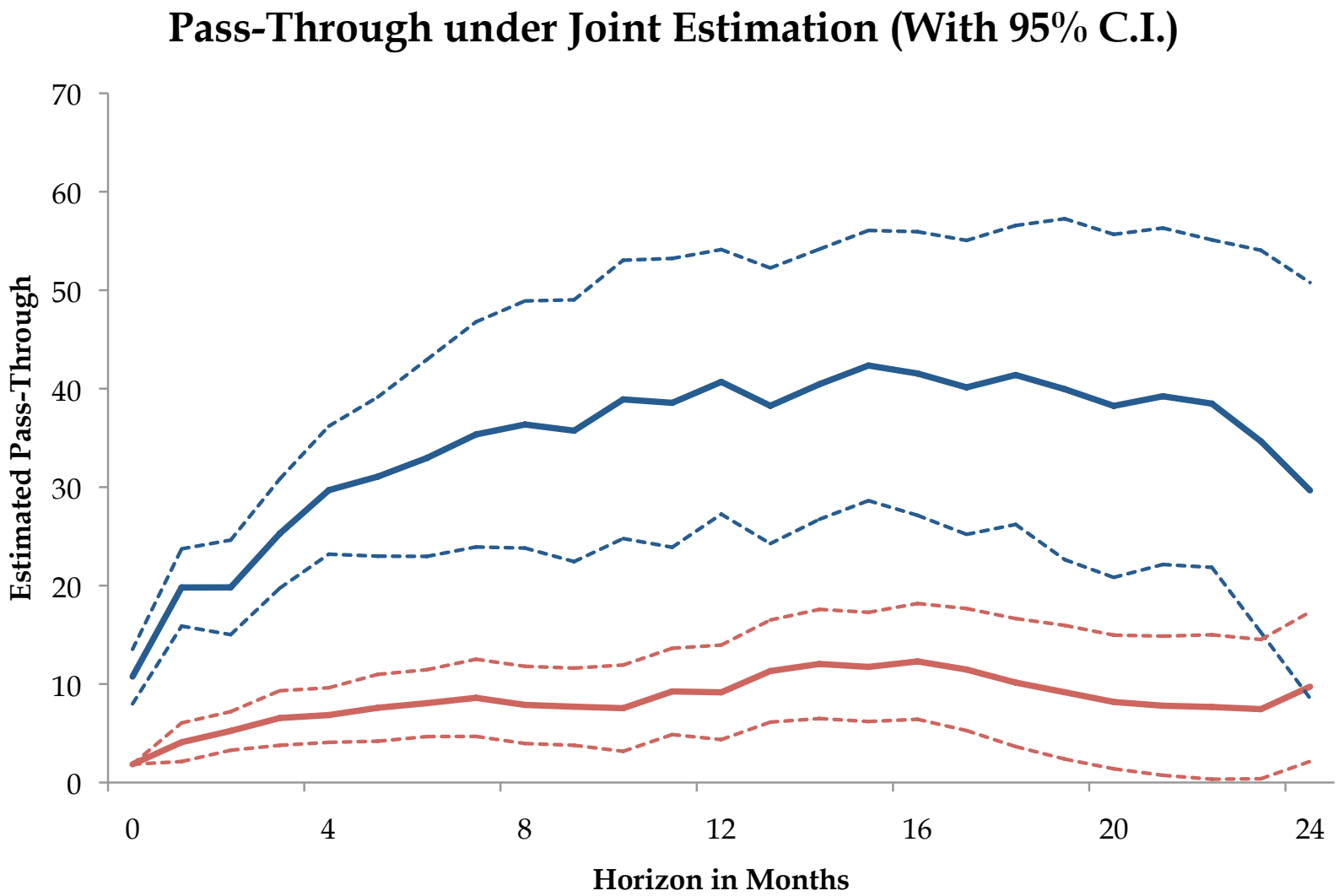
Result I:

Much larger estimated PT for global USD movements than TPC or nominal exchange rate movements

Results


Pass-Through into US Import Prices Following Nominal, USD, and Trade Partner Exchange Rate Changes
Estimated Pass-Through
45.00%
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
0
4
8
12
16
20
24
Horizon in Months

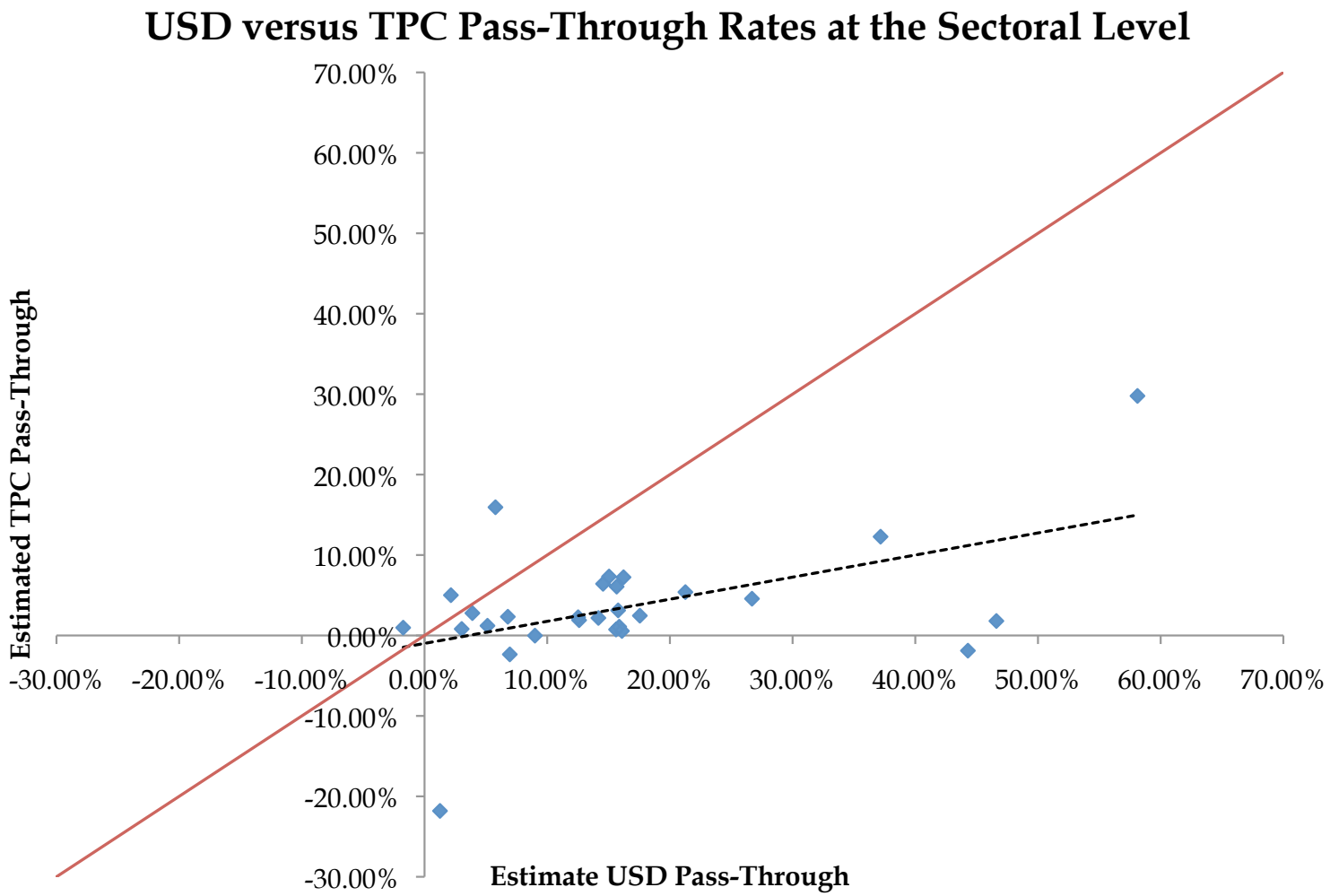
Results


Pass-Through under Joint Estimation (With 95% C.I.)
Estimated Pass-Through
70
60
50
40
30
20
10
0
0
4
8
12
16
20
24
Horizon in Months

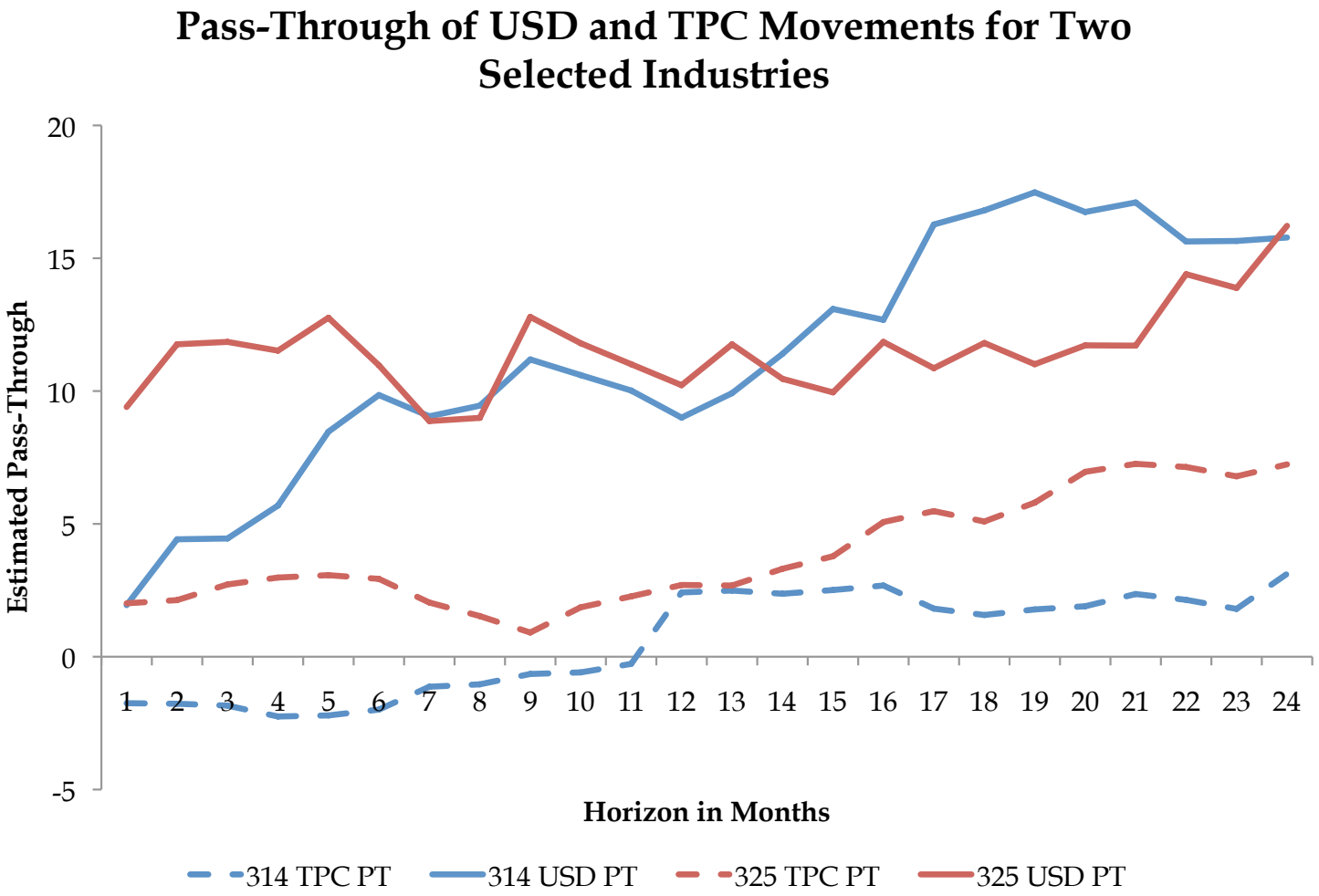
Robustness

Are our results driven by specific sectors or countries?

Robustness


USD versus TPC Pass-Through Rates at the Sectoral Level
Estimated TPC Pass-Through
Estimate USD Pass-Through
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
-10.00%
-20.00%
-30.00%
-30.00%
-20.00%
-10.00%
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%

Robustness


Pass-Through of USD and TPC Movements for Two Selected Industries
Estimated Pass-Through
20
15
10
5
0
-5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Horizon in Months
314 TPC PT
314 USD PT
325 TPC PT
325 USD PT

Robustness

Table: Trade-Partner and USD Exchange Rate Pass-Through by Country

	TPC	USD	TPC	USD
Country/Horizon	6 months		12 months	
Canada	0.16	0.37	0.32	0.54
Mexico	0.02	0.18	0.05	-0.01
Sweden	0.1	0.37	0.18	0.54
Norway	0.16	0.61	0.2	0.63
Finland	0.07	0.26	0.13	0.36
Denmark	0.18	0.43	0.23	0.39
UK	0.04	0.56	-0.44	0.75
Ireland	0.01	-0.09	0.16	-0.09
Netherlands	-0.04	0.87	0.14	0.9
		. . .		
New Zealand	0.21	0.55	0.1	0.53
Mean	**0.24**	**0.37**	**0.30**	**0.51**
Median	**0.25**	**0.34**	**0.29**	**0.50**

Trade-Partner Currency vs USD Movements

Result:

Much larger estimated PT for global USD movements than TPC or nominal exchange rate movements

$\Rightarrow$ Consistent with price complementarities: if USD moves, relative price moves for all importers, so large PT

$\Rightarrow$ Consistent with important role of market power

$\Rightarrow$ Next, we use the cross-section of sectors to discern this view from alternative ones, for example large/persistent USD shocks, i.i.d. TPC shocks.

Pass-Through and Market Share

Part II

If price complementarities matter, shouldnt PT vary with market share?

Pass-Through and Market Share

Two questions:

- Does PT following USD movements depend on the general openness (i.e. the import share) of the sector?
- Does TP following TPC movements depend on the import share of the trade partner in the sector?

Pass-Through and Market Share

Relate pass-through to market power directly by estimating:

$$\Delta p_{k,c,t} = \alpha_c + \sum_{j=0}^{n} \beta_j \Delta e_{c,t-j} + \sum_{j=0}^{n} \theta_j \Delta e_{c,t-j} * s_{k,c} + \gamma s_{k,c} + \epsilon_{k,c,t} \tag{4}$$

where have

- $e_{c,t}$ exchange rate measure
- $s_{k,c}$ measure of market share (of country c) in sector k
- Sectors defined at HS and NAICS six-digit level

Pass-through due to market power: $\theta(n) = \sum_{j=0}^{n} \theta_j$

Pass-Through and Market Share

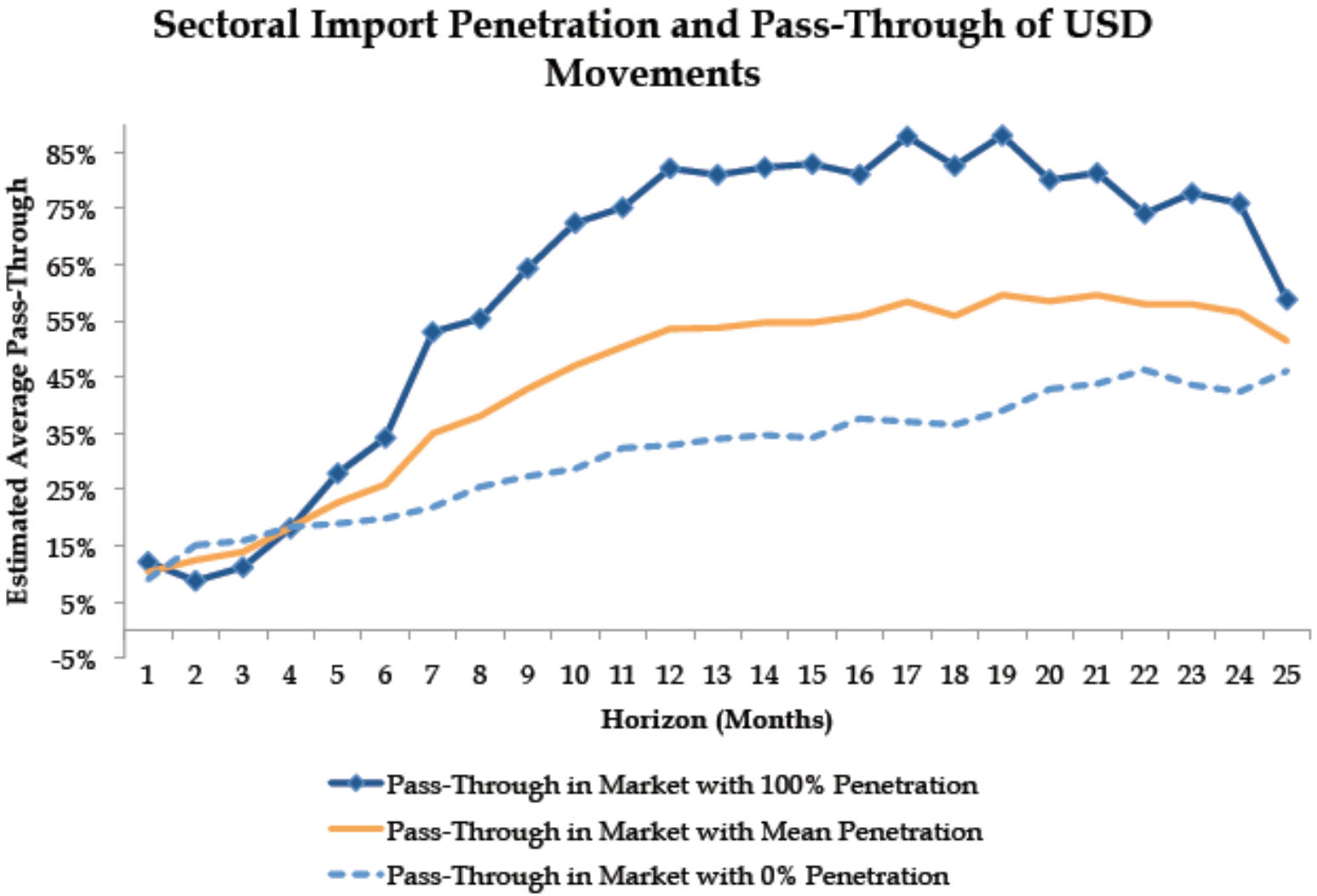
Does a USD movement generate pass-through because it affects the market environment?

Market share measure - sectoral import penetration:

$$1 - m_{US,k} = 1 - \frac{Domestic\ Shipments_k}{Domestic\ Shipments_k + World\ Imports_k}$$

Exchange rate: USD movements

Pass-Through and Market Share



Pass-Through and Market Share

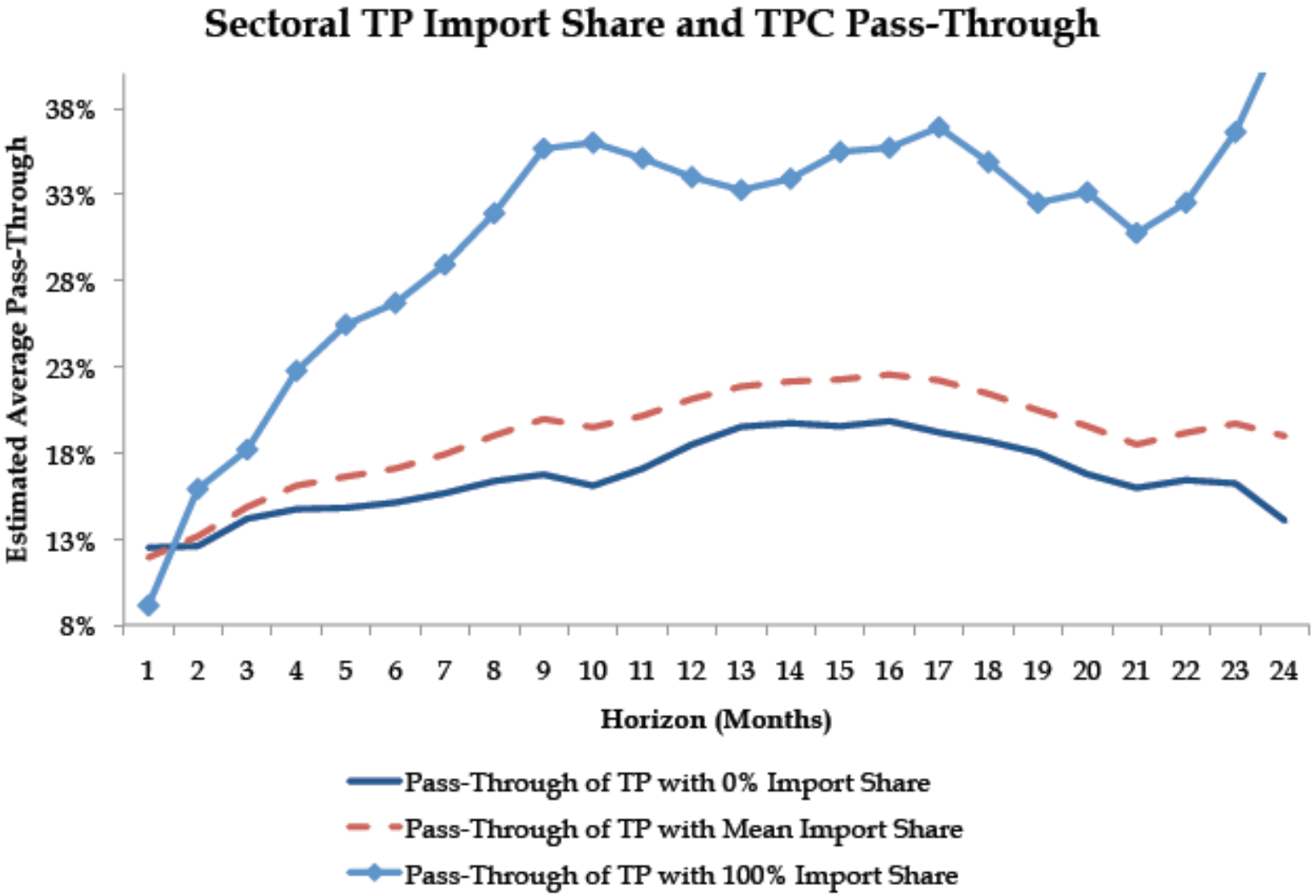
Does a TPC movement depend on the import market share of the importer?

Market share measure - sectoral importer market share:

$$m_{c,k} = \frac{Imports_{c,k}}{World\ \ Imports_k}$$

Exchange rate: TPC movements

Pass-Through and Market Share



Pass-Through and Market Share

Result:

$\Rightarrow$ Important role of market power for PT:

- Total import penetration
- Import market share

$\Rightarrow$ "Mass" of firms affected by the same shocks matters for PT.

- Next, we dig deeper into how the precise market structure matters for PT.

Model

Part III

Theory: Model and Estimation Exercise

Can a simple model of oligopoly pricing explain USD, TPC PT and how PT co-varies with market share?

Model

- Nested demand system, Dornbusch (1987), Yang (1997), Atkeson and Burstein (2008)
- Continuum of competitive firms producing final output

$$c = \left(\int_0^1 y_k^{(1-1)/\eta} dk \right)^{\eta/(\eta-1)}$$

- N monopolists producing inputs

$$y_k = \left(\sum_{n=1}^{N} q_{n,k}^{(\rho-1)/\rho} \right)^{\rho/(\rho-1)}$$

- Firms maximize profits subject to constant $MC = \omega_{n,k}$
- Closer substitutes within than across sectors: $\rho > \eta$

Mechanics of the Model

- A tiny firm $s_{n,k} \approx 0$ faces demand elasticity ρ, a monopolist $s_{n,k} = 1$ faces demand elasticity η
- With $s_{n,k} \epsilon \,]0, 1[$ demand elasticity is variable. It:
  - Decreases in own cost/exrate
  - Increases in the cost/exrate of other firms
- Of course, all prices react to all exchange rates. We next calculate the equilibrium effect of the exchange rate.

Model

- Pricing:

$$
\begin{aligned}
P_{n,k} &= \frac{\varepsilon\left(s_{n,k}\right)}{\varepsilon\left(s_{n,k}\right)-1}\omega_{n,k} \\
\varepsilon\left(s\right) &= \left[\frac{1}{\rho}\left(1-s_{n,k}\right)+\frac{1}{\eta}s_{n,k}\right]^{-1}
\end{aligned}
$$

- Log-linearized:

$$
\begin{aligned}
\widehat{P}_{n,k} &= \Gamma\left(s_{n,k}\right)\widehat{s}_{n,k}+\widehat{w}_{n,k} \\
\widehat{s}_{n,k} &= \left(\rho-1\right)\left(\widehat{P}_{k}-\widehat{P}_{n,k}\right)
\end{aligned}
\tag{5}
$$

Model

Pass-through depends on:

1. price complementarities: mass of firms co-moving with a country
2. precise distribution of firm sizes

Solve for equilibrium price and PT in two cases:

- all firms of equal size
- allowing for heterogenous firm size

Model

Equilibrium price effect:

$$\widehat{P}_{n,k} = \underbrace{\gamma_{n,k}}_{n's \text{ response to } P_k} \underbrace{\frac{\sum_{j \epsilon N_{k,TP}} s_j \alpha_{n,k} \widehat{w}_{n,k}}{\left(1 - \sum_{j \epsilon N_k} s_j \gamma_{n,k}\right)}}_{\text{Equilibrium Effect on } P_k} + \underbrace{\alpha_{n,k} \widehat{w}_{n,k}}_{n's \text{ direct response to } w_{n,k}} \quad (6)$$

Market structure works through four channels:

- a direct cost effect, sensitivity $\alpha_{n,k}$ depending on market share
- the total impact of TP-firms on the general price level
- second-round amplification by all firms in the industry
- reaction to aggregate price level effect at rate of $\gamma_{n,k}$ depending on firm market share

Model: Equal-Sized Firms

Solve generalized formula for PT following TPC movement:

- Equal-sized firms: $\gamma_{n,k} = \bar{\gamma}$, $\alpha_{n,k} = \bar{\alpha}$.
- Assume $w_{USD} = 0$, $w_{TPC} \neq 0$. Normalize $w_{US} = 0$.
- Then,

$$\widehat{P}_{TPC} = \underbrace{\overline{\gamma}\frac{1}{1-\overline{\gamma}} n_{TP} \overline{\alpha} \widehat{w}_{TPC}}_{\text{Effect of TPC on } \widehat{P}_k} + \underbrace{\overline{\alpha}\widehat{w}_{TPC}}_{Direct\text{Cost Effect}}$$

- PT depends on market position of TP.

Model: Equal-Sized Firms

Solve generalized formula for PT following USD movement:

- Assume $w_{USD} \neq 0$, $w_{TPC} = 0$.
- Then,

$$\widehat{P}_{USD} = \underbrace{\overline{\gamma}\frac{1}{1-\overline{\gamma}}\left(n_{ROW}+n_{TP}\right)\overline{\alpha}\widehat{w}_{USD}}_{\text{Effect of USD on } \widehat{P}_k} + \underbrace{\overline{\alpha}\widehat{w}_{USD}}_{\textit{Direct}\text{Cost Effect}}$$

- PT depends on degree of import penetration.

Model Proposition

Key implications:

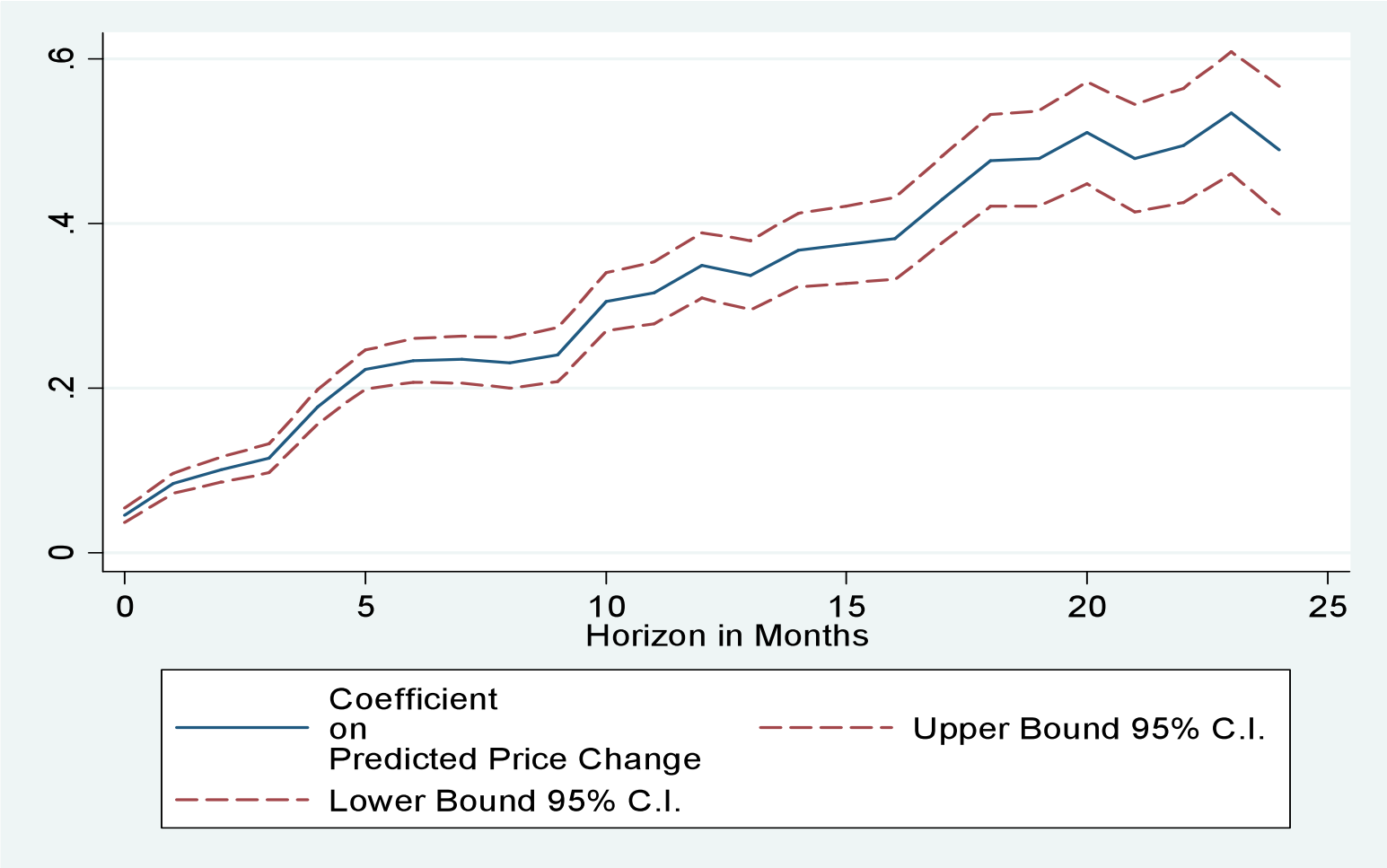
- USD PT $>$ TP PT as $n_{ROW} > 0$
- USD PT increasing in import penetration
- TPC PT increasing in TP market share
- Precise distribution of firm sizes matters

Model Estimation

Map model directly back to data:

- Can we match observed price changes with the calibrated model?
- How important are our findings economically? Can we explain pass-through differences across countries?

Model Estimation

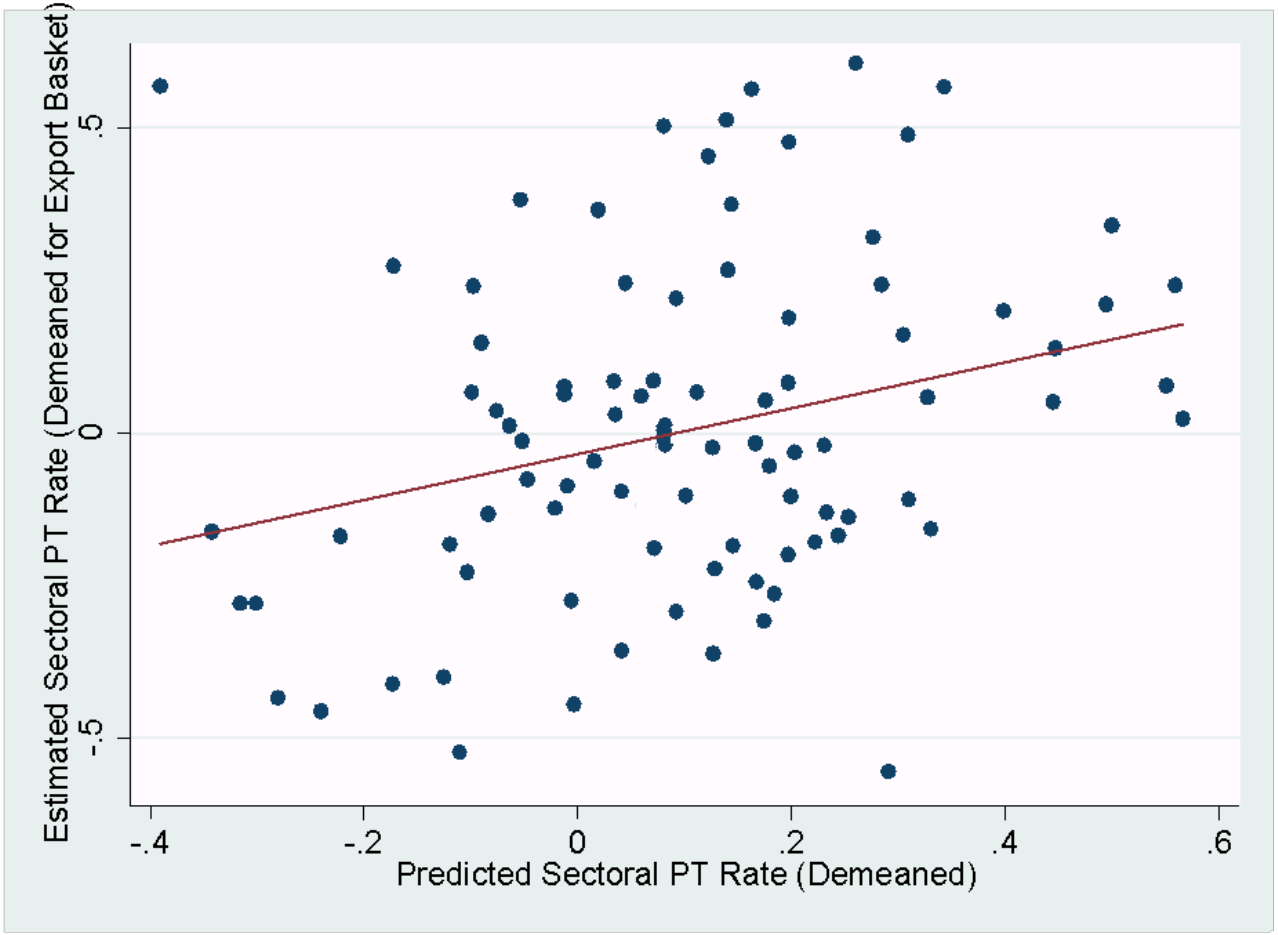


Model Estimation

Can we qualitatively match actual pass through rates?

- Use model to predict PT at the three-digit NAICS level for each trade partner.
- Compare to actual, estimated PT.
- Significant, positive association?
- Regression slope of 1 and a constant of 0?

Model Estimation II: PT Rates

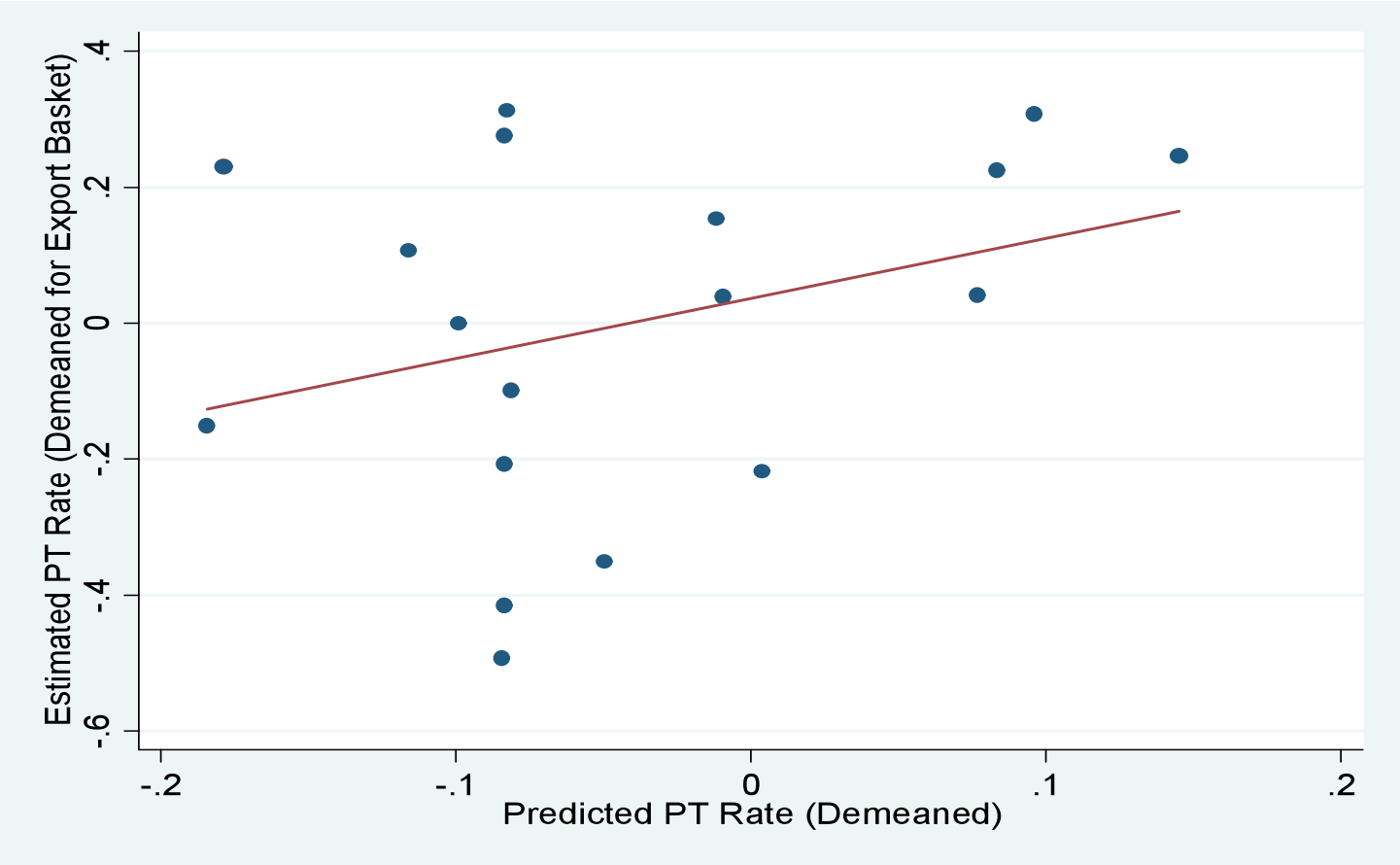


Model Estimation II: PT Rates

Can we match PT rates?

- Aggregate to country level.
- Compare actual and estimated PT.
- Two tests:
  - Hard one: regression slope of 1 and a constant of 0?
  - Realistic One: how much of the variation in PT rates across countries and industries can we explain?

Model Estimation II: PT Rates



The R^2 of the volume weighted regression (red line) is 47%!

Conclusion

Conclusion: Important role of market Structure for Pricing

- Pass-through for global USD movements larger than TPC or nominal exchange rate movements. Two to three times as large at long horizons.
- Oligopoly model of pricing can explain USD, TPC PT.
- Implications for modeling: nominal vs. real rigidities, PTM, decomposing the exchange rate
- Implications for policy-makers: US import inflation, TPC shocks