

Zeros in International Trade*

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Abstract

This paper analyzes the existence of zeros in the US exports - potential trade flows that do not exist. The main findings are: 1) There are many zeros in trade, around 70% of possible trade relationships do not exist; 2) Zeros are very persistent; 3) The number of zeros increases with distance; 4) The impact of distance on the occurrence of zeros has increased over time; 5) The number of zeros increases faster when the real exchange rate appreciates compared to when it depreciates; 6) The introduction of new products is one of the reasons for the existence of zeros and this happens due to products experimentation; 7) Zeros in trade are not just a result of time aggregation; 8) During internal demand peaks there is no evidence of an increase in the number of zeros, but during internal demand troughs the number of zeros decreases significantly - 10% more trade relationships are created on average.

JEL classification codes: F10, F14, F19.

Key Words: Trade, US exports, Export dynamics.

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1. INTRODUCTION

Trade between countries is seen as one of the most important factors behind economic growth and development in general. For this reason, the literature on international trade is extremely vast and rich. To my best knowledge, this literature has mostly been focused on the reasons for countries to trade, what products each country trades, volume of trade, effects of trade barriers like tariffs and/or subsidies and the linkage between trade and economic growth. Surprisingly, very little research has been conducted on the dynamic patterns of trade, that is, the composition of exported goods and importing countries over time. Understanding how the set of importing countries for a given product evolves over time or how the set of exported goods to a certain country changes over time is a first step towards a theory of trade that incorporates dynamic features.

The starting point for my analysis is the paper by Baldwin and Harrigan (2007), which analyzes the question of zeros in trade. Zeros in trade, according to the authors, are defined as a pairing of importing country and exported product for which there is no trade. The only condition that is imposed is that the product has to be exported to at least one country. For example if the US exports cars to Canada, for all countries that the US does not export cars it is considered a zero.

The interest in analyzing the occurrence of zeros is two folded. First, zeros in trade can be associated with inefficiencies or frictions and consequently with losses of welfare. This line of thought is present in some of the conclusions reached by Eaton and Kortum (2002) and Guironi and Melitz (2005), for instance. Nevertheless, the reasons for the occurrence of zeros are not confined to the assumptions of these two models and different assumptions may have different implications for policy design. The ability to understand how or why there are zeros in trade and to distinguish between zeros that lead to losses of welfare and those that do not, is a first step to designing better economic policies. Second, the evolution of zeros and non-zeros over time will allow researchers to understanding better the dynamics of trade and develop new models of trade that incorporate dynamic features, which can be used in policy design.

The remainder of the paper is organized as follows: in section 2 I review the implications of main-stream models of trade for the existence of zeros and propose alternative reasons for both the occurrence of zeros as well as the time evolution of zeros and non-zeros; in section 3 I describe the data that I used in the empirical section; in section 4 I analyze the data to test the different models discussed in section 2; and finally, in section 5 I conclude.

2. ALTERNATIVE MODELS OF TRADE AND THE OCCURRENCE OF ZEROS

In the current mainstream models of international trade - Eaton and Kortum (2002), Bernard et al. (2003), Guironi and Melitz (2005) - zeros in trade are not surprising as they are predicted by most of them. Nevertheless, the reasons for zeros to exist are not confined to the rational of these models and therefore, the policy implications may be different. In this section I review some of the more popular models of trade and propose different mechanisms that could also generate zeros in trade.

The Eaton and Kortum (2002) model is based on the Ricardo model of trade but with transportation costs. The existence of transportation costs is what causes zeros in trade as transportation costs create a wedge between relative production efficiencies. Therefore, a country that might be the most advanced technologically overall does not necessarily export to all other countries because its relative production efficiency is not sufficiently high enough to compensate for the existence of transportation costs.

In Guironi and Melitz (2005), zeros occur because there are sunk costs of exporting goods and not all producers are sufficiently productive to overcome those costs with the additional sales revenues coming from the international market. If such friction did not exist, all goods would be exported as consumers have a taste for variety and all products are different from each other.

In Helpman et al. (2004), besides the existence of sunk costs of exporting goods, firms can choose between exporting the good or investing abroad (FDI). In this case, some of the zeros do not necessarily represent a loss of welfare or a decreased efficiency since

the occurrence of these zeros is endogenous and it was a choice made by the exporting country.

In Segura-Cayuela and Vilarrubia (2008), the authors consider uncertainty and learning as reasons to observe zeros in trade. In this setting, firms don't export immediately as they are uncertain about specific aspects of the external market. As firms learn more about the foreign markets they may choose to either continue exporting or exit those markets.

Baldwin and Krugman (1989) study the impact of a large real exchange rate devaluation on foreign markets entry and exit. Their results point towards an asymmetric effect of the real exchange rate, while appreciations of the currency are incorporated quickly with firms exiting the market, depreciations of the currency take more time to be incorporated. The results of this paper don't relate to the existence of zeros in trade as much as the previous papers but it provides a mechanism for zeros to become non-zeros and vice-versa.

All the papers mentioned above give reasons for the existence of zeros in trade or mechanisms for zeros to transition to non-zeros and vice-versa, but these reasons are not unique. An alternative possibility for observing zeros is the "durability" of goods, that is, while some goods are consumed very frequently (e.g. food or clothes) others may be consumed less frequently (e.g. submarines, airplanes). Zeros in this case, do not represent a welfare loss, they simply reflect certain characteristics of the product itself.

Likewise, the existence of capacity constraints could generate zeros in trade. If a country's production frontier is constrained by the available resources (very mild assumption), then, it might be the case that for certain products it will not be possible to serve the external market in full. For instance, the Heckscher-Ohlin model of trade would predict such an outcome. In a Heckscher-Ohlin type of model, the endowment levels would determine the production capacity of a country and consequently its capacity to serve the external market. Again, the occurrence of zeros would not necessarily represent a loss of welfare, it's just a consequence of the distribution of resources.

In the empirical section of this paper I analyze the occurrence of zeros in US exports from 1962 to 1999 in light of the ideas I just enumerated. In particular I look at the effect

of distance on zeros, the persistence of zeros and non-zeros, the profile of new products, the impact of the real exchange rate on the occurrence of zeros, the impact of time aggregation and the impact of the US internal demand cycle on zeros and non-zeros.

Before presenting the empirical results I proceed by describing the data.

3. DATA

The main data source used in this paper is the NBER World Trade Flows (NBER-WTF) dataset. This dataset collects export data from 1962 to 2000 for all countries with a level of data disaggregation as low as the SITC4 product classification. Because this dataset has a companion paper, Feenstra et al. (2005), which describes in great detail the methodology of construction of the dataset, I only refer to the details that are more directly related to this paper.

The NBER-WTF dataset contains information on all bilateral trade-flow for all countries, but, in this paper I only analyze the export flows from the US to other countries. Based on this data I generate a dummy variable which takes the value 1 if there was any export flow from the US to country j in year t . Following the definition of a zero in trade proposed in Baldwin and Harrigan (2007), zeros and non-zeros are only defined for products that were exported to at least one country. Therefore, a zero represents possible trade flow that did not occur.

A few features of the data must be mentioned: 1) the data between 1962 and 1983 uses the SITC rev.1 coding while the data from 1984 to 2000 uses the SITC rev.2 coding. Despite this change of methodology, the creators of the dataset were able to match most of the old categories with the new ones; 2) the values of export flows for the data between 1984 and 2000 are bounded from below, that is, the value of exports must be at least \$100,000 per year to be included. The authors justify this problem in the data with the fact that the data for these years had to be purchased and they had budget constraints at the time of the construction of the dataset; 3) during the sample period there were some country splits (e.g., U.S.S.R.) and some country reunifications (e.g., Germany) and in order to avoid additional noise in the data that would not be necessarily related

with a normal trade flow pattern determination, I opt to exclude these countries from the analysis; and 4) based on some preliminary calculations I detected some strange patterns in the last year of the sample, 2000, and for this reason I exclude the year. One possible reason for the lower quality of the data in 2000 may be the fact that this type of data requires time to be collected and not all countries are equally fast at doing so and therefore some countries could still be working to gather the data by the time the dataset was constructed.

Before presenting some stylized facts regarding the data under analysis I show some summary statistics of the data in Table 1 and Figures 1 and 2.

	All countries	"Stable" countries
# of Countries	182	147
# of SITC4 product categories	980	980
Total # of observations	7,393,204	5,971,434

Table 1 - Summary statistics.

During the period 1962-1999, the US exported its products to 182 different countries which is the entire set of countries covered by the original dataset. Of these 182 countries, only 147 were the same entity during the 39 years period. The main reason for such a difference between the total set of countries and the set of countries that did not suffer an identity change is because of countries like the U.S.S.R. which split into 15 new different countries or Yugoslavia, which, by 1999 had split into 5 different countries. The total number of different SITC4 product categories that were exported by the US during the 38 year period was 980 and this number corresponds to approximately 92% of the entire set of different SITC4 product categories, 1069. The total number of observations, 5,971,434, does not exclude the SITC4 products that were not exported to some country at a certain point in time. Conditioning on the products for which there was at least one buyer, the total number of observations is 4,210,227, which is still a very large number.

The number of different SITC4 products categories varies over time as well as the number of importing countries. In Figures 1 and 2 I present the number of importing countries and exported SITC4 product categories over time, respectively. In the same

graphs I show the number of countries for which there was no interrupted trade relationship from the date until the end of the sample period and also the number of SITC4 product categories that were continuously exported.

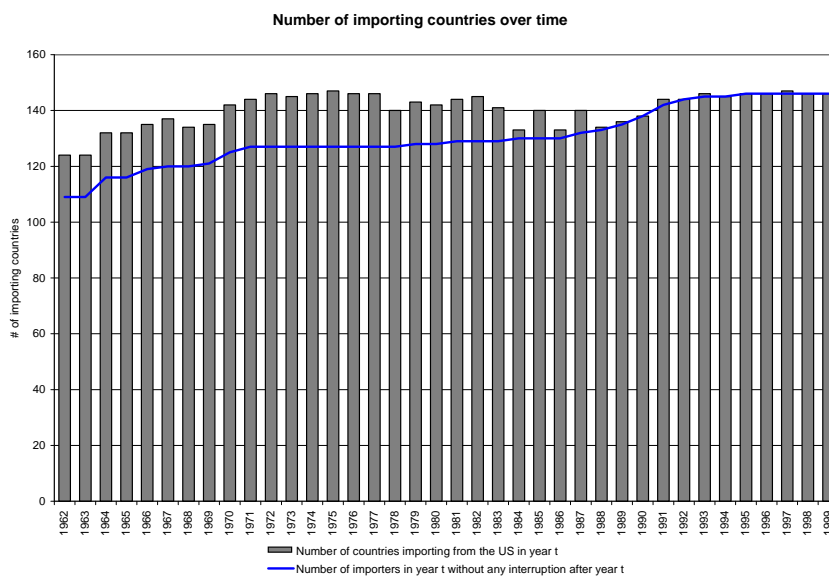


FIG.1 - Number of importing countries over time.

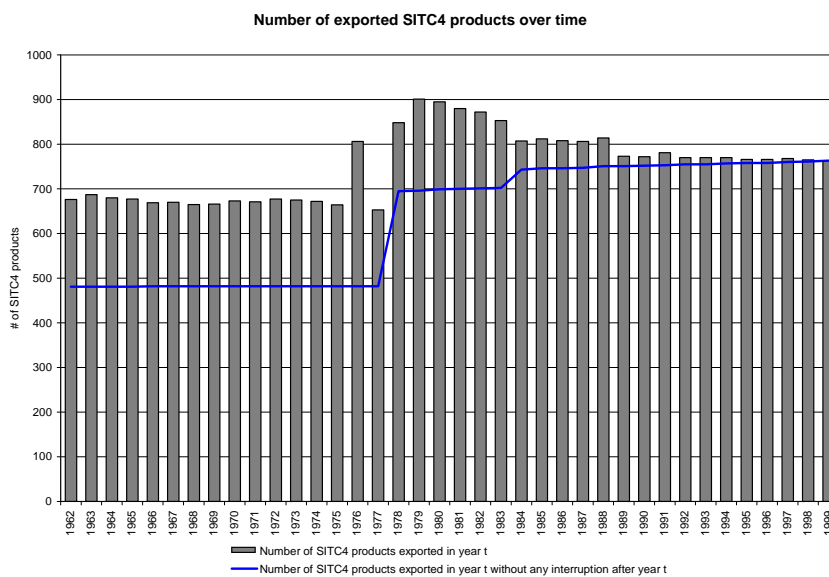


FIG.2 - Number of exported SITC4 product categories over time.

The number of importing countries varied between 124 and 147 during the sample period. The lower number of importing countries happened in the years 1962 and 1963, 124, and the highest was reached for the first time in 1975, 147. During the 15 years after

1975 there was some variation in the number of importing countries but this number was quite stable thereafter.

The number of exported SITC4 product categories show some variation. In 1962 the US was exporting 676 different SITC4 product categories. In 1977, the number of exported SITC4 product categories reaches its minimum, 653, and in 1979 reaches its maximum, 901.¹ By the end of the sample period, the number of exported of SITC4 product categories was only 763. This evolution of the number of exported product categories, first increase then decrease, can to some extent be related to the results of Imbs and Wacziarg (2003), namely a U-shaped path for the degree of sectorial concentration as economic development occurs.

3. STYLIZED FACTS

In this section I analyze the data that I described in the previous section in the light of existing models of trade but also discuss and propose alternative models which could be compatible with some of the results.

Fact 1 - There are many zeros in trade. The number of zeros changes over time. There is large variation among importing countries and exported products.

Using the definition of a zero in trade proposed in Baldwin and Harrigan (2007) I estimate that **70%** of possible bilateral transactions do not occur, that is, of all possible export relationships started by the US, only **30%** happen. This result is not fully new nor necessarily surprising. It is not fully new because it has been previously pointed out by other researchers. Baldwin and Harrigan (2007), for instance, using more disaggregated data estimate 84% of zeros when considering all possible countries and 70% of zeros if the set of trade partners excludes smaller countries. It is not necessarily surprising because

¹For some reason that I was not able to identify, nor there is any reference in Feenstra et. al (2005), the number of exported products strangely "jumps up" in 1976, "jumps down" in 1977 and it "jumps up" again in 1978. This behavior, besides generating some noise in the data for 1977, should not have a very significant impact in the overall results as this only occurs in one year.

this result would be predicted by the current mainstream models of trade, of which the Eaton and Kortum (2002) or Guironi and Melitz (2005) are examples. The question is then why this result is presented at all. The first reason is to show that the data that was used, despite being at a higher aggregation level, does not yield significantly different results from what had been previously obtained using more detailed data; Second and most importantly, is to initiate and motivate the rest of the discussion in this paper.

In Figure 3 I plot the percentage of zeros over time as well as the number of zeros and non-zeros.

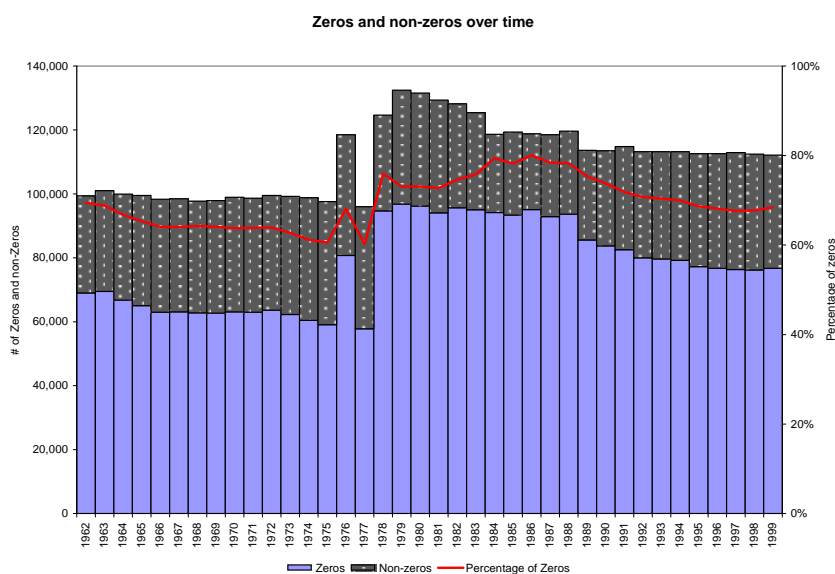


FIG.3 - *Zeros and Non-Zeros over time.*

The first thing to be noticed in Figure 3 is that the percentage of zeros changes over time, and these changes are both upwards and downwards. Between 1962 and 1977 the percentage of zeros declined consistently (except for 1976, which is a year with strange behavior). In 1978 there was a sharp increase in the number of zeros. This increase occurs at the same time new products are introduced or new SITC categories are created (see Figure 2). Between 1978 and 1999 the percentage of zeros first increased, reaching the maximum in 1986 - 80% -, and then it declined until the end of the sample to a level slightly below the initial one - 69.4% in 1962 and 68.4% in 1999.

In Figure 4 I show the percentage of zeros by importing country.

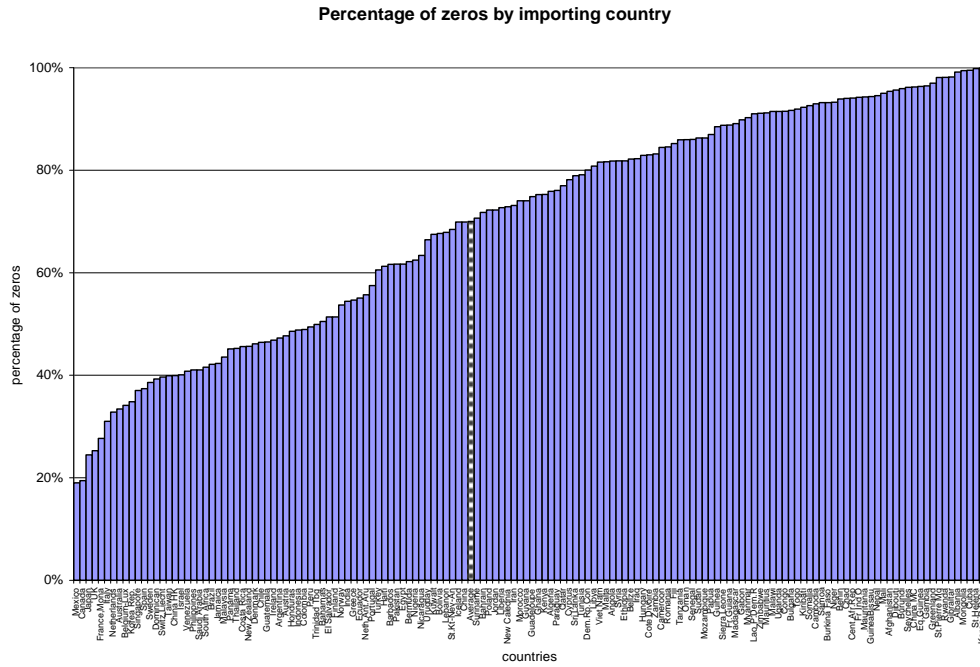


FIG.4 - *Percentage of zeros by importing country.*

As it is very noticeable in Figure 4, the percentage of zeros varies very significantly across countries. While in the cases of Mexico and Canada this number is less than 20%, in the cases of North Korea and Cuba it's almost 100%. If proximity may justify the numbers for Mexico and Canada, it is not distance that justifies the numbers for North Korea or Cuba. The main justification for such a high number of zeros in Cuba and North Korea is political. What is also interesting to notice in that, although Mexico and Canada have the smallest percentage of zeros of all countries, this value is still significantly far from being 0. This means that there are products exported by the US that are not exported to Mexico and/or Canada. If we assume that the transportation costs of exporting from the US to Mexico or to Canada are lower than the costs of exporting from any other country to Mexico or to Canada, then, it is very hard to reconcile this 20% with a model like the Eaton and Kortum (2002).

In Figure 5 I present the empirical distribution of the percentage of zeros by SITC4 product.

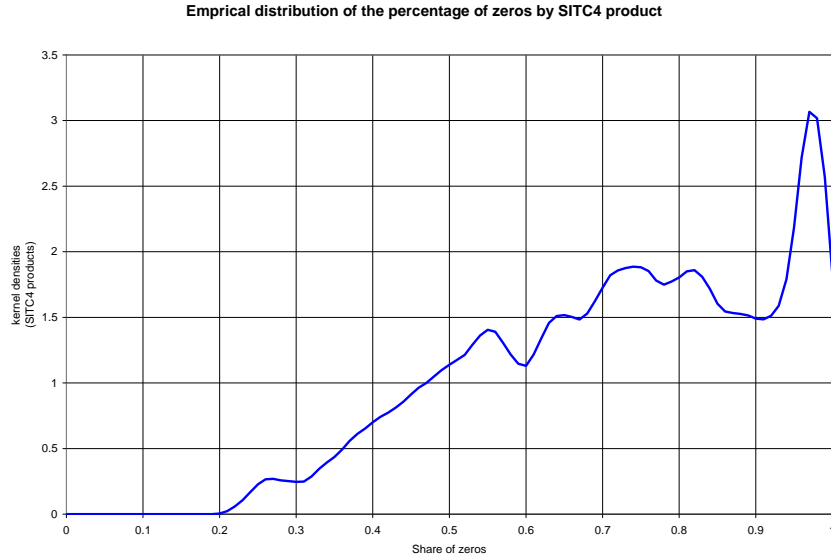


FIG.5 - *Empirical distribution of the percentage of zeros by SITC4 product.*

Similar to the distribution of zeros by country, there is a very significant heterogeneity at the product level. While some products have a relatively low percentage of zeros, other products have a high percentage of zeros. Interestingly, there is no product that is exported to all countries. The lowest percentage of zeros for a single SITC4 product category is around 20%.

Fact 2 - Zeros are more persistent than non-zeros.

An interesting question is whether it is more likely for an existing trade relationship to be interrupted or for a non-existing trade relationship to be initiated. In Table 2 I present estimates of a transition matrix of zeros and non-zeros. In order to avoid possible noise from SITC4 products that may be introduced or may disappear, I estimate these probabilities conditional on the SITC4 product being exported to at least one country in years $t - 1$, t and $t + 1$.

	$Zero_t$	$Non - Zero_t$
$Zero_{t-1}$	93%	7%
$Non - Zero_{t-1}$	15%	85%

TABLE 2 - Transition matrix of zeros and non-zeros.

The results of Table 2 show that it is always more likely to remain in the same state than changing between states with the zero state being more persistent than the non-zero state (93% vs. 85% of not switching states). This result suggests that factors that determine the zeros are more persistent than the factors that determine the non-zeros. Additional evidence of this idea is shown in Figures 6-8. In Figure 6 I plot the estimates of the probabilities of not switching between states (zeros remain zeros and non-zeros remain non-zeros) over time.

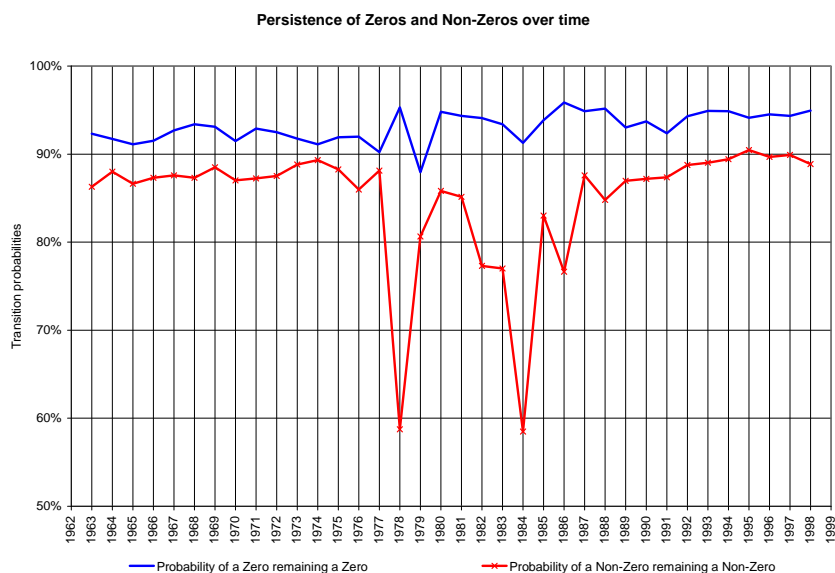


FIG.6 - Persistence of Zeros and Non-Zeros over time.

The results of Figure 6 show that there is some volatility in the transition probabilities. Nevertheless, in the case of the persistence of zeros we see that the values are much more stable than in the case of the persistence of non-zeros, which in two occasions decreased to a level below 60%.

Figures 7 and 8 compare the persistence of zeros with the persistence of non-zeros at the country and SITC4 product levels.

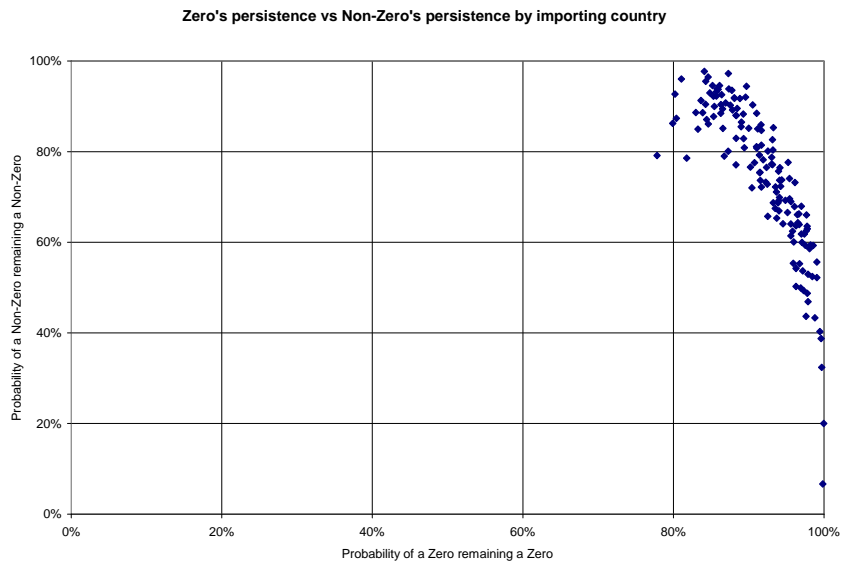


FIG.7 - Zero's persistence vs. Non-Zeros persistence by importing country.

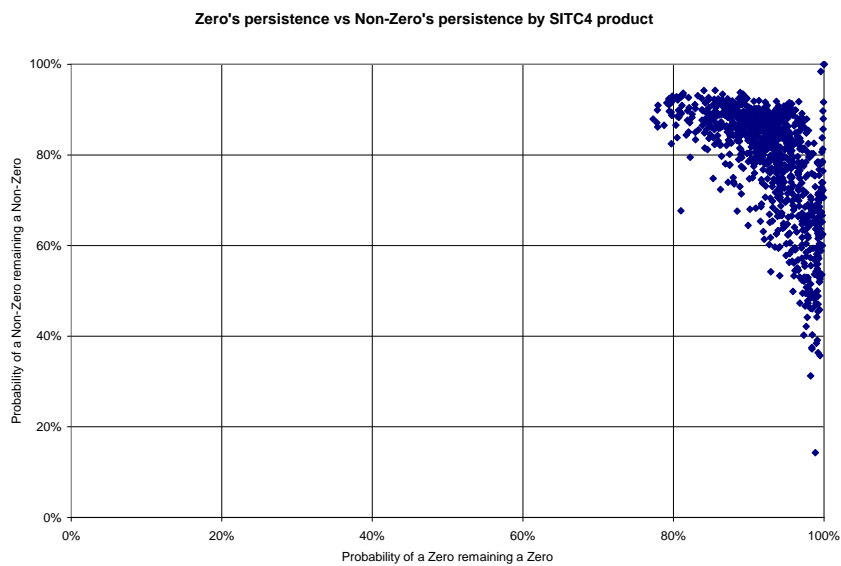


FIG.8 - Zero's persistence vs Non-Zero's persistence by SITC4 product.

Once again, it is visible that the persistence of zeros is higher than persistence of non-zeros. What is interesting to see is that in both cases as the persistence of non-zeros increases, the persistence of zeros tends to decrease. Nevertheless, the range of variation is very narrow in the case of the persistence of zeros and very wide in the case of the persistence of non-zeros.

Fact 3 - Zeros are positively correlated with distance.

One leading explanation for the existence of zeros in trade is transportation costs. One of the sources of transportation costs is the physical distance between exporter and importer. In order to investigate the impact of distance on the number of zeros I divide the importing countries into 5 different groups according to their distance from the US. In group 1 I include the 20% closest countries, in group 2 the second 20% closest countries, and so on. Table 3 presents some statistics for each group of importing countries.

Distance quintile	Mean	Median	Min	Max	Std.Dev.
1	51%	49%	19%	82%	16%
2	63%	68%	28%	96%	24%
3	74%	77%	40%	94%	16%
4	77%	82%	24%	99%	20%
5	70%	85%	33%	96%	24%

TABLE 3 - Percentage of zeros and country distance

The results of Table 3 show an almost perfect monotonic relationship between the percentage of zeros and the distance from the US, that is, as distance increases, the percentage of zeros also increases. This result is what would be expected given the existence of transportation costs. Nevertheless, if instead of looking at the average or median percentage of zeros we look at the raw data, this result is not as clear. In Figure 9, I plot the percentage of zeros for each one of the countries that fall within each one of the 5 distance groups.

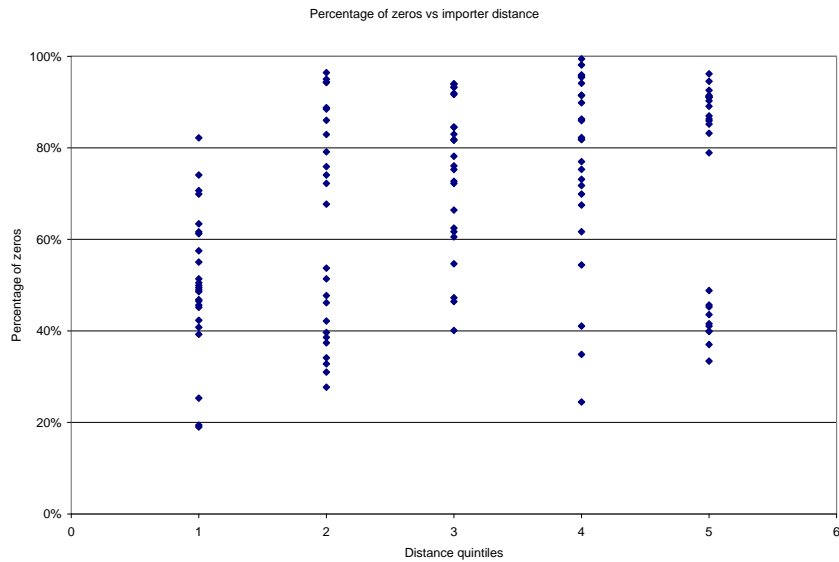


FIG.9 - Percentage of zeros vs importer distance.

In Figure 9 it is visible that the percentage of zeros of each one of the countries varies substantially within each distance group and also there are many countries in the less distant groups for which the percentage of zeros is higher than it is for other countries in the more distant groups. This suggests that distance, vis-a-vis, transportation costs can only explain part of the variation of the percentage of zeros by importing country.

In order to better analyze the relationship between distance and the occurrence of zeros I define a new metric: average product distance. The metric average product distance is very simple and very intuitive. For each SITC4 category I estimate the average distance to where this product is being exported to. For example, if a given SITC4 product is exported only to Canada and Japan I add the distance from the US to these two countries, and divide by two. If distance was the most important factor determining the occurrence of zeros, then, average product distance should increase as the percentage of zeros decreases. In Figure 10 I plot the average product distance and percentage of zeros for each one of the SITC4 product categories in the sample. As a reference point, I also add a line representing what would be the average product distance if a certain product was exported to all countries.

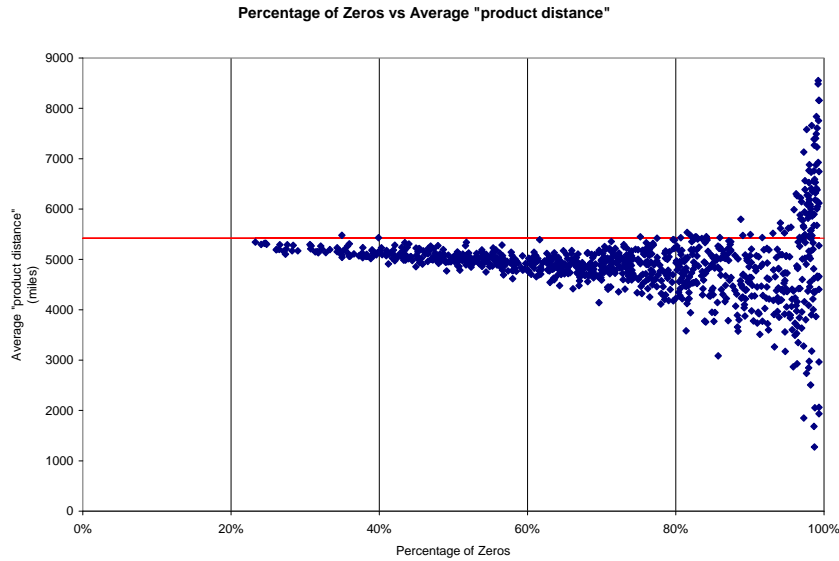


FIG.10 - Percentage of zeros vs average "product distance"

In Figure 10 it is visible that there is a negative but small relationship between the percentage of zeros and average product distance. Nevertheless, this relationship basically disappears between 20 and 60 percentage of zeros, which strengthens the idea that distance is only able to explain partially the occurrence of zeros. What this suggests is that transportation costs are probably not as welfare costly as some authors suggest (e.g. Eaton and Kortum (2002) or Alvarez and Lucas (2007)), meaning that even if there were no transportation costs, there would be other reasons for the existence of zeros.

Fact 4 - The impact of distance on the occurrence of zeros changed significantly over time.

Using the idea of product distance that I introduced in Fact 3, I compute the average product distance of US exports for each year between 1962 and 1999. Figure 11 presents the results.

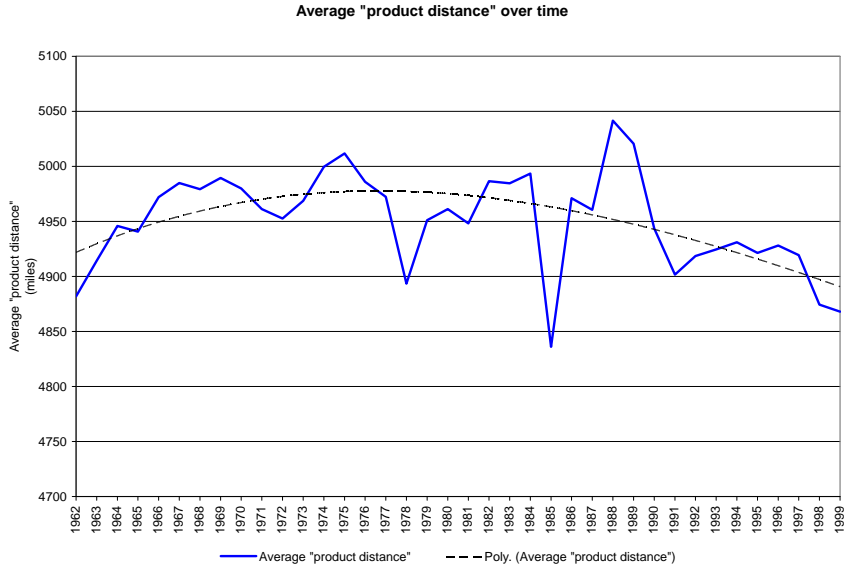


FIG.11 - Average "product distance" over time

In Figure 11 it is visible that the average product distance first increased until 1978/1979 and decreased thereafter. This result is counter-intuitive if one has in mind that during the 1980's and the 1990's there was an expansion of international trade due a generalized reduction of tariffs and quotas. One possible explanation for this evolution of the average product distance is an increase of Foreign Direct Investment (FDI) from the US. That is, as US firms opt for investing abroad in order to serve the foreign markets more efficiently, the average product distance should decrease as the gains from FDI are larger for more distant countries.

In order to reinforce the idea that the impact of distance increased over time, I estimate the elasticity between distance and percentage of zeros over time.

The estimates of the distance-zeros elasticity were obtained in the following way:

- 1) I estimate the equation $\%Zeros_{it} = \frac{\exp(\alpha_t + \beta_t \text{distance}_i)}{1 + \exp(\alpha_t + \beta_t \text{distance}_i)} + v_{it}$ for each year t ; 2)
- Using the estimates of α and β for each year t I obtain the average elasticity $\bar{\varepsilon}_t = \frac{1}{n} \sum_{i=1}^N \left\{ \hat{\beta}_t \frac{\text{distance}_i}{\%Zeros_{it}} \frac{\exp(\hat{\alpha}_t + \hat{\beta}_t \text{distance}_i)}{(1 + \exp(\hat{\alpha}_t + \hat{\beta}_t \text{distance}_i))^2} \right\}$. Figure 12 presents these results.

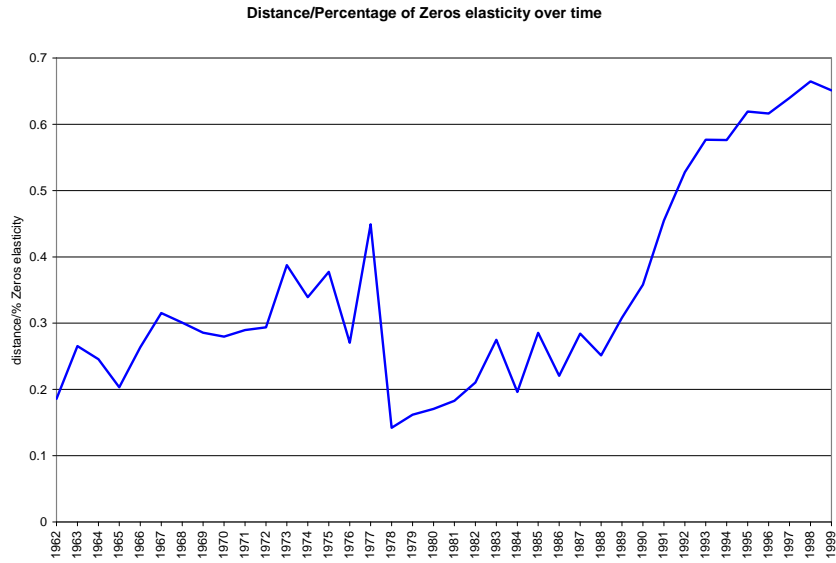


FIG.12 - Distance/Percentage of Zeros elasticity over time.

Figure 12 shows very clearly that the effect of distance on the occurrence of zeros tripled between 1962 and 1999. This result is very extreme and suggests that there must have been some important change of direction in the way international trade is organized.

Fact 5 - The real exchange rate is positively correlated with the occurrence of zeros.

One possible reason for products to exit (enter) markets over time is the appreciation (depreciation) of the real exchange rate (RER). To test this idea I create a RER index for the US against 57 countries.² Because all the statistics regarding zeros and non-zeros are not weighted, the RER index used here is also non weighted. Figure 13 compares the evolution of the RER index with the percentage of zeros over time.

²The number of countries included was constrained by data availability limitations.

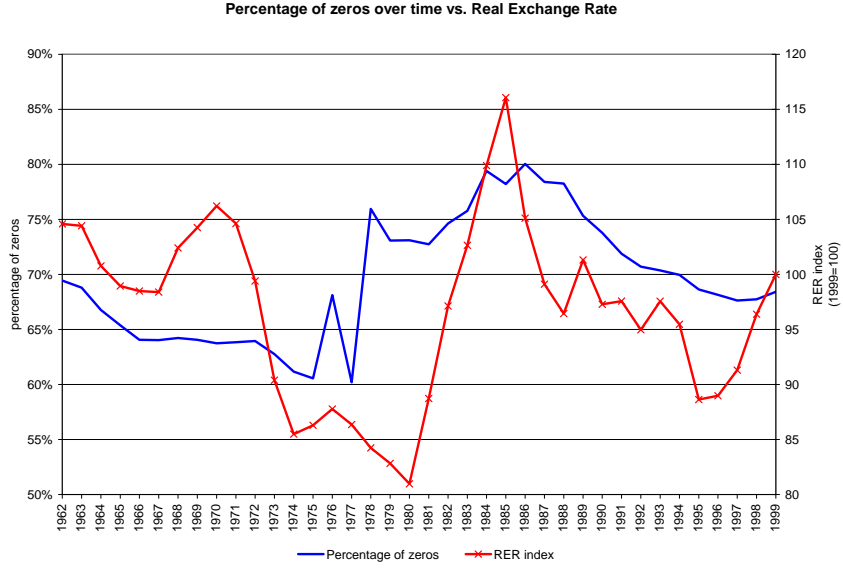


FIG.13 - Percentage of zeros vs. Real exchange rate.

In this Figure it is possible to see that there is a link between RER variation and percentage of zeros. In particular, as the RER appreciates (increases in the RER), the percentage of zeros increases. Nevertheless, the relation does not appear to be very strong (the correlation between the two variables is only 0.24, which is a value not statistically different from 0). In order to better test the relationship between these two variables, I estimate the following simple model:

$$\begin{aligned}
 \Delta \ln (\%Zeros_t) = & \alpha + \beta_1 \Delta \ln (RER_t) 1 [\Delta \ln (RER_t) \geq 0] + & (1) \\
 & \beta_2 \Delta \ln (RER_t) 1 [\Delta \ln (RER_t) < 0] + \beta_3 \Delta \ln (N_t) + \\
 & \gamma_1 \ln (\%Zeros_{t-1}) + \gamma_2 \ln (RER_{t-1}) + \gamma_3 \ln (N_{t-1}) + \varepsilon_t
 \end{aligned}$$

The rationale for the specification of equation (1) comes directly from Baldwin and Krugman (1989). In this paper the authors suggest that market entry/exit by exporting firms is affected asymmetrically by fluctuations in the RER. While an appreciation of the RER leads to a fast exit, a depreciation does not generate market entry as fast. Also, the full effect of RER fluctuations is not immediate and it takes time to fully operate. These two characteristics are contemplated in the model of equation (1) as I allow for asymmetric effects of variations of the RER but also allow for a long run effect to exist,

since I the model is in a error-correction form. Finally, the variable N_t is the number of different SITC4 products exported at time t and the reason to include it is to allow for product introduction/exclusion effects.

The estimation results are presented in Table 4.

Variables	Coeffs.	Std. error	P-value
<i>Constant</i>	-4.065	1.239	0.003
$\Delta \ln(RER_t) 1 [\Delta \ln(RER_t) \geq 0]$	0.252	0.100	0.018
$\Delta \ln(RER_t) 1 [\Delta \ln(RER_t) < 0]$	0.024	0.111	0.826
$\Delta \ln(N_t)$	0.749	0.064	0.000
$\ln(\%Zeros_{t-1})$	-0.495	0.175	0.008
$\ln(RER_{t-1})$	0.256	0.092	0.009
$\ln(N_{t-1})$	0.409	0.119	0.002
R^2	0.860		
<i># Observations</i>	37		

Table 4 - Equation (1) estimation results.

Several interesting results come out of Table 4: 1) the impact in the short run of a RER variation is different for an appreciation of the RER (β_1) and for a depreciation of the RER (β_2). After a RER depreciation there is no evidence of an impact on the percentage of zeros, that is, a RER depreciation does not induce product entry in the short run. In the case of a RER appreciation, the short run elasticity between RER and the percentage of zeros is 0.25. This means that a 1% appreciation of the RER induces a 0.25% increase in the percentage of zeros; 2) the long run impact of a RER variation on the percentage of zeros is around 0.5.³ That is, on average, a 1% appreciation (depreciation) of the RER induces a 0.5% increase (decrease) of the percentage of zeros. These two results are very much in line with the results of Baldwin and Krugman (1989) which were presented previously in section 2.

³The long run impact of the RER on the percentage of zeros is $-\frac{\gamma_2}{\gamma_1}$. This is a standard result in error-correction models

Also in Baldwin and Krugman (1989), it is suggested that after a large RER appreciation, export relationships that are interrupted never re-start again or it takes a very long time to happen. In order to test this idea, I use the 1984/1985 peak of the dollar to see how long it takes for relationships that were interrupted to re-start. The way I run this experiment is the following: 1) I select only products that were continuously exported between 1983 and 1999 to avoid possible contamination of the data due to new product categories that were created in 1984; 2) I use 1983 as the reference point (the pre-shock year) and focus on all the export relationships that were active at that time (all the non-zeros). There were 26,940 export relationships that were active in 1983; 3) I look at all the export relationships that were active in 1983 but were not active in 1984 and 1985 or only inactive in 1985. This corresponds to 9,997 exports relationships that were interrupted or a 37% exit rate (8,065 in both 1984 and 1985 and 1,932 only in 1985); 4) For all 9,997 export relationships I measure the number of years it takes until they are resumed for the first time. Figure 14 summarizes these results and it shows the cumulative re-entry and the re-entry rate (hazard rate).



FIG.14 - Trade relationship re-establishment rates after peak of RER

Figure 14 shows that exports relationships that were interrupted in 2 years, after 14 years only 75% of them had been re-established and it took 6 years for 50% having been resumed. This result is in line with the conclusions of Baldwin and Krugman (1989).

Another interesting fact is that the re-entry rate falls from 15% to roughly 5%. Such a declining pattern does not say much as it may only reflect some sort of heterogeneity in the re-entry (tortoises and hares). What is interesting in the re-entry rate results is that after 8/9 years the re-entry rate is very similar to the transition probability from zero to non-zero that is presented in Table 2.

Fact 6 - New products are characterized by 3 phases: experiment, expand and rationalize.

During the sample period there were several product categories that were introduced while others were discontinued. By looking at the products that were introduced I analyze the path by which new products become part of the US exports product mix. During the period of analysis there were several years which had new product categories introduced, but there were two years, 1978 and 1984, where the introduction of new product categories was higher - 104 in 1978 and 28 in 1984. These new product categories do not necessarily reflect completely new products as in some cases they are just re-classifications from other categories. Nevertheless, the products that make part of these categories have to be significantly new in order to justify the creation of new product categories.

In order to characterize the path of new products in the external market, I define two cohorts of goods - the 1978 cohort and the 1984 cohort. The product categories that make up part of these two cohorts are product categories which had never been exported from the US before 1978 and 1984, respectively. In Figure 15 I show the time evolution of the average number of countries to where these new products were being exported after being launched.

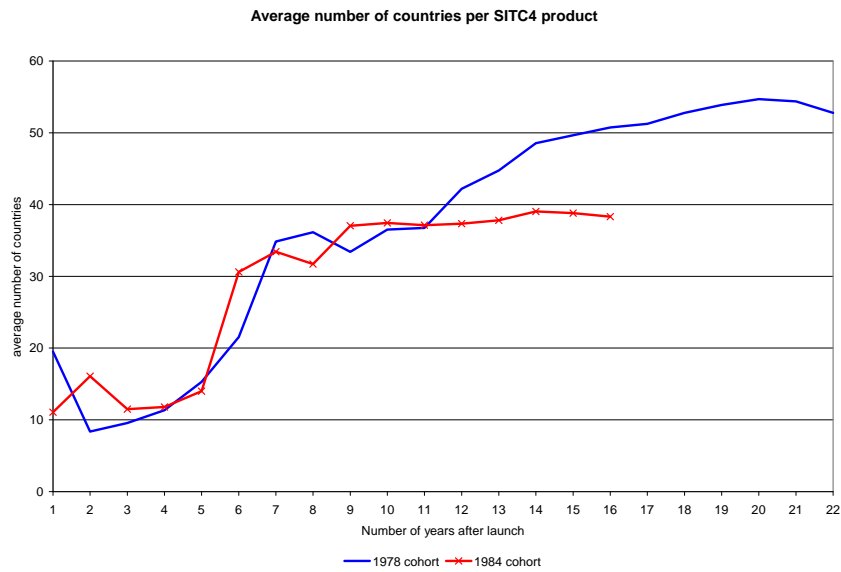


FIG.15 - Average number of countries per SITC4 product.

What is interesting is that in both cases, the average number of countries starts low, around 12, after 5/6 years it increases substantially - growing from 12/14 countries to 30/35 countries, and after 9/10 years after the launch it increases again but this time less than in the previous case. As I show next, this evolution pattern is not related to country distance, that is, the average product distance is basically the same since the first year of launch (eventually decreasing) and the reason why the average number of countries increases after 9/10 years is because the number of different SITC4 product categories decreases (see Figures 16 and 17). The SITC4 categories that disappear are SITC4 categories that were exported to a below average number of countries, and therefore the overall average number of countries per SITC4 category increases.

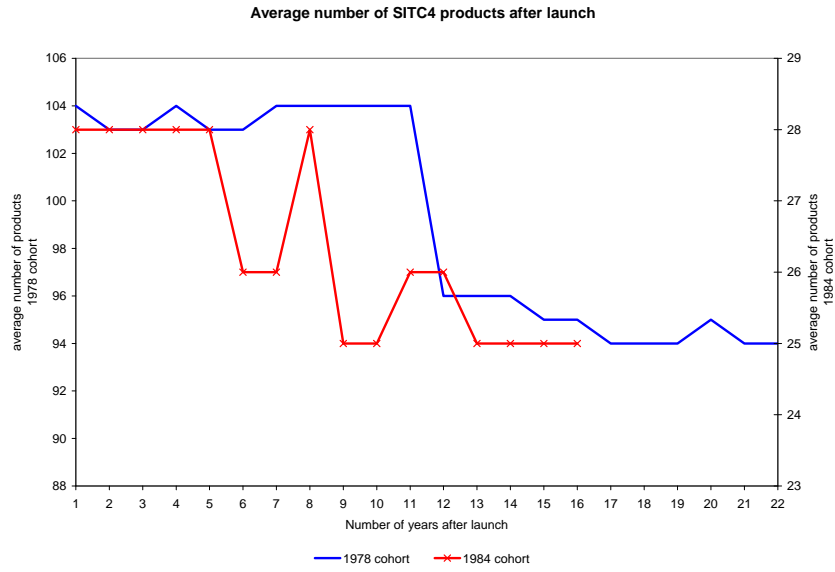


FIG.16 - Average number of SITC4 products after launch.

What this result suggests is that product innovation and consequently product experimentation can give rise to the existence of zeros in trade. Such zeros, nevertheless, have a completely different interpretation from zeros that may exist due to transportation costs or fixed costs of exporting. The zeros arising from product innovation, from an economic growth perspective, are actually very important and welfare enhancing.

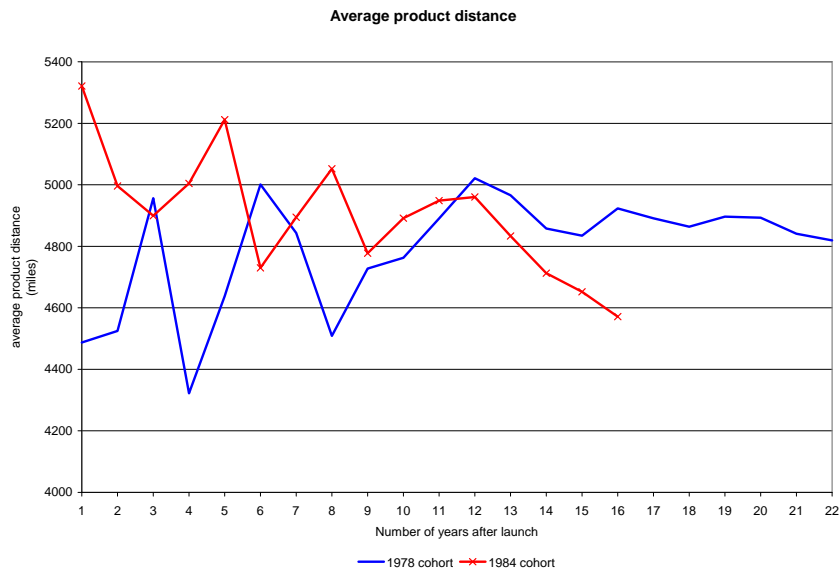


FIG.17 - Average product distance after product launch.

FIG.18 - Percentage of zeros by importing country - considering a time dimension equal to the sample period.

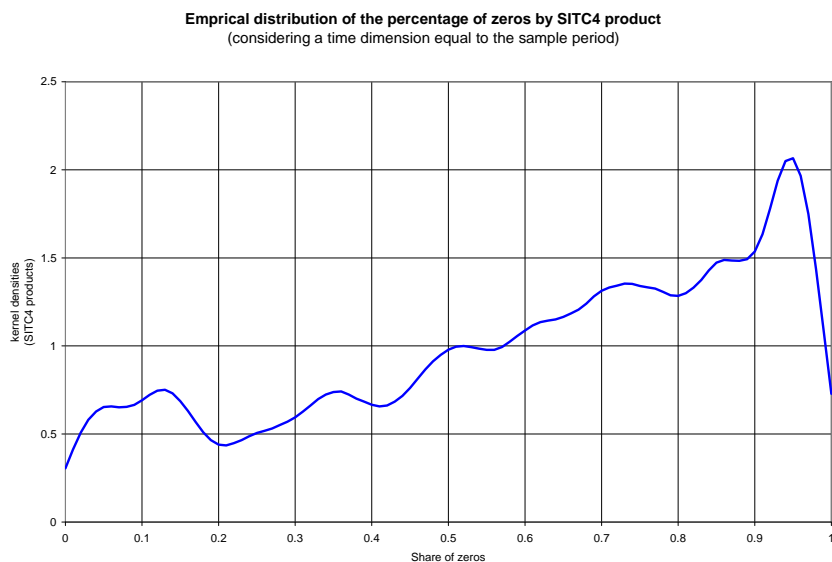


FIG.19 - Empirical distribution of the percentage of zeros by SITC4 product - considering a time dimension equal to the sample period.

Distance quintile	Mean	Median	Min	Max	Std.Dev.
1	21%	18%	10%	39%	8%
2	34%	27%	12%	71%	19%
3	41%	39%	16%	70%	17%
4	45%	40%	12%	92%	24%
5	37%	43%	9%	67%	20%

TABLE 5 - Percentage of zeros and country distance - considering a time dimension equal to the sample period.

Some of the previous results change slightly, yet others not very much. For example, in Fact 1 I showed that there was no SITC4 product that was always exported to all countries in all years. Figure 19, though, shows that when the time horizon is expanded, there is a significant percentage of products which were exported at least once to every country and there are many other SITC4 products which were exported to almost every country at some point in time. This result is more in line with a model like Eaton and

Kortum (2002) where there should exist some positive fraction of products for which a country would be the most efficient both producing and transporting. At the same time, this result highlights some of the dangers of using time insensitive models with time sensitive data.

Also interesting is the fact that even during a period of 38 years, there was no country that imported all the US products at least for one year. This suggests that either there is no demand for those goods, which is contrary to one of the central hypotheses of most current models of trade - preference for variety - or there is overlap in terms of what products each country exports. The cases of Canada and Mexico are particularly suited to illustrate this point. For these two countries there are around 10% of products that the US exported to at least some other country at some point in time, but never to Mexico or Canada. It seems obvious to me that transportation costs arguments are not very plausible here nor the fact that those markets are not large enough to compensate exporting there. Again, the interpretation of zeros in trade is very different here.

Fact 8 - The percentage of zeros is not affected by internal demand peaks, but decreases with internal demand troughs.

One of the hypotheses suggested in section 2 for the time evolution of zeros and non-zeros is internal demand absorbing most production and therefore it would not be possible to supply all different foreign markets. In order to test this idea I estimate periods of peak, normal and trough internal demand in the US. For this I use the Hodrick-Prescott filter to determine the cycle of the US internal demand (Consumption+Investment+Government spending) and based on the estimation of the cycle I define peaks and troughs to be the maximum and the minimum of the cycle conditional on the series of the cycle having crossed the zero line (or mean line). All other years are considered to be normal years. Based on this criteria, between 1962 and 1999 I estimate 4 years of peak internal demand - 1968, 1973, 1978 and 1989 - and 4 years of trough internal demand - 1971, 1975, 1982 and 1995. For peak, normal and trough internal demand years I compute the average percentage of zeros - Table 6 shows the results.

Internal Demand	Percentage of zeros
Peak	70%
Normal	70%
Trough	67%

TABLE 6 - Percentage of zeros vs. internal demand.

The results in Table 6 don't show any evidence of the percentage of zeros being affected by peaks of internal demand, instead, during internal demand trough periods, the percentage of zeros decreases. This result does not seem to be compatible with the idea of capacity constraints as normal and peak periods are very similar with respect to the percentage of zeros. But, it suggests that for some products, the internal and the external markets are substitutes. When the internal demand is not sufficiently strong, producers redirect their products to the external markets. If one thinks of trade as the result of matching buyers and sellers, and sellers have to pay a search fee depending on the distance of the buyer, then sellers would only export (find a buyer outside the country) if they are not able to find a buyer internally. In Table 7 I compute the average product distance in peak, normal and trough periods.

Internal Demand	Average "product distance"
Peak	4842
Normal	4861
Trough	4879

TABLE 7 - Average "product distance" vs. internal demand.

The results of Table 7 show that the average product distance increases when internal demand decreases, nevertheless, this difference is not statistically significant.

In Figure 20 I provide more evidence on the relationship between internal demand peaks/troughs and the occurrence of zeros.

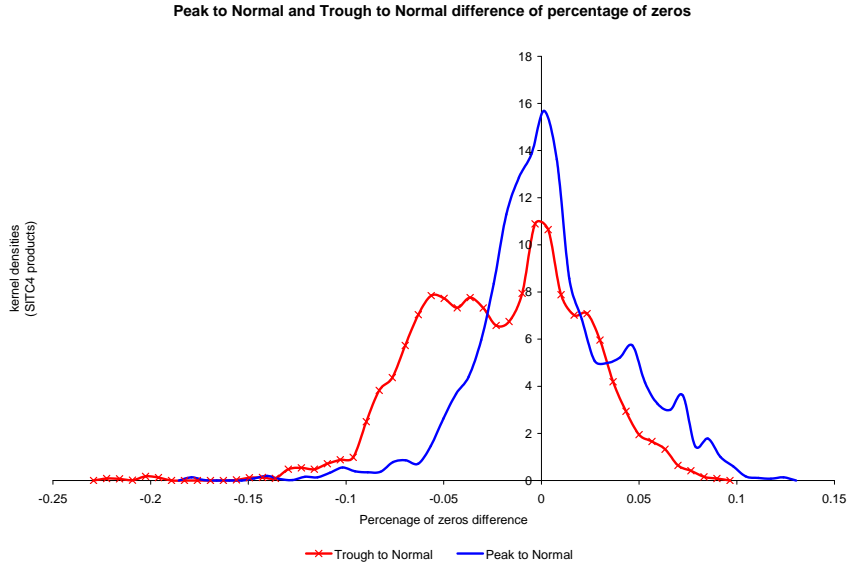


FIG.20 - Peak to Normal and Trough to Normal difference of percentage of zeros.

Figure 20 shows the difference between the percentage of zeros during peak and normal periods and between percentage of zeros during trough and normal periods for all SITC4 categories. The results of Table 5 are confirmed by the individual product data. While the difference between peak and normal periods is very centered around zero, the difference between trough and normal is bimodal, with one mode around zero and the other around -6%.

4. CONCLUSIONS

In this paper I analyze a large dataset on bilateral trade flows at the light of the idea of zeros in trade. This concept is of particular interest because it has a direct relation with some of the current mainstream models of trade - Eaton and Kortum (2002) and Guironi and Melitz (2005). In these two models the existence of transportation costs and/or sunk costs of exporting create inefficiencies in the market because of some trade flows that could exist but do not. Such inefficiency of the market induces a loss of welfare to society. One important point being made in this paper is that this line of thought is not fully correct and consequently it may lead to wrong policies. By focusing on US exports data disaggregated by SITC4 product and importer between 1962 and 1999 I

analyze the occurrence of zeros in trade both from a static and from a dynamic point of view. My findings are the following:

1) There are many zeros in trade, nevertheless, the time frame over which zeros are accounted for is very important. When only one year is considered the percentage of zeros is 70% while this value decreases to 39% if the entire sample period is used to count the zeros and non-zeros. This sharp difference suggests that any exercise that simply looks at the zeros in trade that occur in a time period of only one year is neglecting the possibility that not all products are consumed at the same rate - people buy food very frequently, buy clothes sometimes, and buy a car infrequently.

2) There is a high degree of heterogeneity in the occurrence of zeros both at the importing country level and the individual product level. Some of this heterogeneity is due to distance, in particular, the occurrence of zeros increases with the distance of the importing country. Nevertheless, there is still a high degree of heterogeneity within distance ranges; there are many countries that despite being closer to the US have a higher percentage of zeros than countries that are farther from the US.

3) The relationship between distance and the occurrence of zeros has changed over time, in particular, the elasticity between distance and percentage of zeros has increased from 0.2 to 0.6. This suggests that either the level of competition increased and with that it became harder to export or, there was a change in the way international trade is organized. One possible change to the way international trade is organized that would generate such outcome is an increase in foreign investment. If US firms invest abroad in order to serve the local markets, it will generate additional zeros that do not necessarily imply a loss of welfare.

4) Zeros are more persistent than non-zeros. The average probability of a zero in trade continuing to be a zero in trade in the next year is 93% while non-zeros continue as non-zeros with a probability of only 85%. Also related with the persistence of zeros and non-zeros is the fact that the percentage of zeros is positively correlated with the real exchange rate. Using regression and event study techniques I found that after an exchange rate appreciation the percentage of zeros reacts rapidly while it takes much longer to react in the case of the exchange rate depreciates. This result has several important implications.

First it provides some insight into how exchange rate fluctuations pass to consumers, in particular, it suggests that after an exchange rate appreciation some products exit the market and therefore the set of goods is not comparable over time. With this it creates a sampling bias towards slower adjusting products and therefore it gives the idea that exchange rate fluctuations pass through much slower. Second, because of the asymmetry of effects with respect to changes in the real exchange rate, it may be wise to devise policies that help firms re-enter markets faster as this is a very slow process.

5) New product introduction generates more zeros than average in the early years. The introduction of new products has 3 phases: experiment, expand and rationalize. In this case, there will be additional zeros in trade as products mature. Nevertheless, the interpretation of such zeros is substantially different. In this case it is not obvious if there is a loss of welfare. On the one hand during the initial years there are some potential markets that are not being explored from the beginning, but on the other hand if experimental markets have a cost, then in the case the product is not successful the losses from experimentation would be higher. In any case, the introduction of new products is fundamental for continued growth and therefore, zeros in trade that arise from product innovation are welfare increasing and not decreasing.

6) Periods of high internal demand do not generate additional zeros when compared to normal periods. This result suggests that the hypothesis of capacity constraints doesn't seem to be very plausible or binding. On the contrary, there is a significant decrease in the number of zeros in periods of low economic activity. This result suggests that for many producers internal and external markets are substitutes and not complements. In periods of high internal demand producers do not need to sell their products externally while in periods of economic slowdown producers are forced to find buyers externally in order to sell their products.

Overall this paper raises more questions than provides answers. In particular it would be interesting to see in future research what is behind the increase in the elasticity between distance and percentage of zeros (or market penetration). Is it due to an operational restructuring of production operations (e.g. FDI or outsourcing) or is it higher transportation costs? Another interesting question that is raised in this paper has to

do with the fact that after large exchange rate appreciations, many products exported from the US lost their external markets. This result may in part explain some of the literature on exchange rate pass through, which finds relatively low levels of exchange rate pass through. Finally, it would also be interesting to see how new products evolve for different countries. Is it the case that most new products evolve the same way new products in the US, or they have a different behavior? If so, why? Can the inability to expand to different markets explain part of the economic insuccess of some countries? Why do exports react positively to internal demand slowdown? Are the internal and the external markets substitutes or complements for firms?

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