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ABSTRACT

We investigate and compare countries' export growth based on their performance at the extensive and intensive export margins. Our empirical approach is motivated by an extension to the Melitz (2003) model of heterogeneous firms in which exporters are subject to a one-time sunk cost and also a per-period fixed cost. With imperfect information a firm may enter export markets but shortly exit when it learns its per- period fixed costs. We apply this insight to disaggregated export data and confirm that indeed most export relationships are very short lived. We then show that the survival issue is a significant factor in explaining differences in long run export performance. We find that developing countries would experience significantly higher export growth if they were able to improve their performance with respect to the two key components of the intensive margin: survival and deepening.

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An online appendix is available at:
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1 Introduction

This paper contributes to the emerging literature on the role of the extensive and intensive margins in the growth of trade. There is a considerable debate about the relative impact of each margin; some authors have concluded the extensive margin is the primary avenue for export growth (Hummels and Klenow, 2005) while others have found that the intensive margin plays the dominant role (Helpman, Melitz, and Rubinstein, 2008). We provide both new empirical support in favor of the primacy of the intensive margin and a new theoretical explanation. We show that comparing the value and number of export relationships at two points in time overlooks a tremendous amount of entry, exit, and churning in the intervening years. The frailty of new exporting explains both why many relationships are "missed" and the primacy of the intensive margin.

The frailty of export relationships is an important factor underlying the differences in long-run export growth across countries. A country's poor export performance is not because it struggles to start new relationships. Our results show that differences across countries in the propensity to *start* new relationships are muted by differences in export *survival*. For some countries about 7 of 10 new export relationships fail within two years; by comparison, more successful exporters experience failure at about half that rate. We also find hazard rates are not constant; almost all failure occurs within the initial four to five years of a relationship. The finding has a profound impact on export dynamics.

A model of trade with uncertainty explains our findings. In the canonical Melitz model firms incur a one-time sunk cost to enter export markets. Suppose firms also incur a per-period destination-market-specific fixed cost in order to maintain a presence in a foreign market (Arkolakis, 2008; Segura-Cayuela and Vilarrubia, 2008). With full information both models would yield similar predictions regarding the duration of export relationships — the sunk and per-period fixed costs imply that some export relationships would not be started,

but those that are started would be long-lived. With imperfect information, however, firms may enter markets but later determine they are unable to earn a profit, resulting in short lived new export relationships. There is a potential for a great deal of activity at the extensive margin due to uncertainty, most of which will fail to produce long-run export growth.

We conduct our empirical study using disaggregated bilateral manufacturing exports of 46 countries between 1975 and 2003. We characterize duration and growth of export relationships and examine implications for long term aggregate export growth. We decompose export growth into three distinct parts: (i) establishing new partners and markets, (ii) having relationships survive or persist, and (iii) having existing relationships deepen. We associate the entry channel with the extensive margin as it captures gross additions to the number of export relationships. We associate the latter two channels, survival and deepening, with the intensive margin as they speak to the depth or intensity of a country's trade.

We identify the importance of each channel for the aggregate growth of exports by performing a series of counterfactual exercises using successful developing countries as benchmarks. We ask how a country's exports would have grown had it had a different experience in each of the three dimensions. While our results confirm that the intensive margin is a crucial factor in the growth of trade, they do not imply that the extensive margin (entry) does not or cannot play an important role. Rather, we show that in a comparison of relative performance of the growth of exports, successful developing countries differ significantly from less successful ones along the intensive margin. Differences along the extensive margin are present, but are much smaller and typically in favor of less successful developing countries. While there are differences in the ability of countries to form new export relationships, more significant differences lie in their ability to maintain those relationships. Survival of export relationships is a necessary requirement for trade deepening and export growth, as poor survival prevents deepening from taking place.

2 Related Literature

The literature on the role of intensive and extensive margins in the growth of trade has reached two opposing conclusions. A number of papers have found the extensive margin to be quite important. Most prominent among these is Hummels and Klenow (2005) who examine cross-country differences and find the extensive margin accounts for 60 percent of the greater exports of larger economies. Evenett and Venables (2002) find expansion along the extensive margin played a significant role for the growth in developing country exports.

A large body of work has found the intensive margin to be more influential. Felbermayr and Kohler (2006) find it was a more important factor between 1970 and the mid 1990s, as do Helpman, Melitz, and Rubinstein (2008). Amiti and Freund (2010) find it plays a more important role in the growth of China's exports between 1992 and 2005. Eaton et al. (2008) find while up to one half of Colombian firms exporting in any given year are new, most export growth occurs on the intensive margin. Their finding of new firms exporting small amounts and facing high export failure rates is similar to our findings.

One factor confounding the reconciliation of the differing results is the different definitions of extensive and intensive margins used in the literature. Evenett and Venables (2002) define the extensive margin at the country-product level, Amiti and Freund (2010) at the product level, and Helpman, Melitz, and Rubinstein and Felbermayr and Kohler at the country level. Exports classified at the extensive margin by one approach would be classified at the intensive margin by another. For example, suppose in 1990 Brazil exports ball bearings to Argentina and Germany and steel pipe to Argentina. Then in 1992 Brazil starts to export steel pipe to Germany. Helpman, Melitz, and Rubinstein and Amiti and Freund would not classify these new exports as a change in the extensive margin, but Evenett and Venables would. If Brazil starts to export semiconductors to Argentina, Helpman, Melitz, and Rubinstein would not classify that as a change in the extensive margin, but both Amiti and Freund and Evenett and

Venables would. In effect, Evenett and Venables define the extensive margin broadly while Helpman, Melitz, and Rubinstein define it narrowly. These conceptual differences partly explain different results regarding the importance of the intensive margin. Like Evenett and Venables we define the extensive margin at the country-product level, which gives it the best chance to play a significant role. Unlike Evenett and Venables, however, we find the extensive margin has had only a small impact on long run export growth.

Despite this definitional difference, all of the above papers are similar in that they take a comparative static approach and compare exports in one year with exports in some later year.[1] As we document below, our analysis shows that doing so misses a great deal of, albeit short-lived, export activity. Our dynamic approach makes defining the extensive and intensive margins more complicated. In the static framework the extensive margin is defined as the number of relationships in a year, while the intensive margin is the average value per relationship. In a dynamic setting one must consider how to define changes on the extensive margin. A new relationship will clearly be a change in the extensive margin. The complication arises once it survives beyond year one. As it survives to the second year (and beyond), its contribution to export growth moves to the intensive margin in our approach.

We could alternatively define a relationship as being "new" if it is less than k years old. We choose not to pursue this approach for several reasons. First, choosing any $k > 1$ strikes us as purely arbitrary. Second, it would not be clear how to handle trade embodied in a relationship that ends in less than k years. For example, suppose $k = 5$ and consider a relationship that lasts only 3 years. How should one evaluate a relationship that is both new and dead within a given window? Furthermore, survival and deepening are occurring but are ignored because all trade for $k < 5$ is at the extensive margin. Third, given our empirical findings with respect to the declining hazard rate, many of our results would be qualitatively

[1]Felbermayr and Kohler (2006) discuss vintage accounting but do not explicitly consider the survival issue. Eaton et al. (2008), Freund and Pierola (2009), and Lederman, Rodríguez-Clare, and Xu (2010) examine year-to-year survival but do not take into account the full length of a relationship.

unchanged as long as k is not too large.

3 Theoretical Framework

To help us interpret our empirical findings, we sketch a model of trade based on the seminal work of Melitz (2003) extended by Segura-Cayuela and Vilarrubia (2008).[2] The key new element is uncertainty. While a firm may have a clear idea of its home market conditions and its costs of production, it may not know the level of demand abroad and/or have all information about ongoing costs associated with exporting. Imperfect information may lead a firm to start exporting to a destination market but soon thereafter find it optimal to cease exporting. Segura-Cayuela and Vilarrubia's (2008) extension allows them to explicitly discuss dynamic issues such as how long a firm will export to a given destination market.

There are $J + 1$ markets indexed by $j = 0, 1, \ldots, J$ where $j = 0$ denotes the domestic country. Time is discrete and indexed by t. At the beginning of each period firms make production and pricing decisions. At the end of each period firms that have not entered the export market make a decision whether to remain out and firms that are currently exporting make a decision whether to continue doing so.

The consumer-side of the market is standard. Agents consume a numeraire agriculture good and a bundle of manufactured goods. Consumers have CES preferences with σ denoting the elasticity of substitution between varieties of the manufacturing good. The demand for the homogeneous agricultural good is large enough that it is always produced.

Firms differ in terms of their marginal productivity of labor, the only factor of production. Firm productivity is characterized by φ. Each firm knows the productivity level of every other domestic firm and future profits are discounted at a per-period rate of β.

[2] Arkolakis' (2008) model is also related to this extension; however, his emphasis is on per-period marketing costs to expand initially low-value export sales. Also, Arkolakis does not explicitly examine the implications of marketing costs on duration.

There are additional costs to exporting. First, goods exported from country e to country i are subject to iceberg transportation costs $\tau^{ei} > 1$. Second, there is a one-time sunk cost that a firm in country e needs to pay in order to gain access to a foreign market i, c^{ei}. Third, there is a per period fixed cost, f^{ei}, that a firm of country e must pay each period in order to access country i.

A firm observes f^{ei} *only* after it accesses the foreign market. After learning the size of its per period fixed costs the firm can costlessly switch off its exporting operations to country i. In other words, given its productivity level (φ) the firm can deduce whether it's per period profits exceed the per period market-specific fixed costs. The additional cost of servicing the destination market implies that relationships with high f^{ei} will stop after the initial period.

The model can be extended to generate relationships of varying duration by allowing f^{ei} to vary over time. For example, suppose f^{ei} is serially correlated over time. A relationship with a sufficiently high initial value will end immediately. For one with a moderate initial value, duration will depend on the trend. A positive trend will result in a short duration and vice versa. A relationship with a sufficiently low initial value will generally be long lived.

Although the basic Melitz model does not predict relationships with short duration, a slight modification as suggested by Segura-Cayuela and Vilarrubia will generate relationships with varying duration.[3] As in the basic Melitz model, only "good" firms will start export relationships. However, unlike the basic Melitz model there is no guarantee that simply observing new export starts implies that exporting will be long lived. The ability for these new starts to generate long term export growth depends crucially on whether they survive. The fact that the uncertainty about the costs of servicing an export market is only resolved after the firm has started exporting means that we will potentially observe a significant amount of entry, exit, and churning. The model implies that a country whose firms face less (greater) uncertainty will have longer (shorter) export duration.

[3] An alternative interpretation is that firms need experience to learn about local market conditions.

4 Extensive and Intensive Margins

4.1 Data

Our data come from the UN Commodity Trade Statistics Database. We use export data of 46 countries between 1975 and 2003 recorded using the Standard Industrial Trade Classification Revision 1. We use 4-digit level data due to concerns about quality and consistency of both more disaggregated data as well as earlier years. Given that most countries' growth strategies focus on manufacturing (not agriculture) we restrict our attention to SITC industries Chemicals (SITC=5), Manufactured Materials (6), Machinery (7), and Miscellaneous Machinery (8).[4] The 46 countries export a total of 380 4-digit manufacturing industries to a total of 181 countries. There are 12,235,036 annual bilateral export observations (Table 1).

A key step in our analysis involves converting the annual data into spells of service for each trade relationship.[5] We define a trade relationship as exports of product x from country e to country i. Thinking of bilateral trade data in terms of relationships allows us to calculate survival and deepening rates. If a country exports the same product to the same country in two (or more) distinct non-overlapping spells of service, for example during 1978–1984 and again 1989–1994, we treat this as two independent spells.[6] We have data on 2,594,893 export spells (Table 1).

Given the number of countries we study, we present results for geographical regions — U.S., EU-15, India, East Asia, Caribbean, Central America, South America, Mexico, and Africa. We separate India from other East Asian countries as it is not usually associated with either the East Asian Tigers or East Asian Dragons. We also separate Mexico from Central America due to its strong trade ties with the U.S.[7]

[4] Our main findings are qualitatively unchanged if we consider all industries.

[5] Besedeš and Prusa (2006a) provide an in-depth discussion of applying duration methods to trade data.

[6] Our results are robust to alternative methods for handling multiple spells (Besedeš and Prusa 2006a, 2006b).

[7] Country specific results are available on request.

4.2 Extensive margin

We begin by providing summary statistics on the growth of trade and relationships in Table 2. The first column shows the growth of aggregate exports for each region. The second column presents the growth of country-product relationships, or what we call the extensive margin. A country can experience a change in its extensive margin by exporting to a country that had never been serviced, by exporting a product that had never been previously sold abroad, or by exporting an already exported product to an altogether new destination country.

In Table 2 we report several alternative measures of the extensive margin. Our definition (column 2) is similar to Eaton et al. (2008) and Evenett and Venables (2002).[8] Columns 3 and 4 report the growth at extensive margin as defined by Helpman, Melitz, and Rubinstein and Amiti and Freund, respectively. As seen, our approach creates the largest opportunity for the extensive margin to play an important role.

We have two comments on the positive relationship between the growth in exports and the growth of the extensive margin. First, there is a difference between the dynamics for developed and developing countries. The growth of exports is much higher than the growth in export relationships for more developed regions such as the U.S., EU-15, and East Asia. Developing regions of the Caribbean, Central and South America, and Africa have an almost one-to-one ratio of the growth of exports and the growth of export relationships. Second, these summary statistics intimate that the intensive margin might play a more important role than the extensive margin for developed countries but not developing countries. As we proceed, we will find that this inference is misleading because it ignores the short duration most relationships experience, especially those of developing countries.

East Asian countries experience the largest gains in the extensive margin, followed by Africa, India, and Central and South America. By contrast, the U.S. and EU-15 have

[8]Due to the nature of their data, Eaton et al. define the extensive margin at the country-firm level rather than the country-product level.

experienced small gains. One possible explanation is that the U.S. and EU-15 have already established nearly all export relationships and had little scope for gain. To verify this we create a metric for potential export markets and measure how many are active for each exporter. We need to define "potential" first. One definition would simply use the number of all country-product pairs.[9] This metric is too broad because it assumes a country can export every good to every country. This is simply not true.

We believe a better definition for "potential" export relationships between e and i captures whether a given product x is (1) exported by country e to *any* destination market and (2) imported by country i from *any* source market.[10] If country e does not have the ability to export x to any destination then we will say there is no potential market even if x is imported by other countries. Likewise, if country i does not ever import x then we will say there is no potential relationship even if country e exports x to other markets.

Product x is potentially tradable between e and i if the above two conditions hold. The first condition can be written as

$$P_e^x = \begin{cases} 1 & \text{if } V_{eit}^x > 0, \text{ for some } t \in T, \text{ for some } i \in C, \\ 0 & \text{otherwise,} \end{cases}$$

where V_{eit}^x denotes the value of e's exports of product x to i in year t, T denotes the set of years in our sample (1975–2003) and C denotes the set of countries. The second condition can be written as

$$P_i^x = \begin{cases} 1 & \text{if } V_{eit}^x > 0, \text{ for some } t \in T, \text{ for some } e \in C, \\ 0 & \text{otherwise.} \end{cases}$$

If both conditions hold then we will say product x is potentially tradable between e and i,

[9] This would give a potential size of 68,780 (380 products times 181 possible destination countries).

[10] With respect to product x country e (i) has comparative advantage (disadvantage) vis-à-vis some country.

$$P_{ei}^x = P_e^x \times P_i^x.$$

A potential relationship involving product x is *active* if e exports x to i at any time during our sample period,[11]

$$A_{ei}^x = \begin{cases} 1 & \text{if } V_{eit}^x > 0, \text{ for some } t \in T, \\ 0 & \text{otherwise.} \end{cases}$$

We define country e's utilization rate as the ratio of active relationships to potential relationships,

$$\text{Utilization}_e = \frac{\#\text{ active}_e}{\#\text{potential}_e} = \frac{\sum_i \sum_x A_{ei}^x}{\sum_i \sum_x P_{ei}^x}.$$

In column 1 of Table 3 we report the potential trade relationship utilization rate. For the U.S. and EU-15 the utilization rate is at 50–60%. For developing countries the fraction is significantly lower at 20–35%. Differences in the extensive margin may be partly due to the difference in utilization. Nonetheless, while developing countries have a larger scope for expansion of the extensive margin, developed countries appear to have a large scope as well.

Columns 2 and 3 of Table 3 give another perspective on the amount of entry or, said differently, the gross addition to the extensive margin. For each exporting country in each year t we calculate n_t^0/n_t, where n_t^0 denotes the number of relationships in their initial year of service and n_t denotes the total number of export relationships. In column 2 we average across countries and years and report the fraction of new relationships for each region. There are a lot of new export relationships, especially for developing countries. For all regions except the EU-15 and the U.S., at least 25% of all relationships are new in any given year.

[11] Whether a relationship is active will depend on a variety of factors such as trade impediments, the extent and source of comparative advantage, etc.

In column 3 we report a trade weighted measure of the size of the extensive margin, $(v_t^0 n_t^0)/(v_t n_t)$, where v_t^0 denotes the value of trade in a typical relationship in the initial year of service and v_t denotes the average value of trade for all relationships. The pattern is qualitatively very similar to that observed in column 2. The key difference is that trade values for new relationships are considerably smaller than those for established relationships. This further bolsters the view that new relationships can only have a meaningful impact on aggregate export growth if they survive and deepen — in their early years they are too small to have any appreciable effect on export growth.

A final comment on why we believe it is important to examine export dynamics and not just perform a point-to-point analysis. A comparative static approach compares trade in an initial year with some later year, in our case comparing trade relationships in 1975 with those in 2003. Doing so would not account for any export relationships that start and end during the intervening years. For all countries in our sample these ignored relationships add up to more than a half of all relationships. In column 4 we report the number of relationships that start after 1975 and end before 2003 divided by all relationships, what we call "missing" relationships. For South America almost 72% of all export relationships are neither active in 1975 or 2003. Similar numbers are found for other regions. A comparative static analysis over a long time frame will miss the lion's share of activity at the extensive margin.

4.3 Intensive margin

In contrast with existing studies of the intensive margin which focus on the volume of trade, we characterize the intensity of export relationships in terms of survival and deepening.

Survival

For each country we estimate the Kaplan-Meier survival function and present them in Figure 1. In our benchmark results we estimate a single survival function pooling across all industries and all years. For presentation purposes we pool the results to the regional level; we emphasize, however, that survival functions are estimated using individual country data. It is also instructive to think of the flip-side of the survival function, the hazard rate, which we present in Table 4.

There are a number of interesting results. First, and perhaps most striking, is the finding that export duration is remarkably brief.[12] As shown in Figure 1 the median survival time is 1 or 2 years for *all* regions. More than 50 percent of all export relationships fail within the first two years.[13] By the end of the second year about 53% of U.S. export relationships have failed, implying an average hazard rate of 32% in each of the first two years (Table 4). As striking as this result is, the U.S. actually does better than other regions.

Second, while most relationships end quickly, significant regional differences still emerge, both in short run and long run. In the first few years of service differences of 10 percentage points in survival are commonly observed. These differences persist over the longer run. Export relationships in regions like the U.S. and East Asia are far more likely to survive at least 15 years as those from developing countries. Specifically, about 20% of U.S. relationships but only about 10% of Central American and Caribbean relationships last at least 15 years.

Third, despite differences in the magnitude of failure, the survival experience is qualitatively similar across countries and regions. New relationships are much more likely to fail than existing ones. In Figure 1 this is seen by survival functions' steep slope over the first 6 to 7 years and then the flat slope over the remaining years. Said differently, relationships

[12]Similar results have been found by Brenton, Saborowski, and von Uexkull (2009) and Jaud, Kukenova, and Strieborny (2009) for exports, as well as Besedeš and Prusa (2006a, b) for imports.

[13]To be clear about terminology, failure occurs at the end of a year of service. The earliest we can observe failure is at the end of the first year of service; the next failure time is at the end of the second year, etc.

experience high hazard through the first 6 to 7 years. Thereafter, there is a fairly small risk of failure. The difference is sizeable: the hazard rate of new relationships can be as much as 100 times higher as that of established ones.[14] This point is reinforced by a comparison of the implied constant hazard rate[15] with the hazard rates at different times in a relationship (Table 4). As seen, the actual hazard rate in any year bears little resemblance to the implied average (or constant) hazard rate. Empirically most relationships end quickly which makes it unlikely an exporter can recover the sunk cost required to access an export market. This suggests the common assumption of a constant hazard rate is likely inappropriate.[16]

Deepening

In columns 1–3 of Table 5 we examine deepening of "long term" relationships, those that span the entire 1975–2003 period. In column 1 we report the fraction of 2003 relationships that were active in 1975. While 66% of U.S. export relationships remain intact, developing regions fare far worse. We also see that long term relationships embody the majority of trade for most regions (column 2). These results are similar to those in Felbermayr and Kohler (2006) and Helpman, Melitz, and Rubinstein (2008). Column 3 examines average annual deepening of long term relationships, showing sizable differences across regions.

Next we compare the year-to-year growth rate of relationships that span the whole sample (column 4) with those that started after 1975 (column 5). As expected given their relatively small initial export value, for most countries new relationships grow faster than established relationships. Of course, this comparison is based only on relationships that survive which means we are overstating the impact of the typical new start.

Column 6 offers another perspective on limited impact of new export relationship on

[14]Based on a comparison of the hazard rate in the first year of service (i.e., a new relationship) with the hazard rates for relationships intact for at least 10 years (i.e., established relationships).

[15]This is the average or constant hazard rate that matches the observed failure rate over years 1–15.

[16]Melitz (2003) and Bernard, Redding, and Schott (2007) develop models with this assumption.

growth. Here we report the fraction of export (value) that is accounted for by relationships that are less than six years old. As seen, the average ranges from a low of about 5% to a high of about 22%. Moreover, the highest values are for those regions where very few starts survive for longer than five years. Given results from Table 4 the ability of countries to capitalize on the higher growth rate of new starts is limited.

5 Decomposing Growth

Our results suggest high hazard rates may mute the impact of new relationships on long run export growth. We now examine the extent to which differences in extensive and intensive margins matter for a country's exporting success. In order to identify the impact each margin, we decompose export growth into three distinct channels: entry, survival, and deepening.

5.1 An Accounting of Changes in the Growth of Trade

In order to examine how the three channels affect export growth, we decompose exports. In any year t we can write the value of exports as

$$V_t = n_t v_t$$

where V_t is the value of exports in year t, n_t is the number of export relationships, and v_t is the average value per relationship. Export relationships consist of those that survive from $t-1$ to t, denoted s_t, and new relationships, denoted ε_t, so that $n_t = s_t + \varepsilon_t$.

Export growth from t to $t+1$ can be written as

$$(1) \qquad \begin{aligned} V_{t+1} - V_t &= n_{t+1}v_{t+1} - n_t v_t \\ &= s_{t+1}[v_{t+1} - v_t] - d_t v_t + \varepsilon_{t+1} v_{t+1} \end{aligned}$$

where s_{t+1} is the number of surviving relationships, $[v_{t+1} - v_t]$ is the per relationship growth of surviving relationships, d_t is the number of relationships that end in t with $d_t v_t$ denoting their total value, and ε_{t+1} is the number of new relationships with a total value of $\varepsilon_{t+1} v_{t+1}$.[17]

We can further refine our decomposition in two dimensions. First, the survival of each relationship depends on its age or years of service. Second, survival and hazard functions can be estimated at the industry level. Taking both of these into account we define

$$\begin{aligned} s_t &\equiv \left\{ s^0_{z,t}, s^1_{z,t}, s^2_{z,t}, \ldots, s^i_{z,t}, \ldots, s^I_{z,t} \right\}, \\ d_t &\equiv \left\{ d^0_{z,t}, d^1_{z,t}, d^2_{z,t}, \ldots, d^i_{z,t}, \ldots, d^I_{z,t} \right\}, \\ v_t &\equiv \left\{ v^0_{z,t}, v^1_{z,t}, v^2_{z,t}, \ldots, v^i_{z,t}, \ldots, v^I_{z,t} \right\}, \\ h_t &\equiv \left\{ h^0_{z,t}, h^1_{z,t}, h^2_{z,t}, \ldots, h^i_{z,t}, \ldots, h^I_{z,t} \right\}, \end{aligned}$$

where the subscript $z \in Z$ denotes the 2-digit industry to which the relationship belongs, the superscript i denotes the year of service, and h_t denotes the hazard rate of a relationship in industry z ending between $t-1$ and t. During the first year of service there is no failure. Hence, $s^0_{z,t}$ denotes the survival during the first year of a spell and by definition $s^0_{z,t} \equiv 1$ (by extension, $d^0_{z,t} \equiv 0$ and $h^0_{z,t} \equiv 0$). $s^1_{z,t}$ is the fraction of relationships that survive through the first year and into the second year of service. More generally, $s^i_{z,t}$ denotes the number of relationships between year $t-1$ and t that survive through the i^{th} year of service.

We can now rewrite (1) as

(2)
$$V_{t+1} - V_t = \sum_{z \in Z} \left\{ \sum_{i=1}^{I} \underbrace{\left[\left(1 - h^i_{z,t+1}\right) n^i_{z,t} \right]}_{\text{survival-stayers}} \underbrace{\left[v^i_{z,t+1} - v^i_{z,t} \right]}_{\text{deepening}} - \sum_{i=1}^{I} \underbrace{\left[\left(h^i_{z,t+1} n^i_{z,t} \right) v^i_{z,t} \right]}_{\text{failure}} + \underbrace{\varepsilon_{z,t+1} v^0_{z,t+1}}_{\text{entry}} \right\}$$

where I denotes the maximum potential year of service, $\left(1 - h^i_{z,t+1}\right)$ gives the percentage

[17] Eaton et al. (2008) decompose the growth of trade into continuing, entrant, and exiting firms on a pairwise basis – comparing only two adjacent years.

of surviving relationships between t and $t+1$, and $\left(1-h^i_{z,t}\right) n^i_{z,t}$ gives the total number of surviving relationships between t and $t+1$ in the i^{th} year of service. $[v^i_{z,t+1} - v^i_{z,t}]$ represents deepening or growth of trade for surviving relationships, $h^i_{z,t+1} n^i_{z,t}$ gives the number of relationships that end in year $t+1$, $\left(h^i_{z,t+1} n^i_{z,t}\right) v^i_{z,t}$ gives their total value, and $\varepsilon_{z,t+1} v^0_{z,t+1}$ gives the value of new entrants in year $t+1$.

Equation (2) is our decomposition of the growth of exports into what we interpret as the extensive and intensive margins. The intensive margin is comprised of deepening and survival. Higher survival (lower hazard) results in more relationships (more stayers and fewer failures). The final term captures the extensive margin. We emphasize that year of service (denoted by the superscript i) must be accounted for because of the radically varying hazard rates across spell length. As discussed above, relationships are far more likely to fail in earlier years of service. The hazard rate of new relationships can be as much as 100 times higher than that of established ones. Each summation begins at $i = 1$ because we can only talk about survival and exit after the end of the first year of service. Similarly, the last term pertaining to new relationships only contains $i = 0$ which denotes the initial year of service.

One important issue that must be recognized when studying differences in the extensive margin is the impact of country size. In particular, country size affects the *number* of new starts. A large country like the United States clearly has a greater capacity to service more markets than a small country like Costa Rica. Therefore, we compare entry rates rather than the absolute number of new starts.

To perform our counterfactual exercises we will substitute the performance of an alternative country in the above decomposition. We calculate the export performance of country e had it had some other country's survival ($h^{\mathrm{CF},i}_{z,t+1}$), deepening ($v^{\mathrm{CF},i}_{z,t+1} - v^{\mathrm{CF},i}_{z,t}$) and entry ($\varepsilon^{\mathrm{CF}}_{z,t+1}$), where superscript "CF" denotes counterfactual values.

5.2 Results

We now consider the counterfactual results using two countries that have experienced strong export growth: South Korea and Spain. We chose South Korea as an example of a high achieving developing country. It is unusual in the sense that it is a superior performer in nearly every dimension: it has experienced substantial overall export growth, has had very good survival and deepening performance, and has also demonstrated very good ability to expand along the extensive margin. However, South Korea (and the East Asian economies in general) might have too many institutional and cultural peculiarities to serve as a realistic comparison for other developing countries. Mindful of this concern, we also consider Spain as the counterfactual country. Spain had good, but not spectacular export growth.

To provide some sense of South Korea's and Spain's export performance, Tables 2 through 5 contain information on their intensive and extensive margins. Along many dimensions the tables suggest that they are good comparison countries. Perhaps the best indicator is revealed by the ratio of the growth of aggregate exports and the growth of the number of export relationships (columns 1 and 2 of Table 2). In terms of aggregate export growth the comparison countries are similar to developing countries. On the other hand, in terms of the ratio of the growth of exports to the growth in the number of relationships they are similar to developed countries. Overall, the export performance of South Korea and Spain bears some similarity to both developed and developing countries.

In Table 6 we present results for the counterfactual exercise.[18] We estimate each country's hazard rates pooling across all industries and vintages. That is, we estimate $h^i_{z,t} \equiv h^i$.[19] In Figure 2 we show the evolution of counterfactual exports for several developing regions with

[18]Due to data limitations we perform our counterfactual exercises for the Caribbean through 2002.

[19]We conducted additional robustness exercises where this restriction was relaxed. We allowed each country's hazard rates to vary by 2-digit industry. We performed a very flexible specification where we allowed each country's hazard rate to vary by year of service, industry, and starting year. We also dropped the top 10% of industries to see if our findings are driven by a few strong performers. Results are consistent with those presented in the paper and are available upon request.

South Korea as the counterfactual performer.[20]

In the first column of Table 6 we present average annual (real value) aggregate export growth for each region between 1975 and 2003 period. Moving across the table we report the *change* in the annual export growth that would occur for each of the three key factors (survival, deepening, and entry) under the specific counterfactual exercise. We consistently find large effects under the counterfactual survival and deepening, but small ones due to entry. In most cases we find the deepening impact to be larger than that for survival, but in nearly all comparisons the impact of both is economically significant.

For instance, we see Central American countries experienced export growth of 4.5% over the period. If Central American countries had South Korea's survival experience but no change to their actual deepening or entry their exports would have experienced a 1.5 percentage points higher annual growth rate (i.e., would have been 6% instead of 4.5%). If they had South Korea's deepening but no change to their survival or entry, their exports would have had a 3.4 percentage points higher annual growth rate. Finally, if they had South Korea's entry but survival and deepening were unchanged, their exports would have experienced a 1.4 percentage points *lower* annual growth rate. As depicted in Figure 2 over the long 1975–2003 horizon, a one percentage point higher annual growth (say, from better survival) maps into a huge increase in exports.

Africa stands out as a region where poor performance at the intensive margin has a large impact. In the benchmark counterfactual, we find African exports would have had a 3 percentage points higher growth rate if it had South Korea's survival and a 1.8 percentage points higher growth rate if it had South Korea's deepening. Taken together, better performance at the intensive margin would have generated almost twice the export growth that Africa actually experienced. It seems clear that Africa's poor survival must be addressed if it hopes

[20] A similar figure for Spain is available upon request.

to better its export performance.[21]

Results with Spain as the counterfactual country reinforce South Korean counterfactuals. In particular, we again find that the intensive margin dominates the extensive margin. For virtually all regions we find that substituting Spain's entry rate would lower exports and that the impact is quite small. By contrast, we find that most regions would have had faster export growth if they had Spanish survival or deepening.

Overall, the counterfactuals clarify the relative impact of each of the three dimensions. First, we find that changes along the extensive margin have little impact on a country's export growth. In almost every comparison we find the impact to be small, often around $+/-0.2$ percentage points. Interestingly, when we find a larger impact, the effect is generally negative, meaning that substituting South Korean or Spanish extensive margin performance would result in lower export growth. The small, and often negative impact, suggests that high failure rates during the first few years of most export relationships mostly make new starts moot. That we find the counterfactual entry impact to be negative indicates that South Korea's and Spain's strong export growth is not being driven by their superior extensive margin performance. By thinking of exports in terms of relationships, we find that the extensive margin seems to play a fairly minor role in determining long run export growth.

Second, our results reveal that what appear to be fairly small differences in survival rates can create significant differences in long-run export growth. Over the first two years South Korea's average hazard rate is 37% which appears to be only slightly superior to Central America's average of 42% (Table 4). As our counterfactuals show, however, the long run impact is quite substantial. Over the 1975–2003 period South Korea's superior survival translates into a 1.5 percentage point higher annual growth for Central America — which cumulates to 50% larger exports than they actually achieved by 2003.

[21] This conclusion is supported by Cadot et al. (2010) who find that less than 20% of new export relationships of Malawi, Mali, Senegal, and Tanzania at the firm-product level survive beyond the first year.

Third, counterfactual results confirm the importance of export deepening. For example, in the benchmark simulation Central and South America would have experienced a 3.4 percentage point faster export growth if they had South Korea's deepening. Caribbean countries would have experienced a 5.9 percentage point faster export growth with South Korea's deepening. Similar results are found in the Spain counterfactual. We also note that Mexico's deepening performance is much stronger than either South Korea or Spain. This is very much related to Mexico's post-NAFTA performance.

Fourth, in contrast to the surprisingly large impact of small differences in survival, large differences in deepening often have modest impact on annual export growth. This highlights the crucial role played by survival. The case of Africa is particularly illustrative. Spain's mean deepening rate is 7.2%, far larger than Africa's 2.6%. Yet, over the sample period the impact on long run growth is modest — Africa would experience only a 0.2 percentage point higher export growth with Spain's deepening. The reason is poor survival. African relationships simply do not last long enough for markedly different deepening rates to matter. Thus, while better survival and better deepening both foster faster export growth, better survival is a necessary condition allowing deepening to take place and improve export growth.

6 Concluding Comments

Our results confirm the findings of Felbermayr and Kohler (2006), Eaton et al. (2008), and Helpman, Melitz, and Rubinstein (2008) who find the majority of the growth of trade is due to the intensive margin rather than the extensive margin. While Helpman, Melitz, and Rubinstein conjecture the Evenett and Venables (2002) developing country sample is not representative and that some growth in trade was misclassified to be on the extensive margin, our analysis provides additional insight for the difference in findings. First, export survival for developing countries is shorter than that for developed countries. As a result,

new export relationships generate far less export growth for developing countries.

Second, similar to Evenett and Venables we find that the fraction of 2003 export relationships surviving from 1975 to be far smaller for developing than developed countries. While this could indicate that new relationships are more important for developing countries, we find that for many developing countries new relationships rarely last more than two years.

More generally, our paper implies researchers need to be cautious in interpreting changes in the extensive margin as an indication of export success. For example, Debaere and Mostashari (2010) and Kehoe and Ruhl (2009), document large changes in the extensive margin following NAFTA. While the unique nature of Mexico–U.S. trade likely gives rise to longer lived export relationships, as a general rule point-to-point comparisons (e.g., 1990 vs. 1999) are uninformative if relationships are mostly short-lived. A relationship started in, say, 1998, may well not be active in 2000.

Our findings also extend the insight of Hausmann and Rodrik (2003) who argue that developing countries' shortcomings at the discovery stage are an important explanation for limited export success. Our paper indicates their explanation is only a part of the story for even when new export markets are discovered the relationship often fails within a few years.

Finally, one must be cautious in applying our results to policy prescriptions. We have not uncovered the underlying explanation for the poor survival performance of developing country exports. Until we know whether it is a manifestation of comparative advantage or due to structural reasons, be they poor infrastructure or poor business environment, it is not clear how survival could be improved and at what cost. While our model and results suggest that informational uncertainty can explain why so many export starts end quickly, there may be other possible explanations for the phenomenon.

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Figure 1 − Export Survival

Country level data pooled to regional level

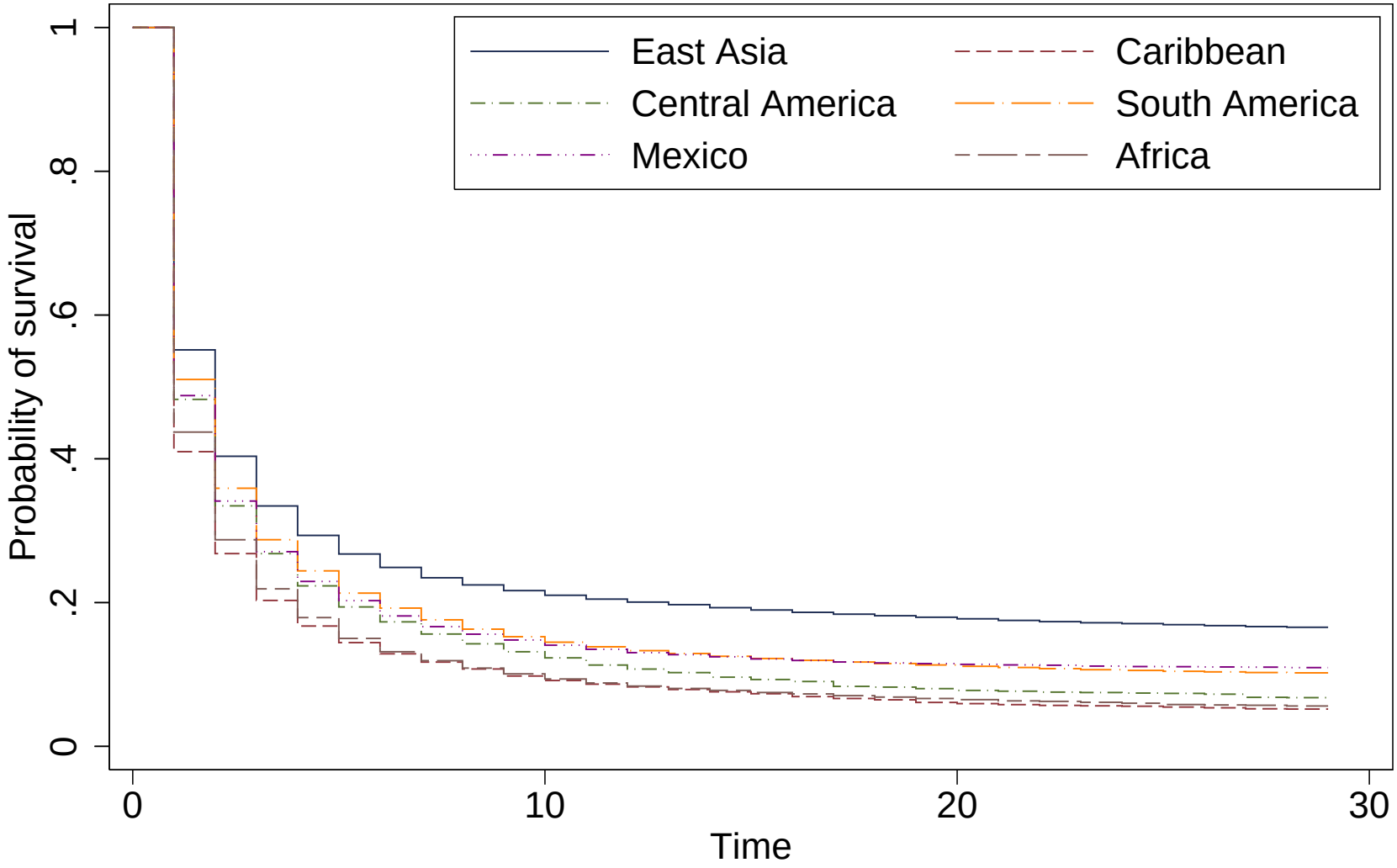

Figure 2 − South Korea as Counterfactual Performer

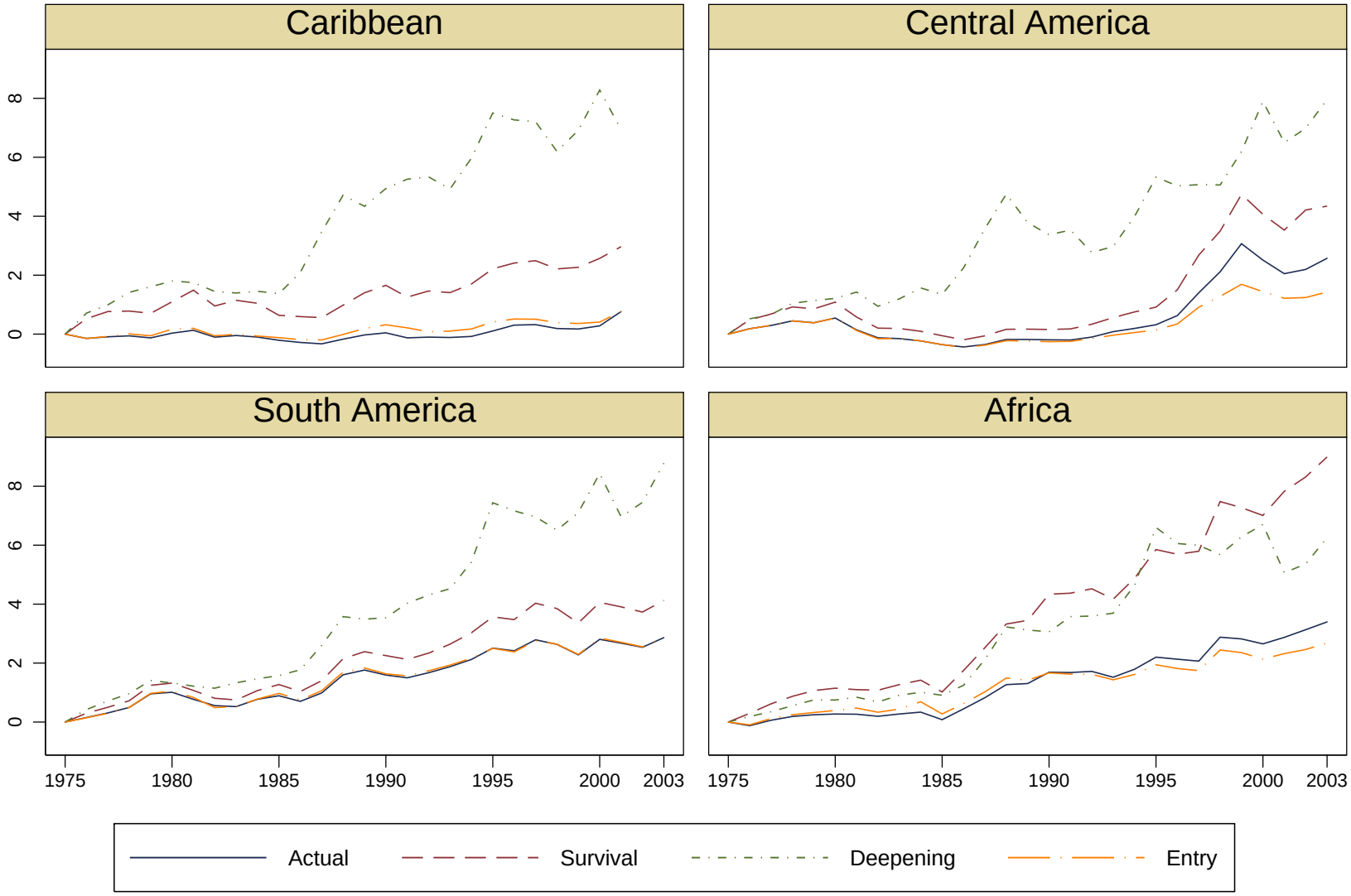

Table 1 - Data snapshot

Region	Country	Annual observations	Spells
USA	USA	879,998	136,519
EU-15	Austria	491,619	102,431
	Bel.-Lux.	663,650	136,046
	Denmark	451,626	100,710
	Finland	298,607	70,651
	France	954,651	141,234
	Germany	1,039,793	137,490
	Greece	174,420	54,228
	Ireland	200,962	58,026
	Italy	887,177	150,052
	Netherlands	677,529	131,921
	Portugal	214,649	60,617
	Spain	567,516	115,207
	Sweden	502,450	100,494
	United Kingdom	994,530	158,051
India	India	388,573	107,926
East Asia	Indonesia	149,637	46,715
	Malaysia	206,859	57,055
	Philippines	101,601	32,079
	Singapore	354,752	78,939
	South Korea	385,170	87,150
	Thailand	238,572	81,567
Mexico	Mexico	192,462	53,771
Caribbean	Barbados	23,246	8,996
	Jamaica	21,485	8,259
	Trinidad and Tobago	36,432	13,127
Central America	Costa Rica	41,681	13,197
	El Salvador	27,412	9,028
	Guatemala	41,310	13,379
	Honduras	15,484	6,914
	Nicaragua	12,456	5,689
South America	Argentina	137,992	39,691
	Bolivia	12,076	5,829
	Brazil	311,480	73,143
	Chile	74,921	25,604
	Colombia	91,055	26,462
	Ecuador	23,652	9,837
	Paraguay	8,261	3,528
	Peru	60,610	21,522
	Uruguay	30,311	10,166
	Venezuela	63,261	24,044
Africa	Algeria	9,718	5,869
	Egypt	56,977	24,619
	Madagascar	12,983	6,536
	Morocco	56,421	20,865
	Tunisia	49,009	19,710
	TOTAL	**12,235,036**	**2,594,893**

* Year coverage is 1975-2003 for all countries except Thailand (1975-88, 1990-2003), Nicaragua (1975-87, 1989-2003), Peru (1975-81, 1983-2003), Madagascar (1975-86, 1991-2003), and Morocco (1975-70, 1971-2003).

Table 2 - Export and Extensive Margin Growth Rates, 1975-2003

	(1)	(2)	(3)	(4)
Region/Country	**Growth of Exports**	**Growth in Export Relationships (Evenett and Venables)**	**Growth in Countries Exported to (Helpman, Meltiz, Rubenstein)**	**Growth in Exported Industries (Amiti and Freund)**
USA	154%	17%	12%	1%
EU-15	153%	41%	19%	2%
India	556%	215%	26%	8%
East Asia	1601%	369%	74%	24%
Caribbean*	49%	75%	85%	18%
Central America	257%	237%	106%	77%
South America	286%	203%	85%	56%
Mexico	3206%	142%	21%	11%
Africa	340%	267%	81%	54%
South Korea	1129%	290%	31%	15%
Spain	569%	104%	29%	5%

* Through 2002

Table 3 - Trade Potential and Long-term Relationships, 1975-2003

Region/Country	(1) Trade Potential Utilization Rate	(2) Fraction of Relationships that are New (avg.)	(3) Value-weighted Fraction of Relationships that are New (avg.)	(4) Fraction of Relationships Not Observed (end-to-end)
USA	60.2%	12.6%	0.8%	64.2%
EU-15	50.5%	16.3%	0.7%	63.2%
India	34.5%	27.1%	3.2%	69.6%
East Asia	32.2%	27.1%	2.9%	67.1%
Caribbean*	20.9%	35.3%	7.6%	75.1%
Central America	23.2%	32.9%	5.9%	73.9%
South America	28.3%	29.0%	5.2%	71.9%
Mexico	31.8%	28.3%	3.2%	75.9%
Africa	18.0%	41.5%	7.7%	77.3%
South Korea	38.7%	23.9%	2.2%	73.5%
Spain	46.9%	19.0%	2.1%	69.8%

* Through 2002

Table 4 - Hazard Rates and Propensity to Fail

	Hazard Rates			
	Constant	Years of Service		
Region	**(15 Years)**	**1 & 2**	**3–5**	**6–15**
USA	0.096	0.32	0.11	0.04
EU-15	0.116	0.35	0.12	0.04
India	0.119	0.38	0.14	0.04
East Asia	0.106	0.36	0.13	0.03
Caribbean	0.148	0.49	0.19	0.07
Central America	0.146	0.42	0.16	0.07
South America	0.140	0.40	0.16	0.05
Mexico	0.132	0.41	0.15	0.05
Africa	0.146	0.48	0.20	0.07
South Korea	0.108	0.37	0.13	0.03
Spain	0.105	0.35	0.13	0.04

* Average failure rates computed directly from number of surviving relationships

Table 5 - Export Deepening, 1975-2003

	(1)	(2)	(3)	(4)	(5)	(6)
	Long Term Relationships			Median Growth Rate (yr-to-yr survivors)		
Region/Country	Fraction of 2003 Relationships	Fraction of 2003 Trade Value	Annual Growth Rate of Trade Value (Intensive)	Long Term	New	Fraction of Trade <= 5 yrs (avg)
USA	66.4%	93.1%	3.4%	2.1%	2.5%	4.1%
EU-15	53.1%	90.1%	3.3%	3.1%	5.9%	3.7%
India	26.5%	72.5%	6.6%	7.0%	12.5%	13.3%
East Asia	17.8%	56.7%	8.7%	6.0%	7.9%	12.1%
Caribbean*	34.7%	53.1%	-1.1%	0.1%	1.5%	22.6%
Central America	21.0%	37.0%	1.6%	2.3%	5.3%	22.2%
South America	23.9%	61.0%	3.7%	1.2%	3.7%	22.1%
Mexico	33.1%	94.5%	13.7%	5.7%	4.7%	10.6%
Africa	14.2%	60.8%	7.1%	2.2%	3.5%	18.5%
South Korea	40.2%	86.4%	6.8%	5.9%	8.6%	8.8%
Spain	21.1%	52.6%	7.0%	4.3%	8.0%	8.6%

* Through 2002

Table 6 - Decomposition of Trade Growth

		South Korea			Spain		
	Actual	Surv	Deep	Entry	Surv	Deep	Entry
USA	3.3%	-0.2%	3.4%	0.0%	-0.1%	2.9%	-0.0%
EU-15*	3.3%	0.1%	1.9%	0.1%	0.1%	2.7%	-0.0%
India	6.7%	0.2%	-0.3%	-0.1%	0.4%	-0.2%	-0.4%
East Asia**	11.2%	0.3%	-1.6%	-0.8%	0.4%	-2.1%	-0.7%
Caribbean***	0.4%	3.5%	7.4%	0.5%	3.7%	6.3%	0.0%
Central America	4.5%	1.5%	3.4%	-1.4%	1.7%	1.1%	-1.8%
South America	4.8%	1.0%	3.4%	0.0%	1.2%	2.0%	-0.2%
Mexico	12.8%	0.6%	-4.4%	0.3%	0.7%	-5.8%	0.1%
Africa	5.2%	3.0%	1.8%	-0.6%	3.2%	0.2%	-0.9%

* Excluding Spain when it is the counterfactual country

** Excluding South Korea when it is the counterfactual country

*** Through 2002