Trade and Worker Deskilling

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Motivation

- Globalisation has been pinpointed as a possible driver of low productivity growth and real wage stagnation in many developed economies.
- At the same time, rising wage inequality has motivated research looking at the impact of international trade on the labour market, yet some fundamental questions remain far from resolved.
- This paper offers complementary new evidence on empirical connections between trade and the labour market.

Approach

- The focus is on a big world event that sent shock waves globally – the EU referendum vote of June 23, 2016 in the UK.
- The unexpected result of the vote induced an unprecedented overnight fall in the value of sterling.
- The biggest drop ever among the world's four major currencies since the collapse of Bretton Woods.
- Unexpected vote-induced sterling depreciation $\rightarrow$ Trade$\rightarrow$ Workers

Trade and Worker Outcomes

- Exports are generally thought of as improving worker outcomes, but the effect of imports on workers is less clear.

- Early studies find a negative impact of imports on workers (Grossman 1987, Revenga 1992), but mixed evidence since then.
  - Huge rise in trade in intermediate goods and services, which makes up 2/3rds of international trade. (Johnson and Noguera 2012)
  - Workers may be hurt through easier offshoring of tasks, but they can benefit through lower production costs from offshoring. (Grossman and Rossi-Hansberg 2006)
  - Imports hurt workers if they substitute for domestic labour, but can benefit them if they are complementary: empirically, endogeneity and anticipation are “first-order” concerns for studying causal effects of trade on workers. (Goldberg and Pavcnik 2016)

Summary of Results

- Based on the pre-referendum trade structure and the referendum-induced sterling depreciation across currencies, workers in industries more exposed to intermediate imports-weighted sterling depreciation
  $\rightarrow$ Saw bigger increases in their industry's intermediate import prices
  $\rightarrow$ Experienced relative wage falls and cuts in job-related education and training.

- A 1% higher increase in the intermediate import price index lowered wages by 0.3-0.5% in the industry, implying complementarity among intermediate imports and workers.

- Training is a key policy tool for redistributing the gains from globalization, but less is known about impacts of trade due to "onerous" data needs (Hummels et al. 2012, 2018)

Real World (27/03/19)

Matthew Naylor, managing director of Naylor's Flowers, said: the drop in the value of the pound had reduced wages for workers. "On the ground, as a British employer, we don't have the reputation we used to have as a place to better yourself," added Mr Naylor. (Sky News 2019)

Wooster (the dog) really is on their website!

Contribution

- This paper further advances trade and labour market research by:
  - Studying the impact of trade on all workers in the economy, not just in manufacturing (Liu and Trefler 2011, Ebenstein et al. 2014)
  - Utilising the large currency depreciation to lever plausible exogenous variation in imports, including in services (Hummels et al. 2018)
  - Providing the first evidence of actual worker-level outcomes being adversely affected by the current surge in nationalist politics (Dhingra et al. 2017, Auer et al. 2018, Fajgelbaum et al. 2019)

- The content of this work relates to two strands of literature
  - Impacts of trade, intermediate inputs/offshoring and exchange rates on labour market outcomes (Feenstra and Hanson 1999, Campa and Goldberg 2001, Pierce and Schott 2016)
  - Actual impacts of nationalist politics (e.g., Breinlich et al. 2017, Amiti et al. 2019) and the dislocation between personal identities and political loyalties (Grossman and Helpman 2019).

Structure of the Talk

- Context of Events of June 23/24, 2016
- Research Design and Data
- Results and Discussion
- Conclusions

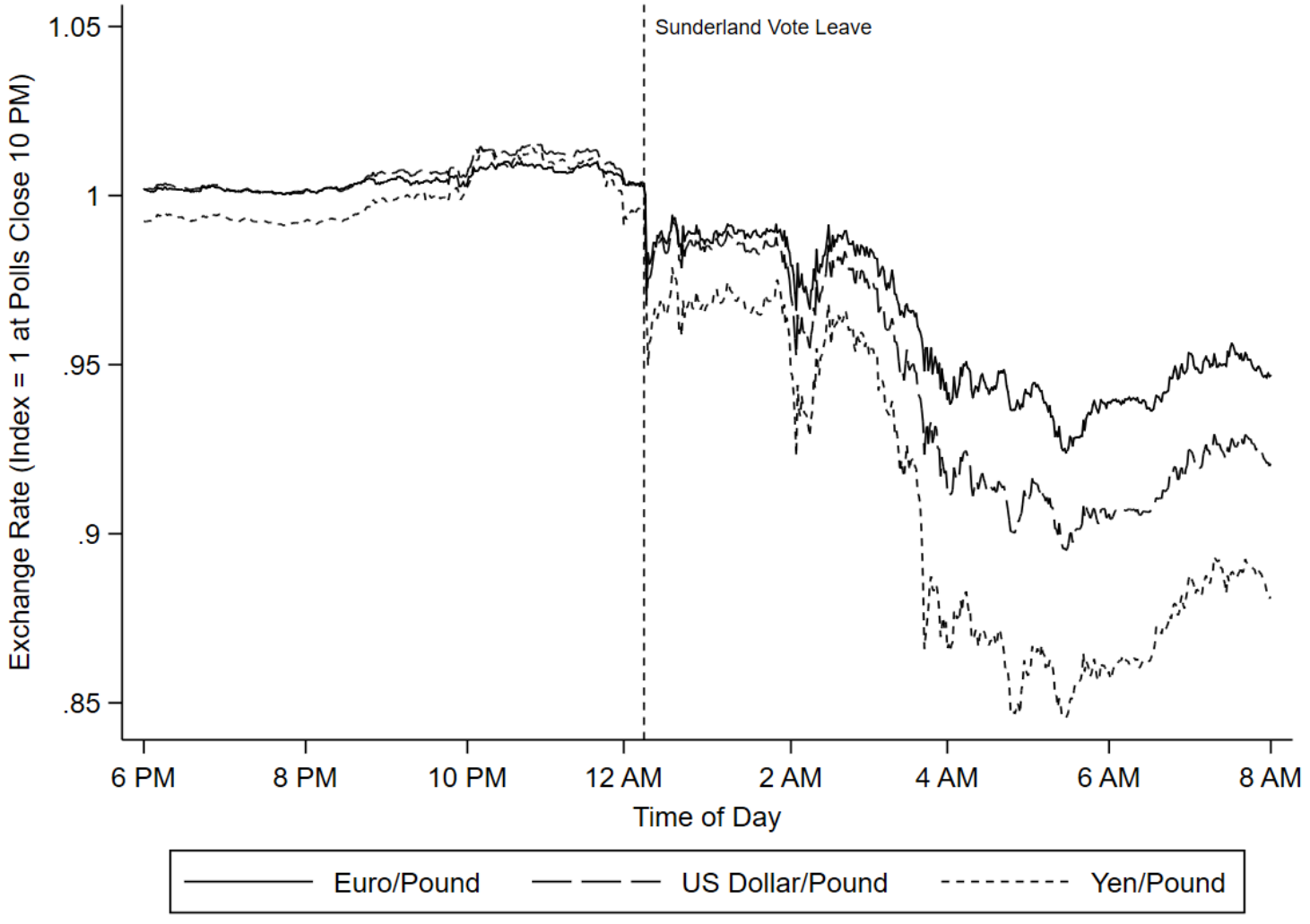
Sterling depreciation from the Brexit news shock

Overnight sterling depreciation

Country-specific depreciation

Persistence of sterling depreciation

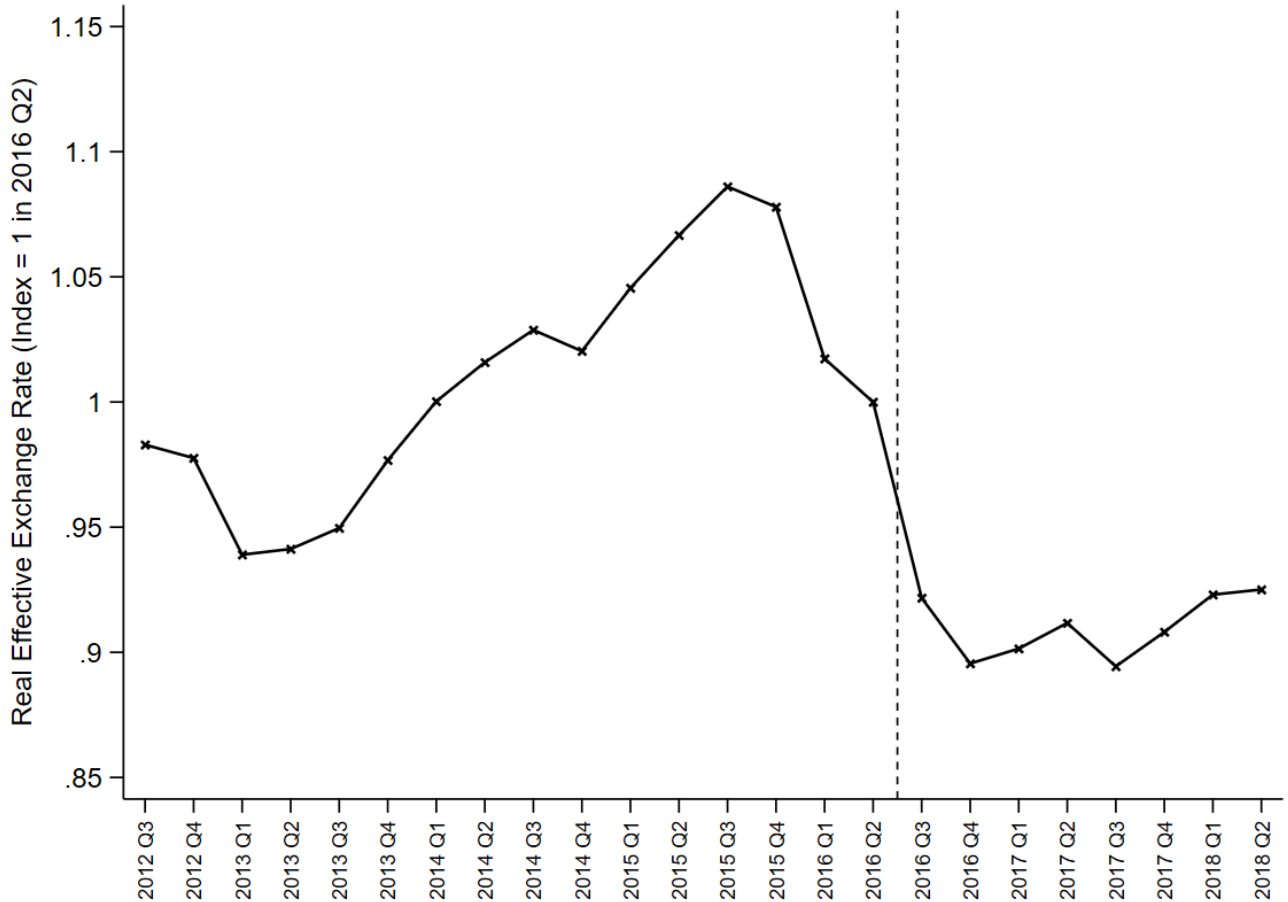
EU Referendum - Exchange Rates



EU Referendum Sterling Depreciation Across Countries

Country	Currency	%	Country	Currency	%
Japan	Japanese Yen	-11.1	Israel	New Israeli Sheqel	-6.8
United States	US Dollar	-8.0	Switzerland	Swiss Franc	-6.6
Saudi Arabia	Saudi Riyal	-8.0	Turkey	Turkish Lira	-6.5
Hong Kong	Hong Kong Dollar	-7.9	Malaysia	Malaysian Ringgit	-6.3
Thailand	Thai Baht	-7.6	Denmark	Danish Krone	-6.1
China	Chinese Yuan	-7.5	Euro Zone	Euro	-6.0
Singapore	Singapore Dollar	-7.4	Czech Republic	Czech Koruna	-5.9
Taiwan	Taiwan Dollar	-7.2	South Korea	Korean Won	-5.7
Russia	Russian Ruble	-7.2	South Africa	South African Rand	-5.3
India	Indian Rupee	-7.1	Hungary	Hungarian Forint	-5.2
New Zealand	New Zealand Dollar	-7.1	Norway	Norwegian Krone	-5.2
Australia	Australian Dollar	-6.9	Sweden	Swedish Krona	-5.1
Canada	Canadian Dollar	-6.9	Poland	Polish Zloty	-4.3

EU Referendum - Peristence of Sterling Depreciation



- Real effective exchange rate persistence:
  $$\log\left(REER_{qt}\right) = \underset{(0.017)}{-0.101} \cdot Post_{qt} + \varepsilon_{qt}$$

Outline of Theoretical Framework

- Segmented markets and CES demand for UK outputs o and intermediates i.
- UK firms combine labour, intermediates, destination numeraire to make o.
- Intermediate suppliers combine source s and UK numeraires to make i.
- Wages are set by market clearing of industry-specific labour.
- $E_c = \phi_c\left(\mathscr{S}, \tilde{\mathscr{S}}\right)$ for state variable $\mathscr{S}$, public's best estimate of it $\tilde{\mathscr{S}}$.
- $\Delta\mathscr{S} = 0$, $\Delta\tilde{\mathscr{S}} = gB$ from Brexit vote news B, so $\Delta E_c = \phi_{2c} gB$.
- By Shephard's lemma, wages change ($\hat{W} \equiv \Delta W / W$) by:

$$-\sigma_{WW} S_{WC} \hat{W}_o = \sigma_{WP^M} S_{P^M C} \hat{P}^M_o + S_{uk} \hat{Q}_{uk\,o} + (1 - S_{uk}) \sum_d S_{dxo} \hat{Q}_{do}$$

- σ_{WP^M} =Allen-Uzawa elasticity of substiution between labour and intermediate imports, Negative for complements; σ_{WW} = Own AUES for labour; S_{dxo} =share of destination d in exports, $S_{WC}, S_{P^M C}$= share of wages, intermediate imports in costs; $P^M_o(P_i(P_{si}))$ = price of intermediate imports; $Q(P_{do}, A_d)$= exports in terms of price and aggregate demand shifter.

Worker Impacts of the Sterling Depreciation

- The structural wage equation is:

$$\hat{W}_o = \alpha + \theta_{MW}\hat{P}_o^M + \theta_{XW}\hat{P}_o^X$$

- $\hat{P}_o^M = \sum_i \sum_s S_{sio}\hat{P}_{si}$, $\hat{P}_o^X = \sum_d S_{dxo}\hat{P}_{do}$ are trade share weighted trade prices.
- The reduced form equations that underpin this are:

$$\hat{W}_o = \alpha_W + \beta_{MW}\hat{E}_o^M + \beta_{XW}\hat{E}_o^X$$
$$\hat{P}_o^M = \alpha_M + \beta_{MM}\hat{E}_o^M$$
$$\hat{P}_o^X = \alpha_X + \beta_{XX}\hat{E}_o^X + \beta_{MX}\hat{E}_o^M$$

- $\hat{E}_o^M \equiv \sum_i \sum_{s\neq uk} S_{sio}\hat{E}_s$ and $\hat{E}_o^X \equiv -\sum_{d\neq uk} S_{dxo}\hat{E}_d$ are trade share weighted exchange rates (in %).

- $\delta =$ share of source country costs in production, $\kappa =$ probability of price adjustment.
$\beta_{MM} \equiv -\delta^M\kappa^M(<0)$, $\beta_{MX} \equiv -\frac{\sigma_{WP^M}-\sigma_{WW}}{\sigma_{WW}-\delta\kappa\sigma}\delta\kappa S_{P^MC}\beta_{MM}$, $\beta_{XX} \equiv \frac{\kappa(1-\delta)(\sigma_{WW}-\delta\kappa S_{uk}\sigma)}{\sigma_{WW}-\delta\kappa\sigma}(>0)$.
$\theta_{MW} \equiv -\frac{(\sigma_{WP^M}-\delta\kappa S_{uk}\sigma)S_{P^MC}}{(\sigma_{WW}-\delta\kappa S_{uk}\sigma)S_{WC}}$, $\theta_{XW} \equiv -\frac{(1-S_{uk})\sigma}{(\sigma_{WW}-\delta\kappa S_{uk}\sigma)S_{WC}}(<0)$.

DID Reduced Forms and IV

- Trade Prices Reduced Form:

$$Log\left(P^M_{oqt}\right) = \alpha_o + \alpha_{qt} + \beta_{MM} Log\left(\text{Depreciation}^M_o\right) * Post_{qt} + \beta_{MZ} Z_{oqt} + \varepsilon^M_{oqt}$$

$$Log\left(P^X_{oqt}\right) = \alpha_o + \alpha_{qt} + \beta_{XX} Log\left(\text{Appreciation}^X_o\right) * Post_{qt} + \beta_{MX} Log\left(\text{Depreciation}^M_o\right) * Post_{qt} + \beta_{XZ} Z_{oqt} + \varepsilon^X_{oqt}$$

- Wages Reduced Form:

$$Log\left(W_{joqt}\right) = \alpha_o + \alpha_{qt} + \beta_{MW} Log\left(\text{Depreciation}^M_o\right) * Post_{qt} + \beta_{XW} Log\left(\text{Appreciation}^X_o\right) * Post_{qt} + \beta_{WZ} Z_{joqt} + \varepsilon^W_{joqt}$$

- Wages Structural Form:

$$Log\left(W_{joqt}\right) = \alpha_o + \alpha_{qt} + \theta_{MW} Log(P^M_{oqt}) + \theta_{XW} Log(P^X_{oqt}) + \theta_{ZW} Z_{joqt} + \upsilon_{joqt}$$

- $\theta_{MW} = \beta_{MW}/\beta_{MM} - \beta_{XW}\beta_{MX}/\beta_{MM}\beta_{XX}$ and $\theta_{XW} = \beta_{XW}/\beta_{XX}$. α_o, α_{qt} are industry and quarter-year fixed effects, $Post_{qt} = 1$ from Q3 2016 onwards, X are controls (comprising demographics of workers).

Data

- The paper uses individual and industry-level data for the UK, combined with trade data from a variety of sources
- The time-frame covers sixteen quarters pre-referendum (2012Q3-2016Q2) and eight quarters post-referendum (2016Q3-2018Q2)
- Worker outcomes come from the quarterly Labour Force Survey (LFS)
- Trade data come from the Office of National Statistics (ONS), including both publicly available data and customized data obtained through freedom of information requests
- Data cover 85 industries which on average have non-zero imports from 146 countries (100 currencies) and non-zero exports to 177 countries (98 currencies)
- The import and export price indices are from ONS data (current price and chained volume measures)
- Observe trade shares S_{dxo}, S_{sio} for services trade from International Trade in Services (ITIS) in 2015; $S_{si}S_{io}$ for goods trade from UN COMTRADE in 2015 and the 2014 IO table from ONS.

Trade Structure

Example - Top/Bottom 4 Industries

DiD results for intermediate imports weighted depreciation

DiD results for exports weighted appreciation

Top/Bottom Intermediate Import Weighted Depreciation Industries

Top 4 Industries	Import Shares of Top 3 Partner Currencies
66 Security & commodity contracts, Fund management	USD 44%, Euro 23%, Yen 6%
72 Biotech, R&D services	USD 47%, Euro 22%, Swedish Kr 10%
09 Mining & gas support activities	Singapore $ 29%, Euro 17%, USD 13%
60 Radio and TV programming	USD 47%, Euro 35%, Yuan 3%

Bottom 4 Industries	Import Shares of Top 3 Partner Currencies
17 Manufacture of paper & paper products	Euro 56%, Yuan 9%, USD 8%
24 Manufacture of basic metals	Euro 33%, USD 11%, CDN 10%
35 Electricity, gas, steam & ac supply	Norwegian Kr 39%, Euro 12%, Alg. Dinar 7%
10 Manufacture of food products	Euro 53%, USD 7%, Yuan 5%

Results - Intermediate Imports Weighted Depreciation

	Post - Pre Referendum Changes			
	Intermediate Import Prices	Export Prices	Wages	Training
	(1)	(2)	(3)	(4)
Highest Quintile	0.081	0.105	0.060	-0.008
	(0.008)	(0.010)	(0.007)	(0.003)
2nd Highest Quintile	0.043	0.118	0.075	0.003
	(0.009)	(0.009)	(0.010)	(0.002)
Middle Quintile	0.074	0.108	0.077	-0.002
	(0.004)	(0.012)	(0.008)	(0.003)
2nd Lowest Quintile	0.052	0.101	0.087	-0.003
	(0.015)	(0.013)	(0.007)	(0.003)
Lowest Quintile	0.037	0.102	0.087	-0.001
	(0.007)	(0.009)	(0.008)	(0.001)
Difference-in-Differences	0.044	0.003	-0.027	-0.007
(Highest - Lowest Quintile)	(0.010)	(0.012)	(0.010)	(0.003)

Results - Exports Weighted Appreciation

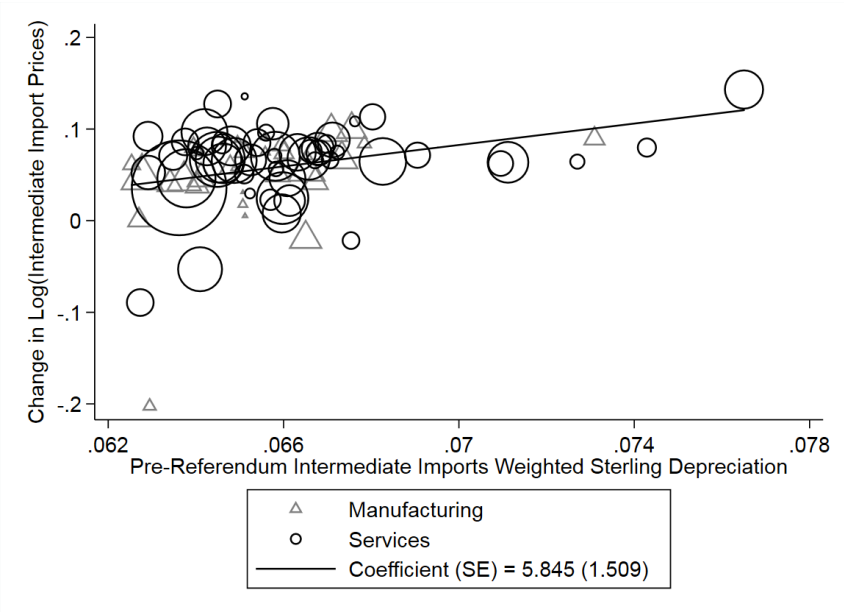
	Post - Pre Referendum Changes			
	Intermediate Import Prices	Export Prices	Wages	Training
	(1)	(2)	(3)	(4)
Highest Quintile	0.052	0.097	0.077	-0.004
	(0.017)	(0.004)	(0.009)	(0.003)
2nd Highest Quintile	0.062	0.125	0.081	-0.001
	(0.013)	(0.015)	(0.009)	(0.002)
Middle Quintile	0.047	0.108	0.064	-0.004
	(0.009)	(0.006)	(0.011)	(0.002)
2nd Lowest Quintile	0.070	0.107	0.073	0.002
	(0.007)	(0.013)	(0.008)	(0.002)
Lowest Quintile	0.051	0.096	0.089	-0.002
	(0.010)	(0.007)	(0.009)	(0.002)
Difference-in-Differences	0.001	0.001	-0.011	-0.003
(Highest - Lowest Quintile)	(0.020)	(0.008)	(0.013)	(0.003)

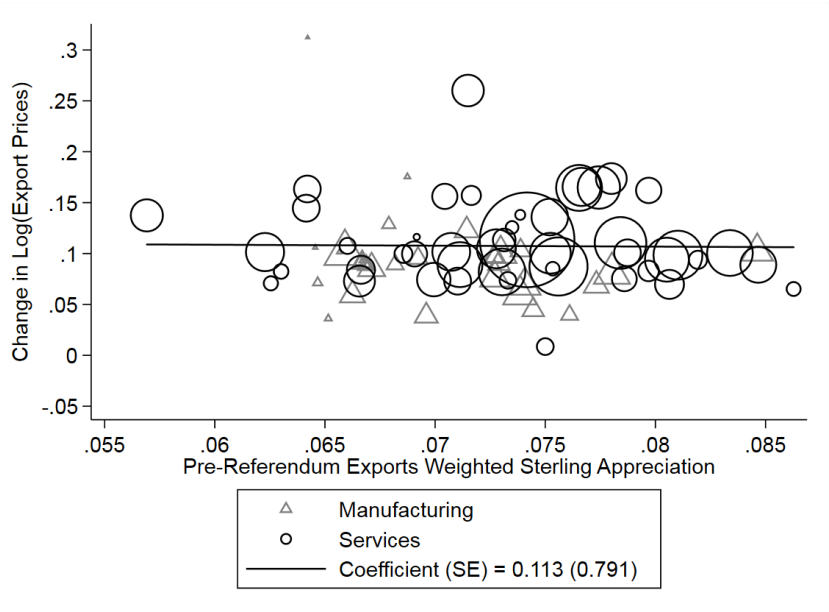
Industry Scatter Plots

Intermediate import prices, export prices and depreciation

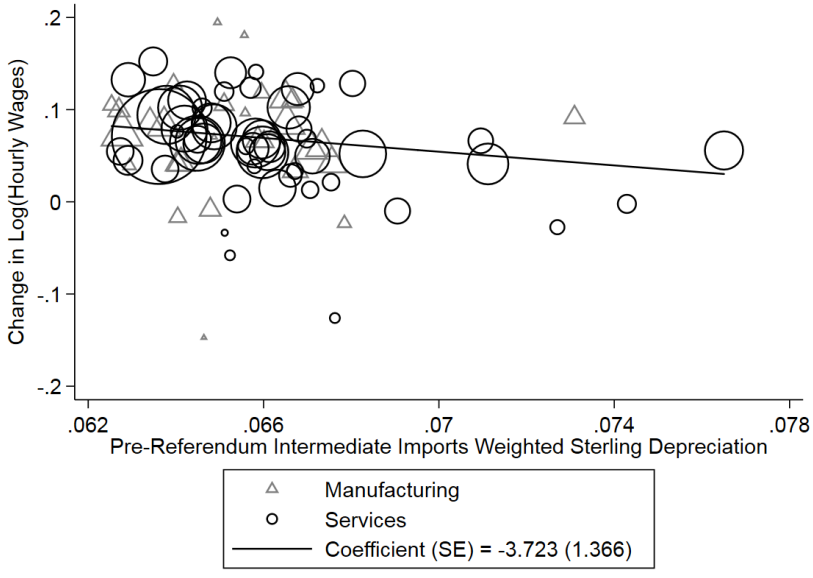
Wages, training and depreciation

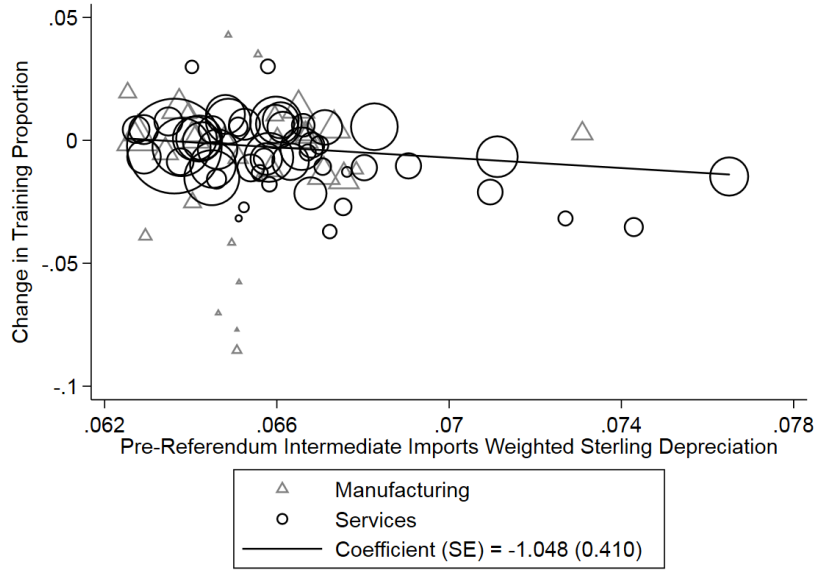
Results - Intermediate Import Prices and Export Prices





Results - Wages and Training





Reduced Form Evidence for Trade Prices

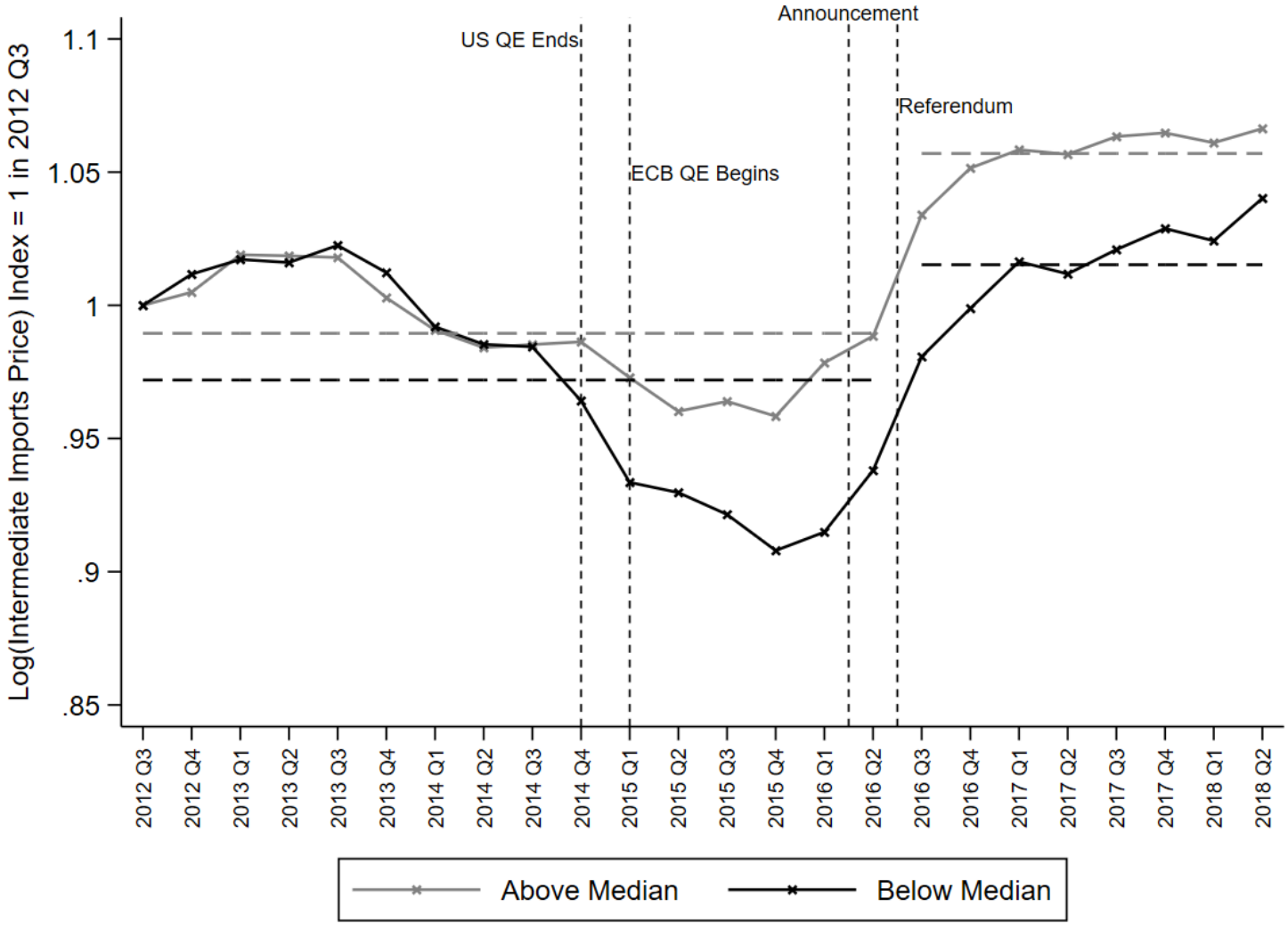
Trade prices and exchange rates

Pre-trends

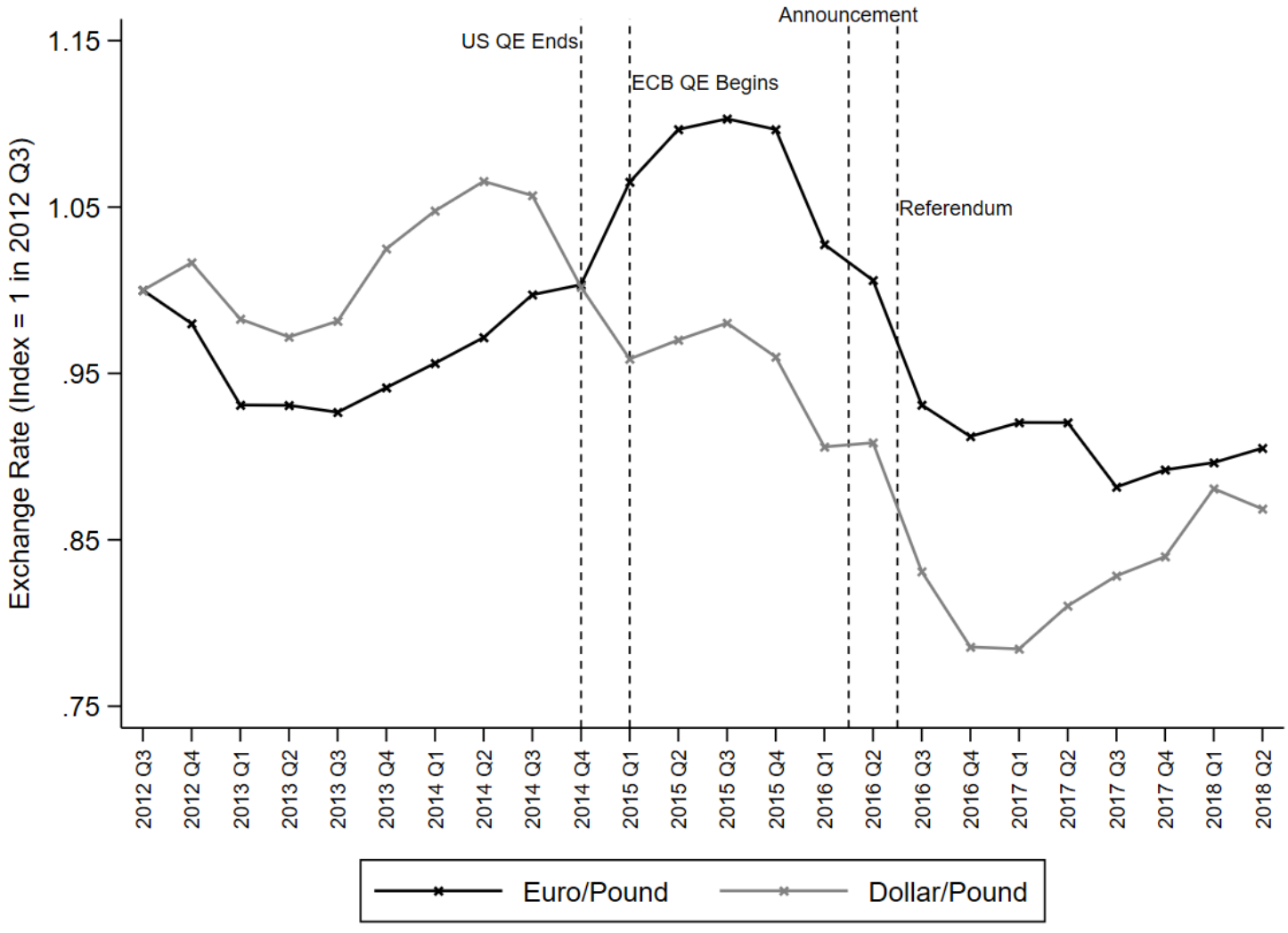
Reduced Form/First Stage - Trade Prices and Exchange Rates

	Full Sample
	(1)
A. Intermediate Import Prices	
Log(Intermediate Imports Weighted	0.375
Depreciation) X Post-Referendum	(0.100)
B. Export Prices	
Log(Intermediate Imports Weighted	0.164
Depreciation) X Post-Referendum	(0.111)
Log(Exports Weighted	0.006
Appreciation) X Post-Referendum	(0.016)
Controls, Time Dummies, Industry Dummies	Yes
Sample Size	2040

Pre-Trends - Intermediate Import Prices



Pre-Trends - Intermediate Import Prices and Exchange Rates



Reduced Form/First Stage - Trade Prices and Exchange Rates

	Full Sample	Restricted Samples	
		Excluding Announcement	Excluding QE
	(1)	(2)	(3)
A. Intermediate Import Prices			
Log(Intermediate Imports Weighted	0.375	0.411	0.589
Depreciation) X Post-Referendum	(0.100)	(0.107)	(0.156)
B. Export Prices			
Log(Intermediate Imports Weighted	0.164	0.171	0.248
Depreciation) X Post-Referendum	(0.111)	(0.114)	(0.143)
Log(Exports Weighted	0.006	0.007	0.011
Appreciation) X Post-Referendum	(0.016)	(0.016)	(0.020)
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	2040	1870	1445

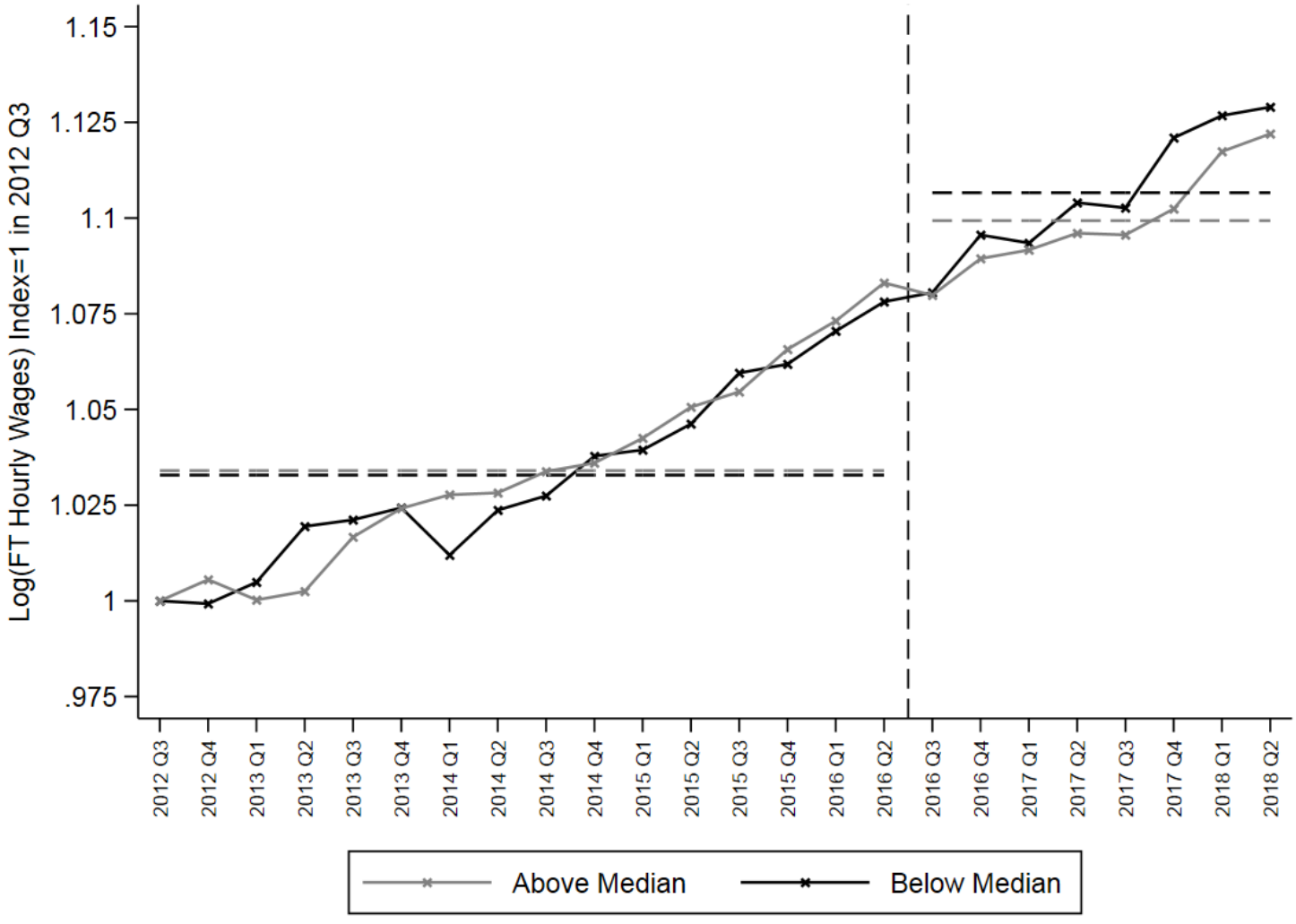
Reduced Form and IV Evidence for Worker Outcomes

Pre-trends in Wages

Wages (Reduced Form, IV)

Different margins of labour adjustment

Pre-Trends - Wages



Wages and Trade, Reduced Form

	Full Sample		Restricted Samples	
			Excluding Announcement	Excluding QE
	(1)	(2)	(3)	(4)
Log(Intermediate Imports Weighted Depreciation) X Post-Referendum	-0.193 (0.068)	-0.196 (0.067)	-0.198 (0.067)	-0.197 (0.076)
Log(Exports Weighted Appreciation) X Post-Referendum		-0.015 (0.014)		
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes	Yes
Sample Size	123,110	123,110	117,001	87,339

Wages and Trade, IV

	Full Sample		Restricted Samples	
			Excluding Announcement	Excluding QE
	(1)	(2)	(3)	(4)
Log(Intermediate Import Prices)	-0.497	-0.528	-0.465	-0.319
	(0.229)	(0.205)	(0.200)	(0.137)
Log (Export Prices)		0.084		
		(0.096)		
First-Stage F Statistic	13.6	4.6	14.1	13.4
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes	Yes
Sample Size	123,110	123,110	117,001	87,339

Margins of Labour Adjustment and Trade

	Wages (All)	Hours	Overtime Hours	Inflow Rate	Outflow Rate	Employment Growth
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Intermediate Import Prices)	-0.628	-0.137	-0.391	-0.038	-0.001	0.056
	(0.283)	(0.105)	(0.172)	(0.026)	(0.032)	(0.109)
First-Stage F Statistic	14.4	14.3	14.3	18.9	19.1	19.1
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sample Size	159,394	571,335	571,335	2040	2040	2040

full

Heterogeneity

Graduate v Non-Graduate

Calibration and Comparison

Skill Variations: Wages

	Full Sample	Restricted Samples	
		Excluding Announcement	Excluding QE
	IV	IV	IV
	(1)	(2)	(3)
Log(Price of Intermediate Imports)× Graduates	-0.597	-0.590	-0.627
	(0.196)	(0.174)	(0.160)
Log(Price of Intermediate Imports)× Non-Graduates	-0.194	-0.164	-0.004
	(0.227)	(0.199)	(0.161)
First-Stage F-Statistic	6.8	7.3	23.8
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	123,110	117,001	87,339

Skill Variations: Training

	Full Sample	Restricted Samples	
		Excluding Announcement	Excluding QE
	IV	IV	IV
	(1)	(2)	(3)
Log(Price of Intermediate Imports)× Graduates	-0.205	-0.199	-0.144
	(0.067)	(0.067)	(0.067)
Log(Price of Intermediate Imports)× Non-Graduates	-0.118	-0.124	-0.030
	(0.085)	(0.087)	(0.081)
First-Stage F-Statistic	6.9	7.4	20.1
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	578,282	548,079	411,173

Calibration - Wages and Intermediate Imports

- Calibrate ratio of intermediate imports to labour share = 0.1/0.4, labour demand elasticity = -0.5, share of home in total sales = 0.7 (ONS), probability of price adjustment = 0.25 (Itskhoki and Mukhin 2017).
- Estimates for Allen Uzawa Elasticities of Substitution (AUES) under different demand elasticities ($\sigma = 1, 3, 5$) and estimated coefficient range.

Estimated Wage Elasticity θ_{MW}	Implied AUES between Workers and Intermediate Imports σ_{WP^M}		
	$\sigma = 1$	$\sigma = 3$	$\sigma = 5$
	(1)	(2)	(3)
-0.30	-1.54	-1.61	-1.68
-0.35	-1.82	-1.96	-2.10
-0.40	-2.11	-2.32	-2.53
-0.45	-2.39	-2.67	-2.95
-0.50	-2.68	-3.03	-3.38
-0.55	-2.96	-3.38	-3.80

Comparison - Offshoring Studies

- $dlogW/dlogP^M = \hat{\theta}_{MW} = [-0.30, -0.55]$
- Offhsoring studies typically use trade values, instead of prices.
- Convert $\hat{\theta}_{MW} \cdot (1/(1-4.8))$ using import demand elasticity for intermediates from Alfaro et al (forthcoming).
- Compare with Hummels et al. (2014) study of offshoring rise on Danish matched employer-employee manufacturing data.

	Estimated Wage Elasticity	
	$\hat{\theta}_{MW}/(-3.8)$	Hummels et al estimate
	(1)	(2)
Graduate	0.16 to 0.17	0.03 to 0.07
Non-Graduate	0 to 0.05	-0.06 to -0.11
Graduate/Non-Graduate	0.11 to 0.17	0.09 to 0.18

Robustness

Import competition

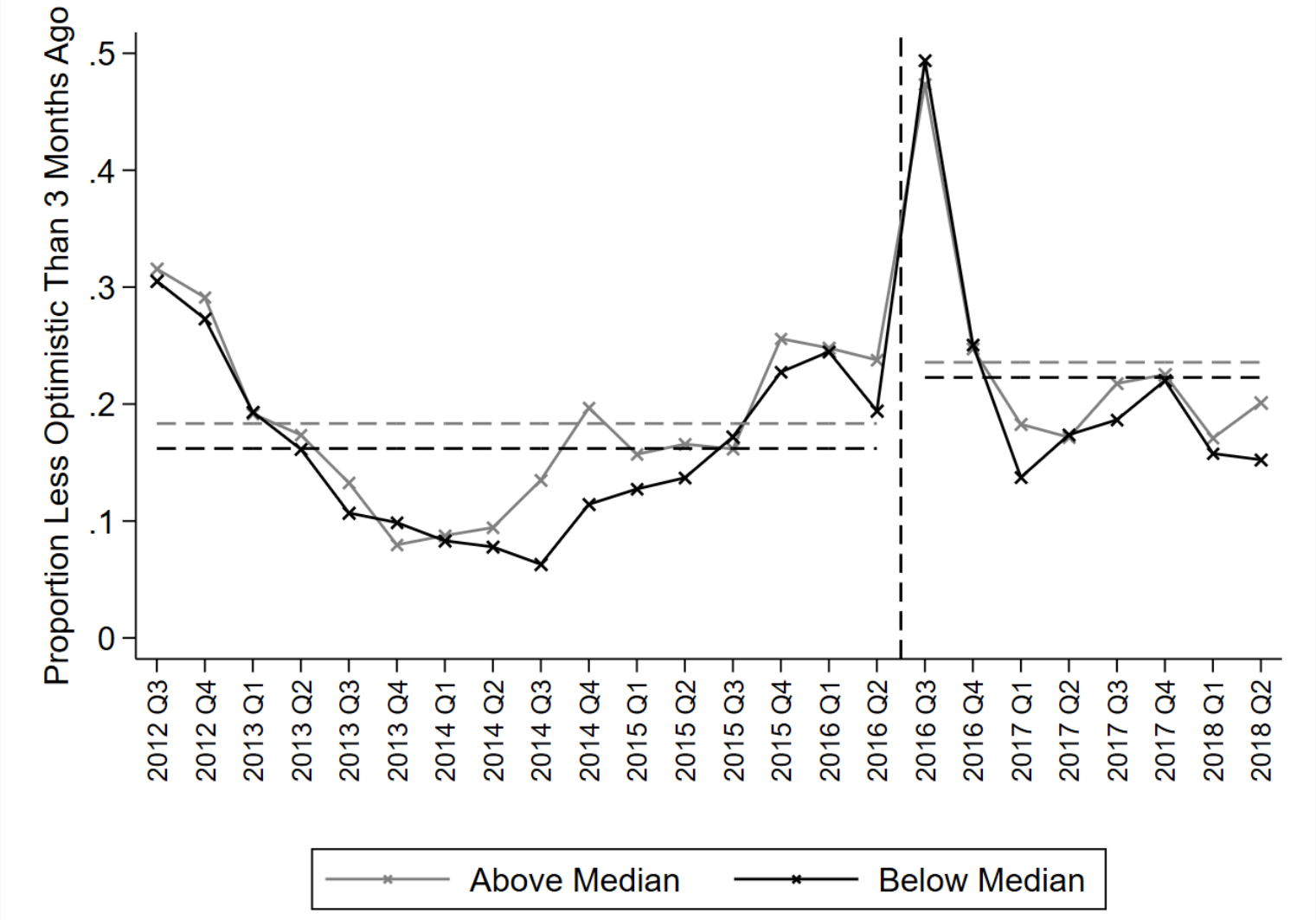
Economic uncertainty

All checks

Robustness - Wages Reduced Form with Import Competition Channel

	Full Sample			Restricted Samples	
				Excluding Announcement	Excluding QE
	(1)	(2)	(3)	(4)	(5)
Log(Intermediate Imports Wtd	-0.193		-0.184	-0.189	-0.187
Depreciation) X Post-Referendum	(0.068)		(0.070)	(0.068)	(0.078)
Log(Total Imports Weighted		-0.069	-0.060	-0.066	-0.066
Depreciation) X Post-Referendum		(0.039)	(0.039)	(0.038)	(0.025)
Controls	Yes	Yes	Yes	Yes	Yes
Time Dummies, Industry Dummies	Yes	Yes	Yes	Yes	Yes
Sample Size	123,110	123,110	123,110	117,001	87,339

Robustness - Less Optimism and Intermediate Imports Weighted Depreciation



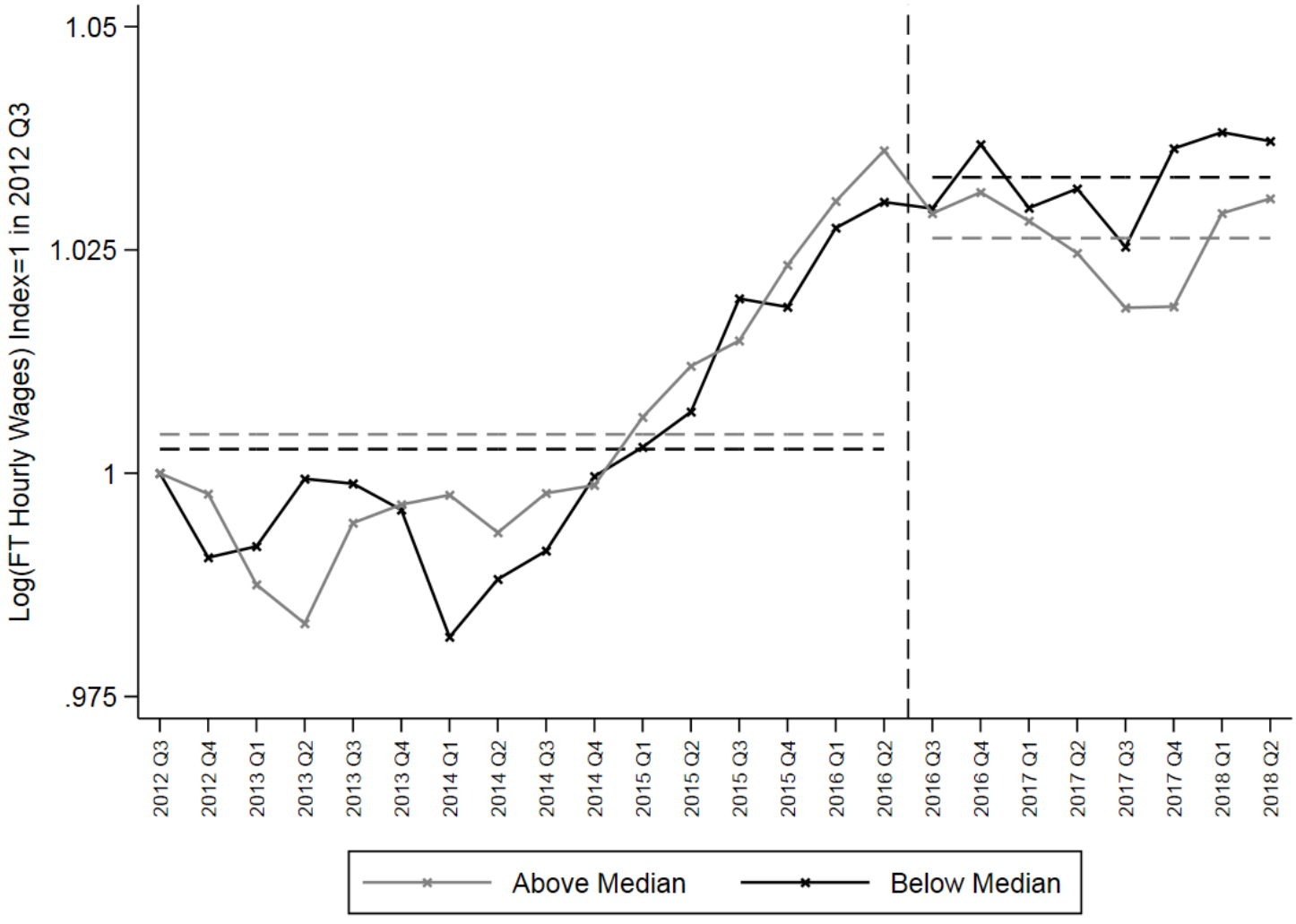
Robustness

- Inclusion of (Imported Intermediates/All Intermediates) $\times$ Post: First-stage of Intermediate Import Prices and Reduced Form of Wages still at 0.382 (FS), -0.197 (RF) wage train
- Inclusion of (Intermediate Imports/Labour) interactions: -0.192 (RF) with $(S_{PMC}/S_{WC}) \times$(Intermediate Import Weighted Depreciation) X Post included and -0.197 (RF) with $(S_{PMC}/S_{WC}) \times$Post also included share
- Export and Import Quantities (no first stages) qty
- Currency of invoicing adjustment with non-EU country shares of LCP/PCP/VCP in UK customs: Estimates still at 0.418 (FS), -0.134 (RF) ->
- Different depreciation windows: 7-day estimates at 0.383 (FS), -0.184 (RF) and 15-day at 0.402 (FS), -0.102 (RF) 7day 15day
- Different Definitions: Wages of all workers, Observations close to referendum, Training in the last 3 months all window

Conclusions

- The depreciation from the Brexit vote imposed a cost shock to make intermediate imports more expensive and workers bore the brunt of it.
- The rationale that protectionist barriers will protect domestic production and workers does not account for trade no longer being dominated by final demand and the sharp rise in production fragmentation globally.
- Combined with rising prices since the referendum, the sterling depreciation from the Brexit vote has acted to reinforce pre-existing trends of real wage stagnation that have been particularly marked for UK workers in the past decade (Blanchflower et al. 2017).

Conclusions - Real Wages



Robustness - Wages with 7-Day Exchange Rate Window

<-	Intermediate Import Prices	Wages	
	First Stage	Reduced Form	IV
	(1)	(2)	(3)
Log(Intermediate Imports Weighted Depreciation) X Post-Referendum	0.383	-0.184	
	(0.116)	(0.067)	
Log(Intermediate Import Prices)			-0.481
			(0.248)
First-Stage F Statistic			10.9
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	2040	123,110	123,110

Robustness - Training with 7-Day Exchange Rate Window

<-

	Intermediate Import Prices	Training	
	First Stage	Reduced Form	IV
	(1)	(2)	(3)
Log(Intermediate Imports Weighted Depreciation) X Post-Referendum	0.370	-0.073	
	(0.113)	(0.024)	
Log(Intermediate Import Prices)			-0.197
			(0.084)
First-Stage F Statistic			10.8
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	2040	578,282	578,282

Robustness - Wages with 15-Day Exchange Rate Window

<-	Intermediate Import Prices	Wages	
	First Stage	Reduced Form	IV
	(1)	(2)	(3)
Log(Intermediate Imports Weighted Depreciation) X Post-Referendum	0.402	-0.102	
	(0.129)	(0.049)	
Log(Intermediate Import Prices)			-0.255
			(0.154)
First-Stage F Statistic			9.2
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	2040	123,110	123,110

Robustness - Training with 15-Day Exchange Rate Window

<-	Intermediate Import Prices	Training	
	First Stage	Reduced Form	IV
	(1)	(2)	(3)
Log(Intermediate Imports Weighted Depreciation) X Post-Referendum	0.386	-0.052	
	(0.127)	(0.024)	
Log(Intermediate Import Prices)			-0.136
			(0.076)
First-Stage F Statistic			9.2
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	2040	578,282	578,282

Robustness - Wages Of All Workers, RF

	Full Sample		Restricted Samples	
			Excluding Announcement	Excluding QE
	(1)	(2)	(3)	(4)
Log(Intermediate Imports Weighted Depreciation) X Post-Referendum	-0.247 (0.082)	-0.251 (0.082)	-0.251 (0.080)	-0.253 (0.103)
Log(Exports Weighted Appreciation) X Post-Referendum		-0.009 (0.012)		
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes	Yes
Sample Size	159,957	159,957	159,957	159,957

Robustness - Time Window and Alternative Training Measure

<-	Excluding Observations Close to Referendum		Received training in Last Three Months
	Wages	Training	Training - 3 months
	IV	IV	IV
	(1)	(2)	(3)
Log(Intermediate Import	-0.471	-0.177	-0.321
Prices) X Post-Referendum	(0.231)	(0.071)	(0.138)
First-Stage F Statistic	13.5	13.9	14.1
Controls	Yes	Yes	Yes
Time and Industry Dummies	Yes	Yes	Yes
Sample Size	121,575	571,049	578,282

Robustness - Inclusion of Pre-Referendum Import Shares, Wages Reduced Form

<-	Intermediate Import Prices	Wages	
	First Stage	Reduced Form	IV
	(1)	(2)	(3)
Log(Intermediate Imports Weighted Depreciation) X Post-Referendum	0.382	-0.197	
	(0.107)	(0.066)	
Share of Imports in Intermediates X Post-Referendum	-0.035	-0.017	
	(0.037)	(0.025)	
Log(Intermediate Import Prices)			-0.428
			(0.195)
First-Stage F Statistic			8.3
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	2040	123,110	123,110

Robustness - Inclusion of Pre-Referendum Import Shares, Training Reduced Form

<-	Intermediate Import Prices	Training	
	First Stage	Reduced Form	IV
	(1)	(2)	(3)
Log(Intermediate Imports Weighted Depreciation) X Post-Referendum	0.371	-0.068	
	(0.101)	(0.021)	
Share of Imports in Intermediates X Post-Referendum	-0.035	0.003	
	(0.035)	(0.009)	
Log(Intermediate Import Prices)			-0.177
			(0.068)
First-Stage F Statistic			8.5
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	2040	578,282	578,282

Robustness - Intermediate Import Prices Reduced Form with Import Competition Channel

	Full Sample			Restricted Samples	
				Excluding Announcement	Excluding QE
	(1)	(2)	(3)	(4)	(5)
Log(Intermediate Imports Weighted	0.375		0.350	0.383	0.548
Depreciation) X Post-Referendum	(0.100)		(0.091)	(0.098)	(0.146)
Log(Total Imports Weighted		0.169	0.147	0.165	0.244
Depreciation) X Post-Referendum		(0.050)	(0.046)	(0.048)	(0.065)
Sample Size	2,040	2,040	2040	1870	1445

Robustness - Wages Reduced Form with Import Competition Channel

	Full Sample			Restricted Samples	
				Excluding Announcement	Excluding QE
	(1)	(2)	(3)	(4)	(5)
Log(Intermediate Imports Weighted	-0.193		-0.184	-0.189	-0.187
Depreciation) X Post-Referendum	(0.068)		(0.070)	(0.068)	(0.078)
Log(Total Imports Weighted		-0.069	-0.060	-0.066	-0.066
Depreciation) X Post-Referendum		(0.039)	(0.039)	(0.038)	(0.025)
Controls	Yes	Yes	Yes	Yes	Yes
Time Dummies, Industry Dummies	Yes	Yes	Yes	Yes	Yes
Sample Size	123,110	123,110	123,110	117,001	87,339

Robustness - Training Reduced Form with Import Competition Channel

	Full Sample			Restricted Samples	
				Excluding Announcement	Excluding QE
	(1)	(2)	(3)	(4)	(5)
Log(Intermediate Imports Weighted	-0.069		-0.063	-0.067	-0.047
Depreciation) X Post-Referendum	(0.021)		(0.022)	(0.022)	(0.026)
Log(Total Imports Weighted		-0.051	-0.048	-0.045	-0.033
Depreciation) X Post-Referendum		(0.014)	(0.014)	(0.015)	(0.017)
Controls	Yes	Yes	Yes	Yes	Yes
Time Dummies, Industry Dummies	Yes	Yes	Yes	Yes	Yes
Sample Size	578,282	578,282	578,282	548,079	411,173

Robustness - Pre-Post Referendum Changes in Trade Quantities

	Full Sample	Restricted Samples	
		Excluding Announcement	Excluding QE
	(1)	(2)	(3)
A. Intermediate Imports			
Log(Intermediate Imports Weighted	0.072	0.088	0.145
Depreciation) X Post-Referendum	(0.079)	(0.085)	(0.122)
B. Exports			
Log(Intermediate Imports Weighted	-0.461	-0.493	-0.699
Depreciation) X Post-Referendum	(0.289)	(0.305)	(0.396)
Log(Exports Weighted	0.010	0.009	0.003
Appreciation) X Post-Referendum	(0.053)	(0.057)	(0.072)
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	2040	1870	1445

Robustness - Wages with Currency of Invoicing Adjustment

- 2-year passthrough of depreciation based on country (0.41) v currency (0.43) in customs data (Chen et al. 2019). <-

	Intermediate Import Prices	Wages	
	First Stage	Reduced Form	IV
	(1)	(2)	(3)
Log(Intermediate Imports Weighted	0.418	-0.134	
Depreciation) X Post-Referendum	(0.151)	(0.074)	
Log(Intermediate Import Prices)			-0.321
			(0.183)
First-Stage F Statistic			7.6
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes
Sample Size	2040	123,110	123,110

Robustness - Wages and Ratio of Industry's Intermediate Imports to Labour Shares

<-	(1)	(2)
Log(Intermediate Imports Weighted	-0.192	-0.197
Depreciation) X Post-Referendum	(0.070)	(0.084)
S_{PMC}/S_{WC} X Log(Intermediate Imports Weighted	-0.001	0.020
Depreciation) X Post-Referendum	(0.001)	(0.1988)
S_{PMC}/S_{WC} X Post-Referendum		0.056
		(0.519)
Controls	Yes	Yes
Time Dummies, Industry Dummies	Yes	Yes
Sample Size	123,110	123,110

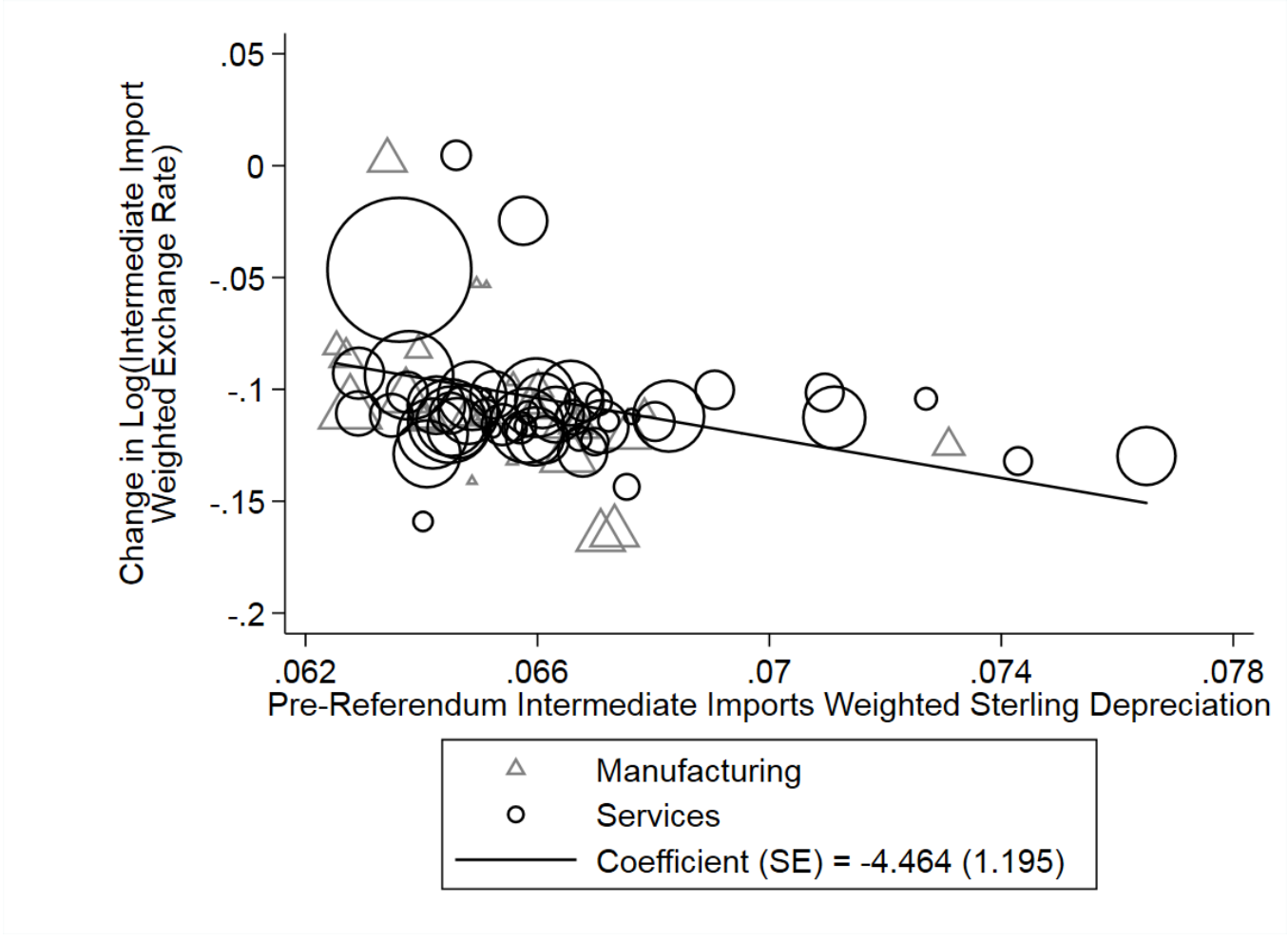
Training and Trade, RF

	Full Sample		Restricted Sample	
			Excluding Announcement	Excluding QE
	(1)	(2)	(3)	(4)
Log(Intermediate Imports Weighted Depreciation) X Post-Referendum	-0.069 (0.021)	-0.071 (0.022)	-0.073 (0.022)	-0.052 (0.027)
Log(Exports Weighted Appreciation) X Post-Referendum		-0.001 (0.007)		
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes	Yes
Sample Size	578,282	578,282	548,079	411,173

Training and Trade, IV

	Full Sample		Restricted Sample	
			Excluding Announcement	Excluding QE
	(1)	(2)	(3)	(4)
Log(Intermediate Import Prices)	-0.184	-0.196	-0.177	-0.088
	(0.073)	(0.076)	(0.073)	(0.057)
Log (Export Prices)		0.024		
		(0.044)		
First-Stage F Statistic	14.1	4.9	14.8	14.7
Controls, Time Dummies, Industry Dummies	Yes	Yes	Yes	Yes
Sample Size	578,282	578,282	548,079	411,173

Results - Intermediate Import Weighted Exchange Rates



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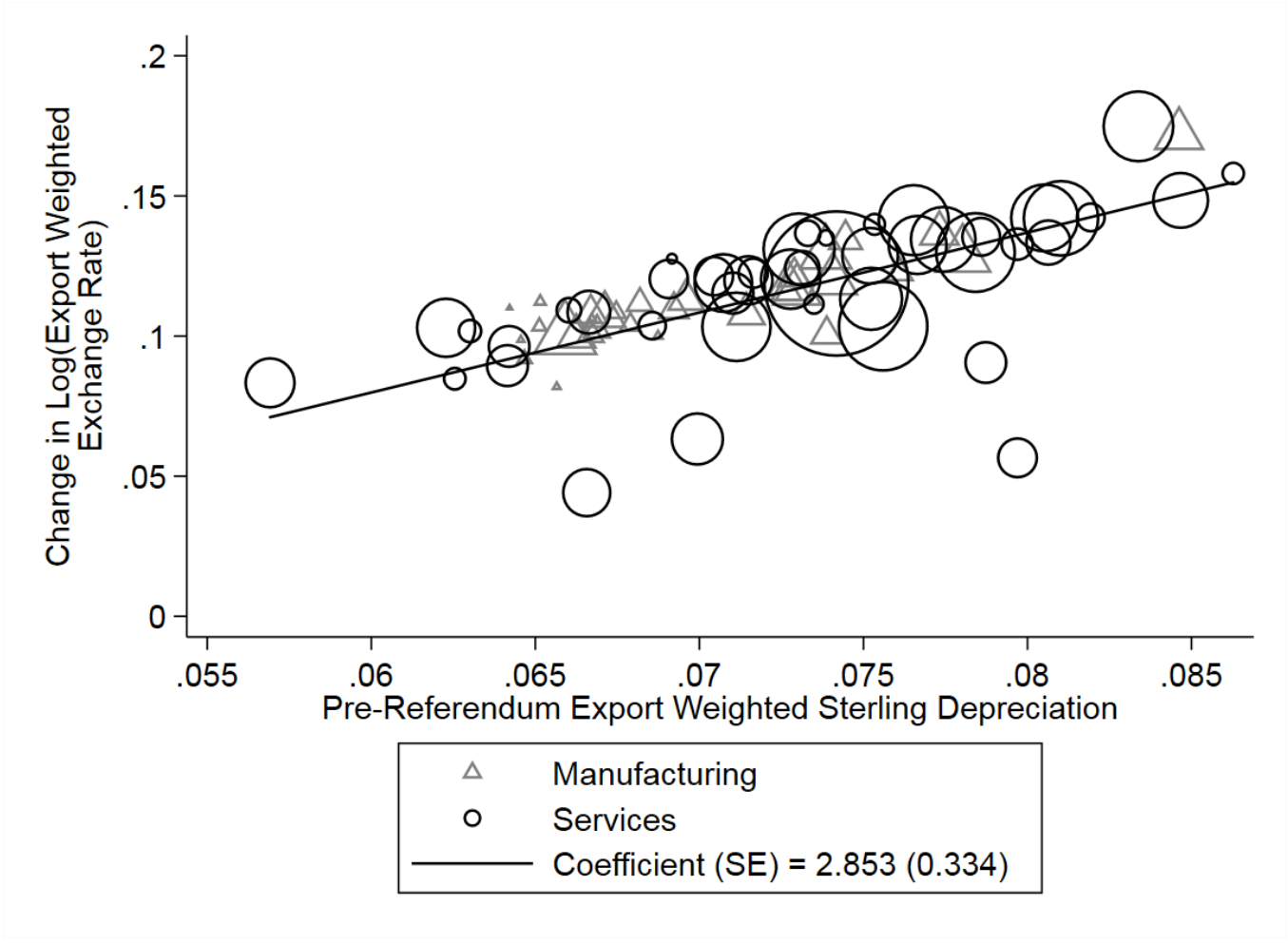
Results - Export Weighted Exchange Rates



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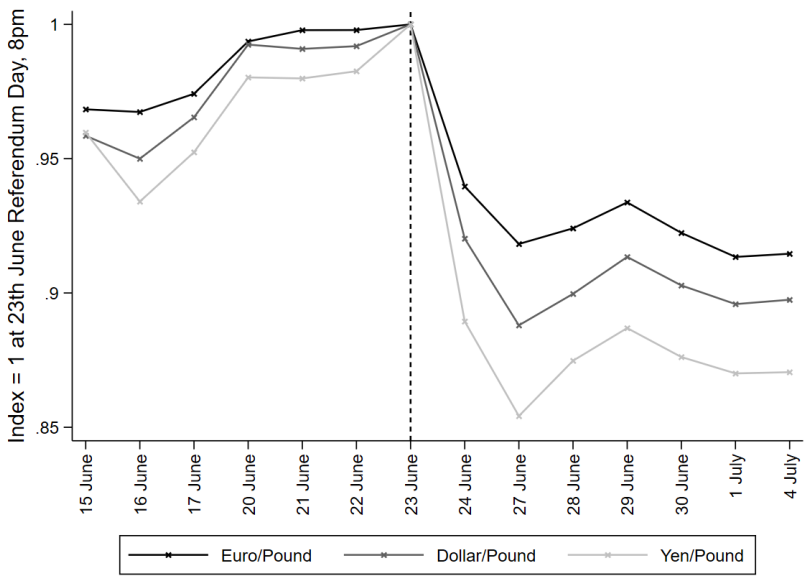
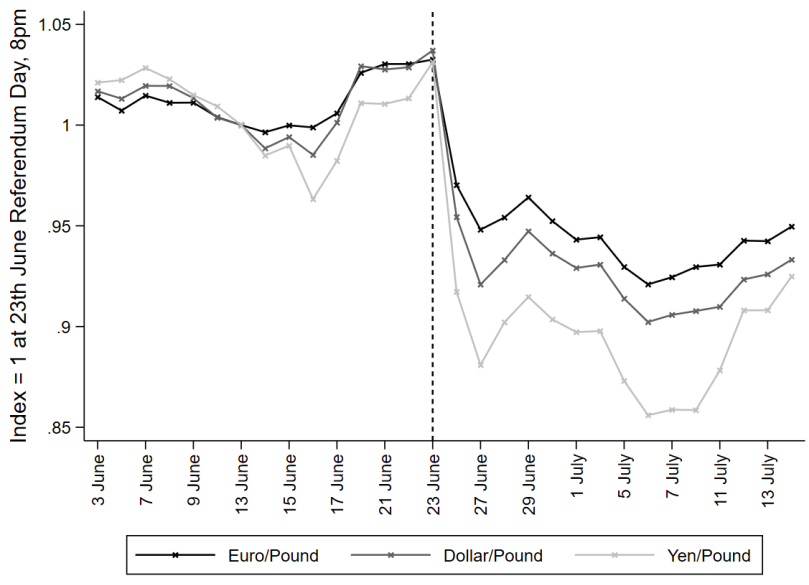
EU Referendum - Exchange Rates - 7-Day and 15-Day



(a) 7-Day



(b) 15-Day

Origin and Destination Country Structure - Intermediate Import Shares and Export Shares