Online Appendix for
"What Drives Exporters' Market Dynamics? A New Framework for Disentangling Micro Shocks"

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OA1 Data Appendix

OA1.1 Market Changes Measured at Different Frequencies

Table OA1-1 replicates Table 7 of Alessandria, Arkolakis and Ruhl (2021), using Chinese customs data. I divide the 7 years (84 months) of data into intervals of 6, 12, 21, and 42 months. There are two key takeaways. First, within each time interval, the continuation rate decreases with the level of disaggregation. At the annual frequency, only 44.7% of the firm-product-destinations that exported within a 12-month window continue to export within the next 12-month window. In contrast, 88.0% of the firms that exported within a 12-month window continued to export within the next 12-month window. This is a natural result, since demand tends to be less stable at more-disaggregated levels. For example, suppose the probability of receiving an order at the firm-product-destination level is x, and the firm has n feasible product-destination pairs. The probability of firm continuation is $1-(1-x)^n$, which increases with the number of product destinations the firm serves.

Second, within each aggregation level, the continuation rate decreases with the time span over which the statistics are calculated, consistent with the findings of Alessandria, Arkolakis and Ruhl (2021). This finding is more nuanced because, in principle, the continuation rate could go either way, depending on the underlying driving forces of firms' export participation decisions. On the one hand, if the low continuation rate is primarily driven by infrequent shipping or lumpiness in demand, one might expect the continuation rate to increase with the time span over which the statistics are calculated. To clarify, consider a product that is shipped or demanded every 18 months. In this case, the continuation rate calculated at 6- and 12-month frequencies will be zero, while it jumps to 100% when calculated at 21- or 42-month frequencies. On the other hand, if the low continuation rate is predominantly driven by firm or product exits, one would expect it to decrease with the time span over which the statistics are calculated. For example, if the 6-month survival rate is constant at y, then the continuation rates at the 12-, 24-, and 48-month frequencies will be y^2, y^4, and y^8, respectively. Consistent with the findings of Alessandria, Arkolakis and Ruhl (2021), I find that the second force dominates and the continuation rate decreases with the time span.[1]

Table OA1-2 shows the corresponding within-firm market changes calculated at different aggregation levels and time spans. The market-changes-to-markets (MCM) ratio increases with the time span over which the measure is calculated, consistent with the facts documented in Table OA1-1.

[1] The entrant share is a flip side of the coin. It increases with the level of disaggregation and the time span over which the statistics are calculated, reflecting the forces discussed above.

Table OA1-1: Entry, Exit and Growth at Different Aggregation Levels and Time Spans

	Continuation Rate		Entrant Share	
	Count	Value	Count	Value
6-month				
Firm level	90.5	98.8	17.9	3.1
Firm-sector level	78.2	97.6	29.0	4.5
Firm-product level	64.7	93.4	40.5	9.6
Firm-destination level	67.5	94.2	39.0	8.9
Firm-sector-destination level	57.7	91.7	47.9	11.6
Firm-product-destination level	48.1	85.2	56.9	18.1
12-month				
Firm level	88.0	97.9	27.6	5.9
Firm-sector level	74.9	96.7	37.6	7.9
Firm-product level	63.3	90.8	47.0	14.7
Firm-destination level	65.5	93.8	46.3	11.9
Firm-sector-destination level	54.8	90.9	55.3	15.7
Firm-product-destination level	44.7	83.5	63.4	24.1
21-month				
Firm level	83.8	96.4	39.3	10.5
Firm-sector level	71.1	94.4	48.1	12.5
Firm-product level	61.2	87.3	55.5	19.9
Firm-destination level	62.3	92.1	57.4	17.4
Firm-sector-destination level	50.5	88.4	64.7	21.2
Firm-product-destination level	40.6	78.2	71.4	30.3
42-month				
Firm level	75.7	92.1	61.0	22.5
Firm-sector level	64.3	89.2	67.3	25.3
Firm-product level	56.9	77.5	68.1	35.9
Firm-destination level	56.0	87.0	73.8	30.9
Firm-sector-destination level	44.6	82.4	78.5	35.5
Firm-product-destination level	34.1	69.2	83.0	47.5

Note: The table shows the continuation and entrant shares by different aggregation levels and time spans over which the statistics are calculated. The continuation rate is the share of exporters that remain active across two time windows. For example, 88.0% of firms that exported during a 12-month window also exported in the subsequent 12-month window. The entrant share indicates the share of total exporters accounted for by the entrants; for example, 27.6% of exporters did not export in the previous 12 months. The value measures are defined analogously, but use export values instead of firm counts. Source: Chinese customs database, 2000-2006.

Table OA1-2: Market Changes at Different Aggregation Levels and Time Spans

Freq.	N. of Dest.	MCM (count)	MCM (value)	DC (count)	DC (value)	Churning Prob.
(a) Firm-product level (mean)						
6 Months	2.49	0.79	0.67	0.48	0.48	0.29
12 Months	2.90	0.86	0.72	0.47	0.46	0.27
21 Months	3.34	0.93	0.78	0.45	0.44	0.23
42 Months	4.17	1.03	0.86	0.42	0.41	0.13
(b) Firm-sector level (mean)						
6 Months	4.10	0.72	0.51	0.47	0.47	0.34
12 Months	4.89	0.78	0.52	0.45	0.44	0.30
21 Months	5.69	0.86	0.56	0.43	0.42	0.24
42 Months	6.89	0.96	0.61	0.40	0.38	0.13
(c) Firm-product level (median)						
6 Months	1.00	0.67	0.16	0.50	0.45	0.30
12 Months	1.00	0.67	0.24	0.50	0.42	0.27
21 Months	2.00	0.86	0.36	0.50	0.36	0.23
42 Months	2.00	1.00	0.54	0.45	0.27	0.06
(d) Firm-sector level (median)						
6 Months	2.00	0.67	0.13	0.50	0.42	0.33
12 Months	2.00	0.67	0.15	0.50	0.37	0.25
21 Months	2.00	0.80	0.21	0.40	0.29	0.00
42 Months	3.00	1.00	0.29	0.33	0.18	0.00

Note: This table shows the mean and median values of different measures of market changes (i.e., market-changes-to-markets MCM ratio, drop-to-change DC ratio, churning probability) by different aggregation levels and time spans. The statistics are calculated at the firm-product level in panels (a) and (c) and at the firm-sector level in panels (b) and (d). The first column shows the time spans over which the statistics are calculated. Source: Chinese customs database, 2000-2006.

OA1.2 Statistics by Industry

Table OA1-3: By Industry:
Trade Patterns Calculated at the (2-digit HS) Firm-sector-year Level

	MCM		DC		Prob. of Churn	Obs
	Count	Value	Count	Value		
1-5 Live animals; animal products	0.40	0.02	0.50	0.49	0.00	20,807
6-14 Vegetable products	0.40	0.01	0.50	0.44	0.00	67,079
15 Animal/vegetable fats	0.36	0.02	0.50	0.44	0.00	2,302
16-24 Prepared foodstuffs	0.29	0.00	0.50	0.37	0.00	51,767
25-27 Mineral products	0.40	0.03	0.50	0.44	0.00	21,617
28-38 Products of chemical and allied industries	0.67	0.16	0.50	0.39	0.25	146,275
39-40 Plastics/rubber articles	0.67	0.19	0.50	0.35	0.33	153,920
41-43 Rawhides/leather articles, furs	0.75	0.19	0.50	0.42	0.33	75,491
44-46 Wood and articles of wood	0.67	0.12	0.50	0.41	0.25	62,147
47-49 Pulp of wood/other fibrous cellulosic material	0.77	0.25	0.50	0.34	0.25	75,932
50-63 Textiles and textile articles	0.67	0.15	0.50	0.37	0.25	353,130
64-67 Footwear, headgear, etc.	0.86	0.26	0.50	0.43	0.33	97,680
68-70 Misc. manufactured articles	0.74	0.21	0.50	0.38	0.33	110,541
71 Precious or semiprec. stones	0.86	0.25	0.50	0.37	0.17	16,984
72-83 Base metals and articles of base metals	0.67	0.17	0.50	0.35	0.25	248,422
84-85 Machinery and mechanical appliances, etc.	0.67	0.11	0.40	0.29	0.29	231,758
86-89 Vehicles, aircraft, etc.	0.67	0.13	0.43	0.32	0.33	46,603
90-92 Optical, photographic, etc.	0.67	0.16	0.50	0.37	0.33	66,768
93 Arms and ammunition	0.80	0.31	0.50	0.43	0.33	474
94-96 Articles of stone, plaster, etc.	0.76	0.19	0.50	0.41	0.33	178,790
97+ Others	0.67	0.06	0.50	0.44	0.00	5,069

Note: This table reports the median values of the market-changes-to-markets (MCM) ratio, the drop-to-change (DC) ratio, and the probability of churn, by different industries. Both the count measure and the value measure of the MCM and DC ratios are reported. The last column shows the number of observations. Source: Chinese customs database, 2000-2006.

OA1.3 Supplementary Statistics and Estimates by Exporter Size Bins

Table OA1-4: Regression Estimates by Exporter Size Bins

	Quantity Elasticity to DC		Price Elasticity to DC	
Size Bin	Count	Value	Count	Value
(a) Firm-product level				
1 (smallest)	-0.24***	-0.24***	0.01	0.00
2	-0.39***	-0.38***	0.01	0.00
3	-0.51***	-0.48***	0.02***	0.01*
4	-0.68***	-0.62***	0.01***	0.00*
5 (largest)	-0.92***	-0.78***	0.00	-0.01***
(b) Firm-sector level				
1 (smallest)	-0.29***	-0.31***	-0.01	-0.03
2	-0.41***	-0.43***	0.03**	0.02
3	-0.59***	-0.55***	0.03***	0.01
4	-0.73***	-0.65***	0.02**	0.00
5 (largest)	-0.77***	-0.63***	0.03***	0.01*

Note: This table presents the elasticities of the quantities and prices to the drop-to-change (DC) ratio by firm size at the firm-product level in panel (a) and at the firm-sector level in panel (b). The first column shows the firm size category, where the firm-products are ordered into 5 equal-sized bins, based on their size measured by their total sales value across all destinations and years. Each column shows the key estimates from regressing the quantity or price measures (indicated by the column header) on the count or value measure of the DC ratio. Each cell presents an estimate from a separate regression. The firm-product and year fixed effects are added for the panel (a) specifications and the firm-sector and year fixed effects are added for the panel (b) specifications. The statistical significance is calculated based on robust standard errors with ***, **, * representing statistical significance at the 1%, 5%, 10% level, respectively. Source: Chinese customs database, 2000-2006.

Table OA1-5: Market Changes by Exporter Size

Size Bins	N. of Dest.	MCM (Count)	MCM (Value)	DC (Count)	DC (Value)	Churning Prob.
(a) Firm-product level (mean)						
1	1.52	0.98	0.96	0.49	0.49	0.23
2	1.79	0.93	0.89	0.49	0.48	0.25
3	2.13	0.88	0.80	0.48	0.48	0.26
4	2.89	0.83	0.68	0.47	0.46	0.28
5	6.15	0.73	0.42	0.45	0.44	0.32
(b) Firm-sector level (mean)						
1	1.82	0.81	0.76	0.48	0.48	0.17
2	2.63	0.82	0.69	0.48	0.47	0.22
3	3.55	0.80	0.58	0.46	0.46	0.27
4	5.34	0.77	0.45	0.45	0.44	0.35
5	11.40	0.68	0.25	0.43	0.41	0.49
(c) Firm-product level (median)						
1	1.00	0.67	0.66	0.50	0.48	0.23
2	1.00	0.67	0.51	0.50	0.47	0.25
3	1.00	0.67	0.39	0.50	0.44	0.26
4	2.00	0.67	0.29	0.50	0.40	0.29
5	3.00	0.67	0.12	0.44	0.35	0.33
(d) Firm-sector level (median)						
1	1.00	0.67	0.12	0.50	0.46	0.00
2	1.00	0.67	0.29	0.50	0.43	0.00
3	2.00	0.67	0.26	0.50	0.38	0.25
4	3.00	0.70	0.18	0.44	0.35	0.33
5	7.00	0.67	0.08	0.41	0.33	0.57

Note: This table shows the mean and median values of different measures of market changes (i.e., market-changes-to-markets MCM ratio, drop-to-change DC ratio, churning probability) by firm size. The statistics are calculated at the firm-product level in panels (a) and (c), and at the firm-sector level in panels (b) and (d). The first column shows the firm size category, where the firm-products are ordered into 5 equal-sized bins, based on their size measured by their total sales value across all destinations and years. The number 5 refers to the largest firm size category. Source: Chinese customs database, 2000-2006.

OA1.4 Supplementary Statistics and Estimates by Product and Firm Types

Table OA1-6: Breakdown by Product and Firm Type: Number of Markets, DC Ratio, and Quantity and Price Elasticities, using the Value Measure of the DC Ratio

	N. of Dest.		DC (count)		DC (value)		Elasticity (value)	
	Mean	Median	Mean	Median	Mean	Median	Quantity	Price
Full sample	2.90	1.00	0.47	0.50	0.46	0.42	-0.61***	-0.00
Rauch classification								
Differentiated products	2.96	1.00	0.47	0.50	0.46	0.42	-0.62***	0.00
Reference priced	2.40	1.00	0.47	0.50	0.47	0.42	-0.51***	-0.00
Organized exchange	2.24	1.00	0.49	0.50	0.49	0.48	-0.54***	-0.02**
BEC classification								
Capital	3.14	1.00	0.46	0.50	0.46	0.41	-0.60***	0.01
Consumption	2.86	1.00	0.47	0.50	0.47	0.43	-0.60***	-0.00
Intermediate	2.69	1.00	0.46	0.50	0.46	0.40	-0.60***	-0.00
Company type								
State-owned enterprises	2.83	1.00	0.49	0.50	0.49	0.47	-0.56***	0.00
Private enterprises	2.88	2.00	0.45	0.50	0.43	0.36	-0.68***	0.01*
Foreign-invested enterprises	2.97	1.00	0.45	0.50	0.44	0.34	-0.65***	-0.02***
Form of commerce								
General trade	2.83	1.00	0.47	0.50	0.47	0.42	-0.60***	0.00
Processing trade	3.25	1.00	0.46	0.50	0.45	0.38	-0.67***	-0.03***

Note: This table supplements Table 3 by reporting additional statistics on the market changes and the quantity and price elasticities estimated using the value measure of the drop-to-change (DC) ratio. All the measures reported in this table are calculated at the firm-product level. Source: Chinese customs database, 2000-2006.

OA1.5 Supplementary Statistics and Estimates by Product Differentiation and Firm Trading Types

Table OA1-7: Breakdown by Product Differentiation and Firm Trading Type

	(1) MCM (Count)	(2) MCM (Value)	(3) Quantity	(4) Price	Obs.
CCHS Classification					
High Differentiation	0.67	0.28	-0.65***	0.01***	1,678,700
Low Differentiation	0.67	0.22	-0.66***	0.01***	2,215,662
Trading Type (based on company name)					
Direct	0.67	0.11	-0.70***	0.00	1,978,239
Possibly Indirect (Commerce)	0.67	0.34	-0.64***	0.01	534,674
Possibly Indirect (Import-Export)	0.97	0.50	-0.61***	0.02***	1,138,626
Possibly Indirect (Other)	1.00	0.49	-0.63***	0.01	242,823

Note: This table provides breakdowns by CCHS classification for product differentiation in Corsetti, Crowley, Han and Song (2024) and firm trading types identified through the name of the company. Trade patterns are calculated at the firm-product level. Median values of the market-changes-to-markets MCM measures (in terms of count and value) are reported in columns (1) and (2), respectively. Estimated elasticities of quantity and price with respect to the drop-to-change ratio are reported in columns (3) and (4), respectively. Source: Chinese customs database, 2000-2006.

OA1.6 Supplementary Estimation Results Using Alternative Fixed Effects

Table OA1-8: Quantity and Price Elasticities to the Drop-to-change Ratio: Alternative Fixed Effects

	(1) Quantity Elasticity	(2) Price Elasticity	Observations
Panel (a) Firm-product + product-time fixed effects			
Count measure			
Firm-product level	-0.64***	0.01***	1,321,242
Firm-sector level	-0.70***	0.04***	667,478
Value measure			
Firm-product level	-0.60***	-0.00	1,321,242
Firm-sector level	-0.62***	0.01***	667,477
Panel (b) Firm + product-time fixed effects			
Count measure			
Firm-product level	-0.68***	0.01***	1,747,784
Firm-sector level	-0.73***	0.03***	773,381
Value measure			
Firm-product level	-0.61***	0.00	1,747,784
Firm-sector level	-0.64***	0.01***	773,380

Note: This table re-estimates the empirical relationships in Table 2 using alternative fixed effects. Panel (a) applies firm-product and product-time fixed effects, while panel (b) applies firm and product-time fixed effects. Column (1) and (2) show the estimated quantity and price elasticities with respect to the drop-to-change ratio. The rows within each panel indicate the level of disaggregation at which the market-change measures are constructed. Each cell reports an estimate from a separate regression. Note that the firm-level estimates are not reported in this table because at the firm level, Table 2 already applied the most stringent fixed effects (i.e., firm and time fixed effects) and no alternative fixed effects can be applied. Source: Chinese customs database, 2000-2006.

OA2 Model Appendix

OA2.1 Extension: Economies of Scale

I extend the baseline model to incorporate economies of scale by allowing the firm's marginal cost to be a function of the number of destination markets it sells to:

$$mc_{ft} = \kappa^{-N_{ft}} \cdot mc_{ft}^{exo} \tag{OA2-1}$$

where mc_{ft}^{exo} denotes the exogenous component of the marginal cost, generated using the same data generating process as in the baseline model. The parameter N_{ft} denotes the number of markets that firm f exports to at time t and the parameter κ governs the degree of economies or diseconomies of scale. When $\kappa = 1$, this corresponds to the baseline model without scale economies, where the marginal cost is independent of the number of destination markets the firm serves. When $\kappa > 1$, the firm experiences economies of scale, where the marginal cost decreases as the number of destination markets increases. Conversely, when $\kappa < 1$, marginal cost increases in the number of markets, reflecting diseconomies of scale.

The key implication of the setting (OA2-1) is that the firm will no longer make independent export decisions for each destination market. Instead, it will choose the set of markets $\mathcal{N}_{ft} \equiv \{\mathbb{1}_{f1t}, \mathbb{1}_{f2t}, ..., \mathbb{1}_{fdt}, ...\}$ to maximize its total profits across all active markets:

$$\max_{\mathcal{N}_{ft}} \sum_{d \in \mathcal{N}_{ft}} [\pi_{fdt}(\mathcal{N}_{ft}) - \zeta] \tag{OA2-2}$$

This problem is generally difficult to solve, as the operating profit in each market depends on the firm's marginal cost, which in turn is endogenous to the set of markets that the firm chooses. However, the assumption in (OA2-1) greatly simplifies the problem, making it much more tractable. In particular, since marginal cost only depends on the number of destination markets N_{ft}, rather than the set of the specific markets $\mathcal{N}_{ft}$, the problem becomes linear and avoids the complexity of solving a combinatorial optimization. For any given N_{ft}, the optimal set $\mathcal{N}_{ft}$ simply consists of the top N_{ft} destination markets ranked by their operating profits π_{fdt}.[2]

Solving the model under this extended setting and applying the same empirical measures

[2]Substituting (OA2-1) into (8), it can be shown that $\pi_{fdt}(\mathcal{N}_{ft}) = \pi_{fdt}(N_{ft}) = \kappa^{N_{ft}(\eta-1)}\pi_{fdt}^{exo}$, where $\pi_{fdt}^{exo} \equiv \frac{1}{\eta} a_{fdt} b_{ft} \left(\frac{\eta}{\eta-1} mc_{ft}^{exo}\right)^{1-\eta}$ is the exogenous part of the operating profit evaluated at the optimal price. The simulation of shocks and the construction of a_{fdt}, b_{ft}, and mc_{ft}^{exo} follow the same procedure discussed in the main text.

discussed in the paper, Figure OA2-1 shows how the key price and quantity elasticities vary with the degree of economies of scale, captured by the parameter κ. The case of $\kappa = 1$ corresponds to the calibrated baseline model without scale economies. To assess the impact of scale economies, the model is simulated using the same shock process as in the baseline model, but under different values of κ.

Figure OA2-1(a) shows that the price elasticity to the drop-to-change (DC) ratio increases as the degree of economies of scale increases. With the same calibrated parameters, introducing a modest degree of scale economies (i.e., $\kappa = 1.02$) increases the price elasticity to DC ratio to around 0.5, which is much larger than the empirically observed value of 0.01. This is because on top of the direct effects from demand or supply shocks, the firm's marginal cost also changes endogenously to its number of destination markets under economies of scale. For example, a firm receiving negative demand shocks and dropping markets will face a higher marginal cost, pushing up prices in its continuing markets and thus raising the price elasticity. As a consequence of the rising marginal costs and the prices, quantity responses also become larger, as shown in Figure OA2-1(b).

Figure OA2-1(c) shows that, under economies of scale ($\kappa > 1$), the price dynamics in core markets deviate markedly from empirical patterns. In the data, a firm's price in its core market is largely independent of the number of destination markets it serves. By contrast, the extended model with economies of scale predicts that as a firm adds more markets, its marginal cost declines, leading to lower prices in its core markets.

Figure OA2-1(d) shows that for a given number of markets, the quantity response decreases in κ for firms with fewer markets ($N_{ft} \leq 9$), but increases in κ when the number of markets is large ($N_{ft} \geq 10$). This is likely due to two opposite effects. On the one hand, with economies of scale, a firm can achieve the same number of destination markets with smaller favorable demand or cost shocks. This tends to make the quantity response smaller for a given number of markets. On the other hand, with a larger number of markets, there is greater cost reduction under economies of scale, which in turn leads to a larger quantity sold in core markets. This effect tends to dominate when the number of markets is large enough ($N_{ft} \geq 10$) and thus we see that with economies of scale, the quantity elasticity is larger for firms in the "10+" destination category.

Results for diseconomies of scale (when $\kappa < 1$) are similar and have the opposite pattern. Results are available upon request.

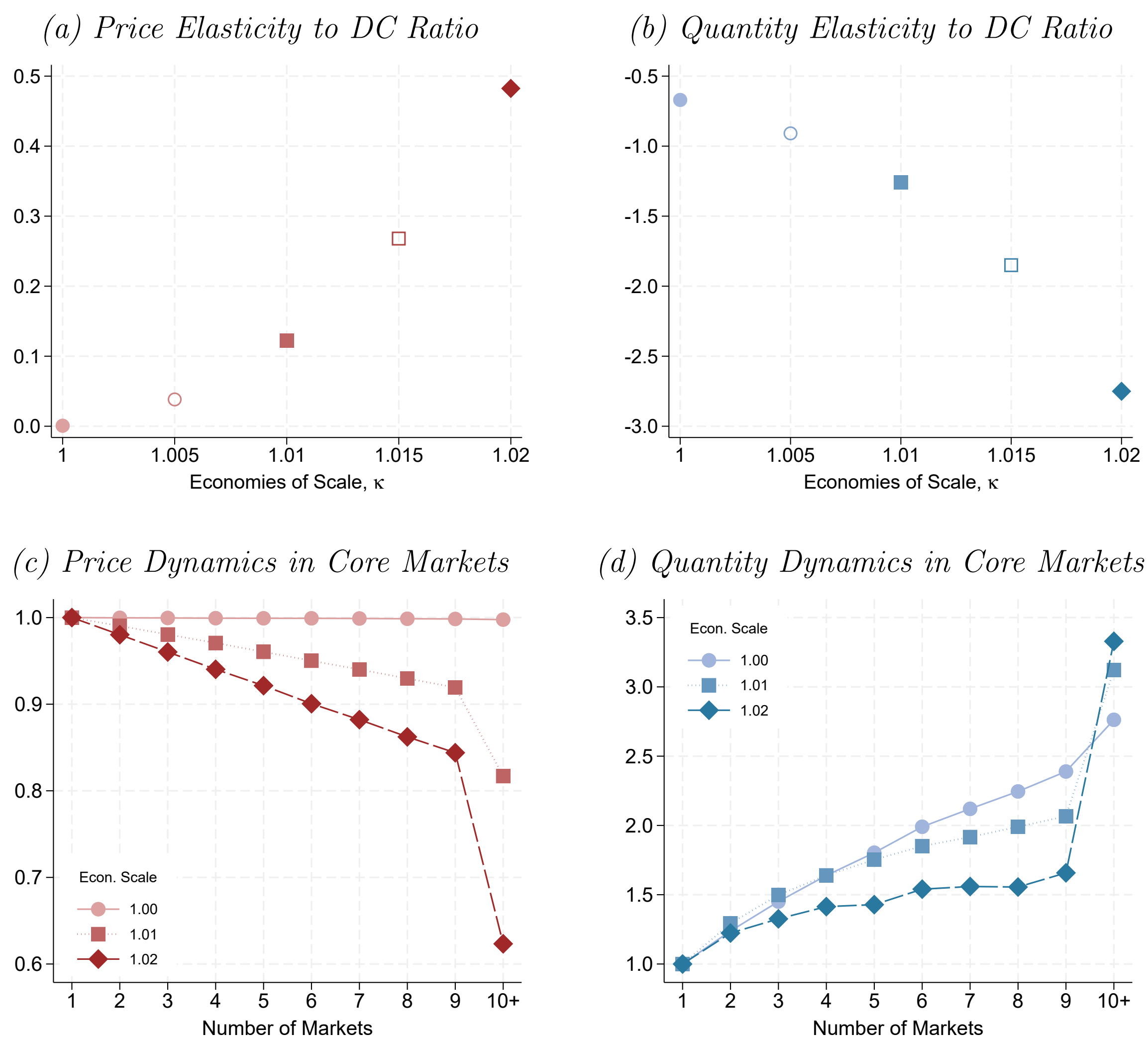

Figure OA2-1: Key Moments Vary with Economies of Scale, κ

Note: The top two graphs plot the price and quantity elasticities with respect to the drop-to-change (DC) ratio in the extended model under different degrees of economies of scale (κ). The bottom two graphs plot the estimated price and quantity dynamics based on specification (16) under different degrees of economies of scale (κ). The data generating processes for all other variables follow the baseline setup described in the main text.

OA2.2 Extension: Variable Markups

This section extends the baseline model to allow for variable markups by adopting the Kimball (1995) demand function, which is widely used in recent open macro studies due to its flexibility:[3]

$$q_{fdt} \equiv a_{fdt} b_{ft} \left[1 - \varkappa \ln \left(\frac{p_{fdt}}{D_{fdt}} \right) \right]^{\frac{\eta}{\varkappa}}, \tag{OA2-3}$$

where $\varkappa$ is the super elasticity that governs the firm's markup adjustment to shocks. As $\varkappa \to 0$, the model converges to the baseline CES case with a constant markup of $\eta/(\eta-1)$. Following Corsetti, Crowley, Han and Song (2024), I set $\varkappa = 0.5$ to match the markup responses to exchange rates by Chinese firms during 2000-2006. The demand shifters $a_{fdt}b_{ft}$ defined in the baseline model do not directly affect the firm's optimal price or markup. To capture the fact that the firms receiving positive demand shocks tend to increase their markups, I model D_{fdt} – capturing the competitiveness of firm f relative to all other firms in destination d at time t – as positively correlated with $a_{fdt}b_{ft}$. Under this setting, a positive demand shock $a_{fdt}b_{ft}$ raises the firm's competitiveness D_{fdt} and thus increases the optimal markup.[4]

This variable markup model differs from the baseline constant markup framework in two ways. First, in the baseline model with constant markups, demand shocks do not affect prices. In contrast, under endogenous markups, demand shocks comove with prices, even in the absence of cost changes. For instance, a firm dropping markets due to a negative common demand shock will now also reduce markups in its continuing markets, which tends to lower the price elasticity with respect to the drop-to-change (DC) ratio. Second, endogenous markup adjustments also dampen price responses to cost shocks. For instance, in response to an increase in the marginal cost, the firm optimally reduces its markup in its continuing markets, again putting downward pressure on the price elasticity to the DC ratio.

[3] The same setting has been used in various studies, such as Gopinath and Itskhoki (2010), Klenow and Willis (2016), Amiti, Itskhoki and Konings (2019), Gopinath, Boz, Casas, Díez, Gourinchas and Plagborg-Møller (2020), Mukhin (2022) and Corsetti, Crowley, Han and Song (2024). Amiti, Itskhoki and Konings (2019) demonstrate that the Kimball demand preference can effectively capture firms' key responses to shocks in a static oligopolistic model (e.g., Atkeson and Burstein 2008) and match the key features of data from Belgian firms. In dynamic settings, Wang and Werning (2022) and Alexander, Han, Kryvtsov and Tomlin (2024) find that firm-level and aggregate price dynamics under a dynamic oligopolistic competition model closely align with those in a well-calibrated Kimball model.

[4] Specifically, I set $D_{fdt} \equiv (a_{fdt}b_{ft})^{0.3}$. I adopt this simple functional form, rather than simulating a new variable D_{fdt}, to ensure consistency and comparability with the baseline model. This formulation allows the same set of shocks—$\widehat{a}_{fdt}$, $\widehat{b}_{ft}$, and $\widehat{mc}_{ft}$—to be applied across both the baseline CES model and the extended variable markup model.

Implications for Matching Empirical Patterns. The key implication of the variable markup model is that it allows supply shocks to play a larger role in explaining observed market dynamics. In the baseline constant markup model, the empirically low price elasticity to the DC ratio of 0.01 restricts the contribution of supply shocks. As supply shocks become more important (i.e., as γ decreases), the baseline model predicts a sharp increase in the price elasticity to the DC ratio, quickly exceeding the empirically observed value, as shown in Figure OA2-2(a1). In contrast, the variable markup model produces a much flatter relationship between the supply contribution $(1-\gamma)$ and the price elasticity to the DC ratio, as shown in Figure OA2-2(b1), which is due to the dampening effects of endogenous markup adjustments discussed above. This feature enables the variable markup model to accommodate a larger supply contribution (a smaller γ) while still matching the empirically observed low price elasticity to DC ratio.

Table OA2-1 shows the estimated parameters by applying the variable markup model to match the empirical moments. The estimates for shock size σ and common contribution ρ remain similar to those in the baseline constant markup model, but the demand contribution γ is smaller, decreasing from 0.89 in the baseline model to 0.71 in the variable markup model.[5]

Figure OA2-2 provides a detailed comparison of key moments from the calibrated baseline model (left panels) and the calibrated variable markup model (right panels). Panels (a1) and (b1) show that the price elasticity to the DC ratio is lower in the variable markup model as the demand contribution parameter γ varies. When all shocks are supply-driven ($\gamma = 0$), the price elasticity to DC ratio in the variable markup model is less than half of that in the baseline model due to endogenous markup adjustments. That is, firms receiving unfavorable cost shocks and dropping markets also reduce their markups in their continuing markets, partially offsetting the price increase from rising costs. In contrast, when all shocks are demand-driven ($\gamma = 1$), the price elasticity to the DC ratio is no longer zero and turns negative. This is because firms that drop markets are likely to receive negative common demand shocks (at $\rho = 0.26$ as shown in Table OA2-1), which lowers their optimal markup in the continuing markets, thereby leading to price reductions in these markets.

Panels (a2), (b2), (a3), and (b3) show that the two models produce similar patterns for the two other moments (i.e. the quantity elasticity to the DC ratio and the market-changes-to-markets MCM ratio), though with slight differences in magnitude. The only notable difference is that the variable markup model generates a much smaller quantity elasticity to

[5]With the additional D_{fdt} shocks in (OA2-3), the calibrated variable markup implies a different shock magnitude with $\sigma^{\text{Variable Markup}} \approx 0.55\sigma^{\text{Constant Markup}}$. Nevertheless, as shown in Panels (a)-(d) in Table OA2-1, the relative magnitude of the shock in each firm or product category remains stable and similar compared to Table 5 in the paper.

the DC ratio when the demand contribution is zero ($\gamma = 0$), as shown by the green lines in panels (a2) and (b2). This is because endogenous markup adjustments absorb part of the shocks, dampening the resulting price changes and thereby reducing the quantity responses.

Table OA2-1: Estimated Parameters Based on Kimball Model

	σ (Shock size)	ρ (Common contrib.)	γ (Demand contrib.)
Full Sample	1.00	0.26	0.71
(a) Rauch classification			
Differentiated products	1.00	0.26	0.70
Reference priced	1.00	0.26	0.70
Organized exchange	0.43	0.40	0.92
(b) BEC classification			
Capital	1.53	0.21	0.68
Consumption	1.01	0.26	0.78
Intermediate	1.02	0.22	0.79
(c) Company type			
State-owned enterprises	2.61	0.15	0.72
Private enterprises	2.17	0.18	0.91
Foreign-invested enterprises	0.43	0.46	0.97
(d) Form of commerce			
General trade	1.98	0.18	0.75
Processing trade	0.43	0.48	0.86

Note: Parameters are estimated separately for each subgroup by matching the empirical moments in Table 3. σ for the full sample is normalized to one.

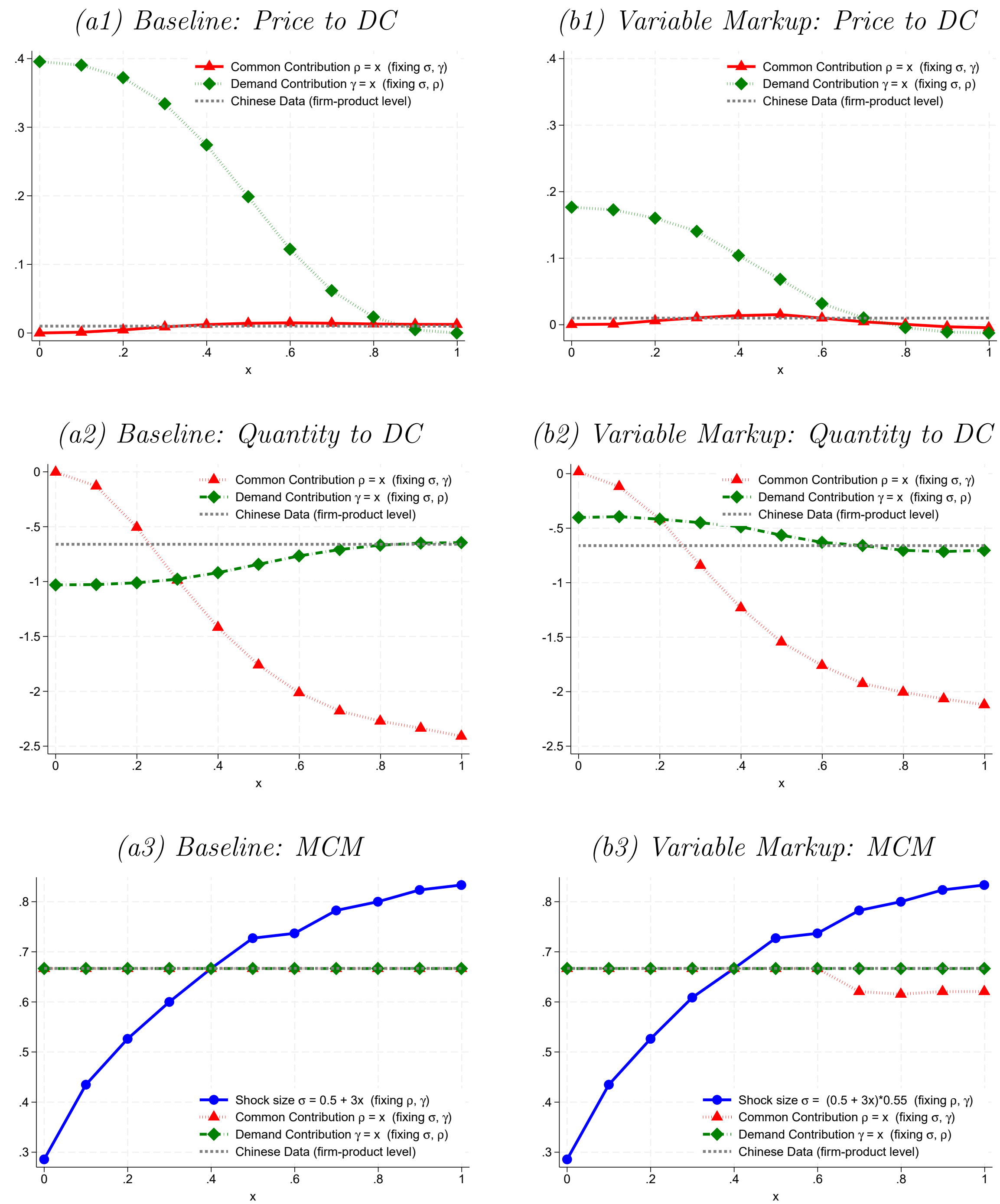

Figure OA2-2: Comparing Key Moments: Baseline Model vs. Variable Markup Model

Note: This figure replicates the exercise shown in Figure 3 for the calibrated variable markup model (right panels). It reports the estimated price and quantity elasticities with respect to the drop-to-change (DC) ratio, as well as the market-changes-to-markets (MCM) measure. The left panels (a1), (a2), and (a3) are included for ease of comparison; they are identical to those in Figure 3.

OA2.3 Price and Quantity Dynamics within a Market

Figure OA2-3 replicates the empirical specification of Fitzgerald, Haller and Yedid-Levi (2023) (FHY), using Chinese customs data and simulated data from the calibrated model. The empirical results show strong support for the findings of FHY. In addition, my calibrated model is able to match the key quantity dynamics within a market. Under the benchmark calibration of my model, price is not destination-specific and its variation is fully differenced out by the firm-time fixed effect, leaving no price dynamics in (b2). It is straightforward to incorporate a small destination-specific cost component into the model to generate the exact data pattern observed in (b1).

For the purpose of illustrating the relative importance of firm-level cost and demand shocks, it is preferable not to include the firm-time fixed effects used in FHY because this absorbs all of the firm-time variations. Therefore, I have chosen to use the alternative specification presented in Section 4.2, which emphasizes the price and quantity dynamics as a firm grows and enters new markets. The empirical specification in Section 4.2 also allows me to conduct counterfactual exercises to highlight the importance of the common shock component (i.e., ρ) in driving a firm's export growth.

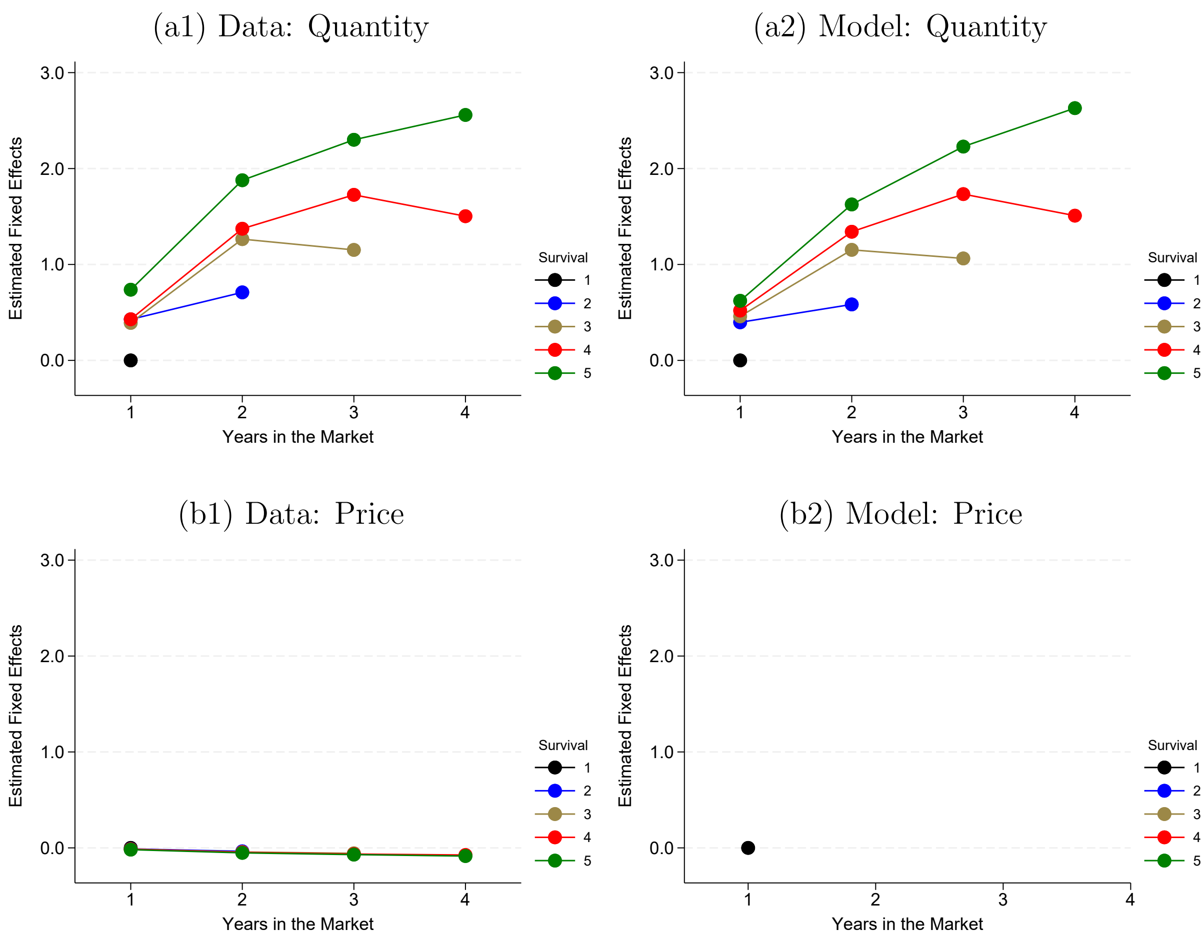

Figure OA2-3: Quantity and Price Dynamics within a Market

Note: The data estimates are calculated based on firm-product-destination-level data of Chinese exporters from 2000-2006. Firm-product-time and destination-product-time fixed effects are added to the estimation equations. The survival years are top-coded at 5.

OA2.4 Additional Model Simulation Results

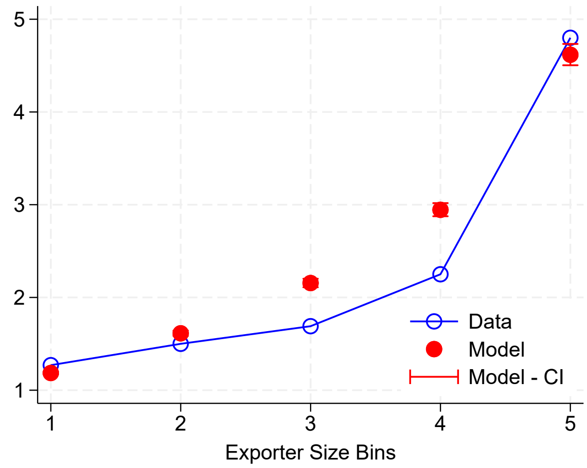

Figure OA2-4: Number of Markets by Firm Size Bin

Note: This figure contrasts the mean number of markets by firm size bins in the data versus in the calibrated model in Section 4.1. The data statistics are calculated using firm-product-level data of Chinese exporters (2000-2006).

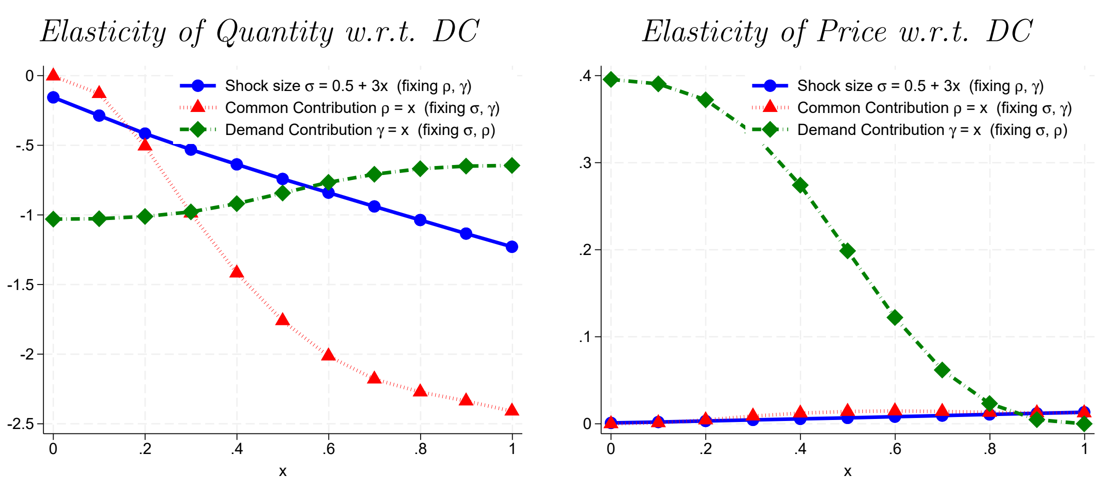

Figure OA2-5: Relationship Between Empirical Measures and Model Parameters

Note: This figure plots the counterpart of Figure 3 (b) and (c) by adding the information on how the two elasticities change with the shock size σ (blue line). Each line shows the change in a given parameter, while keeping the other two parameters unchanged at their initial calibrated values, and the x-axis shows the value of the parameter being changed.

OA3 Supplementary Results from the UK Data

Disclaimer: HM Revenue & Customs (HMRC) agrees that the figures and descriptions of results in the attached document may be published. This does not imply HMRC's acceptance of the validity of the methods used to obtain these figures, or of any analysis of the results. This work contains statistical data from HMRC which is Crown Copyright. The research datasets used may not exactly reproduce HMRC aggregates. The use of HMRC statistical data in this work does not imply the endorsement of HMRC in relation to the interpretation or analysis of the information.

Overview. This section summarizes the main findings from the UK exporters. Two sets of results are discussed: (a) new stylized facts on within-firm market changes and (b) regression results to characterize the relationship between market changes and price and quantity adjustments in the firm's continuing markets.

HMRC Overseas Trade Statistics (OTS) is the main data source. HMRC provides exports at the product level for individual firms in two distinct datasets: the OTS EU Dispatches dataset and the OTS non-EU Exports dataset. The EU dispatches data include monthly records of export value and quantity at the firm-product-destination-time level for UK firms whose exports to the EU exceed £250,000 in a given calendar year.[6] The non-EU exports dataset includes transaction level records of export value and quantity at the firm-product-destination-time level for all trade between the UK and non-EU foreign markets. I aggregate data on firm export dynamics at the product level into calendar year annual observations (January-December). A summary of aggregate statistics of the datasets including the number of observations, trade value and number of firms is reported in Table OA3-4.

To account for the possible heterogeneity across groups, statistics are calculated separately for the following sub-samples:

- Non-EU exports versus all exports (including both EU and non-EU destinations)
- All firms versus large firms (those with export values at the top 50% percentile at the firm-product level or firm level)

[6] These firms account for the majority of value of UK-EU exports. Whilst the legal requirement for the Intrastat reporting threshold is that 93% of the value of trade must be recorded, comparison with official statistics indicates that the £250,000 threshold captures 96-98% of the total value of UK exports to the EU. The Intrastat threshold has changed over time, rising progressively from £135,000 in 1993 when the UK joined the Single Market to £270,000 in 2009. Since 2009, the nominal value of the threshold for dispatches has remained fixed at £250,000 and therefore is constant over the time period of the analysis in this paper.

OA3.1 Key Statistics

Table OA3-2 presents the median of market change measures for UK exporters. Overall, I find very similar patterns to those documented using the Chinese customs data. At the firm-product level, 92% of markets have changed between two observed trading years. Large firms seem to have slightly more stable trade patterns and only 75% of markets have been changed. Note that large firms tend to trade with more markets and therefore the number of markets changed is still greater than that of small firms.

Table OA3-2: Statistics on Within-Firm Market Changes

	Non-EU Markets		All Markets	
	All Firms	Large Firms	All Firms	Large Firms
(a) Firm-product level				
Market Changes/Markets (MCM)	0.92	0.75	0.50	0.50
Drop/Changes (DC)	0.50	0.50	0.50	0.50
Prob. of Churn	0.36	0.50	0.33	0.46
Number of Markets	1.00	2.00	1.00	4.00
(b) Firm-sector level				
Markets Changes/Markets (MCM)	0.67	0.50	0.50	0.40
Drop/Changes (DC)	0.50	0.50	0.50	0.50
Prob. of Churn	0.33	0.71	0.33	0.71
Number of Markets	2.00	9.00	2.00	11.00
(c) Firm level				
Market Changes/Markets (MCM)	0.69	0.50	0.62	0.38
Drop/Changes (DC)	0.50	0.50	0.50	0.50
Prob. of Churn	0.43	0.71	0.43	0.83
Number of Markets	2.00	10.00	2.00	18.00

Note: This table summarizes key statistics of market changes for UK exporters. The median value of each measure is presented in the table. The market-changes-to-markets (MCM) ratio is defined as the number of markets that have changed from one year to the next, divided by the total number of markets in the current year. The drop-to-change (DC) ratio is defined as the number of markets that have been dropped, divided by the total number of markets that have changed. More details regarding the distribution of relevant statistics are discussed in the later sections. Source: Calculations based on HMRC administrative datasets.

The drop-to-change ratio suggests market entries and exits account for roughly equal shares of market changes. Moreover, these statistics suggest firms simultaneously add and drop markets at the same time. It is important to note that the behavior of market churning is not restricted to small firms. As can be seen in the table, the median drop-to-change ratio is the same for large and small firms. In fact, the probability of churn is higher for larger firms due to the fact that these firms sell to a significantly higher number of destination markets.

OA3.2 Key Elasticities

Table OA3-3: Elasticities of Quantity and Price Changes in Continuing Markets to Drop-to-Change Ratio

	Non-EU Markets		All Markets	
	Quantity	Price	Quantity	Price
Count Measure				
Firm-product level	-0.35***	0.01**	-0.51***	0.00
Firm-sector level	-0.28***	0.03***	-0.40***	0.01**
Firm level	-0.21***	0.01	-0.25***	0.01*
Value Measure				
Firm-product level	-0.34***	0.00	-0.45***	-0.02**
Firm-sector level	-0.25***	0.01**	-0.34***	0.00
Firm level	-0.21***	0.01	-0.23***	0.01

Note: This table summarizes the key estimates characterizing the relationship between market changes and price and quantity adjustments in the continuing markets. The top and bottom panels show estimates using count and value measures of the drop-to-change ratio respectively. The different rows within each panel indicate the level of disaggregation at which the trade pattern measures are constructed. *Each cell represents an estimate from a separate estimation equation.* Firm-product (firm-sector) and year fixed effects are added for firm-product (firm-sector) level specifications. Firm and year fixed effects are added for firm level specifications. The statistical significance is calculated based on robust standard errors with ***, **, * representing statistical significance at 1%, 5%, 10% respectively. Source: Calculations based on HMRC administrative datasets, 2010-2016.

Table OA3-3 reports estimates regressing the quantity and price changes in a firm's continuing markets on its drop-to-change ratio, capturing the proportion of markets being dropped among all changed markets. Consistent with the patterns documented using Chinese customs data, I find that firms that drop more markets sell significantly less quantity in their continuing markets, but there is little change in price in these markets.

Table OA3-4: Aggregate Statistics of Estimation Samples

Sample	Observations	Value (million £)	Firms	Products	Firm-product pairs
(a) Firm-product Level Trade Pattern					
All Countries	3,901,312	1,876,415	92,123	9,076	1,133,615
All Countries - Large Firms	911,433	1,699,776	36,248	8,418	178,387
Non-EU Countries	2,191,645	930,073	84,518	8,446	705,417
Non-EU Countries - Large Firms	515,137	825,783	27,131	7,277	106,369
(b) Firm-sector Level Trade Pattern					
All Countries	1,170,211	1,876,415	92,123	8,684	562,222
All Countries - Large Firms	143,703	1,761,017	15,011	6,961	70,640
Non-EU Countries	817,697	930,073	84,518	7,982	402,884
Non-EU Countries - Large Firms	84,657	870,808	9,529	5,629	43,516
(c) Firm Level Trade Pattern					
All Countries	524,105	1,983,699	137,670	-	-
Non-EU countries	491,313	987,495	131,965	-	-

Source: Calculations based on HMRC administrative datasets, 2010-2016.

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