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Emprical investigation on the predictions of the Heterogeneous Firms Trade models

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Key words: NAFTA, Exports Diversificaion

JEL Classification: F14, F15

INTRODUCTION

Since 1960s, especially after the Prebisch-Singer hypothesis of terms of trade deterioration, policy makers of developing countries have been aiming for export diversification. Several Asian countries, such as South Korea or Taiwan, showed examples of remarkable export-led growth. Some economists show the association between the degree of export diversification and economic growth. For example, Sachs and Warner (1995), using cross-sectional data, suggests the association between low export diversification and slow growth.[1] However, despite the policy makers' quest for export diversification, trade economists did not pay much attention to the issue, mainly because the classical trade theories tell the virtue of

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1 More recently, using diaggregated panel data, Imbs and Wacziarg (2003), Klinger and Lederman (2004) and Cadot et al. (2007) show that poor countries tend to have lower degree of export diversification.

specialisation into products in which countries have comparative advantage, not *diversification*. It is the theoretical breakthrough by Melitz (2003) which opened the door to a rapid increase of research on export diversification. The model is often called in the literature as the Heterogeneous Firms Trade (HFT) model.

Melitz (2003) incorporates the endogenous selection of heterogeneous firms of Hopenhayn (1992) into Krugman (1980)'s model of trade under increasing returns and monopolistic competition. It shows that trade barrier reductions allow non-exporting-firms due to low productivity to become exporters after the trade liberalisation.[2] In Melitz (2003) model, a firm draws its productivity from a given distribution.[3] A lucky firm, which has drawn high productivity will be active both in domestic and export market. An unlucky firm, which ended up with low productivity will exit from the market after having paid a fixed cost of the invention of its product. Firms with productivity in middle range will serve only the domestic market. The borders among these three types of firms are determined by the two cut-off productivity conditions. Trade liberalisation lowers the cut-off productivity point for export and consequently leads to a higher number of export varieties.[4]

If the HFT model well describes the international trade, we should observe an acceleration of the number of exported products shortly after the trade liberalisation. As Mexico experienced a rapid and large trade liberalisation through the formation of NAFTA (North American Free Trade Agreement), Mexico's export is a very good example to see if an increase in the number of exported goods ensued a trade liberalisation. Moreover, we can use US trade data, which keeps the world's most disaggregated trade data at the 10-digit level to analyze Mexico's export because the US is the Mexico's dominant export destination. The first focus point of this paper is an examination of NAFTA's effect on the number of exported products of Mexico. It shows a rapid increase of the number of exported goods from Mexico to the US shortly after NAFTA became effective, using 10-digit HS (Harmonised System) code of US imports from 1989 to 2001.[5] The paper also shows that the proportions of the trade values accounted by new goods, which is called 'extensive margins' in the literature, vary substantially across industries and that those industries which experienced a higher export growth tend to have higher extensive margin ratios.[6]

While the HFT model have been shown to well explain the international trade by many studies, one stylized fact which goes at odds with the prediction of the HFT is a rising price-distant link, i.e., FOB (or ex-factory) prices tend to be higher for further destinations. US export FOB price of a product to Japan, for example, is higher than the US export price of the same product to France. Baldwin and Harrigan (2007) shows a large positive effect of distance on unit values, using US export data in 2005. Having been motivated to explain this stylized fact, Baldwin and Harridan (2007) have incorporated quality difference across firms

2 For details, see Melitz (2003) or Baldwin (2006).

3 Melitz (2003) assumes a general probability density function which is skewed toward low productivity. However, the model can better be understood, assuming Pareto distribution as Baldwin (2006) explains. In industrial economics, Pareto distribution is shown to well represent the distribution of firm productivity within an industry.

4 Although the focus of this paper is the change in the number of exported products, the emphasis of Melitz (2003) is on the change of the average industry productivity. The selection process, i.e. firms' exit from the markets due to higher competition leads to ex-post higher average industry productivity.

5 HS10 digit is the most disaggregated trade data available in the world.

6 Trade values which are accounted by existing or 'old' goods are called intensive margins.

into the HFT model, which we call the Quality Heterogeneous Firm Trade (QHFT) model. Although the original motivation of the QHFT model is the above mentioned stylized fact, there is another prediction of the QHFT model, which also contrasts with that of the HFT model. While, in the framework of the HFT model, the average price of 'new' goods must be higher than those of 'old' goods because lower productivity (i.e. higher cost) firms join the export market after the trade liberalisation, the QHFT model's prediction is opposite. In the QHFT model, the 'new' goods must fetch lower price than the 'old' goods, since newly exported goods are lower quality goods. The second focus of this paper concerns these opposing predictions of the two models. The essential idea of a simple test this paper proposes is the following. Using the information of FOB prices, we can rank HS 6-digit product codes by the degree of quality competition. The HS 6-digit code products which have higher FOB price gaps for two differently distanced destinations are higher quality goods according to the QHFT model. We match this ranking with the ranking of price gaps between 'old' and 'new' products within each HS 6-digit product code, expecting a correlation between the two.

Literature Review

One of the early papers which deal with the extensive and intensive margins is Helpman, Melitz and Rubinstein (HMR) (2008). It develops a-theory-based gravity model of trade which predicts *positive as well as zero trade flows* across pairs of countries. Using total trade value data of 158 countries in 1986, HMR shows that among 24,806 possible bilateral export relationships, only 11,146 pairs have non-zero exports. More importantly, HMR finds that the usual gravity equation variables also affect the *probability* of bilateral export relationship. While HMR studies the export relationship between country pairs, extensive margins by *product groups* between a set of countries are examined by others. The extensive margins of Mexico's exports to the US by products, an issue dealt with in this paper, is the subject of Feenstra and Kee (2007). Using HS 10-digit US import data, it shows that Mexico's export to the US experienced a substantial increase in the extensive margins, but it is hampered by China's export to the US. Although not for the case of NAFTA, FTAs' effects on the evolution of the number of zeros, the first question this paper addresses, is examined, for example, by Amurgo Pacheco (2006) for the case of Mediterranean countries. Using HS 6-digit data, it finds a large decrease in the number of zeros in the exports of Mediterranean countries to the EU from 1994, almost at the same timing with the Barcelona declaration, which paved the way toward free trade areas between Mediterranean countries and the EU.

Plan of paper

Section 1 summarizes the prediction of the HFT model and the QHFT model. Section 2 analyzes the evolution of zeros and extensive margins at the HS 10-digit level of US imports data. Econometric analyses are in Section 3. Section 4 studies which model (HFT or QHFT)'s prediction on unit price evolution fits better the data. The final section concludes.

1. THEORETICAL FRAMEWORK

We briefly summarize the mechanism of the HFT model and the QHFT model to provide a backbone for the subsequent empirical analysis. The exposition here draws on Baldwin (2006), Baldwin and Harrigan (2007).

1.1. HFT model

The basic set-up is the same with Krugman (1980). Two symmetric nations are endowed with a single production factor, labour. A single sector produces differentiated goods. Each firm

makes a single variety subject to increasing returns to scale technology. Consumers have CES preferences over all varieties.

$$U = \left(\int_{i=0}^{n} (c_i)^{1-1/\sigma} di \right)^{\frac{1}{1-1/\sigma}} \quad ; \sigma > 1 \qquad (1)$$

As in Dixit-Stiglitz (1977), there are a large number of firms, thus each firm ignores the impact of its own decision to the market. Trade is subject to iceberg trade costs, namely, 1+t units must be shipped to deliver 1 unit of goods. Then, the demand function facing the typical firm-j, its optimal pricing rule and the operating profit are, respectively,

$$c_j = p_j^{-\sigma} \frac{E}{P^{1-\sigma}} \qquad (2)$$

$$p_j(1-1/\sigma) = a_j \qquad (3)$$

$$\pi_j = \left(\frac{p_j}{P} \right)^{1-\sigma} \frac{E}{\sigma} \qquad (4)$$

$$\text{where} \quad P = \left(\int_{i=0}^{n} p_i^{1-\sigma} di \right)^{1/(1-\sigma)} \qquad (5)$$

The HFT model incorporates firm heterogeneity in the marginal cost, a. The marginal cost of each firm is assumed to be assigned randomly from a known distribution function. The HFT model usually assumes Pareto distribution[7], i.e.:

$$G[a] = \frac{a^k}{a_0^k}, \qquad 0 \le a \le a_0 \qquad (6)$$

Here, a_0 is the maximum marginal cost and k is the shape parameter of the Pareto distribution. The Figure 1 illustrates the distribution of a's and prices. The proportion of low marginal cost firms is small while there are many high marginal cost firms. G[a] is the cumulative density function (CDF) of the marginal costs. nG[a] represents the CDF of varieties because there are 'n' firms with each 'a'. The marginal firm which can sell in the domestic market just breaks even, i.e., the operating profit is equal to the beachhead cost for the domestic market. Thus, the cut-off condition is:

$$\left(\frac{a_D}{1-1/\sigma} \right)^{1-\sigma} \left(\frac{E}{\sigma P^{1-\sigma}} \right) = F_D \qquad (7)$$

Similarly, for the export market,

$$\phi \left(\frac{a_X}{1-1/\sigma} \right)^{1-\sigma} \left(\frac{E}{\sigma P^{1-\sigma}} \right) = F_X \qquad (8)$$

The per-firm operating profit (the equation (1)) can be worked out once we know the CES price index *P* under the above asymmetric marginal cost distribution. The CES price index is the integral over prices raised to the power of 1-σ. So,

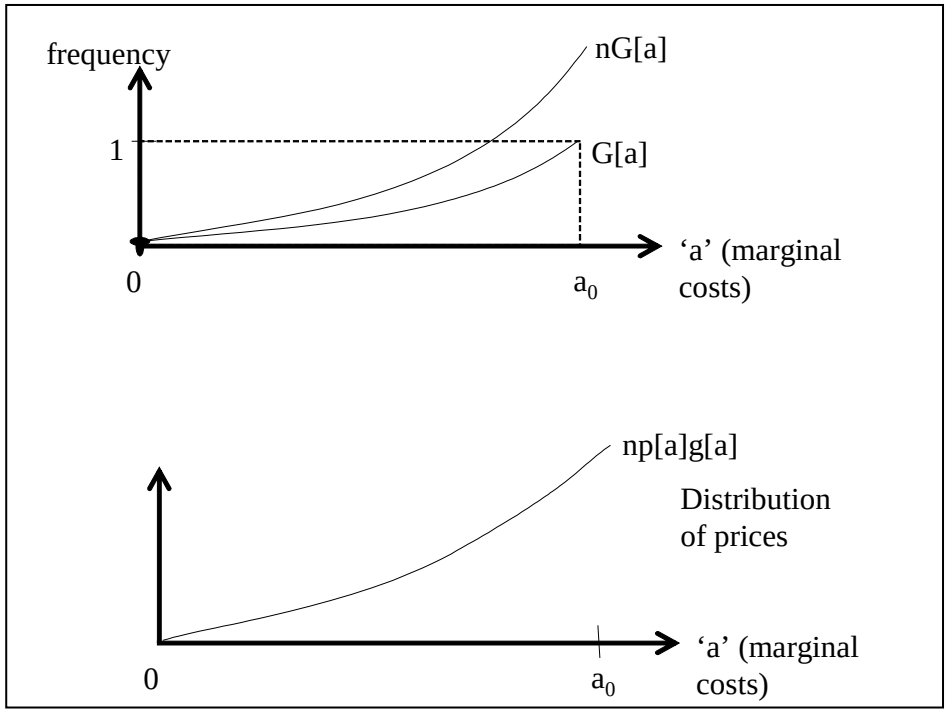
7 Melitz (2003) assumes a more general distribution function.

$$P = \left(\int_0^{a_o} ((\frac{a_i}{1-1/\sigma})^{1-\sigma}) n g[a] da \right)^{1/(1-\sigma)} \quad where \qquad g[a] = k \frac{a^{k-1}}{a_o^k} \tag{9}$$

Solving the integral and assuming the regularity condition 1-σ+k>0, we get:

$$P = \left((\frac{a_o^{1-\sigma}}{(1-1/\sigma)^{(1-\sigma)}}) \frac{nk}{1-\sigma+k} \right)^{1/(1-\sigma)} \tag{10}$$

Figure 1: Distribution of marginal costs



Substituting this CES price index to the typical firm's operating profit yields:

$$\pi_j = (1 + \frac{1-\sigma}{k}) \left(\frac{a_j}{a_o} \right)^{1-\sigma} (\frac{E}{n\sigma}) \tag{11}$$

Low marginal cost firms are large firms, i.e. earning higher operating profits. In this model, *expected* pure profits are zeros. But ex-post, lucky firms who have drawn low marginal costs enjoy higher profits while unlucky firms find that they cannot recuperate the cost they incurred, F_I, for the invention of a new variety and decide not to enter the market.

Adding two different market entry costs, or so called 'beachhead costs' for the domestic market and export market, F_D and F_X, respectively, the free entry conditions and the cut-off conditions yield the equilibrium cut-off marginal costs:

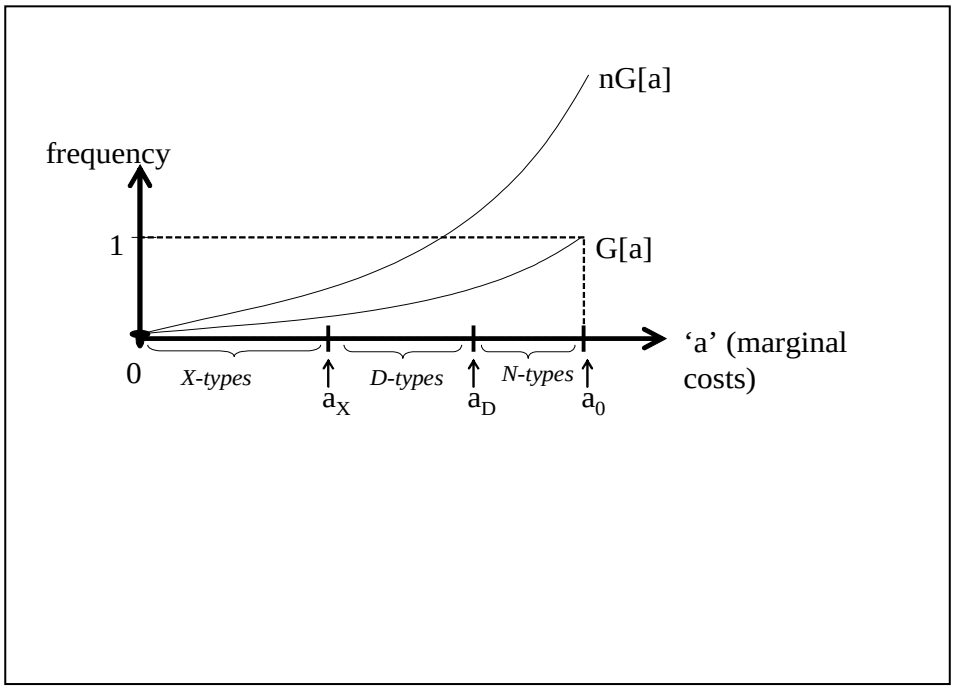
$$a_D = a_o\left(\frac{(\beta-1)F_I}{(1+\Omega)F_D}\right)^{1/k}, \qquad a_X = a_o\left(\frac{\Omega(\beta-1)F_I}{(1+\Omega)F_X}\right)^{1/k} \tag{12}$$

$$\text{where } \beta \equiv \frac{k}{\sigma-1} > 1, \qquad \Omega \equiv \phi^{\beta}(F_X / F_D)^{1-\beta}$$

The variable Ω represents openness. When the trade freeness $\phi = (1+t)^{1-\sigma}$ rises, a_X goes up. Firms which were not able to export can export after trade liberalisation. On the other hand, a_D goes down, i.e. firms which were close to the border-line productivity level are forced to exit the market due to competition with foreign firms. The Figure 2 illustrates the three types of firms, X-types: firms servicing both of the domestic market and the export market, D-types: firms selling only in the domestic market, and N-types: firms which decide to exit the market because of the high marginal cost they have drawn.

In the framework of this model, trade liberalisation leads to a higher number of firms (products) being engaged in the export activity. Thus, the formation of NAFTA should have a positive effect on the number of exported goods. In terms of prices, the average export price must rise after the trade liberalisation, because higher marginal cost firms go into the export market. Due to the constant mark up pricing, those firms charge higher prices than the traditional exporters.

Figure 2: Cut-off points



1.2. QHFT model

In the QHFT model, consumers appreciate both the quantities and the qualities of goods, thus have CES preferences:

$$U = \left(\int_{i=0}^{n} (c_i q_i)^{1-1/\sigma}\, di\right)^{\frac{1}{1-1/\sigma}} \quad ;\sigma > 1 \tag{13}$$

where c and q represents consumption quantity and quality. The good-j firm's revenue is:

$$p_j c_j = \left(\frac{p_j}{q_j}\right)^{1-\sigma} \frac{E}{P^{1-\sigma}}; \qquad P \equiv \left(\int_{i=0}^{n} \left(\frac{p_i}{q_i}\right)^{1-\sigma} di\right)^{\frac{1}{1-1/\sigma}} \tag{14}$$

where $\frac{p_j}{q_j}$ is the quality-adjusted price of good-j.

Quality is assumed to be linked to marginal cost:

$$q_i = \left(a_j\right)^{1+\theta}; \qquad \theta > -1 \tag{15}$$

Assumed distribution of a is

$$G[a] = 1 - \left(\frac{a_0}{a}\right)^k; \qquad a_0 < a \tag{16}$$

Contrary to the HFT model's assumption of a's distribution, there is a small number of high marginal cost (i.e. high quality) firms and a large number of low marginal (low quality) firms. The cut-off condition is:

$$\phi\left(\frac{a_X^{-\theta}}{1-1/\sigma}\right)^{1-\sigma}\left(\frac{E}{\sigma P^{1-\sigma}}\right) = F_X \tag{17}$$

The difference with the HFT model is –θ. The HFT model is the case when θ=-1. Assuming θ>0, meaning an increase in marginal cost is accompanied by an even higher increase in quality, a rise in ϕ, i.e., a higher trade liberalisation leads to a lower cut-off marginal cost. When trade liberalisation takes place, lower quality (lower marginal cost) goes into the export market. Thus, the number of exported goods rises, which is the same prediction with the HFT model. However, in contrast with the HFT model, in the QHFT model the price of 'new' products will be lower than the already exported 'old' goods,

2. THE EVOLUTION OF ZEROS AND THE EXTENSIVE MARGINS

Recent studies on the exports of new goods show that there is a very large number of zeros in trade matrix. Baldwin & Harrigan (2007) says: 'The United States imported in nearly 17,000 different 10-digit HTS categories from 228 countries, for a total of over 3.8 million potential trade flows. Over 90% of these potential trade flows are zeros. Hummels and Klenow (2005) show that 60 percent of the greater export of larger economies in their sample of 126 countries is due to the increase of the number of exported products.

Mexico is the third largest import partner for the US in the period of 1989-2001. For Mexico, the US is, by far, the largest trade partner both in imports and exports. The share of the US in Mexico's exports has steadily increased and reached 89% in 2001. We analyze Mexico's exports, using import data of the US since the US keeps record of its trade at the most disaggregated level of classification, namely HS 10-digit codes, and makes them publicly

available[8]. The export data from Mexican side is only available at 6-digit, which does not capture well the export of 'new' products. Although the 10- digit is still not perfect to represent the 'new' goods exports, it can reflect the tendency of new goods exports. The data is from Feenstra (2004) US import data, which covers the years from 1989 to 2001. The HS 10-digit codes during this period have, in total, 22,758 items.[9] Table 1 shows the evolution of the number of *zeros* in US imports from the top 20 import partners plus Colombia and Chile. The order of the countries in the table represents the ranking of exports into the US, except Colombia (ranked 29) and Chile (ranked 40)[10]. Mexico ranks the number three next to Canada and Japan. There were 17,045 zeros in 1989. The number went down to 14,190 in 2001. The last row in the table shows the number of reduction in zeros during the period. The number for Mexico, 2855, comes next to China, a rapidly expanding huge country, which is increasing its export to all over the world. In that sense, China can be considered as an exceptional case. Mexico had more zeros, or non-exported items, than Korea and Taiwan in 1989. In 2001, the number of zeros for Mexico became less than the numbers of zeros for Korea and Taiwan. Mexico surpassed Korea and Taiwan in terms of its export varieties into the US market.

Since the absolute numbers of zeros at the initial year of the time series, namely 1989, varies much across countries, we have indexed the number of zeros of each year, taking the number in 1994 as the base (=1) for the purpose of comparison across countries. The result is in Figure 3. The imports from China underwent the largest decrease of zeros during the period and Mexico is the second, being followed by Canada. But the imports from Mexico registered the most rapid decrease of the number of zeros during the period of 1994-1997, shortly after the formation of NAFTA. The number stayed almost at the same level after 1997.

While the evolution of zeros describes the change in the *number* of exported items, we need to analyse the trade *values* of these new products to see the impact of 'new' export goods in the total export *values*. Defining the 'new' goods as those goods which were not exported pre-NAFTA (1989-1993) but had a positive record post-NAFTA (1994-2001), the ratio of 'new' export goods value among the total export value from Mexico to the US in the period of 1994-2001 was 35.7%. Namely, 35.7% of Mexico's export value to the US is accounted by the 'new' goods.

8 US import data is from Foreign Trade Statistics, US Census Bureau

9 This number differs from the above mentioned 'nearly 17,000' of Baldwin & Harrigan (2007) since they count the categories which registered a positive import value at least from one country in a single year. Here, 22758 is the number of HS10 digit categories which had imports from at least one country during the period of 1989-2001.

10 We have included Colombia and Chile as good candidates for comparison with Mexico since both are Latin American countries and their economic sizes are not far from that of Mexico.

Table 1: The number of zeros in US imports from the 20 largest import partners plus Colombia and Chile

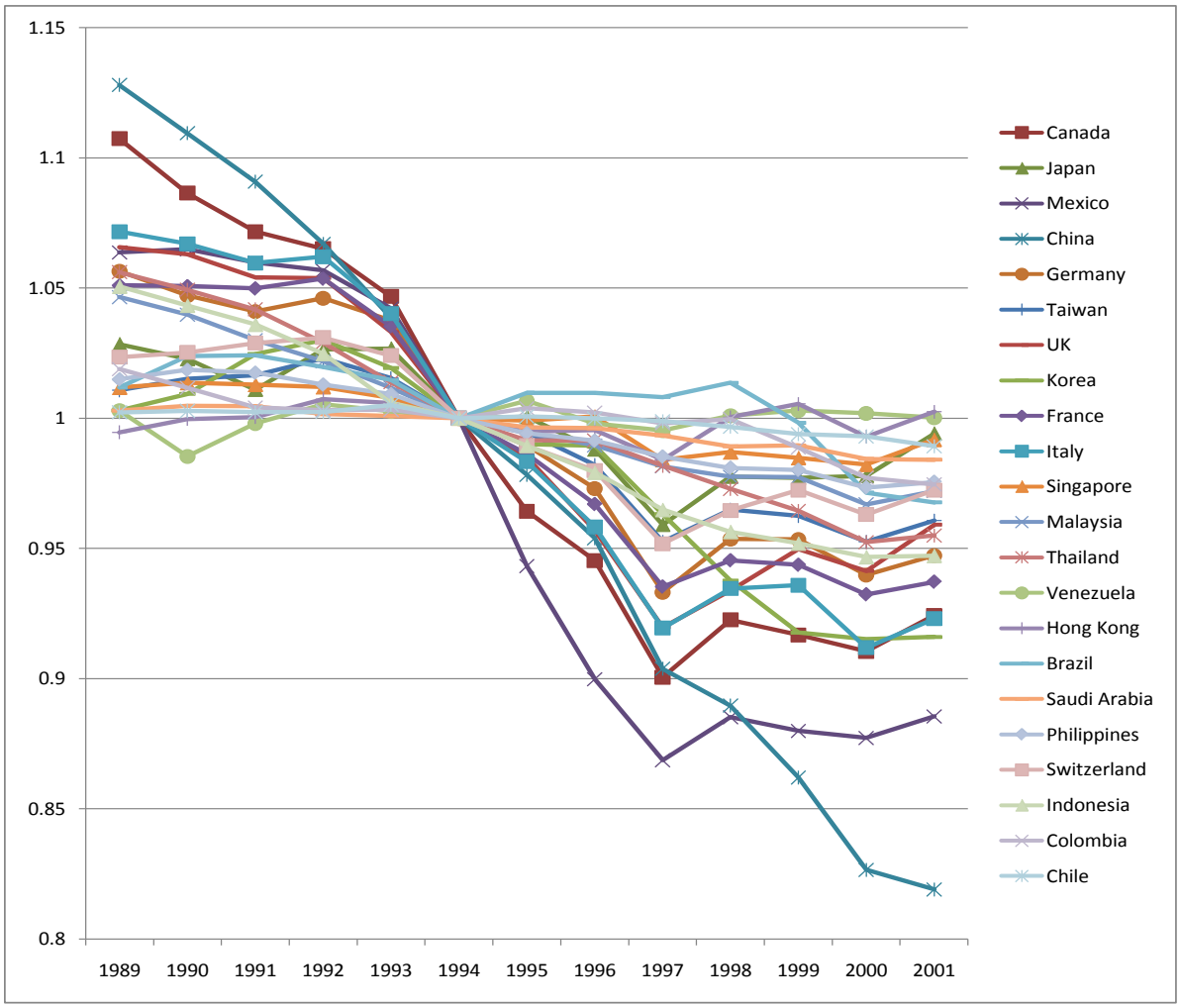
Number of zeros **US import partner Top 20 plus Colombia and Chile**

year	Canada	Japan	Mexico	China	Germany	Taiwan	UK	Korea	France	Italy
1989	13119	13688	17045	17138	13540	15799	13824	16894	14541	14749
1990	12871	13613	17064	16858	13421	15866	13788	17001	14537	14685
1991	12696	13456	16983	16574	13341	15887	13673	17260	14525	14583
1992	12618	13661	16934	16212	13407	15989	13671	17350	14577	14616
1993	12401	13666	16701	15782	13297	15872	13403	17169	14324	14316
1994	11847	13310	16024	15194	12816	15630	12973	16843	13835	13763
1995	11424	13317	15116	14865	12683	15548	12779	16677	13645	13534
1996	11200	13151	14418	14495	12471	15350	12415	16665	13379	13189
1997	10669	12766	13920	13733	11960	14889	11932	16223	12940	12654
1998	10930	13012	14185	13518	12223	15081	12115	15793	13080	12864
1999	10862	13005	14101	13100	12220	15043	12322	15456	13056	12881
2000	10787	13016	14057	12561	12044	14890	12212	15414	12899	12551
2001	10950	13232	14190	12446	12141	15017	12443	15429	12966	12704
Change 1989-2001	-2169	-456	-2855	-4692	-1399	-782	-1381	-1465	-1575	-2045

Singapore	Malaysia	Thailand	Venezuela	Hong Kong	Brazil	Saudi Arabia	Philippines	Switzerland	Indonesia	Colombia	Chile
20103	20922	19844	21393	17319	18837	22529	20289	17079	21148	21302	21616
20139	20786	19717	21018	17408	19062	22569	20362	17110	21001	21151	21627
20125	20591	19576	21287	17421	19067	22567	20340	17169	20854	20993	21617
20107	20429	19336	21445	17540	18984	22499	20249	17205	20628	20971	21618
20023	20226	19050	21386	17514	18891	22482	20175	17090	20249	20974	21677
19868	19992	18790	21330	17413	18618	22462	19991	16688	20130	20907	21567
19850	19877	18632	21473	17324	18800	22384	19875	16513	19918	20988	21582
19883	19783	18630	21288	17335	18799	22376	19818	16353	19711	20953	21565
19551	19622	18448	21229	17136	18769	22314	19696	15884	19423	20867	21542
19610	19543	18281	21351	17420	18872	22219	19610	16098	19253	20901	21495
19567	19541	18122	21394	17509	18586	22228	19594	16227	19163	20672	21435
19515	19331	17897	21372	17291	18086	22111	19459	16071	19058	20430	21415
19705	19433	17945	21336	17457	18016	22105	19502	16227	19068	20376	21335
-398	-1489	-1899	-57	138	-821	-424	-787	-852	-2080	-926	-281

Source: Author's calculation based on US import data at HS10 digit

Figure 3: The evolution of zeros in US imports from the 20 largest import partners plus Colombia and Chile



Source: Author's calculation based on US import data at HS10 digit

Zeros and the extensive margins by industry

The evolution of zeros may be highly heterogeneous across industries. The manufacturing sector has a higher number of varieties than mining sector, for example. Even within the manufacturing sector, industries differ in their number of varieties.

Table 2 shows the evolution of zeros by ISIC Revision2 3-digit manufacturing industries. Absolute levels of zeros vary substantially across industries. Textiles, Apparel, Industrial chemicals and Machinery have large numbers of zeros in 1989 and these industries underwent the largest decrease of zeros in absolute numbers during the period of the analysis.

In order to see the impact of new goods' exports in *values*, I define those goods which were not exported before NAFTA but exported after NAFTA as new goods' exports. The sum of the new goods' exports values within a particular industy code gives "extensive margin". Dividing the "extensive margin" values by the total values of exports during the whole period (1989-2001) gives "extensive margin ratio". Thus, the extensive margin ratios are the proportions of new goods' exports out of the total exports values for a particular industry. Figure 4 shows the extensive margin ratios by industry. As in the case of the *numbers* of

zeros, they vary substantially different across industries. Furniture (332), Rubber (355), Plastics (356), Machinery except electric (382), Machinery, electric (383) have a large extensive margin ratio.

Figure 5 plots the growth of Mexico's export value to the US from before-NAFTA to after-NAFTA and the extensive margin ratios by industries. The industries which have had higher export value growth seem to have registered higher extensive margin ratios.[11] P-value of the regression shows 0.081, so at least significant at 10% level.

Table 2: Mexico's export to the US, Evolution of zeros by industry

Evolution of zeros by Industry Mexico's exports to the US.

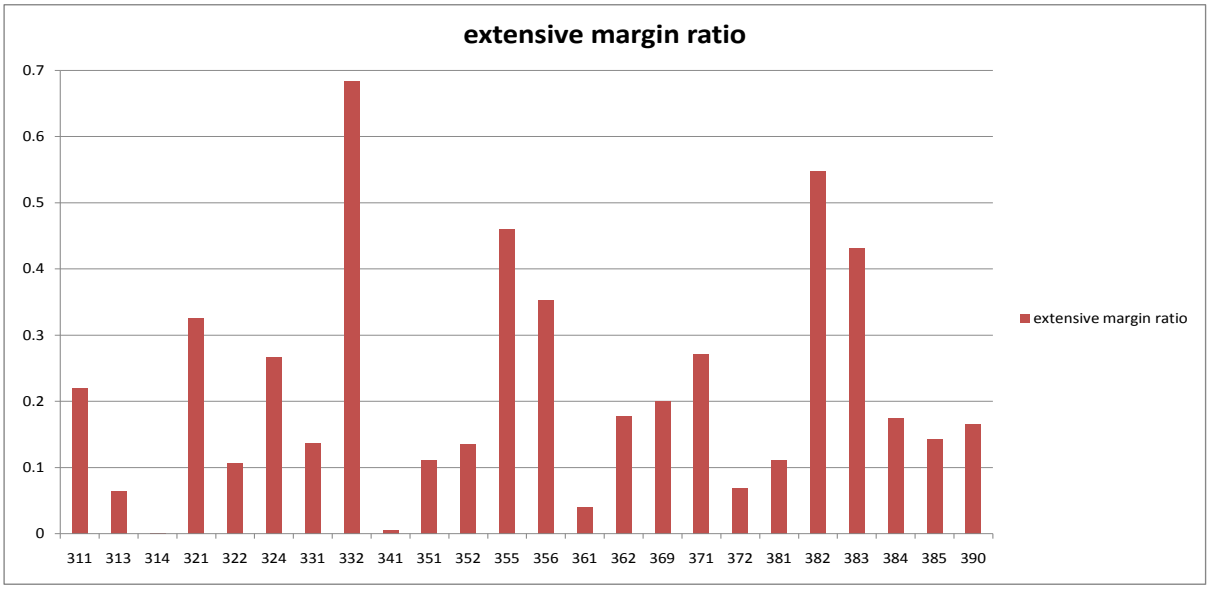
	Food products	Beverages	Tobacco	Textiles	Wearing apparel, except footwear	Footwear, except rubber or plastic	Wood products, except furniture	Furniture and fixtures, except primarily of metal	Paper and products	Industrial chemicals	Other chemicals	Rubber products
year	311	313	314	321	322	324	331	332	341	351	352	355
1989	530	50	9	1226	1203	131	199	62	94	862	201	101
1990	556	52	10	1213	1241	141	218	49	122	839	201	90
1991	562	56	10	1193	1206	136	215	45	106	829	185	92
1992	552	56	10	1188	1186	129	215	50	104	811	182	84
1993	536	51	10	1150	1217	112	211	50	114	788	193	88
1994	509	49	9	1096	1058	122	205	44	121	781	184	75
1995	469	50	10	910	908	102	161	38	101	739	174	71
1996	419	48	10	829	763	90	151	36	90	734	159	62
1997	398	47	7	833	710	80	150	37	87	675	155	57
1998	408	49	9	764	764	90	171	36	90	679	153	58
1999	417	51	7	688	727	81	166	37	95	695	157	56
2000	414	49	7	713	714	86	167	31	100	705	158	54
2001	385	42	10	735	765	108	174	37	89	687	173	56
Change 1989-2001	145	8	-1	491	438	23	25	25	5	175	28	45

Plastic products	Pottery, china, earthenware	Glass and products	Other non-metallic mineral products	Iron and steel	Non-ferrous metals	Fabricated metal products	Machinery, except electrical	Machinery, electric	Transport equipment	Professional and scientific equipment	Other manufactured products
356	361	362	369	371	372	381	382	383	384	385	390
177	30	89	52	638	166	329	1166	961	350	301	252
177	33	91	50	652	171	326	1150	952	348	277	249
177	31	86	57	662	177	336	1140	945	353	294	254
176	31	87	54	674	167	322	1158	931	359	295	259
166	33	90	47	633	155	318	1120	922	330	284	243
161	28	81	44	599	141	307	1011	846	289	262	235
157	27	75	39	519	130	270	949	842	266	253	210
125	22	59	34	499	126	228	939	782	253	231	191
117	22	44	41	479	126	201	821	684	246	201	181
115	23	50	37	488	127	220	889	752	238	220	206
126	24	58	36	474	124	228	876	745	228	217	217
124	27	55	36	467	107	217	848	750	227	202	213
125	23	55	39	479	122	223	860	720	244	212	238
52	7	34	13	159	44	106	306	241	106	89	14

Source: Author's calculation based on US import data at HS10 digit

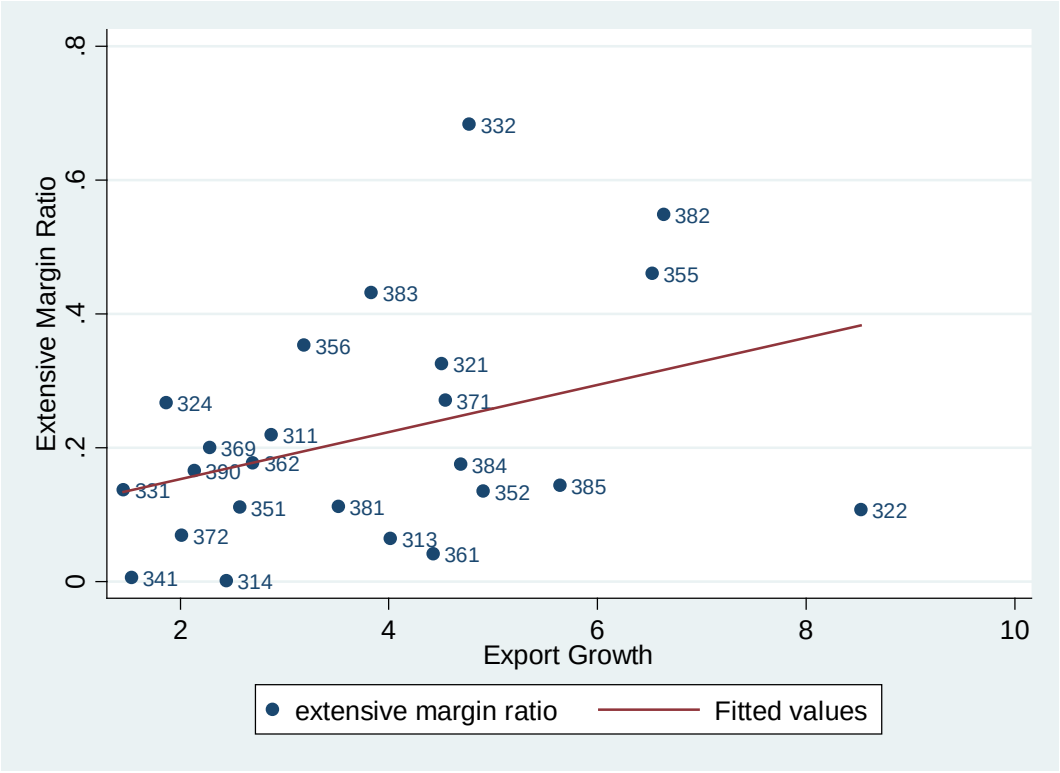
11 Full list of ISIC Revision2 3-digit industry code and name is in Appendix.

Figure 4: Extensive margin ratio by industry



Source: Author's calculation based on US import data at HS10 digit

Figure 5: The growth ratio of Mexico's export to the US and the extensive margin ratio

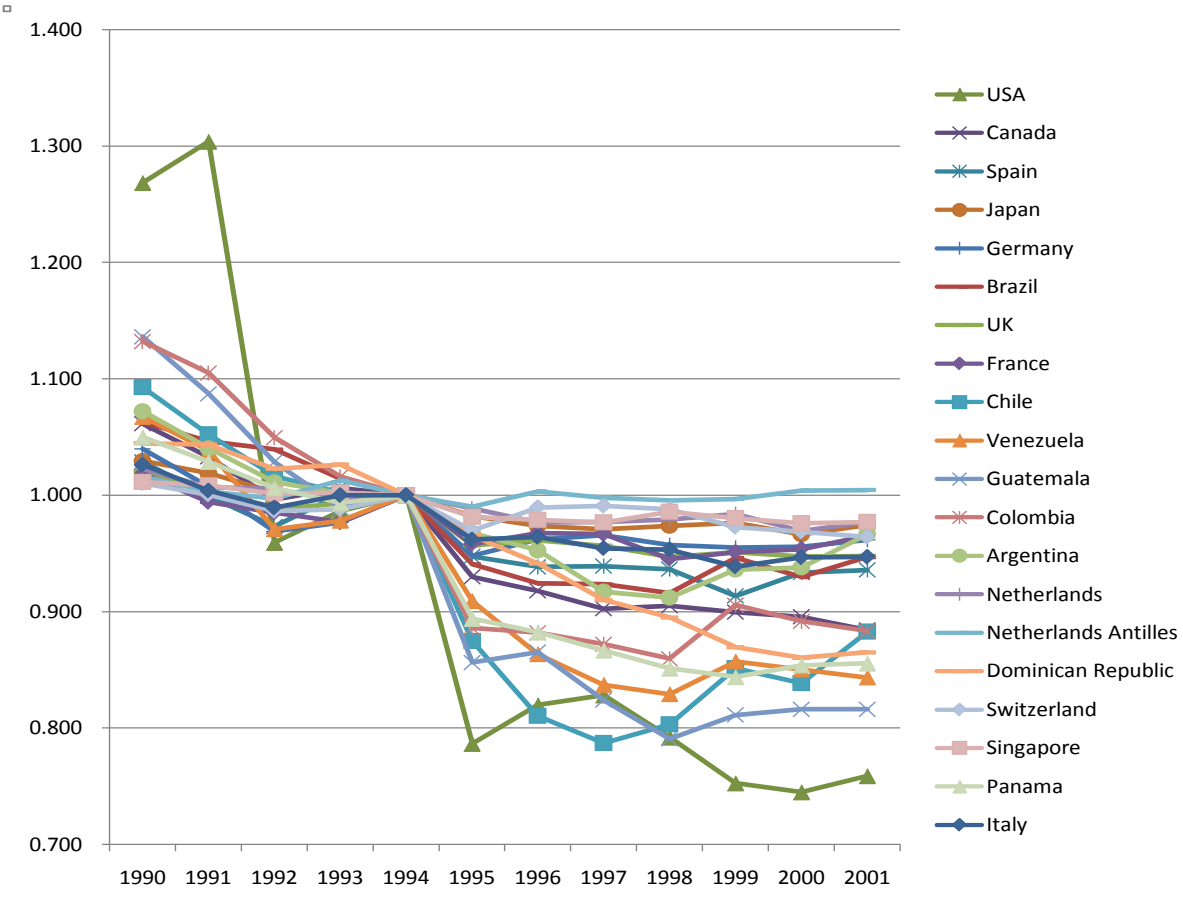


Mexico's exports at HS 6-digit

Although HS 6 digit is probably too broad to capture 'new' goods exports as discussed above and Mexico's export is almost all for the US, it might be useful to see Mexico's export evolution at HS 6-digit level. As we expect, the level of zeros for US market is far smaller

than that for the other export destination. Thus, it does not make much sense to compare evolutions of zeros in *levels*. Instead, Figure 6 shows the evolution of zeros, taking the number of zeros in 1994 as the base (=1). The evolution of the level of zeros is in the Appendix (Table A 1). The number of zeros in Mexico's exports to the US experienced a sharp decrease during the period of 1990-2001 [12]. Another interesting feature is that destinations which had a rapid fall in zeros except the US and Canada are all Latin American countries. This may suggest the role of the US market for export to other new markets. Thanks to the access to the US market by the formation of NAFTA, Mexican firms find it profitable to go into the US market and pays the export related fixed costs. This allows Mexican firms to go into other neighbouring countries. However, an analysis of this issue is beyond the scope of this paper.

Figure 6: The evolution of zeros in Mexico's export to the 20 largest export destinations.



Source: Author's calculation based on Mexico's exports data at HS 6-digit

12 The data are taken from UNCOMTRADE which reports Mexico's data only from 1990 at HS6 digit.

3. ECONOMETRIC ANALYSIS

As a more rigorous test of NAFTA's effect on the evolution of zeros, we conduct an estimation of gravity type Tobit model. The gravity equation is the most frequently used model of trade flow estimations.[13] When we have limited dependent variables as in our data where data are censored at zero, the Ordinary Least Square estimators are biased. Tobit model addresses this problem of biaseness. While it yields asymptotically unbiased coefficient estimates (e.g., 1% increase of destination country GDP is associated with 0.8% increase in export to that country), it also computes the effects of explanatory variables on the *probability of observations being uncensored.* Thus, by using Tobit model, we can find the effect of NAFTA on the probability of exports values being positive (uncensored).We estimate the following simple model of gravity equation by Tobit using HS 10-digit imports from the top ten import partners.[14] The details of the data are described in the Appendix.

$$V_{ijt} = \beta_0 + \beta_1 y_{jt} + \beta_2 NAFTA + \beta_3 t + \beta_4 c$$

where V_{ijt} is the log of US import value of product item i from country j at time t

y_{jt} is the log of GDP at current US dollars of country j at time t

$NAFTA$ is NAFTA/Mexico dummy (It is 1 if country is Mexico and years are 1994-2001. Otherwise, it is 0.

t is time specific effects

c is country specific effects

Usual control variables such as distance, common language, or common borders are captured by country dummies.[15]

The regression results are shown in Table 3. Almost all the coefficient estimates are highly statistically significant. The coefficient estimate on the log of GDP indicates that 1 % increase in GDP of partner (origin) country is associated with 1.229% increase of export values to the US. Also being MEXICO and a member of NAFTA (captured by NAFTA-MEXICO dummy) is associated with approximately 2.064% increase in export values to the US. Look at country dummies, of which reference category is Taiwan.. The dummy for Canada shows a large coefficient estimates, which indicates a large trade effect of Canada-US Free Trade Agreement signed in 1988. The dummy for Mexico shows a negative coefficient estimate. Other factors being controlled, being Mexico has a negative impact compared with the reference category country Taiwan. Thus, the above-mentioned positive large effect of NAFTA further stands out. Year dummies, whose reference category is the year 1995,

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13 The simplest Gravity equation is Ordinary Least Square Regression on basic explanatory variables including GDP, GDP per capita, population, land area, distance, and language. These variables are assumed to predict 'normal' trade patterns between countries. If we add trade bloc dummies, the coefficients pick up the bloc effects. Gravity models have been employed for empirical studies in the international economics literature since the 1960s and have gained theoretical credibility from the late 1980s onwards.

14 Here the regression is conducted for the top 10 import partners since the data with more than 10 countries exceeds the memory of the computers at hand.

15 Using country dummies in place of variables, such as distance, common language, or common borders, to control the effects of all those country-pair variables, is a common practice in the gravity equation trade literature.

indicate that the year effects of US partners' imports were in rising trend, which is in line with a boom of US economy and an associated increase of import values in the 1990s.

As mentioned above, Tobit model also yields the marginal effects, which includes the probability of variables uncensored, the focus of this paper. The column 'Probability uncensored' of Table 3 shows the effect of explanatory variables on the probability of variables being uncensored. The coefficient estimate of MEXICO-NAFTA dummy indicates that Mexico's entry into NAFTA raises the probability of any product to become export products from non-export products by 5.9% with statistical significance of 0.1%. This result can be compared with the finding of Amurgo Pacheco (2006), which shows 6% as the impact of Barcelona declaration on Mediterranean countries' export of 'new' products to the EU.

Table 3: Tobit estimation result

Dependent variable: Log of export values

		Marginal Effects at Observed Censoring Rate		
		Unconditional Expected Value	Conditional on being Uncensored	**Probablity Uncensored**
Log of GDP	1.229***	0.4761	0.3757	0.0355
	(0.0542)			
NAFTA_MEXICO	2.064***	0.7998	0.6310	**0.0597**
	(0.0645)			
Year 1989	-0.832***	−0.3223	−0.2543	−0.0240
	(0.0542)			
Year 1990	-0.918***	−0.3557	−0.2806	−0.0265
	(0.0509)			
Year 1991	-0.927***	−0.3593	−0.2835	−0.0268
	(0.0497)			
Year 1992	-1.035***	−0.4010	−0.3164	−0.0299
	(0.0485)			
Year 1993	-0.723***	−0.2803	−0.2211	−0.0209
	(0.0484)			
Year 1994	-0.325***	−0.1261	−0.0995	−0.0094
	(0.0471)			
Year 1996	0.311***	0.1206	0.0951	0.0090
	(0.0467)			
Year 1997	1.065***	0.4126	0.3255	0.0308
	(0.0475)			
Year 1998	0.929***	0.3600	0.2840	0.0269
	(0.0465)			
Year 1999	0.992***	0.3842	0.3032	0.0287
	(0.0468)			
Year 2000	1.201***	0.4653	0.3671	0.0347
	(0.0469)			
Year 2001	1.047***	0.4056	0.3200	0.0303
	(0.0470)			
Canada	4.114***	1.7766	1.8451	0.4133
	(0.0631)			
China	-0.145**	3.0230	3.1395	0.7033
	(0.0687)			
Germany	1.195***	0.1795	0.1864	0.0418
	(0.120)			
France	-0.0189	0.9330	0.9690	0.2170
	(0.100)			
United Kingdom	1.391***	−0.8191	−0.8507	−0.1906
	(0.0930)			
Italy	0.411***	1.0939	1.1361	0.2545
	(0.0916)			
Japan	-0.172	1.0939	1.1361	0.2545
	(0.156)			
Korea	-2.409***	1.0939	1.1361	0.2545
	(0.0503)			
Mexico	-1.859***	1.0939	1.1361	0.2545
	(0.0638)			
Constant	-36.77***			
	(1.427)			
Observations	2893952			

Standard errors below the coefficient estimates (in parenthesis)

*** p<0.01, ** p<0.05, * p<0.1

The above regression does not include any product specific variables, which might be relevant explanatory variables. Due to the unavailability of product specific variables, one solution is to include product specific dummies. However, creating dummies for about 20 thousand HS 10-digit codes has exceeded the capacity of the computer at hand, I have grouped products into HS 2-digit and created dummies. The regression result is in Table 4. There is practically no change in estimation results.

Table 4: Tobit model with HS 2-digit dummies

Dependent variable: Log of export values

		Marginal Effects at Observed Censoring		
		Unconditional Expected Value	Conditional on being Uncensored	**Probablity Uncensored**
ln_gdp	1.217***	0.4714	0.3719	0.0376
	(0.0513)			
NAFTA_MEXICO	2.076***	0.8045	0.6347	**0.0642**
	(0.0612)			

Product grouping may be very different from industrial category. Thus, I have grouped the HS 10-digit into ISIC Revsion 3 3-digit industry and have done the same regression. Table 5 shows the result, which is very similar to the previous regression results.

Table 5: Tobit model with industry code dummies

Dependent variable: Log of export values

		Marginal Effects at Observed Censoring		
		Unconditional Expected Value	Conditional on being Uncensored	**Probablity Uncensored**
ln_gdp	1.209***	0.4686	0.3697	0.0374
	(0.0513)			
NAFTA_MEXICO	2.073***	0.8034	0.6338	**0.0641**
	(0.0611)			

Another issue worth investigating is which industry benefited most in its export diversification from the formation of NAFTA. To see this, I have run regressions for industry by three digit of ISIC Revision 3 code.

Table 6 shows the probability uncensored of those industries which have yielded statistically significant coefficient estimates. The top 10 industries which have enjoyed the highest effect of NAFTA is shown in the table. The full table is in Appendix. Notably, textiles, apparels, and bodies for motor vehicles have enjoyed NAFTA's effect of about 16 to 17 percent on its export diversification, which is substantially higher than the above average rate of 6 percent.

Table 6: NAFTA's effect on Mexico's new goods' exports to the US by industry

ISIC Rev.3 code	NAFTA's effect on new goods' exports (Probability uncensored)
111: Extraction of crude petroleum and natural gas	17.50%
171: Spinning, weaving and finishing of textiles	17.49%
173: Manufacture of knitted and crocheted fabrics and articles	16.72%
181: Manufacture of wearing apparel, except fur apparel	15.80%
342: Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	15.72%
352: Manufacture of railway and tramway locomotives and rolling stock	14.94%
152: Manufacture of dairy products	14.76%
172: Manufacture of other textiles	13.27%
332: Manufacture of optical instruments and photographic equipment	12.61%
192: Manufacture of footwear	9.41%

4. UNIT PRICE EVOLUTION OF MEXICO'S EXPORTS

Having shown that NAFTA's effect on Mexico's export of 'new' goods both in numbers and in values are in line with the predictions of the HFT model and the QHFT model, this section turns to the unit price of Mexico's exports and attempts to see which model (HFT or QHFT) better explains the behaviour of unit price of Mexican exports.

As mentioned above, the stylized fact which motivated the construction of the QHFT model was the positive correlation between distance and FOB price. Using Mexico's exports data at HS 6-digit for 1990-2001 from UNCOMTRADE[16], we have counted the number of HS 6-digit items which recorded exports to the US and Spain and also to the US and Japan in the same year[17]. We have compared the unit price of these products by destinations, namely the US versus Japan and the US versus Spain. There were 4457 HS 6-digit items which had exports both for the US and Japan, among which 3264 items recorded a higher FOB price for Japan. The proportion is 73 percent. For the US versus Spain, 5179 HS 6-digit items registered positive values, out of which 3304 fetched a higher price for Spain.[18] The percentage is 64 percent. Thus, the QHFT model's prediction fits the Mexican exports' unit price difference by distance.

As discussed in Section 2, the QHFT predicts a lower average price of 'new' goods after trade liberalisation. To see if the Mexico's export is compatible with this prediction, we have computed the prices of 'new' goods and 'old' goods by HS 6-digit line. We regard HS 6-digit line as a product group which comprises of similar products of HS 10-digit. Using the US HS

16 Data for Mexico's export is only available from 1990.

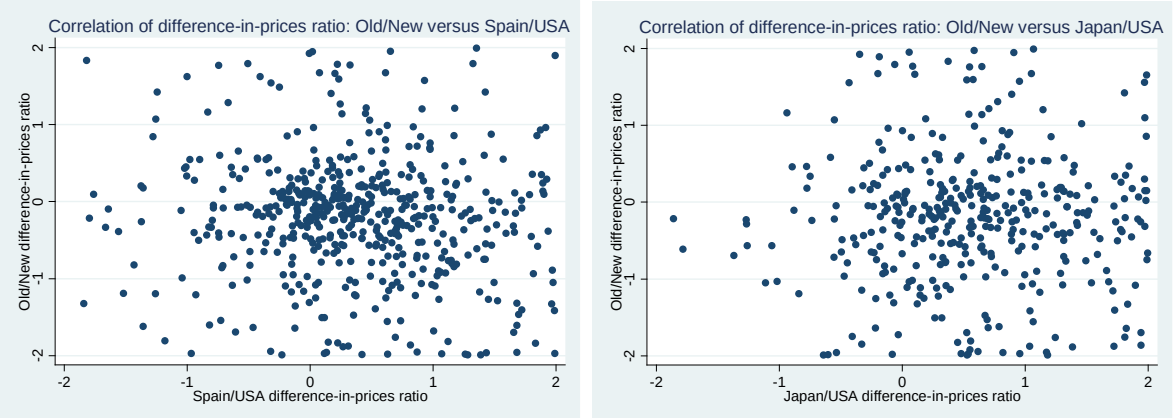
17 We have chosen Spain and Japan for comparison because Spain and Japan are Mexico's 3rd and 4th export destination during 1990-2001 and also because these two countries are good examples to see the distance effect.

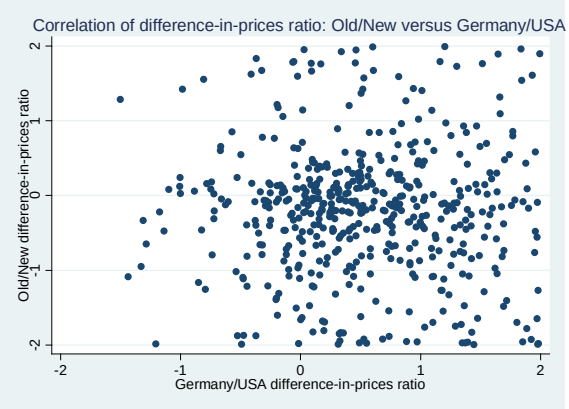
18 HS6 digit items which had positive values for both the US and Japan in a single year during the whole period, i.e. 1990-2001, was counted as one such case. So, in most cases, the same item was counted 12 times because there had records for all the years of the period. Similarly for the US – Spain pair.

10-digit import data from Mexico, the HS 10-digit goods which have positive trade values both before and after NAFTA are defined as ‘old’ goods within a given HS 6-digit line. The HS 10-digit goods which have zero trade values before NAFTA but positive trade values after NAFTA are defined as ‘new’ goods within the same HS 6-digit line. For the post-NAFTA period, i.e. 1994-2001, the average unit price for each HS 10-digit product is computed, by dividing the total trade value in the period by the total quantity in the period. Since unit price is known to be unreliable data for a small value of trade, we have dropped from the sample those trades which recorded less than 10 thousand dollars. The computed average unit prices of HS 10-digit goods for 1994-2001 are aggregated by ‘new’ and ‘old’ categories defined above. Then, we can compare the unit prices of the ‘new’ and ‘old’ goods within each HS 6-digit line. There are 997 HS 6-digit lines which have both of ‘new’ and ‘old’ products exports from Mexico to the US, among which 570 have higher prices for the ‘new’ goods than the ‘old’ goods. The ratio is 57%, almost like a flip of a coin. Thus, the simple test does not support the QHFT model, and does not go well with the prediction of the HFT model, either.

Another simple test of the QHFT model this paper proposes is to analyze unit price behaviour across products. We can measure the degree of quality competition across products by FOB price gaps to two differently distanced destinations. If the QHFT model were correct, the goods characterised by a high quality competition should have larger FOB price gaps. Then, we can rank HS 6-digit codes by the degree of quality competition. On the other hand, in the framework of the QHFT model, goods with high degree of quality competition should have lower price for ‘new’ goods than ‘old’ goods. Thus, we can expect a positive correlation between the degree of quality competition and the ratios of the ‘old’ goods prices divided by ‘new’ goods prices. Figure 7 shows plots of FOB price gaps (in the horizontal axis) and the old/new goods price gaps (in the vertical axis). The FOB price gaps are defined as: (Unit price for market “i” – Unit price for market “j”)/((Unit price for market “i” + Unit price for market “j”)/2). The old/new goods price gaps are defined as: (Unit price for old goods – Unit price of new goods)/((Unit price for old goods + Unit price of new goods)/2). The top-left panel has the gaps of FOB prices between US market and Spanish market in the vertical axis. The top-right panel is for FOB price gaps between US and Japanese markets. The panel at the bottom is for the case of US and German markets. Contrary to the positive correlation we have expected, we donot see any correlation.

Figure 7: FOB price gaps and Old/New price ratio





CONCLUSION

Using Mexico's exports as a natural experiment to conduct an empirical analysis on the explanatory power of the recent theoretical development of the heterogeneous firms trade models, this paper has shown that there is a large increase in the number of varieties of export goods from Mexico to the US shortly after the formation of NAFTA. This is in line with the prediction of both of the heterogeneous firm trade (HFT) model and its variant, the quality heterogeneous firm trade (QHFT) model. From the policy point of view, this phenomenon is encouraging for developing countries which are forming FTAs with developed countries and are seeking to diversify their exports. A notable difference between the HFT and the QHFT model comes in the unit prices. While the HFT model predicts a negative correlation between FOB unit prices and distances, the QHFT model is designed to explain a positive correlation between FOB prices and distances, which has been evidenced by some economists. Using Mexico's exports data for 1990-2001, this paper has shown that there is indeed a positive correlation between FOB prices and distances. Another difference between the HFT and the QHFT models is that while the HFT model predicts higher average prices for 'new' goods, the QHFT model predicts the opposite. This paper has proposed a simple way to check the unit price difference between the 'new' and the 'old' goods and has shown that there is no evidence of lower average prices for the 'new' goods. Moreover, taking the degree of FOB price gaps as a measure of quality competition following the QHFT model, the paper has studied whether this ranking of quality competition sits well with the QHFT model's prediction on old/new goods price differences. It yields yet another puzzling result. Since this study only deals with Mexican export data, it may be worthwhile doing the same analysis using other countries' cases.

REFERENCES

Amurgo Pacheco, Alberto (2006) "Preferential Trade Liberalization and the Range of Exported Products: The Case of the Euro-Mediterranean FTA" HEI Working Paper No.18/2006

Baldwin, Richard E. (July 2005), "Heterogeneous Firms and Trade: Testable and Untestable Properties of the Melitz Model" NBER Working Paper No. W11471.

Baldwin, Richard E. (September 2007), "Melitz made easy " Mimeo.

Baldwin, Richard E. and Harridan, James (July 2007), "Zeros, Quality and Space: Trade Theory and Trade Evidence " CEPR Discussion Paper No. 6368.

Cadot, Olivier, Carrère Céline, and Strauss-Kahn, Vanessa (November 2007), "Export Diverfication: What's behind the Hump? " CEPR Discussion Paper No. 6590.

Feenstra, Robert C. and Kee Hiau Looi (2007), "Trade Liberalisation and Export Variety: A Comparison of Mexico and China" The World Economy Volume1, Issue1 pp5-21, January 2007

Helpman, E., M. Melitz and Y. Rubinstein (2008), " Trading Partners and Trading Volumes", Quarterly Journal of Economics 2008, Vol.123.

Hummels and Klenow (2005), "The Variety and Quality of a Nations Exports," American Economic Review, June 2005, 704-723.

Imbs, J. and Wacziarg, R. (2003) "Stages of diversification," American Economic Review , March 2003, Vol.93 No.1 pp63-86.

Klinger, Bailey and Lederman, Daniel (2004), "Discovery and Development: An empirical exploration of 'new' products," World Bank Policy Research Working Paper Series No. 3450

Krugman, P. (1980) "Scale Economies, Product Differentiation and the Pattern of Trade" American Economic Review, 70, 950-959.

Melitz, Marc J. (2003), .The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity,. Econometrica, 71:6, pp. 1695-1725.

Sachs, Jeffery D. and Warner, Andrew (1995) "Economic Reform and the Process of Global Integration" Brookings Papers on Economic Activity, 1: 1-118.

APPENDIX

Table A 1: The number of zeros in Mexico's export to the top 20 destinations

year	USA	CAN	ESP	JPN	DEU	BRA	GBR	FRA	CHL
1990	1645	4336	4529	4537	4307	4640	4535	4542	4677
1991	1691	4219	4399	4490	4172	4568	4453	4434	4503
1992	1244	4070	4285	4418	4014	4538	4388	4392	4350
1993	1279	4111	4405	4410	4046	4427	4411	4357	4289
1994	1297	4085	4403	4407	4143	4366	4442	4460	4280
1995	1020	3798	4172	4328	3928	4107	4251	4273	3744
1996	1063	3750	4132	4291	3985	4035	4270	4315	3468
1997	1074	3686	4134	4279	4001	4031	4249	4311	3368
1998	1027	3697	4123	4291	3965	3998	4207	4216	3437
1999	976	3675	4022	4302	3956	4130	4225	4242	3644
2000	966	3658	4110	4259	3959	4058	4208	4254	3588
2001	984	3612	4120	4294	3984	4133	4211	4306	3777
Change in 1990-2001	661	724	409	243	323	507	324	236	900

VEN	GTM	COL	ARG	NLD	ANT	DOM	CHE	SGP	PAN	ITA
4531	3983	4585	4685	4726	4962	4826	4771	4935	4606	4675
4407	3811	4475	4546	4653	4900	4821	4725	4921	4513	4574
4121	3606	4250	4418	4647	4869	4725	4659	4886	4414	4507
4152	3468	4114	4378	4599	4946	4741	4666	4890	4357	4556
4245	3506	4050	4370	4622	4884	4620	4723	4880	4387	4556
3859	3002	3588	4227	4568	4836	4459	4579	4788	3921	4382
3665	3033	3571	4163	4512	4900	4349	4673	4777	3870	4392
3553	2889	3532	4008	4515	4874	4204	4679	4766	3802	4348
3519	2772	3481	3985	4524	4863	4135	4666	4811	3734	4343
3638	2844	3667	4091	4547	4868	4017	4594	4783	3702	4276
3609	2861	3611	4099	4479	4904	3974	4575	4762	3746	4312
3580	2861	3577	4223	4514	4906	3996	4554	4767	3753	4314
951	1122	1008	462	212	56	830	217	168	853	361

Country code list

Country code	ANT	BRA	CAN	CHE	CHL	CHN	COL	DEU	DOM
Country name	Netherlands Antilles	Brazil	Canada	Switzerland	Chile	China	Colombia	Germany	Dominican Republic

Country code	FRA	GBR	GTM	HKG	IND	IRL	ISR	ITA	JPN
Country name	France	UK	Guatemala	Hong Kong	India	Ireland	Israel	Italy	Japan

Country code	KOR	MEX	MYS	PAN	SAU	SGP	THA	TWN	VEN
Country name	Korea	Mexico	Malaysia	Panama	Saudi Arabia	Singapore	Thailand	Taiwan	Venezuela

Table A 2: NAFTA's effect on new goods' exports by industry

ISIC Rev.3 code	NAFTA's effect on new goods' exports (Probability uncensored)
111: Extraction of crude petroleum and natural gas	17.50%
171: Spinning, weaving and finishing of textiles	17.49%
173: Manufacture of knitted and crocheted fabrics and articles	16.72%
181: Manufacture of wearing apparel, except fur apparel	15.80%
342: Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	15.72%
352: Manufacture of railway and tramway locomotives and rolling stock	14.94%
152: Manufacture of dairy products	14.76%
172: Manufacture of other textiles	13.27%
332: Manufacture of optical instruments and photographic equipment	12.61%
192: Manufacture of footwear	9.41%
341: Manufacture of motor vehicles	9.24%
251: Manufacture of rubber products	8.55%
153: Manufacture of grain mill products, starches and starch products, and prepared animal feeds	8.16%
271: Manufacture of basic iron and steel	7.82%
202: Manufacture of products of wood, cork, straw and plaiting materials	7.60%
281: Manufacture of structural metal products, tanks, reservoirs and steam generators	7.24%
293: Manufacture of domestic appliances n.e.c.	7.11%
359: Manufacture of transport equipment n.e.c.	6.30%
191: Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness	6.08%
252: Manufacture of plastics products	5.96%
343: Manufacture of parts and accessories for motor vehicles and their engines	5.93%
243: Manufacture of man-made fibres	5.84%
222: Printing and service activities related to printing	5.77%
289: Manufacture of other fabricated metal products; metalworking service activities	5.61%
311: Manufacture of electric motors, generators and transformers	5.56%
154: Manufacture of other food products	4.86%
331: Manufacture of medical appliances and instruments and appliances for measuring, checking, testing, navigating and other purposes, except optical instruments	4.78%
333: Manufacture of watches and clocks	4.75%
291: Manufacture of general-purpose machinery	4.67%
261: Manufacture of glass and glass products	4.66%
155: Manufacture of beverages	4.63%
012: Farming of animals	4.12%
272: Manufacture of basic precious and non-ferrous metals	4.06%
020: Forestry, logging and related service activities	4.06%
210: Manufacture of paper and paper products	3.74%
361: Manufacture of furniture	3.53%
011: Growing of crops; market gardening; horticulture	3.51%
151: Production, processing and preservation of meat, fish, fruit, vegetables, oils and fats	3.48%
321: Manufacture of electronic valves and tubes and other electronic components	2.62%
000: Unclassified	2.27%
242: Manufacture of other chemical products	1.99%
369: Manufacturing n.e.c.	1.88%
292: Manufacture of special-purpose machinery	1.57%
132: Mining of non-ferrous metal ores, except uranium and thorium ores	-6.39%
351: Building and repairing of ships and boats	-7.44%

Notes: Only for those industries which show statistically significant coefficients at least at 10%.

Source: Author's computation

Appendix to Section 3　Data description

Data source:

US import data　Feenstra's web site at http://cid.econ.ucdavis.edu/data/sasstata/usiss.html

GDP data　World Development Indicators, The World Bank

Other remarks: In order to estimate the log linear equation, we have added one to all the trade values including zero trade values and have taken the logs of these numbers so that zero trade values takes zero after taking logs.

Appendix to Section 4

For Industry analysis, the concordance table from HS 6-digit to ISIC Revision2 3-digit available at the UN web-site (http://unstats.un.org/unsd/cr/registry/regot.asp?Lg=1) is used.

Table A 3: ISIC Revision2 3-digit industry list

111	Agriculture and livestock production
113	Hunting, trapping and game propagation
121	Forestry
122	Logging
130	Fishing
210	Coal Mining
220	Crude Petroleum and Natural Gas Production
230	Metal Ore Mining
290	Other Mining
311	Food products
313	Beverages
314	Tobacco
321	Textiles
322	Wearing apparel, except footwear
323	Leather products
324	Footwear, except rubber or plastic
331	Wood products, except furniture
332	Furniture and fixtures, except primarily of metal
341	Paper and products
342	Printing and publishing
351	Industrial chemicals
352	Other chemicals
353	Petroleum refineries
354	Manufacture of miscellaneous products of petroleum and coal
355	Rubber products
356	Plastic products
361	Pottery, china, earthenware
362	Glass and products
369	Other non-metallic mineral products
371	Iron and steel
372	Non-ferrous metals
381	Fabricated metal products
382	Machinery, except electrical
383	Machinery, electric
384	Transport equipment
385	Professional and scientific equipment
390	Other manufactured products
410	Electricity, Gas and Steam

Appendix to Section 5

Product codes which have changes of units during the period of the analysis were discarded from the sample.

For the matching of the ranking by FOB prices and the ranking of old/new goods prices, the ratios of prices, i.e. FOB price to Spain divided by FOB price to the US and 'old' goods prices divided by 'new' goods prices, are taken instead of differences (i.e. FOB prices to Spain minus FOB prices to the US, similarly to old/new goods), because units are different. Since the FOB price ratios computed as above are for several years, the simple average across years is computed in order to match with the old/new goods price ratios. Inflation is adjusted by using Consumer Price Index data from Penn World Table.