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Firm heterogeneity and export–domestic price differentials
A study of Taiwanese electronics products

Bee Yan Aw[a,*], Geeta Batra[b], Mark J. Roberts[c]

[a]*Pennsylvania State University, Department of Economics, 608 Kern Graduate Building, University Park, PA 16802, USA*

[b]*Private Sector Advisory Services Department, The World Bank, Washington, DC 20433, USA*

[c]*Department of Economics, Pennsylvania State University and NBER, University Park, PA 16802, USA*

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Abstract

This paper uses firm-level data to determine if there are systematic differences in the export and domestic prices charged by Taiwanese electronics producers. The analysis exploits new micro data that allow us to measure firm-level prices in both the domestic and export market for each of 30 disaggregated products in 1986 and 24 products in 1991. We find a substantial difference in the average domestic and export price of most products but trace much of the difference to heterogeneity in prices across firms in the same product market. Once this firm-level heterogeneity is accounted for, statistically significant price differences between the export and domestic market are found for seven products in 1986, with the domestic market price always being higher. The largest price differences are found for consumer electronics products where there were significant import restrictions. By 1991, when all import restrictions had been relaxed, the export–domestic price differential narrows, often substantially, for 18 of the 24 products where comparisons are possible. Statistically significant price differences are found for only one product in 1991. The pricing patterns are consistent with price discrimination in some product markets with the discrimination supported by trade restrictions that raised domestic prices. The magnitude of price variability across firms in the same product market also provides further evidence of the danger of using market-level aggregates to infer competitiveness.

*Corresponding author. Tel.: +1-814-863-1996; fax: +1-814-863-4775.

E-mail addresses: byr@psu.edu (B.Y. Aw), gbatra@worldbank.org (G. Batra), mroberts@psu.edu (M.J. Roberts).

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1. Introduction

The tremendous success of the Newly-Industrializing Countries (NICs) in penetrating developed-country markets for certain manufactured products has increasingly been perceived by the importing countries as resulting from unfair trade practices. Among the alleged practices is the strategy of combining low export prices with import restrictions that protect domestic sellers and raise prices in the domestic market. This in turn has led to increased use of antidumping restrictions and countervailing duties in developed countries.[1] In this paper we examine one of the classic export success stories, the Taiwanese electronic products industry, and develop an empirical model to determine if Taiwanese firms charge different prices in the domestic and export markets.[2] We exploit a unique data set containing prices charged by individual firms in both the domestic and export market and test for price differences for each of 30 highly-disaggregated electronics products in two different time periods.

Several empirical methodologies have been used to examine pricing patterns in export markets while allowing for deviations from competitive norms. One approach follows the empirical industrial organization literature and uses cost and market-level export price data to estimate quasi-supply curves that allow for deviations from price-taking behavior by exporters.[3] A second approach, which is commonly employed in the literature on exchange rate pass-through, uses market-level price data for traded goods and asks if exchange-rate variation explains price variation across destination markets or over time.[4] Finally, direct comparisons of export and domestic price indexes and their change over time have been used to

[1] See the report by Committee on Foreign Affairs (1987) and The World Bank (1994).

[2] In his detailed analysis of the electronics industry, Mody (1990,1993) identifies the combination of import protection and aggressive export pricing of key electronic items as a common strategy used by Taiwan and Korea in the development of the electronics industry.

[3] Aw (1992) estimates a structural model that allows for mark-ups of price over marginal cost in the market for Taiwan's footwear exports to the US; Bernstein (1994) analyzes time-series data for the Canadian softwood lumber industry and cannot reject that prices are equal to short-run marginal cost in both domestic and export markets. This methodology is reviewed in Bresnahan (1989).

[4] Empirical studies of exchange-rate pass through generally examine if the local currency price of imports adjusts fully to changes in the nominal exchange rate. Evidence of incomplete pass through is consistent with the presence of market power by the exporters. Empirical studies include Hooper and Mann (1989), Feenstra (1989), Knetter (1989, 1993), Ohno (1989), Marston (1990), Aw (1992, 1993), and Athukorala and Menon (1994).

draw inferences about export competitiveness.[5] The choice of empirical methods is often determined by the availability of production cost data for exporters and/or price data for comparable goods sold in the exporter's domestic market. In this paper we use firm-level data to make direct comparisons of the prices charged in export and domestic markets.

In a recent review of the literature on prices of goods traded in international markets, Goldberg and Knetter (1997) emphasize that the ideal test of the law of one price would compare prices for two transactions in which all characteristics of the transactions are held constant except the geographic location of the buyers. That is, a clean test requires that price comparisons refer to transactions involving 'identical' goods. To date, empirical tests of the law of one price have fallen short of this ideal, primarily because they utilize data that is aggregated over heterogeneous goods. For example, many studies rely on industry-level unit value indexes for exports where these indexes are aggregated both over exporting firms and products.[6] If the export bundle for an industry contains a different mix of products than the bundle produced for the domestic market, export–domestic price differences could be observed that simply reflect the different mix of products in the two aggregates and have nothing to do with price discrimination between markets. Even if the export–domestic price comparison is made for very narrowly defined products, to minimize the first source of aggregation bias, these prices still aggregate over different firms. If firms produce differentiated products that sell for different prices then price differentials between the export and domestic market will arise unless the mix of firms is identical in the two markets. This condition is particularly unlikely to occur if the product differentiation is in the quality dimension and the firms' product quality is an important factor in the decision to enter the export market in the first place. This self selection into the export market can generate differences in export and domestic prices that are unrelated to price discrimination by the producers.[7]

In this paper we utilize micro data on the prices charged by individual firms in the domestic and export markets and test for equal prices. Comparisons are made for each of 30 electronics products manufactured in Taiwan in 1986 and 24

[5] See Kravis and Lipsey (1971) and Lipsey et al. (1991).

[6] These include Kravis and Lipsey (1977) which aggregates over products and Isard (1977) which aggregates over goods produced in different countries. Studies that rely on very narrowly defined products to remove product aggregation bias are Richardson (1978), Feenstra (1989) and Knetter (1989, 1993). The prices used in these studies still represent an aggregate over different firms.

[7] There is substantial evidence that firms that participate in the export market have higher productivity than nonexporters and that entry and exit patterns in the export market reflect the productivity differences across producers. Aw and Hwang (1995), and Aw et al. (2000) document this pattern in Taiwan and Korea, Clerides et al. (1998) in Mexico, Morocco, and Colombia, and Bernard and Jensen (1995) in the United States. These studies have not had corresponding data on output prices or quality in either the export or domestic market to study if this sorting on firm productivity also leads to sorting on output price.

products manufactured in 1991. Observed price differences may be generated by either heterogeneity in the underlying products across markets or firms, discriminatory pricing between markets, or marginal cost differences among firms. We use the data in several ways to isolate these sources of price variation. In particular, we exploit the fact that a subset of the firms in our data sell in both markets. In these cases, we can control for product heterogeneity and marginal cost differentials across firms by examining the relative price of each firm's output in the two markets, effectively differencing out several sources of across-firm variation. If the marginal cost of production does not vary with the final destination of the product, then price discrimination can be inferred from differences in the prices these firms charge in the two markets.

For the subset of producers operating in both the domestic and export markets the empirical results indicate that for 23 of the electronics products, no significant average price differences are found between the export and domestic markets in either sample year. For the remaining products we find statistically significant differences in prices in 1986 for seven of the products and in 1991 for only one of the products. The largest price differences are found for color televisions and VCRs, with the average domestic price exceeding the export price in 1986 by 103 and 98%, respectively. Significant import protection, which included quotas, tariffs, and domestic-content requirements, appears to be the source of the differential. After 1986, all forms of import protection were reduced in Taiwan and they had largely disappeared by 1991. In that year, we find the domestic-export price difference is statistically significant for only one product. These conclusions are supported when we extend the analysis to include producers that specialize in only one of the two markets.

The remainder of the paper is organized as follows. Section 2 provides an overview of the data and the firm-level pricing patterns for electronics products in Taiwan. Section 3 develops a simple empirical model to quantify the source of the export–domestic price differential. The empirical results are discussed in Section 4 and a summary of major findings and conclusions is reported in Section 5.

2. Export–domestic price differentials

The data we analyze is drawn from firm-level information collected in the Taiwanese Census of Manufactures in 1986 and 1991. Each of the censuses provides complete cross-sectional coverage of all manufacturing firms and we focus on the firms producing any of 30 major electronics products defined at approximately the seven-digit ISIC level.[8] Observations from the separate censuses

[8]Taiwan uses its own industrial classification scheme. The products we study are comparable to the seven-digit product definition in the ISIC coding scheme. We will also summarize patterns at a more aggregate level that corresponds to a five-digit industry grouping in the ISIC. We will refer to our classification as seven-digit products or five-digit industries.

are not matched over time so it is not possible to follow individual firms across the two years. Each firm's export (domestic) price is calculated as the ratio of the firm's value of exports (domestic sales) to the firm's total quantity of exports (domestic sales). All values are measured at the production source and do not include transportation, insurance, or customs charges and thus represent the revenue actually received by the producer. The output prices we measure are firm-level unit values for very disaggregated products (i.e color televisions). While these are still aggregates over more narrowly-defined electronics products (i.e. color televisions distinguished by picture tube size), these unit values are constructed at the most disaggregated level for which information is generally collected. In addition, since our data is at the firm level, the more firms specialize in few products, the more likely it is that our price data is not affected by product aggregation. Heterogeneity in products will then appear as across-firm variation in prices.[9]

Table 1 reports the unit-value index of exports relative to the unit-value index of domestic output at various levels of product aggregation. The relative unit values are reported for the whole electronics industry, for five-digit electronics industries, and seven-digit product categories. The unit-value indexes suggest that there are substantial differences in export and domestic prices, particularly in 1986. For the whole electronics sector, the ratio of export to domestic prices is 2.24 in 1986, raising the possibility of higher marginal costs or substantial market power and high markups in the export market. This finding, however, is driven by the aggregation over products. Disaggregating to the four five-digit industries within the electronics sector, Table 1 reveals that the relative prices are 0.51 for data storage, 0.42 for consumer electronics, 1.55 for parts and components, and 4.37 for communication equipment. At this level two of the industries suggest higher costs or higher markups in the domestic market. Even at this level, the price ratios do not fully reflect the underlying price differences at the product level. In each of the industries there are products in which the price ratio exceeds one and others where it is less than one. This illustrates the commonly made point (Leamer and Stern (1970)) that aggregate unit-value indexes are poor measures of traded goods prices and generally provide a poor basis for analyzing market competition in traded goods.

Focusing on the unit-value indexes at the most disaggregated product level we continue to observe substantial price deviations between the export and domestic markets. In 1986, 21 of the 30 products have price ratios less than one, indicating

[9]Most electronics firms in Taiwan are very specialized. Among the electronics firms in our dataset in 1986, 91.9% produce one seven-digit product, 6.2% produce two products, and 1.9% produce three or more. The most diversified firms each operate in six product markets and only six of the 2,546 electronics firms fall in this category. In 1991, 87.5% of the firms produce in one product category, 9.3% in two, and 3.2% produce three or more. This is consistent with the tendency of Taiwanese firms to concentrate in specialty product niches. Levy (1991) and Pack (1992) have discussed how the dense network of subcontractors permits both small scale production and specialization in a limited number of products.

Table 1
Export–Domestic price ratio: $\left(\frac{UV^E}{UV^D}\right)$ and mean export share

Industry and product	Export–Domestic price ratio		Median of firm-level export Shares
	1986	1991	
All electronics products	2.24	0.971	
Data storage & processing	0.510	0.558	
Floppy disk drive	0.708	0.885	0.661
Monochrome monitor	1.140	0.948	0.862
Color monitor	0.698	0.639	0.898
Other monitor	1.366	1.075	0.825
Terminal	0.571	0.909	0.962
Keyboard	0.945	0.952	0.680
Pocket calculator	1.021	0.721	0.954
Consumer electronics	0.421	1.162	
Color TV	0.273	0.609	0.774
B&W TV	0.505	0.867	0.939
Video cassette	0.695	0.774	0.057
Radio	0.543	1.554	0.711
Radio with tape	0.731	0.711	0.729
Other recorders	0.370	0.545	0.816
Recorder frame	0.395	1.202	0.842
Tuner	1.042	1.180	0.792
Speakers	0.697	1.206	0.601
Parts and components	1.546	1.257	
Color CRT	0.953	0.756	0.672
Digital integrated	0.607	1.313	0.556
Electrolyte capacitor	0.835	0.799	0.469
Ceramic capacitor	0.908	1.121	0.455
CMF resistor	0.570	1.057	0.591
Rheostat	2.827	1.256	0.564
S-S Printed circuit	0.981	NA[a]	0.530
D-S Printed circuit	0.968	NA	0.390
Micro motor	1.091	NA	0.560
Communication equipment	4.368	0.886	
Telephone	0.473	1.025	0.664
Other telephones	2.414	0.815	0.482
Antennas	1.815	0.906	0.623
Non wireless transfer	0.485	NA	0.264
Other wireless comm.	1.023	NA	0.545

[a] NA: data for this product was not available in 1991.

lower export prices, and this is particularly true among the consumer electronics products. The magnitude of the deviations is also substantial. Only 9 of the 30 products have price ratios of 0.9–1.1 and 12 products have price ratios that fall outside of the 0.6–1.4 range. Finally, there is some weak evidence of a narrowing of price differentials between 1986 and 1991. For 16 of the 24 products for which

we have data for both years the export and domestic prices are more similar in 1991 than in 1986. This pattern is also clearly reflected in the industry-level aggregates.[10]

With only two cross-sections of data available, there is obviously insufficient time series data to be of much help in statistical tests of the law of one price at the product level. Instead we exploit the richness of the cross-sectional coverage to determine if the relative product prices reported in Table 1 accurately reflect the prices which firm's charge in the two markets or result from bias due to aggregation over heterogenous firms. Specifically, if all firms charged the identical price in the export market for a given product and, similarly, the domestic price of the product was identical across all firms, then across-firm variation in relative prices would not exist. The export–domestic price ratios in Table 1 would be identical for all firms and accurately reflect price differences in the two markets. Alternatively, if firms charge different prices, for example, because they produce different quality products, but each firm charges the identical price for its output in the domestic and export markets, then across-firm variation would be responsible for all the export–domestic price variation observed in Table 1.

Price differences across the export and domestic market can result from differences in the type or quality of product sold in each market and differences in the degree of competition between markets. Price differences across firms in the same market can result from product differentiation, systematic differences in production costs or product quality, or random measurement and reporting errors. Before developing the empirical model to separate the roles of firm heterogeneity and market differences, we summarize the magnitude of across-firm and across-market variation in the data. Table 2 reports the partial sum of squares for the log of the firm's output price in the market, firm, and residual dimensions of the data, divided by their respective degrees of freedom.[11]

The main point revealed by the table is that across-firm differences in prices are the major source of price variation in the data and the differences across markets are relatively unimportant. In 1986 for virtually every product, both the firm variation and the residual variation exceed the across-market variation, with the firm variation often being larger by an order of magnitude. While the price differences across firms in a market are statistically significant at the $\alpha = 0.05$ level for 22 of the 30 products, the price differences across markets are significant

[10]The final column of Table 1 reports the median of the firm-level export shares among all firms that produce in both markets in either 1986 or 1991. While some of the firms that sell in both markets are heavily concentrated in one of them, the median firm export share indicates that dual market firms do divide their sales between the two markets. The exceptions to this are the four products, terminals, pocket calculators, black and white televisions, and VCRs, where the median firm is still heavily concentrated in one of the markets.

[11]Using standard analysis of variance definitions, the market (firm) variation is measured as the partial sum of squares from adding the market (firm) dimension to a model that already contains the firm (market) dimension and dividing by its degrees of freedom.

Table 2
Mean squared error of log price – market, firm, and residual variation

Product	1986				1991			
	Market	Firm	Residual	Number of observations	Market	Firm	Residual	Number of observations
Floppy disk drive	0.358[a]	4.902[a]	0.216	22	0.041	1.091[a]	0.083	13
Monochrome monitor	0.017	9.647[a]	0.046	20	0.039	0.438	0.749	47
Color monitor	0.001	6.122[a]	0.281	23	0.078	6.990[a]	0.568	53
Other monitor	0.066	1.592[b]	0.104	18	0.075	0.390	0.493	26
Terminal	0.270	4.436	0.464	23	0.185	2.770	0.353	12
Keyboard	0.031	3.356[a]	0.322	33	0.001	4.636[a]	0.652	65
Pocket calculator	0.041	1.343[a]	0.068	11	0.053	16.850[a]	0.439	31
Color TV	4.213[a]	5.843[b]	0.615	29	0.047	5.301[b]	0.235	23
B&W TV	0.473	4.552	0.325	20	0.033	0.038	0.038	9
Video cassette	1.436[a]	0.492	0.037	14	0.334	0.775	0.773	11
Radio	0.110	26.911[a]	1.963	35	0.231	14.008[a]	0.200	20
Radio with tape	0.452	13.492	1.459	65	0.034	4.864	2.625	35
Other recorders	0.429	38.559[a]	0.452	20	1.131	1.741	0.000	8
Recorder frame	1.203	69.117[a]	2.890	40	0.001	2.484[a]	0.001	16
Tuner	0.488	18.418	0.563	18	0.023	47.655[a]	0.286	30
Speakers	0.088	158.744[a]	5.158	150	0.140	93.120[a]	6.916	237
Color CRT	0.485	4.925[a]	0.306	14	0.102	1.466	0.452	23
Digital integrated circuit	0.084	9.332	1.112	15	0.100	249.877[a]	6.248	122
Electrolyte capacitor	0.452[b]	78.725[a]	5.762	174	0.254	197.758[a]	13.798	156
Ceramic capacitor	0.005	6.176[a]	1.022	60	0.001	58.375[a]	2.605	65
CMF resistor	0.152	20.378[a]	0.981	60	0.014	123.029[a]	2.776	65
Rheostat	0.009	106.950[a]	1.093	39	0.103	60.221[a]	0.787	49
S-S Printed circuit	0.001	1.066[a]	0.020	117	NA[c]	NA	NA	NA
D-S Printed circuit	0.001	0.474	0.051	49	NA	NA	NA	NA
Micro motor	0.003	22.337[a]	0.385	43	NA	NA	NA	NA
Telephones	0.102	63.489[a]	4.141	106	0.005	7.414	1.513	91
Other telephones	0.531	62.272[a]	1.877	55	0.021	0.542	0.139	23
Antennas	0.001	26.038[a]	0.067	96	0.119	1.250	0.613	70
Non-wireless transfer	0.106	80.528[a]	0.607	23	NA	NA	NA	NA
Other wireless comm.	0.009	0.706	0.080	64	NA	NA	NA	NA

[a] Significant at the 1% level. [b] Significant at the 5% level. [c] NA: data for this product was not available in 1991.

at this level for only four products. The same pattern also holds in 1991, except that the across-market differences are even less substantial. None of the products have price differences between markets that are significant at the $\alpha = 0.05$ level, while 14 of the 24 products have across-firm price differences that are statistically significant.

The importance of the firm-level variation in prices that is revealed in Table 2 suggests that product differentiation among firms is likely to be important even within these disaggregated product categories. Any attempt to construct a domestic and export price for each product is going to require aggregation over firms with very different prices for the product and this will generate differences in the product-level export and domestic prices unless the mix of firms is identical in both aggregates. Without controlling for differences in the firm mix in each market, a comparison of the aggregate domestic price of color televisions with the aggregate export price of color televisions is not likely to reflect the true across-market price differentials that exist at the firm level and will not correctly reveal the presence of price discrimination between the two markets.

3. Empirical specification

This section develops an empirical model to measure the average price difference for a product between the export and domestic markets, after controlling for firm-level differences in the nature of the product. Assume that each firm manufactures a differentiated product and faces downward-sloping demand curves for its output in the domestic and export markets. Firms operate in the short-run with fixed capital stocks and exogenous input prices. The bulk of firms in Taiwan are single-plant producers so that output sold in the domestic and export markets is produced in the same production facility. As such, the marginal costs of firm i in the domestic (H) and export (E) markets in year t are likely to be the same. We assume that each firm first chooses whether to sell in the domestic market, export market, or both and then, given that decision, chooses the profit-maximizing price in each market it operates in. For firm i operating in both the domestic (H) and export (E) markets in year t the profit maximizing conditions, written in logs, are:

$$\ln P^{j}_{it} = \ln MC_{it} - \ln\left(1 - \frac{1}{\eta^{j}_{it}}\right) \qquad j = H,E. \tag{1}$$

Firm i's markup in market j (H or E) depends upon the firm's demand elasticity (η^{j}_{it}) in the market.[12]

[12]Rather than treating firms as monopolists, we could view them as differentiated product oligopolists with each firm's demand curve and demand elasticity depending on the prices charged by all other firms in the market. We do not estimate structural firm demand curves and the distinction between the market structures is not important for the empirical tests we perform.

Higher average prices in the export market could reflect that either higher-cost firms are in the export market (because only firms with higher quality products are able to sell in that market, for example) or that exporters have higher markups due to more inelastic demand. Higher average domestic prices could similarly result from a higher concentration of producers with high costs or more inelastic demands. One source for the latter are import restrictions that reduce the number of substitute products in the domestic market.

The traditional definition of dumping focuses on price differences between export and domestic markets that cannot be rationalized by cost differences (Viner, 1923).[13] In order to isolate these market-level price differences in our micro data, it is necessary to simultaneously account for firm-level heterogeneity. The empirical model we will work with is:

$$\ln P^j_{it} = \theta^j_t + \beta X_{it} + \mu_i + \epsilon^j_{it} \quad j = H,E \qquad \text{and } t = 1986, 1991. \tag{2}$$

In this model the θ's are market-year effects common to all firms, μ_i is a firm effect, the X's are observable cost determinants for firm i in year t and ε is a random disturbance. Within each market and year there will be firm-level variation in prices arising from differences in marginal cost, markups, and random noise. This will be controlled for with a combination of observable cost shifters βX_{it} that include factor prices and firm capital stocks, a firm-specific effect μ_i, and a random error.[14] In particular, if there are unobserved quality differences in output among firms this will be controlled for with the firm-specific effect.[15] The four θ parameters, one for each market ($j = H,\ E$) in each year ($t = 1986,\ 1991$), summarize the pattern of average prices across markets and time, controlling for firm-level heterogeneity. These are the main focus of interest and our goal will be to test if average prices are equal across the two markets in each year ($\theta^H_t = \theta^E_t$). A finding that we reject equality of the two parameters implies significant price differences between markets, on average, across all firms and will be interpreted as rejection of the law of one price.

[13]This definition is used by many researchers (Lloyd, 1977; Dale, 1980; Das and Mohanty, 1984), although dumping is often more broadly defined to include an exporter charging prices below average cost in the foreign market, rather than charging prices below the prices charged in the exporter's domestic market. Theoretical models have demonstrated how this can be a profit maximizing response to learning effects (Gruensprecht, 1988) or demand uncertainty (Ethier, 1982).

[14]The cost variables are the firm's average wage rate and the book value of the firm's capital stock. The wage rate is defined as total payments to the firm's labor divided by the total number of production and nonproduction workers.

[15]We do not have any observable firm-level variables that can control for differences in demand elasticities. These differences will have to be captured by the firm-specific effect and random noise terms. The observable cost variables included in X are only available in the 1986 data set. As a result, when the model is estimated using the 1991 data, across-firm cost variation will also be captured by the error structure. The effect of this is discussed below when the results are reported.

There are two sources of price variation in our data that we can exploit to estimate the θ parameters in (2). In one case we use all price observations from both markets. Because our data consists of separate cross-sections for the years 1986 and 1991, and is not a firm-level panel, we only have two price observations for firms that produce in both markets in a given year and a single price observation for firms that specialize in one of the markets. The latter prevents us from treating μ_i as a firm fixed effect and instead requires us to treat it as part of a composite error term $\mu_i + \epsilon_{it}^j$. If firms sort into the two markets based on the quality of their product then the μ_i will vary systematically across markets and bias estimates of the θ parameters. If firm-level quality differences do not vary systematically across markets their presence does not bias estimates of the θ's but, if the variance of μ_i is large, it will adversely affect the precision of the estimates. Assume that μ_i is distributed with zero mean and constant variance σ_μ^2 and ϵ_{it}^j is distributed with zero mean and constant variance σ_ϵ^2 and the two error components are uncorrelated.[16] The variance of the error term in (2) is $\sigma_\mu^2 + \sigma_\epsilon^2$. A large σ_μ^2 will result in less precise estimates of θ and make it more difficult to reject the hypothesis that the prices are equal in the two markets, even when we find large numerical differences in average prices.

Alternatively, we will exploit the fact that many firms in our data produce for both the domestic and export market in the same year and we observe the price they charge in each market. By relying on a comparison of the relative price these firms charge in the two markets we can remove all firm-level sources of heterogeneity including marginal cost and unobserved quality differences. This can be seen by rewriting Eq. (2) as the difference between the firm's price in the export and domestic market in year t. This gives:

$$\ln P_{it}^E - \ln P_{it}^H = (\theta_t^E - \theta_t^H) + (\epsilon_{it}^E - \epsilon_{it}^H). \tag{3}$$

By focusing on the log of the relative price of exports to domestic output in (3), the unobserved firm effect and all observable firm characteristics common to both outputs, such as all cost variables βX_{it}, are removed by the differencing, leaving only the market-level and year factors. The difference in the θ's estimated from Eq. (3) will not be biased by the presence of unobserved firm characteristics, captured by the μ_i, that are correlated with the firm's decision regarding which markets to sell in.

Eq. (3), unlike Eq. (2), can only be used to estimate the difference in θ's between markets and not the level in each market. Either equation can be used to test the equality of the θ's between the export and domestic market. The difference in mean prices between the two markets may also be more precisely estimated in

[16] We assume that the variance of ϵ is the same in the home and domestic market. In the empirical work we attempted to estimate separate variances for the shocks in each market but did not have sufficient observations to do so accurately.

Eq. (3) than in Eq. (2). The variance of the error term in (3) $V(\epsilon_{it}^{E} - \epsilon_{it}^{H}) = 2\sigma_{\epsilon}^{2}$, will be smaller than the variance of the error in (2), $V(\mu_i + \epsilon_{it}^{j}) = \sigma_{\mu}^{2} + \sigma_{\epsilon}^{2}$, if across-firm dispersion is greater than random dispersion ($\sigma_{\mu}^{2} > \sigma_{\epsilon}^{2}$). Thus, if there is substantial across-firm dispersion in prices, as indicated in the variance decomposition in Table 2, then focusing on the relative prices of the firms selling in both markets may provide more precise estimates of the across-market differences in mean prices. One disadvantage of using only the data for firms that operate in both markets is the reduction in sample size that results and this could offset the gain in precision from removing μ_i from the error.

In order to examine the tradeoffs involved in using Eq. (2) or (3), we adopt the following two-step approach. First, we estimate Eq. (3) using only the firms that operate in both the export and domestic markets and test for equality of prices across markets. Second, we estimate Eq. (2) using the complete set of firms and compare if the differences in the θ's are similar to those estimated from Eq. (3). Similarity in the differences in the θ's would indicate little bias from the firm effects, but larger standard errors would reflect the additional noise introduced by the firm heterogeneity. By comparing the estimated error variances from Eqs. (2) and (3), denoted s_2^2 and s_3^2 respectively, we can identify the two variances σ_{ϵ}^{2} and σ_{μ}^{2}. An estimate of σ_{ϵ}^{2} is given by $0.5\, s_3^2$. The amount of across-firm variation σ_{μ}^{2} can then be estimated as $s_2^2 - 0.5 s_3^2$.[17]

4. Estimation results

The results of estimating Eq. (3) using firms that operate in both the domestic and export markets are reported in columns 1–4 in Table 3. Columns 2 and 3 report the mean proportional price difference between the domestic and export markets in 1986 and 1991, respectively, for each of 30 seven-digit products. Column 4 reports the estimate of σ_{ϵ}^{2}.

Focusing on the mean price differences for 1986, the domestic output price is greater than the price of the exported output for 22 of the 30 products. For example, in the case of floppy disk drives, domestic prices are, on average, 28.2% higher than export prices. For the 22 products with higher domestic prices, the average difference is 28.1%, while for the other eight products the domestic price averages 9.3% below the export price. In 1991, the domestic price is higher for 18 of 24 products with an average differential of 13.4%. Of the six products with higher export prices the average differential is 6.6%. Two patterns are noteworthy. First, in all the cases where export prices are greater than import prices, the differences are not statistically significant. Second, the absolute value of the price

[17] This method of estimating the variance components can result in an estimate of σ_{μ}^{2} that is negative. If this occurs we will interpret it as evidence that firm heterogeneity is not important for that product.

Table 3
Price regression parameter estimates by seven-digit product

Product	Firms in both markets[a]				All firms[b]				
	Sample size	$\theta^E_{86}-\theta^H_{86}$	$\theta^E_{91}-\theta^H_{91}$	σ^2_ϵ	Sample size	$\theta^E_{86}-\theta^H_{86}$	$\theta^E_{91}-\theta^H_{91}$	$\sigma^2_\epsilon+\sigma^2_\mu$	σ^2_μ
Floppy disk drive	14	−0.282[d]	−0.127	0.025	35	−0.247	−0.116	0.203	0.178
Monochrome monitor	21	0.083	−0.070	0.042	67	0.218	−0.061	0.173	0.131
Color monitor	25	−0.009	−0.093	0.037	76	−0.017	−0.287[e]	0.194	0.157
Other monitor	14	0.148	0.137	0.050	44	0.119	0.086	0.065	0.015
Terminal	9	−0.300	−0.351	0.117	35	−0.429	−0.152	0.259	0.142
Keyboard	34	−0.072	−0.004	0.030	98	−0.024	0.033	0.095	0.061
Pocket calculator	16	−0.143	−0.094	0.036	42	−0.117	−0.135	0.492	0.456
Color TV	14	−1.026[d]	−0.125	0.071	52	−1.116[d]	−0.148	0.250	0.179
B&W TV	8	−0.486[e]	−0.128	0.060	29	−0.232	−0.118	0.198	0.138
Video cassette recorder	7	−0.978[e]	−0.408	0.162	25	−0.771[d]	−0.395[e]	0.099	[c]
Radio	16	−0.141	−0.304	0.154	55	−0.320	−0.237	0.845	0.690
Radio with tape	23	−0.264	−0.082	0.195	100	−0.425[d]	−0.148	0.234	0.039
Other recorders	6	−0.378	NA	0.090	28	−0.610	−1.249	1.698	1.608
Recorder frame	11	−0.548	−0.026	0.321	56	0.285	−0.105	1.433	1.111
Tuner	13	−0.570[e]	−0.068	0.077	48	1.676[d]	−0.196	1.521	1.444
Speakers	101	0.061	−0.072	0.122	387	−0.070	−0.075	0.689	0.567
Color CRT	16	−0.402[d]	−0.143	0.054	37	−0.385	−0.192	0.217	0.163
Digital integrated circuit	39	0.205	0.075	0.199	137	0.409	0.303	2.004	1.805
Electrolyte capacitor	90	−0.132	0.116	0.222	330	0.027	0.267	0.908	0.686
Ceramic capacitor	43	−0.021	0.007	0.088	125	−0.056	−0.149	0.564	0.475
CMF resistor	39	−0.120	0.040	0.102	125	−0.131	−0.412	1.216	1.115
Rheostat	25	−0.041	−0.121	0.082	88	0.479	−0.285	2.013	1.931
S-S Printed circuit board	21	−0.010	NA	0.001	117	−0.009	NA	0.010	0.009
D-S Printed circuit board	11	0.011	NA	0.005	49	−0.011	NA	0.011	0.006
Micro motor	9	0.024	NA	0.048	43	−0.208	NA	0.554	0.506
Telephones	55	−0.079	0.021	0.107	206	−0.206	−0.087	0.379	0.272
Other telephones	22	−0.275[e]	−0.072	0.108	78	0.237	−0.029	0.876	0.775
Antennas	44	−0.008	−0.118[e]	0.016	166	0.016	−0.066	0.173	0.157
Non-wireless transfer	7	0.174	NA	0.101	23	−0.115	NA	3.864	3.762
Other wireless comm.	11	0.039	NA	0.008	64	−0.032	NA	0.013	0.005

[a] The dependent variable is the log of the relative price. [b] The dependent variable is the log of the absolute price. [c] Estimate is negative. [d] Reject hypothesis at 1% significance level. [e] Reject hypothesis at 5% significance level. NA: data for this product was not available in 1991.

differences are smaller in 1991 than in 1986 for 18 of the 24 products where comparisons can be made.

Tests that $\theta^E - \theta^H = 0$ indicate that, in 1986, the equality of the mean export and domestic prices is rejected for seven products; floppy disk drives, color TV, black and white TV, VCRs, tuners, color cathode ray tubes, and other telephones. For all of these products the average domestic price exceeds the average export price. For the consumer electronics products in 1986, the domestic price exceeds the export price by an average of 102.6% for color TV, 97.8% for VCR, 57% for tuners, and 48.6% for black and white TV. The remaining three products have differentials of 40.2% for color CRT, 28.2% for floppy disk drives, and 27.5% for other telephones.

In 1991 the price differentials for all seven products are substantially smaller. Domestic prices now exceeded export prices on average by 12.5% for color TV, 12.8% for black and white TV, 40.8% for VCR, 6.8% for tuners, and 14.3% for color CRT, 12.7% for floppy disk drives and 7.2% for other telephones. This represents an average 72% narrowing of these price differentials between 1986 and 1991. In 1991 it is only possible to reject the equality of domestic and export prices for one product, antennas, where domestic prices are 11.8% higher than export prices.

While focusing on the firms that produce in both the export and domestic markets allows us to control for important sources of firm heterogeneity, such as quality differentiation, that could bias across-market price comparisons, it has the limitation that the results are only applicable to a subset of exporters. The figures in columns 6–8 of Table 3 are estimates of the across-market price differences from Eq. (2) in which we use the data for all firms regardless of whether they are single or dual market firms.[18] These price differentials are remarkably similar to those estimated using only the firms that sell in both markets, suggesting that the market selection bias is not important for most products. In 1986, domestic prices are higher for 21 of 30 products and in 1991 they are higher for 21 of 24 products. Among the seven products with significant price differentials in 1986 for firms in both markets (column 2 of Table 3), the differentials using all firms are similar for five of the products. For example, the domestic price premium for color TV changes from 102.6% to 111.6% when the sample of firms is expanded to include all single market producers. In two cases, tuners and other telephones, the change in sample matters, with the specialized firms having a higher ratio of export to domestic prices in 1986. The shift is particularly large for tuners where firms producing in both markets had export prices that were 57% below domestic prices in 1986 but over all firms the average export price was 168% higher. This occurs

[18]To maintain comparability of the model across the two years, we have deleted the cost controls X_{it} from the estimating equation for 1986 when generating the results in columns 6–8. When we include the firm's wage rate and capital stock as cost controls in 1986 we reject the hypothesis that their coefficients are jointly equal to zero for 8 of the 31 products. The effect of the cost controls on the θ coefficients is discussed below.

because the producers specializing in the export market had much higher prices than other firms, suggesting that, in this case, quality differences among firms may be an important factor in the decision to export.

In general, the price differentials that are reported in columns 6 and 7 are not statistically significant and we reject the equality of export and domestic prices for only four products in 1986 and one product in 1991. This does not occur because the differentials are smaller than the corresponding figures reported in columns 2 and 3, but because they are less precisely estimated. Estimates of the across-firm variance σ_{μ}^2 are reported in the last column of Table 3 and estimates of the variation arising from other sources σ_{ϵ}^2 are reported in column 4. For 27 of the 30 products $\sigma_{\mu}^2 > \sigma_{\epsilon}^2$, sometimes by as much as a factor of 10. The noise introduced by the across-firm heterogeneity contributes to the inability to reject the hypothesis that domestic and export prices are equal even though we may find large numerical differences in average prices between the domestic and export prices. In most cases, the gain in precision resulting from the increase in the number of price observations is offset by the additional firm-level price variability arising from quality differences or other sources of firm heterogeneity.[19]

4.1. The role of trade policy in explaining price differences

The conclusion to be drawn from Table 3 is that domestic prices are higher than export prices for most products in 1986 and the differentials narrow considerably over time. Both the pattern across products and the narrowing over time are consistent with restrictions on imports to the Taiwanese domestic market. For the seven products with significant 1986 price differences in column 2 the average tariff rate in 1986 was 30.35%, with only floppy disk drives having a tariff rate less than 20%. The tariff rates on consumer electronic products, notably televisions (color and black and white), and VCRs were between 45 and 50% . Overall, for the 29 electronics products for which we could collect tariff rate data, the average tariff was 24.3% in 1986.[20]

Wade (1990), Dahlman (1993), and Mody (1993) document how restrictions on competing imports were used in the early to mid 1980s to develop local production of several consumer electronics products, particularly televisions and VCRs. In 1982 the government banned imports of Japanese VCRs to help the domestic electronics companies build their own production capacity. Since Japan was

[19]When we include cost controls as determinants of the 1986 prices we find that the market-level price differentials are reduced, in absolute value, for 21 of the 30 products, and remain statistically insignificant for all but four products. Of the four products with significant price differences without the cost controls, three of them, color TVs, VCRs, and tuners, have price differences that change little and remain significant. The price differential for the fourth product, radio-tape players, is reduced to $-.261$ and is no longer significantly different than zero. One product, speakers, has a price differential that increases to 0.312 and is now statistically significant. Overall, the cost controls do not affect our conclusions about the presence of price discrimination or the role of trade policy in generating it.

[20]Tariff rates are obtained from the Inspectorate General of Customs (1986, 1991).

virtually the world's only producer of VCRs, this amounted to a total import ban and many local companies began production during that period. According to Dahlman (1993), the orientation of VCR producers continues to be toward the domestic market. While import duties on VCRs were gradually reduced over the period, they equaled 50% in 1986, the first year of our data. In addition, approximately 60% of the components used in VCRs were imported and faced an import duty of 50% in 1986. Domestic sales of television sets were also protected from import competition with tariff rates of 45%, although restrictions also took the form of local content regulation requiring domestically-produced parts to be used in their manufacture.

Trade policy is the likely source of the observed price differences across the domestic and export markets and this is reinforced by comparing the differential in 1986 (Table 3, column 2) and 1991 (column 3). In general, after the mid-1980s import restrictions were significantly reduced so that by the second year of our data, 1991, the average tariff rate had fallen to 6.88% for the twenty nine electronics products.

To see the role of tariff and exchange rate changes on prices we examine how the θ_t^j parameters estimated in Eq. (2) vary across markets and time. These parameters are the mean prices across Taiwanese manufacturers in each market/year. The factors that affect the domestic price are the price of competing imported products and the tariff rate imposed by Taiwan. The magnitude of their effect on domestic depends on the cross-price elasticity of demand between the competing imported product and the domestically sold good. Changes in the exchange rate can lead to changes in the export price if the exporting country is not a price-taker in its export markets.[21] In our data, the tariff rate on competing imports to Taiwan varies across products and over time. The price index of competing imports and the exchange rate are common to all products in each year, although they do change over time, and will be indistinguishable from a simple year effect in each market. For the price of competing imports we use a price index for imported electronic products at c.i.f. values. For the exchange rate on exported products we use the Taiwan/US exchange rate because the US is the major destination market for Taiwan's exports.[22] In this exercise we pool all products to get sufficient

[21]This has been the focus of the empirical tests of complete exchange rate pass through. If the exporting country has market power in the destination market then a change in the exchange rate can lead to either an increase or decrease in the export price depending on the curvature of the marginal cost and demand functions. See Feenstra (1989) for the comparative statics.

[22]If we had data on the destination market of the exports of each product we could construct an export-weighted exchange rate that would differ across products if the mix of destination markets varied across products. We are only able to acquire destination-specific exports by product for five electronics products in 1986 and 10 (different) products in 1991. The US was the dominant purchasing country for Taiwan exports of all these products so there is little across-product variation in the export-weighted exchange rate. As a result, we treat the exchange rate as common to all products in a year and use the Taiwan-US exchange rate as our measure. During the period of our data the Taiwan dollar appreciated 27.5%, from 35.5 NT dollars per US dollar in 1986 to 25.75 in 1991. Exchange rate data is obtained from the Council of Economic Planning and Development (1993).

degrees of freedom to exploit the across-time differences in the tariffs. Let τ_{jt} be the tariff rate on Taiwanese imports of product j in year t. We estimate the following regression:

$$\theta_t^j = \beta_j + \beta_1 (\text{EXP} \times \ln(ex_t)) + \beta_2 (\text{DOM} \times \ln(pm_t)) + \beta_3 (\text{DOM} \times \ln(1 + \tau_{jt})) + \epsilon_{jt}$$

This regression summarizes variation in the θ_t^j with product dummies β_i (to control for differences in the type of product, production costs, and the price of competing imports measured in foreign currency), the log of the exchange rate from the major export destination market (ex) interacted with an export market dummy (EXP), the log of the price of competing imports (pm) interacted with a domestic market dummy (DOM) and the log of one plus the tariff rate on competing imports in each year interacted with the domestic market dummy variable. With this specification only the variation in the average price by market and year is used to estimate the tariff and exchange rate effects. We estimate the regression with weighted least squares using the standard errors of the estimated θ_t^j as weights. The estimated regression equation (with t-statistics in parentheses) is:

$$\theta_t^j = b_j + \underset{(1.70)}{0.418} (\text{EXP} \times \ln(ex_t)) + \underset{(1.84)}{0.262} (\text{DOM} \times \ln(pm_t)) + \underset{(0.39)}{1.805} (\text{DOM} \times \ln(1 + \tau_{jt})) + e_{jt}.$$

where the individual product intercepts b_j are not reported. The exchange rate coefficient indicates that a depreciation of the Taiwan currency, an increase in $\ln(ex_t)$, will raise export prices, although the coefficient is not statistically different than zero. A zero coefficient on $\text{EXP} \times \ln(ex_t)$ is consistent with Taiwanese exporters having no market power in their destination markets, so that export prices are determined by domestic production costs and not by demand conditions in the destination market, while the positive coefficient of 0.418 indicates an ability of exporters to increase prices as the Taiwanese currency depreciates. The price of imports has a positive but statistically insignificant effect on the price of domestically sold electronics products.[23] The tariff coefficient indicates that domestic prices are significantly higher for products where competing imports face higher tariffs. A 1% point increase in $(1 + \tau_{jt})$ increases the price of the domestic good by 1.805%. This could occur if the domestic product and the competing

[23]Because the exchange rate and price of imports are constant across all products in a year they will also pick up time effects, such as general cost or price-level increases, that are common to all products. We have also estimated the regression using the exchange rate interacted with the domestic market dummy, rather than the price of imports. In this case the coefficient on the exchange rate variable is 0.244 ($t = 1.103$) which is consistent with the coefficient on the price of imports. Depreciations of the currency which will increase the price of imports act to increase domestic prices. Again, the effect is not statistically significant.

import were differentiated and there was a large cross-price elasticity between the two goods so that tariff increases led to large increases in demand for the domestic variety.

The tariff coefficient could be biased upward by the presence of non-tariff barriers to imports, such as domestic content requirements, that were also used on some of the high tariff consumer electronics products. To see if the tariff effect is stronger in the consumer electronics industry we interacted the domestic tariff variable with a dummy for the nine consumer electronics products (DCE). To see if there were also more pronounced effects of the change in the price of imports on the consumer electronics products we also interacted the price of imports with DCE. The estimated regression with these two additional variables is:

$$\begin{aligned}\theta_t^j = b_j &+ \underset{(1.92)}{0.460}(\mathrm{EXP} \times \ln(ex_t)) + \underset{(1.84)}{0.331}\,(\mathrm{DOM} \times \ln(pm_t)) \\ &+ \underset{(0.39)}{0.286}\,(\mathrm{DOM} \times \ln(1+\tau_{jt})) \\ &- \underset{(1.50)}{0.065}\,(\mathrm{DOM} \times \ln(pm_t) \times \mathrm{DCE}) + \underset{(2.59)*}{2.328}\,(\mathrm{DOM} \times \ln(1+\tau_{jt}) \\ &\times \mathrm{DCE}) + e_{jt}\end{aligned}$$

This indicates that for products that were not in the consumer electronics industries a 1% increase in the price index for electronics goods raised domestic prices by 0.331%, with the coefficient significant at the 0.10 level. For consumer electronics products the elasticity is smaller by 0.065 but the difference in the two coefficients is not significant. The main change in results occurs with the tariff coefficient. In the industries other than consumer electronics, a 1% increase in $(1+\tau)$ raises domestic prices by 0.286% but the effect is not significant. Instead the entire price effect of the tariff increase is due to the effect on the domestic price of consumer electronics products. In this case a 1% increase in the tariff variable increases domestic prices by a statistically significant 2.33%. This large effect likely reflects the increase in demand for the domestic variety as a result of increases in both measured tariffs and use of non tariff barriers that, while not quantified in these regressions, were used in conjunction with tariffs to restrict competing imports of some products. These two regressions support the conclusion that the main source of export–domestic price differences are the trade restrictions on competing imports of consumer electronics products that contributed to higher domestic prices.

5. Summary and conclusions

In this paper we develop an empirical model to determine if Taiwanese producers of electronics products charge different prices in the domestic and export market. Using firm-level data for 1986 and 1991, we isolate price

differences generated by discriminatory pricing between markets from other sources of price variation including product heterogeneity and marginal cost differences across firms.

Our results indicate a substantial difference in the average domestic and export price of most products, with the export price being lower, but trace much of the difference to heterogeneity in firm prices within each market. We control for this by focusing on the relative export–domestic price of firms that operate in both the export and domestic markets, effectively differencing out many sources of firm-level heterogeneity. Once this is accounted for, domestic prices are found to be significantly higher than export prices for seven products in 1986. The largest price differences are for a number of consumer electronics products for which there were significant import restrictions. The trade restrictions were relaxed in the late 1980s and we observe substantially smaller price differentials between markets in the 1991 data. Our finding that trade policy is the apparent source of price discrimination mirrors the finding by Aw (1993) that US import restrictions in the 1980s were the cause of noncompetitive pricing of Taiwanese footwear exports to the US.

This micro data we analyze provides evidence of substantial firm-level price heterogeneity in narrowly-defined product markets. This within-market variation, which is likely to reflect differences in product attributes or quality across firms, is several times larger than the across-market variation which is the focus of price discrimination tests. It indicates the danger of using price data aggregated over firms, as virtually all studies do, to draw inferences about the competitiveness of domestic and export markets.

Finally, the empirical results do provide support for the argument that Taiwanese producers benefitted from trade policies that raised domestic prices (Mody, 1990, 1993). If firms operate in both the domestic and export market, cross subsidization of export market entry costs through protection and higher profits in the domestic market provides one rationale for the domestic protection. While this may have been a consideration in the early years of the electronics industry expansion, the domestic market protection was relatively short lived, and its effects on the domestic price dissipated after its removal. Import protection can most effectively raise domestic prices, thereby shielding domestic producers from foreign competition, only if other domestic firms do not enter and compete away the rents that accrue to existing domestic producers. In the Taiwanese electronics industry there was substantial entry during the 1980s. Aw et al. (1997, Tables 1 and 2) report that the number of firms in the two-digit electrical machinery and electronics industry increased by 150% between 1981 and 1991 and, in 1991, firms that entered the industry after 1981 accounted for 58% of industry production.

Therefore, as a policy tool for export promotion, domestic market protection is crude since it mainly provides incentives to specialize in serving the domestic market, and many firms of this type are present in Taiwanese manufacturing. An alternative strategy for export promotion, which has also been pursued in Taiwan,

is to reduce the sunk costs which new firms must incur when entering the export market. The well-developed network of trading firms, which acts to facilitate information flows between manufacturers and foreign buyers, can lower entry costs (Levy, 1991). This in turn will result in higher rates of entry and more rapid exit of inefficient producers from the export market.[24] This, more than domestic market protection, is likely to encourage the entry and expansion of efficient producers and lowering of output prices in the export market.

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References

Athukorala, P., Menon, J., 1994. Pricing to market behaviour and exchange rate pass-through in Japanese markets. Economic Journal 104, 271–281.

Aw, B.Y., 1992. An empirical model of mark-ups in a quality differentiated export market. Journal of International Economics 33 (3–4), 327–344.

Aw, B.Y., 1993. Price discrimination and markups in export markets. Journal of Development Economics 42, 315–336.

Aw, B.Y., Hwang, A., 1995. Productivity and the export market: A firm-level analysis. Journal of Development Economics 47, 313–332.

Aw, B.Y., Chen, X., Roberts, M.J., 1997. Firm-level evidence on productivity differentials, and turnover in Taiwanese manufacturing. NBER Working Paper 6235, Cambridge, MA.

Aw, B.Y., Chung, S., Roberts, M.J., 2000. Productivity and turnover in the export market: micro evidence from Taiwan and South Korea. The World Bank Economic Review 14 (1), 65–90.

Bernstein, J.I., 1994. Exports, margins and productivity growth: With an application to the Canadian softwood lumber industry. Review of Economics and Statistics 76, 291–301.

Bernard, A.B., Jensen, J.B., 1995. Exporters, jobs, and wages in US manufacturing, 1976–1987. Brookings Papers on Economic Activity-Micro, pp. 67–112.

Bresnahan, T., 1989. Empirical studies of industries with market power. In: Schmalensee, R., Willig, R. (Eds.), Handbook of Industrial Organization. North-Holland, Amsterdam.

Clerides, S., Lach, S., Tybout, J., 1998. Is learning-by-Exporting important? micro-dynamic evidence from Colombia, Mexico and Morocco. Quarterly Journal of Economics 113 (3), 903–947.

Committee on Foreign Affairs, 1987. US Trade Relations with Asia. US Government Printing Office, Washington, D.C.

Council of Economic Planning and Development, 1993. Industry of Free China, Vol. LXXXIX, No. 3. Executive Yuan, Republic of China.

Dahlman, C.J., 1993. Electronics development strategy: The role of government. In: Wellenues, B., Miller, A., Dahlman, C.J. (Eds.), Developing the Electronics Industry. The World Bank, Washington, D.C.

[24] Aw et al. (1997) provide evidence of high turnover rates among firms in the export market but very high levels of total factor productivity among the survivors.

Dale, R., 1980. Antidumping Law in A Liberal Trade Order. St. Martin's Press, New York.
Das, S.P., Mohanty, A.K., 1984. Dumping in international markets and welfare. Journal of International Economics 17, 149–157.
Ethier, W.J., 1982. Dumping. Journal of Political Economy 90, 487–506.
Feenstra, R., 1989. Symmetric pass-through of tariffs and exchange rates under imperfect competition: an empirical test. Journal of International Economics 27, 25–46.
Goldberg, P., Knetter, M., 1997. Goods price and exchange rates: what have we learned? Journal of Economic Literature 35, 1243–1272.
Gruensprecht, H.K., 1988. Dumping and dynamic competition. Journal of International Economics 25, 225–248.
Hooper, P., Mann, C.L., 1989. Exchange rate pass-through in the 1980s: The case of US imports of manufactures. Brookings Papers on Economic Activity 1, 297–337.
Inspectorate General of Customs, 1986, 1991. Customs Import tariff of the Republic of China. Taipei.
Isard, P., 1977. How far can we push the law of one price? American Economic Review 67, 942–948.
Knetter, M.M., 1989. Price discrimination by US and German exporters. American Economic Review 79 (1), 198–210.
Knetter, M.M., 1993. International comparisons of pricing-to-market behaviour. American Economic Review 83, 473–486.
Kravis, I.B., Lipsey, R.E., 1971. Price Competitiveness in World Trade. Columbia University Press (for National Bureau of Economic Research), New York.
Kravis, I.B., Lipsey, R.E., 1977. Export prices and the transmission of inflation. American Economic Review, 155–163.
Leamer, E.E., Stern, R.E., Stern, 1970. Quanitative International Economics. Allyn and Bacon, Boston.
Levy, B., 1991. Transactions costs, the size of firms and industrial policy. Journal of Development Economics 34, 151–178.
Lipsey, R.E., Molinari, L., Kravis, I.B, 1991. Measuring prices and price competitiveness in international trade in manufactured goods. In: Hooper, P., Richardson, J.D. (Eds.), International Economic Transactions: Issues in Measurement and Empirical Research. University of Chicago Press, Chicago and London.
Lloyd, P. J., 1977. Anti-dumping actions and the GATT system. Thames Essay No. 9. Trade Policy Research Centre, London.
Marston, R.C., 1990. Pricing to market in Japanese manufacturing. Journal of International Economics 29, 217–236.
Mody, A., 1990. Institutions and dynamic comparative advantage: The electronics industry in South Korea and Taiwan. Cambridge Journal of Economics 14, 291–314.
Mody, A., 1993. Alternative strategies for developing information industries. In: Wellenius, B., Miller, A., Dahlman, C. (Eds.), Developing the Electronics Industry. The World Bank, Washington, D.C.
Ohno, K., 1989. Export pricing behavior of manufacturing a US-Japan comparison. IMF Staff Papers 36 (3), 550–579.
Pack, H., 1992. New perspectives on industrial growth in Taiwan. In: Ranis, G. (Ed.), Taiwan: From Developing To Mature Economy. Westview Press, Boulder, Colorado.
Richardson, J.D., 1978. Commodity arbitrage and the law of one price. Journal of International Economics 8 (2), 341–351.
Viner, J., 1923. Dumping: A problem in international trade. University of Chicago Press, Chicago.
Wade, R., 1990. Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization. Princeton University Press, Princeton.
The World Bank, 1994. East Asia's Trade and Investment. The World Bank, Washington, D.C.