Trade Integration and the Fragility of Trade Relationships: Theory and Empirics

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Abstract

We provide a theoretical framework to analyze the effects of economic integration agreements on the stability of trade relationships. We examine how the establishment of an economic integration agreement affects the value of trade at the start of a new trade relationship, the length of a trade relationship, and the growth of trade within a relationship. Our findings indicate an interesting dichotomy in the effect of an agreement on already active and new trade relationships: already active relationships become longer and grow more, while new relationships are shorter, grow less, and start with smaller values. Agreements increase entry of relationships.

JEL Codes: F13, F14, F15
Keywords: economic integration, agreements, survival, growth

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1 Introduction

Over the last few decades, economic integration agreements (EIAs) have become increasingly common. As Figure 1 illustrates, few agreements were in existence 50 years ago, covering just over 1% of all country pairs.[1] By 2005 this share had risen to over 20%. More notably, more than one half of world trade now takes place between countries with an agreement. In view of the growing importance of EIAs, we examine their effect on patterns of trade, focusing, in particular, on the stability of product-level trade relationships.

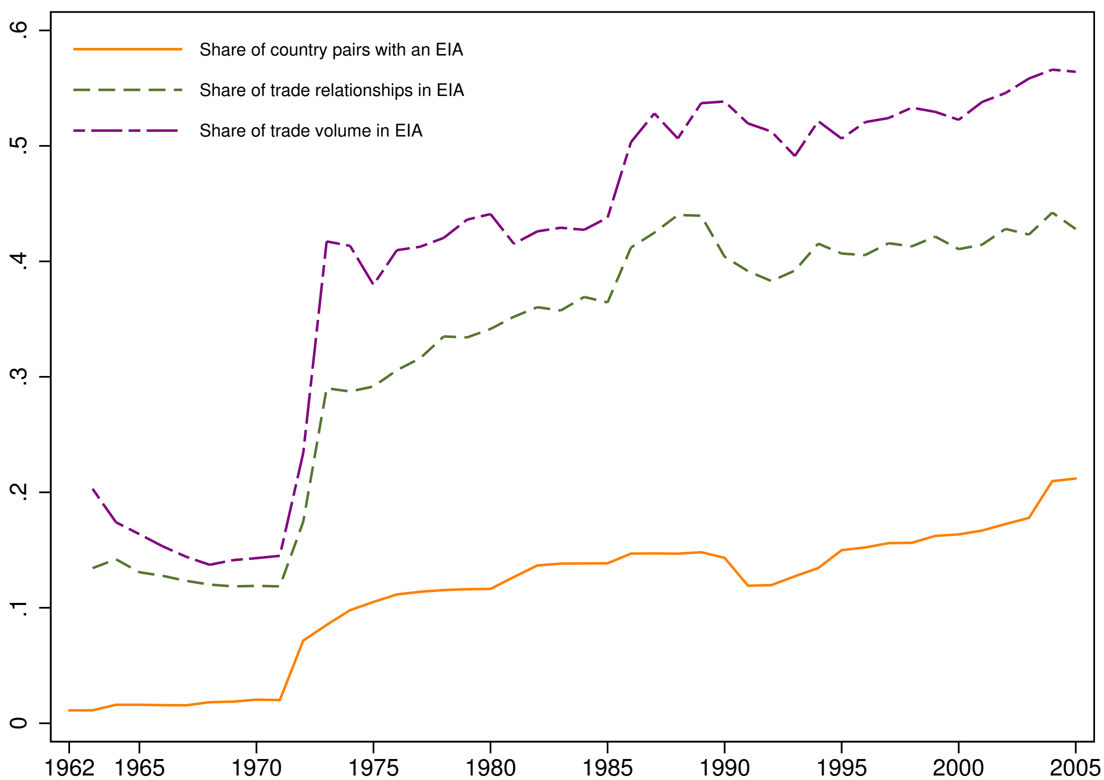

Figure 1: **Growing Relevance of Economic Integration Agreements**

To guide our empirical analysis, we develop a dynamic model of international trade which allows us to track the entire evolution of a trade relationship: its initial

[1]This figure is similar to Figure 1 in Bergstrand, Egger, and Larch (2016). However, in contrast to their figure, which is based on data on preferential trade agreements, free trade agreements, and currency unions only, our plot uses data on all types of available agreements.

size, duration, and rate of growth over time. We do so by combining the heterogenous firm model of Melitz (2003) with Klepper and Thompson's (2006) model of industry evolution, the former guiding the firm's decision to enter a market and the latter describing the evolution of the trade relationship. As is common in most models of trade with heterogeneous firms, the decision of a firm to enter a market depends on its productivity and the characteristics of the destination market: size, trade barriers, and the competitive environment. In our model, however, the decision to enter a market is only part of the story. Upon entry, we require a firm to match with a possible buyer in the country of destination. If successful, both parties establish a business relation. Using this set-up we are able to track the evolution of trade relationships, which are the aggregation of business relations across the same country of origin and country of destination in a specific product category. Thus, a trade relationship exists due to the activity of at least one exporting firm.

Our parsimonious model delivers a rich set of predictions about the dynamic evolution of disaggregated trade. The first set of predictions pertains to the survival and growth of trade relationships and formalize by now established results in the duration of trade literature. Trade relationships can and do cease to exist, with the probability of ceasing becoming smaller the longer they are active and the larger in size they are. Buyers in the destination market, however, appear and disappear following a process that is independent of the exporting firm. This independence of the two processes allows for the possibility of the exporting firm to re-enter a market and begin exporting again after some period of not having exported to a particular destination. In our data set 55% of all trade relationships are active in multiple distinct spells, each separated by a period of inactivity. Allowing for re-entry of a once abandoned market is a new feature in this literature. Similarly, trade growth slows as a trade relationship matures and grows in size.

The second set of predictions revolves around the effect of economic integration agreements. Trade relationships which are already active at the time when an agreement begins benefit from the agreement by becoming less likely to cease (and, therefore, longer in duration) and by growing faster. In contrast, trade relationships that begin after the agreement are more fragile: they are more likely to cease and grow less. Finally, the establishment of economic integration agreements results in an increase in entry and creation of new trade relationships as more firms are able to export once an agreement reduces costs of trading.

We find strong empirical support for these predictions analyzing annual imports at the 5-digit level of the SITC revision 1 classification for all countries available in the UN Comtrade database over the period from 1962 to 2005. The object of our investigation is a trade relationship defined as a country exporting a product to a trading partner, for example, Argentina exporting beef to the United States. Using data from the Database on Economic Integration Agreements constructed by Scott Baier and Jeffrey Bergstrand (2007), we examine the effect of trade liberalization on the initial value of trade of new trade relationships, their duration, and their growth while they are active. In line with our theoretical predictions, we find that longer lived and larger trade relationships grow less and are less likely to cease after the agreement. More notably, economic integration makes already active trade relationships more stable, while those starting after the agreement are, on average, less stable. We show that agreements result in increased entry and more trade relationships between the countries that sign an agreement.

While much effort has been dedicated to investigating the effects of economic integration agreements on aggregate patterns of trade, their effects on disaggregated trade outcomes remain unexplored. In a seminal contribution Baier and Bergstrand (2007) argue that aggregate trade between two countries that sign a trade agreement doubles after ten years. Little is understood about how such an increase in aggregate trade occurs at a disaggregated level. One possibility is that all existing trade relationships between the two countries double in magnitude in the ten years after signing an agreement. However, this simplistic possibility is almost surely wrong as it would entail that trade agreements only have an effect on the intensive margin. On the contrary, since trade agreements reduce the costs of doing cross-border business, they are bound to have an effect on the extensive margin, ushering the creation of new trade relationships. Often this is one of the motivating factors behind signing a trade agreement, to open doors of new trading opportunities. Baier, Bergstrand, and Feng (2014) indeed show that trade agreements do have an effect on both the intensive and extensive margins, with the former effect dominating in the short run.

The finding that trade agreements affect the extensive margin raises additional questions about their effects on patterns of trade. In our analysis, we differentiate between trade relationships that started before and after the agreement itself. In particular, one might expect pre- and post-agreement relationships to be structurally different as it is likely that a good number, if not the majority, of post-agreement relationships will tend to be relationships which become feasible because of the agreement. Therefore, our effort aims to provide a more granular understanding of the intensive and extensive margin effects identified by Baier, Bergstrand, and Feng (2014).

2 Literature Review

Our analysis contributes to an increasing literature that relates to export dynamics. Most of this literature concentrates on the expansion of the geographical coverage of trade as a firm continues to access more distant markets. Chaney (2014), for instance, provides a theory and evidence on the expansion of trade networks and the dynamic evolution of trade frictions. Albornoz et al. (2012) and Defever, Heid, and Larch (2015), using a simpler model of market access, provide evidence that current export relationships influence the decision of where to export next. Complementary to these findings, we provide the first theoretical model able to truly capture the dynamic evolution of existing trade relationships.

Our model is related to a recent set of papers that focus on the destination market, more so than on the firms in the country of origin. Bernard, Moxnes, and Ulltveit-Moe (2018) show that heterogeneity in the characteristics of buyers in the destination market matters for explaining trade relationships. Using highly disaggregated Norwegian data, they find that the extensive margin of the number of buyers plays an important role in explaining the variation in exports at the aggregate level and at the firm level. Carballo, Ottaviano, and Volpe Martincus (2018) use highly disaggregated data from Costa Rica, Ecuador, and Uruguay to show that while most firms serve only very few buyers abroad, the number of buyers and the skewness of sales across them increases with size and accessibility of destinations. Because we assume the process that generates buyers varies across destinations, our model is able to explain some of the results in these papers.

We contribute to a large and still growing literature that aims to examine the effects of economic integration agreements on trade. The majority of papers in this literature focus on aggregate effects of integration agreements typically using the gravity framework.[2] The most disaggregated approach is offered by Anderson and Yotov (2016) who analyze 2-digit manufacturing trade data. In contrast to these papers, we provide a comprehensive cross-country investigation of the effects of integration agreements on as detailed a level of analysis as possible. In another departure, while the majority of papers in this literature focus on the effect of free trade agreements, we examine the effect of a larger set of economic integration agreements of which free trade agreements are but one type.

Another relevant strand of the literature examines duration of trade. This litera-

[2]See for example Baier and Bergstrand (2007) who estimate that free trade agreements, on average, double trade between member countries. While some studies, such as Carrère (2006) and Kohl (2012), allow for differences across individual arrangements, others estimate an average effect.

ture, however, mainly documents empirical findings. We provide the first theoretical model able to make predictions about the hazard of a relationship ceasing, thus explaining now standard results in the literature.[3] Most similar to our work in terms of hazard effects is Kamuganga (2012) who shows that regional trade cooperation within Africa reduces the hazard of exports ceasing across all types of agreements. Our effort is broader in scope, analyzing data for all available countries and agreements, as well as a much longer time frame.

We add to the literature examining the growth of trade at disaggregated product levels. Araujo, Mion, and Ornelas (2011) show that countries with weaker institutions experience faster growth of exports from a given exporting firm. Muûls (2015) uses Belgian firm-level data to examine the role of credit constraints on firm's exports, including their growth. Besedeš, Kim, and Lugovskyy (2014) find that more credit constrained exporters have faster growing relationships, conditional on survival.

Unlike the issue of the hazard of trade ceasing and trade growth, the final elements of our investigation, the value of trade at the start of a relationship and the creation of new trade relationships in the wake of an agreement, have rarely been analyzed before. Besedeš and Prusa (2006b) find that trade in differentiated goods typically starts with smaller values relative to homogeneous goods. Besedeš (2008) shows that larger initial trade values are associated with longer lasting relationships and lower hazard rates, a result our theoretical model can now explain.

3 Theoretical Model

We start our analysis of the dynamic behavior of trade relationships by outlining a theoretical framework that guides our interpretation of empirical results discussed below. We start with a few definitions. There are two countries, origin o and destination

[3] See for example Besedeš and Prusa 2006a, 2006b, 2017; Nitsch 2009; Carrère and Strauss-Khan 2017; Görg, Kneller, and Muraközy 2012; and Cadot et al. 2013.

d. A *business relation* consists of a firm in country o selling its product to a firm in country d. We refer to firms in the origin country as *sellers (exporters)* and to firms in the destination country as *buyers (importers)*. A *trade relationship* is the collection of all business relations trading in the same product category between origin and destination countries. Finally, a *trade spell* is a realization of a trade relationship or the period of time, in consecutive years, during which the trade relationship is active. Among other things, we are interested in characterizing trade spells.

At the beginning of exporting, a seller identifies potential buyers and bids for a business opportunity to sell its product. Following Klepper and Thompson (2006) we assume potential buyers of a particular product in the destination country appear following a Poisson process with parameter λ. Once a seller successfully contracts with a buyer, the business relation is active for an exogenously determined length of time, z, drawn from the exponential distribution $H(z) = 1 - e^{-z/\mu}$ with mean μ. After period z, the buyer disappears.[4]

The probability that a seller will enter the destination market is θ and the size of the business relation is randomly drawn from a distribution $F(r)$, where r is the revenue of the seller. While most of the results below are independent of the exact form of θ and $F(r)$, we borrow the characterization of these two model parameters from Melitz (2003).

In Melitz (2003) firms are characterized only by their productivity levels, indexed by ϕ. Firms in the origin country selling in the destination country incur per-unit trade costs $\tau > 1$ and must pay fixed exporting costs f_x to set up operations in the destination country.[5] As a result, the probability of a firm entering the destination

[4]A business relation may end from the buyer's side for at least two reasons. First, the buyer may have gone out of business following a random idiosyncratic shock. Second, the seller may have been replaced by a new firm selling the product to the buyer. Although we do not explicitly model this process of creative destruction it can be rationalized along the lines of Klette and Kortum (2004). It is also possible to reconcile the process of arrival of new buyers with a model of advertising similar to Arkolakis (2008).

[5]All firms that export will also sell in their domestic market. Because we are only looking at business relations across countries, we focus on the fraction of profits and the probability of entry

country depends on the productivity of the firm, the per-unit trade costs, and the set-up costs. We characterize the probability of entering the destination country as $\theta = \theta(\phi, \tau, f_x)$. Only sufficiently productive firms will enter the domestic market and among those, only the most productive firms will export, $\partial\theta/\partial\phi > 0$.

In similar fashion, the size of each firm, described here by its revenue, is a function of the same three parameters presented above, $r = r(\phi, \tau, f_x)$. It follows from the results in Melitz (2003) that more productive firms are larger, $\partial r/\partial\phi > 0$. The distribution of firms' sizes in the destination country is denoted by $F(r)$ with expected value $E[r]$ and variance $var[r]$.

We could model trade liberalization events in two ways, either by reducing per-unit costs, $\tau' < \tau$, or by reducing set-up costs, $f_x' < f_x$. As τ or f_x decrease, the productivity cut-off value also decreases thereby making it possible for marginally less productive firms to enter the destination market. That is:

$$\frac{\partial\theta}{\partial\tau} < 0 \quad \text{and} \quad \frac{\partial\theta}{\partial f_x} < 0. \tag{1}$$

Similarly, decreasing τ or f_x increases the revenue and profit margins of firms, resulting in larger firms in equilibrium. Because only the best firms export, an increase in trade costs narrows the distribution of firms in the destination country, such that

$$\frac{\partial E[r]}{\partial\tau} < 0 \quad \text{and} \quad \frac{\partial E[r]}{\partial f_x} < 0, \tag{2}$$

$$\frac{\partial \text{var}[r]}{\partial\tau} < 0 \quad \text{and} \quad \frac{\partial \text{var}[r]}{\partial f_x} < 0. \tag{3}$$

derived from exporting and thus, we only mention the fixed costs of exporting, f_x. Domestic firms that do not export will also have to pay a fixed cost, f_e to set up operations, but we are not concerned with that set of domestic-only firms.

3.1 Characterizing trade spells

Define $v_k(t)$ as the probability that a trade spell has exactly k business relations at time t. This probability is distributed according to:[6]

$$v_k(t) = e^{-\theta\rho(t)} \left(\theta\rho(t)\right)^k / k! \tag{4}$$

which is a Poisson distribution with parameter $\theta\rho(t) = \theta\lambda\mu\left(1 - e^{-t/\mu}\right)$. This is the probability that k sellers draw productivities higher than the cutoff and that they had successfully bid for a business opportunity in the destination country. Notice that as time approaches infinity, $\rho(t)$ approaches $\lambda\mu$ and the stationary distribution is $v_k = e^{-\theta\lambda\mu}(\theta\lambda\mu)^k/k!$. In the long run, the probability that a trade spell has exactly k business relations is a function of the probability of entry and parameters associated with the process that generates buyers in the destination market. In addition, any trade policy that affects the terms of trade will also affect θ, and as a result trade policy will affect the long term stationary distribution of trade relationships.

3.1.1 Size, Duration, and Survival

A trade spell starts when a business relation was not present in period t and at least one exists in period $t + \Delta t$. Symmetrically, a trade spell ceases to exist when at least one business relation existed in period t and no such relation exists in $t + \Delta t$. The *duration* of a trade spell, $s(t)$, is then defined as the length of time that has elapsed since it was last inactive. In our model, trade spells can appear, disappear, and reappear at various occasions. That is, there is re-entry resulting in multiple spells of the same trade relationship. The possibility of re-entry is a novel feature of our model and usually not found in previous attempts at modeling dynamic behavior of firms, such as Nguyen (2012).

[6] The proofs and several other derivations are in Klepper and Thompson (2006). We also replicate them in the theoretical appendix for completeness.

The number of business relations in a trade spell is a function of the duration of the spell. Define $w_k(s(t), t)$ as the probability that a spell with duration s at time t has exactly k active business relations. Then $w_k(s(t), t)$ is distributed Poisson according to:

$$w_k(s(t), t) = e^{-\theta\rho(s)} \left(\theta\rho(s)\right)^k / k! \tag{5}$$

with the mean given by $\theta\rho(s) = \theta\lambda\mu \left(1 - e^{-s/\mu}\right)$, which is increasing in duration of trade, s. Economic integration, by increasing θ, should increase the number of business relations in any given trade relationship.

Denote by $n(t)$ the number of business relations in a trade spell at time t. The size of the trade spell is $y = \sum_0^{n(t)} r$, where $n(t)$ is a random number and each term in the sum is a random draw from $F(r)$. We show in the appendix that the distribution of sizes of all active trade spells has mean

$$E[y] = E[r]\theta\rho(s) \tag{6}$$

and variance

$$\text{var}[y] = E[r^2]\theta\rho(s). \tag{7}$$

The quantities θ, $E[r]$ and var$[r]$ increase when τ decreases, thus:

Result 1 *Holding everything else equal, trade spells in more open trade relationships (with a lower τ) are necessarily larger and have a higher variance when compared to trade relationships with larger trade barriers (large τ).*

Because we have assumed the distribution $H(z)$ is exponential, the arrival of new buyers is independent of the duration of previous relations and $n(t)$ is enough to explain the probability of exit. In other words, the more business relations there are in a trade spell, the lower the chance of the spell ending in any finite time period.

Result 2 *For any $t, T \in (0, \infty)$, the probability of a trade spell ending by time $(t+T)$ is strictly decreasing in $n(t)$.*

Moreover, both the duration and size of a spell are related to $n(t)$, but in different ways because size is drawn from a distribution that is independent of $n(t)$ and the process that generates buyers. Therefore, the probability of exit will decline with the size of the trade spell, holding duration constant. Likewise, the probability of exit will decline with duration, holding firm size constant.

Result 3 *For any $t, T \in (0, \infty)$, the probability of a trade spell stopping by time $(t + T)$ is decreasing in its size, $y(t)$, and age, $s(t)$.*

3.1.2 Growth

The model allows us to describe the relationship between the growth rate of a trade spell and its size and duration. The growth rate of a trade spell is given by

$$(8) \qquad g_y(t, t+T; y, s) = \frac{E(y(t+T|s)) - y(t, s)}{y(t, s)} = \left(\frac{\theta\lambda\mu E(r)}{y} - 1\right)\left(1 - e^{-\frac{T}{\mu}}\right)$$

which is a decreasing function of size y, but is independent of the duration conditional on y.

Conditioning on survival, however, the average growth rate decreases as the size of the spell, y, increases. In other words, smaller trade spells have a greater probability of disappearing, which reduces the overall growth rate. Denote the mean growth rate of surviving trade spells as $g_y(t, t+T; y, s|n(t+T) > 0)$ and the growth rate of disappearing trade spells as -1. The probability of trade spells disappearing is given by $\Pr\{n(t+T)=0|y(t),s(t)\}$. Using this definition, we can write the growth rate as

$$g_y(t,t+T;y,s) = g_y(t,t+T;y,s|n(t+T)>0)(1-\Pr\{n(t+T)=0|y(t),s(t)\}) + (-1)\Pr\{n(t+T)=0|y(t),s(t)\}.$$

Now we can solve for the average growth rate, conditional on survival

$$(9) \quad g_y(t,t+T;y,s|n(t+T)>0) = \frac{g_y(t,t+T;y,s)+\Pr\{n(t+T)=0|y(t),s(t)\}}{1-\Pr\{n(t+T)=0|y(t),s(t)\}}.$$

Given that the probability of a trade spell disappearing is decreasing in the duration and size of the spell, we obtain the following result:

Result 4 *Conditional on survival, the growth rate of a trade spell is strictly decreasing in size conditional on duration and strictly decreasing in duration conditional on size.*

3.2 Trade liberalization

Our model provides two important results concerning the effects of trade liberalization on trade relationships: when trade barriers are removed (or reduced) the fraction of firms exporting increases and the average size of the exporting firm increases. Characterizing the dynamic behavior of trade allows us to understand the effects of trade liberalization and to differentiate these effects depending on the timing of the trade liberalization event. In particular, we expect the effects of trade liberalization to differ between trade spells *already in existence* at the time of trade liberalization and *new trade spells* formed after trade liberalization.

To fix ideas, Figure 2 provides a schematic illustration of the types of trade spells a pair of countries can have as they relate to an economic integration agreement. The advent of an agreement allows us to distinguish between three types of spells. There will be spells such as spell A, which begin and end before the agreement goes into effect. These spells are unaffected by the agreement. There are also spells such as spell B which start before the agreement, but do not end until after the agreement goes into effect. These spells will be directly affected by the agreement. Finally, there are also spells, such as spell C, which start after the agreement has been established and are affected by it.

In our model, trade spells formed before the episode of trade liberalization, such as B, are different from those formed after trade liberalization, such as C, for two reasons. First, business relations already in place experience an increase in their individual size because exporting firms incur lower trade costs, while holding their productivity constant. This will in turn increase duration of those spells and will boost their growth rates, albeit temporarily. Second, new business relations include marginal firms that are able to export only because their effective costs have been reduced. While standard trade models indicate that the average new business relation is larger due to trade liberalization, separating the old business relations from the new would show that new business relations are, on average, smaller than old ones. In addition, our results above suggest that new trade relations tend to be shorter lived, simply because exporters have not been able to accumulate enough business relations.

The next result summarizes the intuition regarding the effects of trade liberaliza-

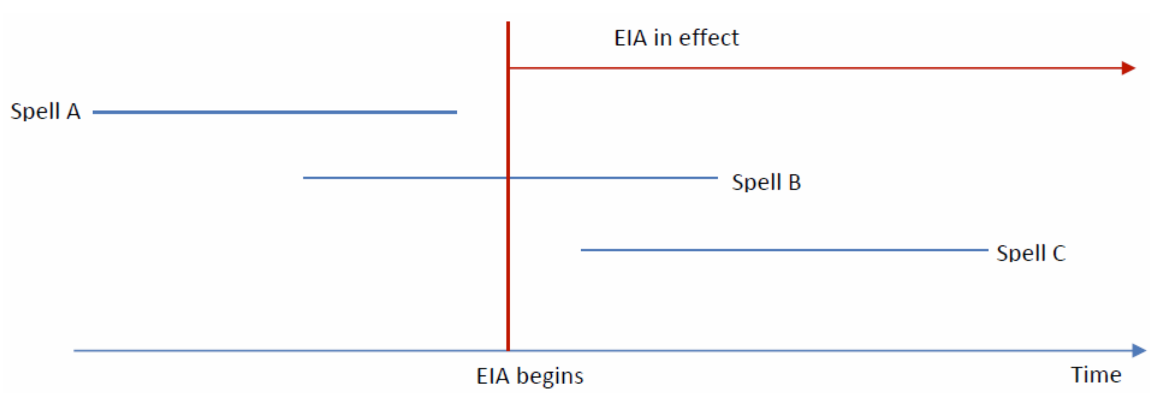

Figure 2: **Effects of trade liberalization on trade spells**

tion on size, duration, and growth of trade spells:

Result 5 *Trade spells that started before the episode of trade liberalization last longer and grow faster as a result of trade liberalization. Trade spells starting after the episode of trade liberalization may start larger or smaller, but exhibit lower growth, and have shorter duration than those that began before trade liberalization.*

The ambiguity in the effect of trade liberalization on initial values owes to the fact that a newly traded product in the wake of an agreement is potentially exported by two different types of exporters: highly productive firms who never exported before because they were unsuccessful in finding a buyer and marginally productive firms who begin to export only because the agreement reduced trade costs. If the former dominate the initial value will likely be larger, ceteris paribus, while if the latter dominate the initial value will likely be smaller compared to a product which began to be exported before the agreement was signed.

Finally, the last result we investigate is the predicted increase in the number of exporting firms in the wake of an agreement. This is a consequence of a trade agreement reducing the exporting productivity cutoff θ allowing more firms to become exporters (see equation 1).

Result 6 *Trade agreements result in increased entry as more firms export.*

4 Data

Our theoretical framework yields three sets of results the empirical verification of which is a function of available data. Results 1 and 2 are verifiable only with very detailed firm-level data, which would allow the observation of some form of a business relation. This could be a destination-product pair, or if taken very literally, every single business partner a firm obtains in a foreign market. While the former types of data exist, the detailed nature of the latter type are not yet readily available and we leave their empirical verification for future work.

Results 3 and 4 provide the second set of results and pertain to spells of trade. Since spells of trade are some form of aggregation of the fundamental business relations our model is based on, data required to examine these results are generally more readily available. These two results provide a theoretical underpinning for well established results in the duration and disaggregated growth of trade literatures and we briefly examine them in the empirical appendix.

The third set of insights are summarized by results 5 and 6. They pertain to the effect of trade liberalization on incumbent and newly started trade spells as well as the rate of entry of new spells. These two results are the primary focus of our empirical analysis. To investigate this set of results we must combine trade flow data with data on economic integration agreements. In order to cast as wide a net as possible, we conduct our empirical investigation using a data set with the richest coverage of products, countries, and economic integration agreements.

We combine data from two sources. First, trade flow data are obtained from UN's Comtrade Database. We use the longest possible panel available with trade recorded annually from 1962 until 2011 using the 5-digit SITC revision 1 classification.[7] As Comtrade provides data on both imports and exports, we use data as reported by importers given their widely perceived greater accuracy. Since we use imports of all countries available through Comtrade, our analysis can be equivalently thought of as an analysis of imports or of exports. However, we shall simply use the term trade to avoid any confusion.

Second, data on economic integration agreements are from Baier and Bergstrand (2007). Their Database on Economic Integration Agreements collects information on various agreements as entered into by 195 countries on an annual basis between 1950

[7] At the 5-digit level, there are 944 product categories.

and 2005.[8] Our sample observations are defined by the temporal intersection of our two sources, from 1962 to 2005.

One advantage of using trade data at the SITC revision 1 level, reaching back to 1962, is the relative paucity of economic integration agreements at the beginning of the sample period. Thus, for the vast majority of agreements that have been in existence in the post-World War II period, we observe their effect from the start of the agreement itself. This would not be the case if we used data at the 6-digit HS level which are only available from 1989. Note from Figure 1 that in 1962, when our sample begins, only 1.1% of country pairs have an agreement in place. Thus, not taking into account the exact starting point of this small number of agreements likely generates only a small bias. By 1989, when the HS data become available, the fraction of country pairs with an agreement increases by an order of magnitude to 14.8%. By the end of our sample, around 21% of country pairs share an agreement.[9]

Since we are interested in the effect of economic integration agreements on trade relationships we define as a unit of observation a continuous trade spell involving two countries and a specific product. By this we mean consecutive years when a trade relationship is active, beginning with a clearly observed starting point. Consistent with our model, we differentiate between a trade relationship which denotes an exporter-importer-product triplet and a trade spell which indicates the consecutive years during which a relationship is active.

There are a total of 29,671,095 observations on (positive) trade flows between 1962 and 2005. Of these we have no information on economic integration agreements for 2,021,121 observations (about 7% of trade flow observations), which account for 1.7% of total observed trade in our sample. Most often this pertains to instances of trade with very small economies, or countries which disappeared during the observed

[8] Available at `http://www3.nd.edu/~jbergstr/`.

[9] The drop in the utilization rate in the early 1990s (1991 through 1994 to be precise) stems for the break up of the eastern block countries in Europe, Czechoslovakia, Soviet Union, and Yugoslavia. By 1995 the utilization rate returns to its pre-breakup levels.

period as the database does not offer a historical perspective on agreements.[10]

Type of agreement	Number of observations	Number of observations used in estimation
None	16,990,281	15,237,989
Non-Reciprocal Preferential Trade Agreement	2,468,555	2,389,726
Preferential Trade Agreement	1,459,940	1,418,321
Free Trade Agreement	3,736,467	3,274,454
Customs Union	1,404,939	907,092
Common Market	1,122,545	906,884
Economic Union	465,962	375,559
Total	27,649,671	24,510,480

Table 1: **Number of Observations by Agreement Type**

Of the remaining 27,649,671 observations, as documented in Table 1, some 61% involve pairs of countries which have no economic integration agreement in place at any point in time during our sample period. These observations account for 41.5% of all observed trade. The remaining observations account for 56.7% of all observed trade and belong to the six types of agreements in the data: non-reciprocal preferential trade agreements (NR-PTA), (reciprocal) preferential trade agreements (PTA), free trade agreements (FTA), currency unions, common markets, and economic unions. FTAs are the most common type accounting for 14% of observed disaggregated trade flows, followed by NR-PTAs with 9% and PTAs with 5% of observations. Deeper integration schemes are typically less frequent. Currency unions account for roughly 5% of the bilateral trade observations, while common markets account for 4% and economic unions for only 2%. For the purpose of understanding the effect of economic integration on the product-level patterns of trade, we do not distinguish between the different types of agreements, but rather focus on the sheer existence of an agreement of some sort. This simplifying assumption allows us to ignore issues arising from countries upgrading or downgrading their agreements.[11]

[10] One could interpret these observations as no agreement existing, but that would be incorrect as one would have to make sure no agreement in fact was in place.

[11] The former is far more common than the latter. As an example, Germany and Austria signed a

We are primarily interested in the effects of economic integration agreements in a multicountry context. It follows from our model that we need to include standard variables capturing country characteristics.[12] We use the CEPII gravity data as the source for both the exporter's and the importer's GDP, distance, and existence of a common border and a common language.[13]

The second column of Table 1 shows the number of observations on each type of agreement in the dataset used in estimation. Our estimation sample is smaller by 3,139,494 observations, or some 10%, due to two factors. The majority of these observations, 2,843,686 to be precise, are omitted since they belong to spells of trade that are left censored. For all spells which are active in the first year in which an importing country reports data, the actual start of the spell is not observed. For example, the first year in which the U.S. reports imports in our data set is 1962. Consequently, all spells involving the U.S. in 1962 are left censored, and we omit all such observations from our analysis. The remaining omitted observations, almost 300,000, have missing gravity data and are not used.

Our model accounts for the fact that, in the 44 years in our data set, relationships frequently display multiple spells of service. There are a total of 3,109,559 trade relationships in our data with 7,191,964 observed active spells, or 2.3 per relationship. Some 45% of all trade relationships have only one active spell, with 22% having two active spells, and less than 7% having six or more active spells. Table 2 shows that the vast majority of observed spells of trade are of very short duration, with slightly more than 55% of all spells observed for just a single year and 90% observed for seven or fewer years.

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free trade agreement in 1973, upgraded it to a common market in 1994, and again to an economic union in 1999. To properly investigate the effects of specific types of agreements, we would need to control for such changes dynamically. We refer the interested reader to Besedeš (2015) who examines similar dynamic issues in the context of the European Union.

[12] In our model we use Melitz (2003) to characterize individual firm behavior. It has been shown in Chaney (2008) that Melitz translates into a distorted gravity equation, so we need to account for those variables as well.

[13] Available at `http://www.cepii.fr/anglaisgraph/bdd/gravity.htm`.

Spell length	Number of spells	Fraction of spells
1	4,009,321	55.7%
2	1,109,540	15.4%
3	507,534	7.1%
4	294,258	4.1%
5	213,270	3.0%
6	174,633	2.4%
7	115,726	1.6%
8	99,488	1.4%
9	80,455	1.1%
10	80,313	1.1%
11-20	327,288	4.6%
21-30	82,061	1.1%
31-43	98,077	1.4%
Total	7,191,964	100.0%

Table 2: **Distribution of Spell Lengths**

5 Empirical Approach and Results

We discuss our empirical results in the same order as they were derived in Section 3. We focus our empirical investigation to Results 5 and 6 that examine the effect of economic integration agreements on disaggregated trade patterns and are new to the literature. Results 3 and 4 are by now a stylized fact explored in multiple papers.[14] We reproduce them here, but relegate them to the empirical appendix. Our data are not sufficiently detailed to examine Results 1 and 2, the investigation of which we leave to future work.

We use four variables to capture all the effects of economic integration agreements. The first variable, labeled 'EIA in effect,' identifies years during which an agreement is in force, capturing the differential effect of the agreement itself. Since our model predicts that spells which start after the agreement are different from already active ones, we use a second dummy variable, 'Spell starts after EIA,' which identifies spells which started after the agreement is put in force. The 'EIA in effect' and 'Spell starts

[14]See Besedeš and Prusa (2006b), Nitsch (2009), Carrère and Strauss-Khan (2017), Besedeš, Lugovskyy, and Kim (2014), and Mûls (2015) among others.

after EIA' variables in conjunction identify the effect on spells which begin after the agreement is in effect.

The next two variables are designed to capture any change in the effect of an agreement the longer the agreement is in existence. The third variable, labeled 'Duration of EIA,' measures how long an agreement has been in place. This variable identifies, at a micro level, whether the effect of an agreement depends on how long it has been in place, as has been shown to be the case in aggregate measures by Baier and Bergstrand (2007) and Baier, Bergstrand, and Feng (2014). Finally, the fourth variable, labeled 'Duration of EIA for post-agreement spell,' captures the effect of how long the agreement has been in place only on spells which start after the agreement, the post-agreement spells.

For each regression we estimate two specifications. The first one only uses the two dummy variables to estimate the effect of economic integration agreements and will be referred to as the 'static' specification. The second specification will use all four variables. We will refer to it as the 'dynamic' specification since it accounts for the possibly changing effect of an agreement over time. Much of our discussion will be focused on the results of the dynamic specification.

5.1 Initial value of trade

We begin by examining the effect of economic integration agreements on initial values by estimating the following OLS regression:

$$\ln(y(1)^i_{kodt}) = \alpha + \mathbf{EIA}_{odt}\beta + \gamma_{od} + \delta_{ot} + \zeta_{dt} + \eta_k + \epsilon^i_{kodt} \tag{10}$$

where $\ln(y(1)^i_{kodt})$ is the logged value of trade in the first year of spell k of a trade relationship between origin o and destination d in product i which occurs in calendar year t, $\mathbf{EIA}_{odt}$ is the vector of variables describing an agreement between origin o and destination d in year t, γ_{od} are origin-destination pair fixed effects, δ_{ot} are origin-year fixed effects, ζ_{dt} are destination-year fixed effects, η_k are spell fixed effects, and ϵ^i_{kodt} is the error term.

The two regressions on initial value of trade only require one observation for each spell, that of the first year. As a result, there are two kinds of spells, those that start before the agreement and those that start after the agreement. We can then identify only two of our four variables as the 'EIA in effect' dummy and the 'Spell started after EIA' dummy are identical for every spell. To put it differently, in this regression a spell which starts and ends before the agreement is in place and the spell which starts before but ends after the agreement are identical: we only use the first year which is observed before the agreement. Thus, we can only obtain an estimate on one of our dummies and one variable that measures how long the agreement has been in place. Our results are collected in the first two columns of Table 3.

Using only the static specification, with just the dummy variable identifying when the agreement is in effect, we find that an agreement decreases the initial value by 1% ($exp(-0.010) = 0.99005$). In the dynamic specification, we add the variable measuring how long an agreement was in effect when the spell started. Doing so results in a fixed (with respect to time) effect of an agreement decreasing initial values by 1.2%, as well as a time-dependent effect which increases initial values by 0.1% for every year (on a log scale) of the agreement being in force. While the initial value of trade increases after the agreement, it increases at such a low rate that it will not result in a post-agreement initial value being larger than the pre-agreement value in any reasonable time frame.[15]

[15] To be precise, the negative fixed effect of an agreement being in place and the positive temporal effect of how long it has been in place will offset each other after 162,754.8 years (the solution to the equation $-0.012 + 0.001 ln(x) = 0$).

	Initial Value (OLS)		Hazard (RE probit)		Growth (OLS)	
	(1)	(2)	(3)	(4)	(5)	(6)
Duration (ln)			-0.423***	-0.430***	-0.060***	-0.060***
			(0.001)	(0.001)	(0.001)	(0.001)
Imports (ln)			-0.126***	-0.125***	-0.253***	-0.254***
			(0.000)	(0.000)	(0.000)	(0.000)
Importer GDP (ln)			-0.013***	-0.014***		
			(0.000)	(0.000)		
Exporter GDP (ln)			-0.086***	-0.085***		
			(0.000)	(0.000)		
Distance (ln)			0.121***	0.117***		
			(0.001)	(0.001)		
Contiguity			-0.112***	-0.112***		
			(0.002)	(0.002)		
Common language			-0.002	-0.009***		
			(0.001)	(0.001)		
EIA in effect	-0.010**	-0.012***	-0.224***	-0.126***	0.080***	-0.004
	(0.004)	(0.004)	(0.002)	(0.004)	(0.002)	(0.004)
Spell started after EIA			0.245***	0.017***	-0.074***	-0.065***
			(0.002)	(0.003)	(0.002)	(0.003)
Duration of EIA (ln)		0.001***		-0.009***		0.010***
		(0.000)		(0.000)		(0.000)
Duration of EIA for post-agreement spells (ln)				0.095***		-0.005***
				(0.001)		(0.001)
Constant	9.786	9.780	1.341***	1.300***	3.708***	3.786***
	(25.350)	(19.551)	(0.006)	(0.007)	(0.023)	(0.024)
Observations	7,353,211	7,353,211	24,510,177	24,510,177	17,555,604	17,555,604
Relationships	3,185,092	3,185,092	3,109,593	3,109,593	1,871,657	1,871,657
R^2	0.304	0.304			0.143	0.143
ρ			0.164	0.166		

Robust standard errors in parentheses for OLS regressions with *, **, *** denoting significance at 10%, 5%, and 1%.

Table 3: **Effects of Economic Integration Agreements**

5.2 Hazard of trade ceasing

The second characteristic of spells we examine is the hazard of a spell of trade ceasing, h^i_{kodt}. The hazard is the probability of exports of product i from country o to country d in spell k ceasing at time $t+n$ conditional on it having survived until time t (or in our model notation, age, $s(t)$), $P\left(T^i_{kod} \leq t+n | T^i_{kod} \geq t\right)$, where T^i_{kod} is a random variable measuring the survived duration of spell kod. We estimate the hazard of exports ceasing at time n by estimating a discrete hazard using a random effects probit specification to take into account unobserved heterogeneity:

$$
\begin{aligned}
h^i_{kodt} &= P\left(T^i_{kod} \leq t+n | T^i_{kod} \geq t\right) \\
&= \Phi\left(\mathbf{EIA}_{odt}\beta + \mathbf{X}_{od}\omega + \kappa \ln(s(t)_{kodt}) + \lambda \ln(y_{(t-1)kodt}) + \right. \\
&\quad \left. + \rho \ln \text{GDP}_o + \tau \ln \text{GDP}_d + \eta_k + \nu^i_{kod}\right)
\end{aligned} \tag{11}
$$

where $\mathbf{EIA}_{odt}$ is the vector of variables describing an agreement between origin o and destination d in year t, $\mathbf{X}_{od}$ is a vector of of bilateral time-invariant gravity variables (distance, common border, and common language), $\ln(s(t)_{kodt})$ is the log of the age of spell k in year t, $\ln(y_{(t-1)kodt})$ is the size of trade in the previous year of the spell, $\ln \text{GDP}_o$ and $\ln \text{GDP}_d$ are the log of origin's and destination's GDP, and η_k are spell fixed effects. Relationship-specific random effects are captured by ν^i_{kod}. We assume the hazard depends on the duration of a spell as the logarithm of the current length of the spell (age) at every point in time (measured in years).

As predicted by our model, results in columns (3) and (4) of Table 3 show the effect of an agreement on already active spells is to reduce their likelihood of ceasing, thus making them longer and more stable. However, spells which begin after the agreement is in place are more likely to cease. This effect is slightly larger than the effect of an agreement being in place. Thus, the net effect on spells starting after the agreement, as we illustrate below, is to increase their hazard rate. As indicated by results in column (4), the hazard of pre-agreement spells is lower the longer an agreement is in place. Thus, the beneficial effect of an agreement on spells already in place when the agreement starts increases as they survive. For post-agreement spells the story is very different. For every year they survive their hazard increases by a net of 0.086 log points (the sum of the two length of EIA in place variables) in addition to the fixed effect of having started after the agreement of 0.017 log points.

To evaluate whether a variable has a significant effect on the hazard as well as the magnitude of the effect, we first calculate the predicted hazard at the mean of every variable and then calculate the predicted hazard while changing the value of the variable of interest. Such an approach to examining the effect of a covariate is necessary as the effect and the precision with which it is estimated depend on the standard errors of all estimated coefficients, all pairwise covariances, and the distributional specification of the probit model. To evaluate whether active spells of trade are affected by the onset of the agreement, we calculate and plot the estimated hazard with the 'EIA in effect' dummy first set to zero and then set to one, while keeping all other variables at their respective means. We plot both the estimated hazard along with the 99^{th} percentile confidence interval.[16] As long as confidence intervals do not overlap, the effect of the agreement is deemed to be statistically significant.[17] In fact, in every plot we examine below, we find that differences are statistically significant.

As our comparison benchmark we use the hazard in the absence of an agreement. Our model indicates that taking into account the timing of when an agreement takes effect and when a spell starts is important. Thus, we compare that hazard to the hazard profile for spells which are in their sixth year as the agreement comes into effect.[18] That is, for spells which start after the agreement we assume that they start in the sixth year of the agreement. Given the small magnitude of the coefficient on the length of an agreement, changing the year of the spell in which an agreement starts, or the year of the agreement in which a spell starts, has only minimal effects on our plotted hazard profiles.

To conserve space our discussion here focuses on the dynamic specification for

[16]The corresponding confidence interval is always represented with a dotted line and of the same color as the curve depicting the predicted hazard. In most instances the confidence interval is imperceptible given the high precision of our estimated coefficients.

[17]See Sueyoshi (1995) for a longer discussion of how to evaluate whether the effect of a variable is significant when using a probit approach to estimate the hazard and Besedeš and Prusa (2017) for an application in international trade.

[18]Note that given the distribution of spell lengths (as tabulated in Table 2), a full 85% of spells do not make it into year six, our chosen year to illustrate the effects of an agreement. This should not be particularly troubling as year six was chosen purely for illustrative purposes. Moving the onset of the agreement to an earlier year of the spell would not drastically affect our conclusions.

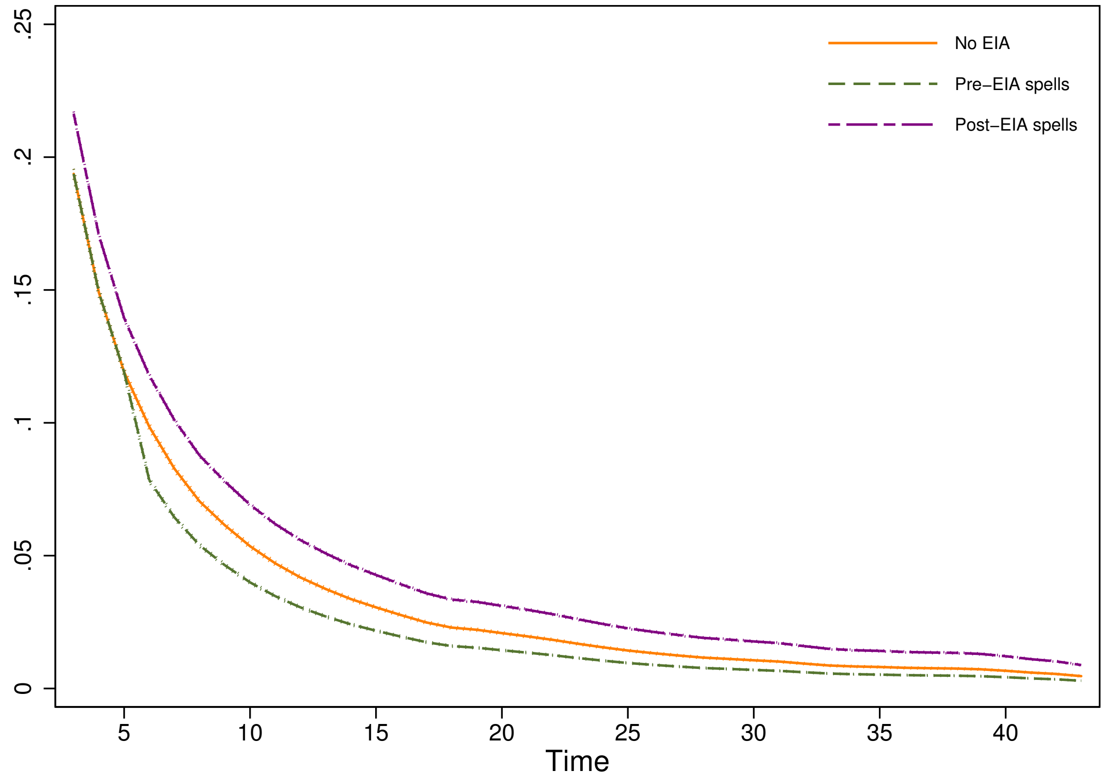

Figure 3: **Simulated Effects of EIAs on Hazard using the Dynamic Specification**

which we plot the predicted hazards in Figure 3,[19] while in Table 4 we summarize the relative differences in predicted hazards for both the static and dynamic specifications. In Table 4 we provide average differences over the first five years that an agreement has an effect, followed by years 6 through 10, then 11 through 20, 21 through 30, and then all years. Given that 85.3% of all spells in our sample are observed for five years or less (see Table 2), we consider the effects during the first five years to be of most interest and most representative.

The decreasing nature of the hazard of trade ceasing makes it somewhat tricky to discuss the magnitude of the effect of an agreement as does the timing of both the agreement and the spell. To explain the latter issue, consider Table 4 summarizing differences in the hazard for spells affected by the agreement relative to spells that

[19]The corresponding plot for the static specification can be found in the empirical appendix.

are not affected by an agreement. Using the dynamic specification, the first row shows that the hazard of a pre-agreement spells ceasing decreases by an average of 23.2% during the first five years, while that of post-agreement spells increases by 11.5%. It is important to realize that the first five years affected by an agreement occur at different points of the spell, depending on whether the spell started before the agreement or after the agreement. For pre-agreement spells, the first five years affected by the agreement (the effect of which is shown in the first row) are actually years 6 through 10 of the spell since the agreement is assumed to have started in year 6 of pre-agreement spells. For post-agreement spells the first five years affected by the agreement are the first five years of the spell as the entire spell is affected by the agreement. As a result, the effect for pre- and post-agreement spells summarized in the table are not directly comparable as they do not occur during the same stages of each spell. The plots in Figure 3 are more instructive if one wants to compare the entire hazard profile.

As conveyed by both Table 4 and Figure 3, an agreement reduces the hazard of spells already in place when an agreement starts and increases the hazard of spells that begin after the agreement. According to the static specification, the effect of an agreement on already active spells is on average a reduction of 42.5% across all years. The effect increases from an average of 35% lower hazard during the first five years of the effect of an agreement to a 45% lower hazard during years 21 to 30. These effects are somewhat lower when using the dynamic specification where the hazard decreases by an average of 31.5% across all years. For spells that begin after the agreement, the agreement increases the hazard by an average of 20.4% under the static specification and by an average of 51.0% under the dynamic specification. As is the case with pre-agreement spells, the effect of an agreement on post-agreement spells increases with duration, though in a different way. While pre-agreement spells become less likely to cease as they age relative to spells unaffected by an agreement, post-agreement spells become more likely to cease with duration. One could ask how each of the agreement-related variables affects the hazard of spells ceasing on its own. In the interest of conserving space, we refer the interested reader to the empirical appendix.

	Static Specification		Dynamic Specification	
Spell years affected by agreement	Pre-agreement spells	Post-agreement spells	Pre-agreement spells	Post-agreement spells
1-5	-35.0%	3.1%	-23.2%	11.5%
6-10	-38.8%	7.6%	-27.6%	24.4%
11-20	-42.1%	13.8%	-31.1%	40.7%
21-30	-45.0%	21.3%	-34.3%	59.1%
All years	-42.5%	20.4%	-31.5%	51.0%

Table 4: **Effect of Agreement on the Hazard of Trade Ceasing**

An economic integration agreement has a dual effect on the hazard of trade ceasing, just as our model predicted. It reduces the hazard of already active spells, but increases it for any spell starting after the agreement. To put it in different terms, economic integration promotes the stability of trade spells active when the agreement is signed and reduces the stability of those which commence in its wake.

5.3 Growth of trade

We now turn to examining the effect of economic integration agreements on the growth of trade embodied in active spells. In particular, we are not concerned with explaining the negative growth that occurs once the spell ends, but with the growth of trade conditional on spell survival. To examine the effect on the growth of trade within active spells we estimate an OLS regression specified by:

$$\begin{aligned} \ln(g^i_{kodt}) = \alpha + \mathbf{EIA}_{odt}\beta + \kappa \ln(s(t)_{kodt}) + \lambda \ln(y_{(t-1)kodt}) + \\ + \gamma_{od} + \delta_{ot} + \zeta_{dt} + \eta_k + \iota_k + \xi_t + \tau + \varepsilon^i_{kodt} \end{aligned} \tag{12}$$

where $\ln(g^i_{kodt})$ is the log of the growth of trade from year $t-1$ to t of product i's spell k between o and d, $\mathbf{EIA}_{odt}$ is the vector of variables describing an agreement between origin o and destination d in year t, $\ln(s(t)_{kodt})$ is the log of the age of spell k in year t, $\ln(y_{(t-1)kodt})$ is the size of trade in the previous year of the spell, γ_{od} are origin-destination pair fixed effects, δ_{ot} are origin-year fixed effects, ζ_{dt} are destination-year fixed effects, η_k are spell fixed effects, ι_k are spell length fixed effects, ξ_t are calendar year fixed effects, τ are 3-digit SITC industry fixed effects, and ε^i_{ktod} is the error term. Our results are collected in columns (5) and (6) of Table 3.

As our model predicts, and similar to the results of Besedeš, Kim, and Lugovskyy (2014), we find that the rate of growth of trade within a spell decreases the longer the duration of the spell. Larger spells grow less. The effect of economic integration agreements also confirms our theoretical predictions. Without accounting for how long an agreement has been in place, the effect on active spells is an increase of 8.0 percentage points in the growth rate, while the effect of an agreement on spells which start after the agreement is a reduction in their growth rate of 7.5 percentage points. On net, post-agreement spells have a 0.5 percentage point higher growth rate than what would be the case in the absence of an agreement.

Accounting for how long the agreement has been in place changes the two static effects. The agreement itself no longer has an effect on growth that is statistically distinguishable from zero. The positive effect of an agreement on pre-agreement spells is entirely captured by the temporal effect which indicates that for every year that the agreement is in effect, the growth rate increases by 1.0 percentage points. Post-agreement spells, however, have a 6.5 percentage points lower growth rate. This negative effect of agreements on the growth of post-agreement spells is compounded by the negative temporal effect of 0.5 percentage points per year. These effects are illustrated in Figure 4, while we illustrate the effects corresponding to the static specification in the empirical appendix.

Economic integration agreements have a positive effect on the growth of spells already active when an agreement starts and a smaller, though still positive, effect on

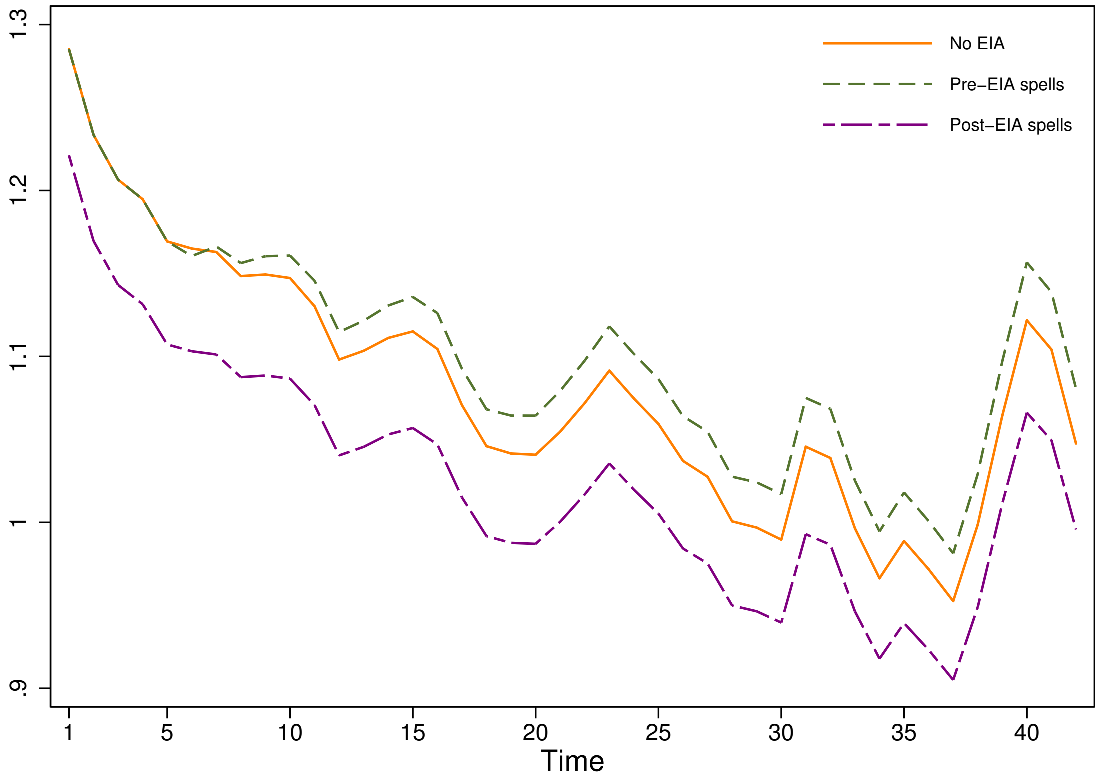

Figure 4: **Simulated Effects of EIAs on Growth using the Dynamic Specification**

spells which started after the agreement. Importantly, from the point of view of our theoretical predictions, spells started after the agreement grow less than those which started before the agreement.

5.4 Rate of entry of new spells

The last object of our empirical investigation is the rate of entry of new spells of trade between two countries in a particular year. To investigate the effect of agreements on the rate of entry we estimate an OLS regression of the following specification:

$$\ln(\text{entry rate}_{odt}) = \alpha + \mathbf{EIA}_{odt}\beta + \delta_{ot} + \zeta_{dt} + \sigma_{odt} \tag{13}$$

where ln(entry rate$_{odt}$) is the logged percentage of new spells of trade from country o to country d in year t, σ_{odt} is the error term, and the remaining variables are defined above. In this regression, rather than investigating characteristics of individual spells, we simply count the number of new spells in any given year and use that number, expressed as percentage of all spells in a given year, as our dependent variable. Hence, our basic unit of account now is at the origin-destination level, rather than origin-destination-product level. Because of this change, and similar to our investigation of initial values, we can only estimate two agreement-related variables, the existence of an agreement and how long it has been in place. It should be noted that our results for entry rates have the highest chance of being affected by aggregation bias. Our model predicts that there will be more entry at the firm level after an establishment of an agreement. As our data are at the product level, however, an existing trade spell may mask a lot of entry on the part of firms beginning to export a product which is already being exported. Our data preclude us from observing this entry. The only entry we can observe is a new spell of trade becoming active involving a product that no firm was previously exporting.

In addition to our model predicting that an agreement will increase the rate of entry, or re-entry, of (new) spells, these results are important from another point of view. The results we have presented so far indicate that economic integration agreements have a dual effect. While they make already active spells more stable and larger, spells created after an agreement are more likely to fail and their growth rate is marginally higher than the growth rate in the absence of an agreement. Such dual effects create a potential puzzle: if the effects at the disaggregated level indicate that old spells become more stable and new spells become less stable, what is driving the strong growth of trade found at the aggregate level?[20] An additional factor contributing to this puzzle is the distribution of length of spells shown in Table 2,

[20]Baier and Bergstrand (2007) conclude that ten years after an agreement is signed the amount of trade between the two countries doubles.

EIA in effect	-0.056***	0.304***
	(0.021)	(0.046)
Duration of EIA (ln)		-0.040***
		(0.005)
Constant	-1.144***	-1.477***
	(0.006)	(0.040)
Observations	367,715	367,715
R^2	0.294	0.294

Robust standard errors in parentheses for OLS regressions with *, **, *** denoting significance at 10%, 5%, and 1%.

Table 5: **Effect of Economic Integration Agreements on Entry**

which indicates that the majority of spells are short lived. Thus, even the positively affected spells eventually end. They are replaced by more fragile spells which grow far less. A possible explanation behind the observed aggregate growth, put forth by Baier, Bergstrand, and Feng (2014), is that agreements create new spells which account for much of the aggregate growth. That is, in the short run the effect of agreements tends to be on the intensive margin, but with time much of the effect moves to the extensive margin.

Our results are collected in Table 5. Using only the static effect of agreements indicates that the rate of entry decreases. However, the addition of the variable indicating how long an agreement has been in place changes results drastically. The static effect now indicates that an agreement increases the rate of entry by 30.4%, which is then slowly reduced by 0.04 log points for every year that an agreement is in place. This is a very slow rate of reduction with the rate of entry 43 years after an agreement has been in place still some 15.3% higher than would be the case in the absence of an agreement. Thus, taken together our results indicate that new spells of trade which begin after an agreement are more likely to fail and grow less than those started before the agreement, but their sheer numbers play an important role in the aggregate growth of trade in the wake of an agreement.

6 Conclusion

In this paper we characterize the dynamic behavior of trade, on both the intensive and extensive margins, and analyze the effects of trade liberalization on trade dynamics. We start by building a theoretical model which characterizes the behavior of a trade relationship observed at the product level by starting from firm decisions. We characterize the decision of the firm using Melitz (2003) and aggregate to the trade relationship using Klepper and Thompson (2006). In our model, firms acquire new business relations and by accumulating new business relations, an exporter can grow its presence in the market. If an exporter looses all business relations the trade relationship will go dormant until a new business relation is acquired by an exporter firm, or seller.

Our model creates predictions about both duration and growth of trade of active spells of trade, an active instance of a trade relationship. Duration increases in size and age of a spell (and its converse, the hazard, is decreasing in both). The growth rate of a spell is decreasing in duration as well as its size. Both of these predictions are borne by our data. Moreover, our model is able to generate both exit of a once active trade relationship as well as its regeneration. This feature matches a fact present in international trade data that a number of trade relationships are present in multiple distinct instances.

Our model predicts that an economic integration agreement will reduce the likelihood of trade ceasing and will increase the growth of trade in an active spell. However, the effect will be reversed for spells started after the agreement, which start with somewhat smaller values, and are more likely to cease and grow less. In addition, our model predicts that there will be additional entry of new trade relationships or spells of trade after an agreement is signed. Taking the model to the data, we analyze the effects of economic integration agreements on trade. We examine three attributes of trade embodied in trade relationships defined as importer-exporter-product triplets:

the initial value of trade, the growth of trade within a spell, and the hazard of trade ceasing. Using revision 1 SITC 5-digit level data in conjunction with Baier and Bergstrand (2007) data on economic integration agreements spanning the period between 1962 and 2005, we empirically confirm all theoretical predictions.

Our results are potentially puzzling. On the one hand, spells active when an agreement begins become longer lasting and larger, while those which start after the agreement are more likely to be shorter and to grow less. These two types of spells exert opposite forces on the aggregate level of trade, the former contributing to the growth of aggregate trade, while the latter potentially contributing to a decrease in aggregate trade. Our results also show that there is a large increase in entry and creation of new trade relationships or spells of trade after the agreement, thus offering a channel for the observed large increases in aggregate trade after an agreement – while new spells may be shorter and grow less, there is such a large number of them after the agreement that their sheer number increases aggregate trade.

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A For Online Publication - Theoretical Appendix

As we mentioned in the paper, most proofs follow directly from the results in Klepper and Thompson (2006). We present them here for completeness.

Preliminary results: We start by characterizing the process that generates buyers in the destination country, d. Suppose $N(t)$ buyers have been generated by time t. New buyers disappear after some length of period distributed exponentially. So the probability of the i^{th} buyer still being active at time t is $1 - H(t - t_i)$. Because the arrival of new buyers is distributed according to a Poisson process, the probability that the i^{th} buyer is still alive at time t is given by

$$\text{Pr}(\text{buyer } i \text{ is active at } t) = \frac{\int_0^t 1 - H(v)dv}{t} \tag{A.1}$$

It follows that, conditional on there being $N(t)$ buyers, the number of buyers alive at time t, apart from the first,[21] $n^*(t)$, is binomial:

$$Pr(n^*(t) = k|N(t)) = \binom{N(t)}{k} \left[\frac{1}{t}\int_0^t (1 - H(v))dv\right]^k \left[\frac{1}{t}\int_0^t H(v)dv\right]^{N(t)-k} \tag{A.2}$$

Next, recall that $N(t)$ is distributed Poisson with parameter λt so the CDF is given by

$$CDF = \sum_{N=k}^{\infty} \frac{(\lambda t)^N e^{-\lambda t}}{N!} \tag{A.3}$$

[21] JUAN: 'First' here refers to the first buyer, not the firct unit of time, correct?

Then the unconditional distribution is

$$\text{(A.4)} \qquad p_k(t) = \sum_{N=k}^{\infty} \frac{(\lambda t)^N e^{-\lambda t}}{N!} \binom{N}{k} \left[\frac{1}{t}\int_0^t (1-H(v))dv\right]^k \left[\frac{1}{t}\int_0^t H(v)dv\right]^{N-k}$$

$$= \sum_{N=k}^{\infty} \frac{(\lambda t)^N e^{-\lambda t}}{N!} \frac{N!}{k!(N-k)!} \left[\frac{1}{t}\int_0^t H(v)dv\right]^{N-k}$$

$$= \frac{\lambda^k e^{-\lambda t}}{k!} \left[\int_0^t (1-H(v))dv\right]^k \sum_{N=k}^{\infty} \frac{\lambda^{N-k}}{(N-k)!} \left[\int_0^t H(v)dv\right]^{N-k}$$

We can change variables, $z = N - k$, to obtain

$$\text{(A.5)} \qquad p_k(t) = \frac{\lambda^k e^{-\lambda t}}{k!} \left[\int_0^t (1-H(v))dv\right]^k \sum_{z=0}^{\infty} \frac{\lambda^z}{z!} \left[\int_0^t H(v)dv\right]^z$$

and using the series expansion $e^x = \sum_{z=0}^{\infty} x^z/z!$ we can rewrite the expression above as

$$\text{(A.6)} \qquad p_k(t) = \frac{\lambda^k e^{-\lambda t}}{k!} \left[\int_0^t (1-H(v))dv\right]^k e^{\lambda \int_0^t H(v)dv}$$

$$= \frac{1}{k!} \left[\lambda \int_0^t (1-H(v))dv\right]^k e^{-\lambda \int_0^t (1-H(v))dv}$$

$$= \frac{\rho(t)^k}{k!} e^{-\rho(t)}$$

where $\rho(t) = \lambda\mu\left(1 - e^{-t/\mu}\right)$. Finally the probability of the first buyer still being alive is $1 - H(t)$. With these results in hand, we can write the probability of exactly k buyers being active at time t as

$$\text{(A.7)} \qquad \Pi_k(t) = \begin{cases} H(t)p_k(\rho(t)) & k = 0 \\ (1-H(t))p_{k-1}(\rho(t)) + H(t)p_k(\rho(t)) & k = 1, 2, 3, \ldots \end{cases}$$

where we have shown $p_k(\rho(t))$ is the probability of exactly k events from a Poisson distribution with mean $\rho(t) = \lambda \int_0^t (1 - H(v))dv$. Because we have assumed $H(z)$ is exponential with mean μ we find $\rho(t) = \lambda\mu\left(1 - e^{-t/\mu}\right)$. As t approaches infinity, the first market vanishes with probability 1, and the stationary distribution is Poisson with mean $\lambda\mu$.

The number of business relations in a trade spell, excluding the first buyer, is the sum of n Bernoulli trials with probability of success θ where n is distributed Poisson with mean $\rho(t)$. The distribution of this random sum is

$$p_k(t) = \sum_{n=k}^{\infty} \binom{n}{k} \frac{e^{-\rho(t)}\rho(t)^n}{n!} \theta^k (1-\theta)^{n-k} \tag{A.8}$$

which following the same steps as above we can write as

$$p_k(t) = \frac{e^{-\theta\rho(t)}(\theta\rho(t))^n}{n!} \tag{A.9}$$

Adding to this the probability $\theta(1-H(t))$ that the business relation with the first buyer is still active at time t, we find

(A.10)

$$v_k(t) = \begin{cases} (\theta H(t) + (1-\theta))p_k(\theta\rho(t)) & k = 0 \\ \theta(1-H(t))p_{k-1}(\theta\rho(t)) + (\theta H(t) + (1-\theta))p_k(\theta\rho(t)) & k = 1, 2, 3, \ldots \end{cases}$$

As $t \to \infty$ the first buyer dies and the stationary distribution is Poisson with parameter $\theta\rho(t)$.

Because we defined the duration of a trade spell as the time that has elapsed since the trade spell became active again, and because buyers die independently of new arrivals, the duration of a trade relation is also independent of new arrivals. Then, the distribution for $w(s(t), t)$, is the same as $v_k(t)$ replacing t by s and ignoring the first buyer.

We are now ready to prove **Result 1**. To do so, recall the size of a trade spell is given by $y(t) = \sum_0^{n(t)} r$, where $n(t)$ is a random number following the distribution $w(s(t), t)$ and r is a random draw from the distribution $F(r)$. We can use the result that the characteristic function of a sum of random variables is equivalent to the multiplication of their characteristic functions. The characteristic function for the unconditional distribution of trade spell sizes is obtained by taking the expectation over all n

$$\text{(A.11)} \qquad \begin{aligned} \phi_y(u;s) &= E_n[\phi_r(u)^n|s] \\ &= \sum_{k=0}^{\infty} w(s(t),t)\phi_r(u)^k \\ &= \sum_{k=0}^{\infty} \frac{e^{-\theta\rho(s)}(\theta\rho(s))^n}{n!}\phi_r(u)^k \\ &= e^{\theta\rho(s)(\phi_r(u)-1)} \end{aligned}$$

To find the expected value we calculate

$$\text{(A.12)} \qquad E[y] = \frac{\partial\phi_y(u;s)}{\partial u}|_{u=0} = \theta\rho(s)\frac{\partial\phi_r(u)}{\partial u}|_{u=0} = E[r]\theta\rho(s)$$

and to find the variance we calculate

$$\begin{aligned} E[y^2] &= \frac{\partial^2\phi_y(u;s)}{\partial u^2}|_{u=0} \\ &= \theta\rho(s)\frac{\partial^2\phi_r(u)}{\partial u^2}|_{u=0} + \left[\theta\rho(s)\frac{\partial\phi_r(u)}{\partial u}|_{u=0}\right]^2 \\ \text{(A.13)} \qquad &= \theta\rho(s)\frac{\partial^2\phi_r(u)}{\partial u^2}|_{u=0} + E[y]^2 \end{aligned}$$

From here we find

$$\text{(A.14)} \qquad \text{var}[y] = \theta\rho(s)E[r^2]$$

Result 1 follows directly from these outcomes.

To show **Result 2**, we first need a definition and a result. Let $G_n(\tau|z_1, z_2, \ldots, z_n)$

denote the distribution of the first passage time, τ, to a state of zero active business relations for a trade spell with n business relations of ages z_i. Now add one business relation of age z_{n+1}. By construction, the first passage distribution is given by

$$\begin{aligned} G_{n+1}(\tau|z_1, z_2, \ldots, z_n, z_{n+1}) &= \frac{H(z_{n+1}+\tau) - H(z_{n+1})}{1 - H(z_{n+1})} G_n(\tau|z_1, z_2, \ldots, z_n) \\ &< G_n(\tau|z_1, z_2, \ldots, z_n) \end{aligned}$$

Then, for **Result 3**, we recognize that $n(t)$ is positively related to duration, $s(t)$, according to Result 1. Since the size of a trade spell equals the product of $n(t)$ and the average size of business relations in each trade spell, it is also positively related to $n(t)$. Duration and size are related to $n(t)$ in different ways, and thus both will be positively related to $n(t)$ even conditional on the other. A more direct proof is provided by Klepper and Thompson (2006).

Result 4 requires one more definition and a result. Let's define $G(z; s)$ as the distribution of ages of all the business relations in a trade relation of duration s. In the case of $H(z)$ exponential, the distribution $G(z; s)$ is equal to

$$G(z; s) = \frac{1 - e^{-z/\mu}}{1 - e^{-s/\mu}} \tag{A.15}$$

which is the exponential $H(z)$ with the support truncated at s. This is the simplicity afforded by the exponential distribution. The future depends only in the current state of affairs.

With this result in hand, we proceed to calculate the growth rate of a trade spell. Consider a business relation of duration z. Then, the probability that it vanishes in the subsequent period T is simply given by

$$\frac{\int_z^{z+T} dH(z)}{1 - H(z)} = 1 - e^{-T/\mu}.$$

Taking expectations over all possible ages, $z \in [0, s]$, using the distribution $G(z; s)$, we find

(A.16)
$$E[\text{Number of lost business relations after interval } T|s] = n(s)\frac{\int_0^s e^{-z/\mu}(1-e^{-T/\mu})dz}{\mu(1-e^{-s/\mu})}$$

where each lost relation has an expected size $\bar{r}_n$ which is independent of n.

Using the distribution for $w(s(t), t)$, the expected number of new business relations appearing in the interval of length T is given by

$$\text{(A.17)} \qquad E[\text{Number of new business relations during interval } T|s] = \theta\rho(T)$$

Each new relation has an expected size $E[r]$.

We can define the growth rate as the difference between the new arrivals and the losses:

$$\text{(A.18)} \qquad \begin{aligned} g_y(t, t+T; y, s) &= \frac{E(y(t+T|s)) - y(t,s)}{y(t,s)} \\ &= \frac{E[r]\theta\rho(T)}{y(t,s)} - (1-e^{-T/\mu}) \\ &= \left(\frac{E[r]\theta\mu}{y(t,s)} - 1\right)(1-e^{-T/\mu}) \end{aligned}$$

Let's denote the growth of trade spell that survive the interval time T as $g_y(t, t+T; y, s|n(t+T) > 0)$ and the probability of dying as $\Pr\{n(t+T) = 0|y(t), s(t)\}$. Then, it follows that

(A.19)
$$\begin{aligned} g_y(t, t+T; y, s) =& (1 - \Pr\{n(t+T) = 0|y(t), s(t)\})g_y(t, t+T; y, s|n(t+T) > 0) \\ &+ \Pr\{n(t+T) = 0|y(t), s(t)\}(-1) \end{aligned}$$

from where

$$\text{(A.20)}\quad g_y(t, t+T; y, s | n(t+T) > 0) = \frac{g_y(t, t+T; y, s) + \Pr\{n(t+T) = 0 | y(t), s(t)\}}{1 - \Pr\{n(t+T) = 0 | y(t), s(t)\}}$$

We showed that the probability of a trade spell ceasing to exist is decreasing in its size and age, thus mean firm growth decreases with size and age, as described in **Result 4**.

B For Online Publication - Empirical Appendix

B.1 Duration and growth without agreement-related variables

Result 3 states that the probability of a trade relationship ceasing is decreasing in its size and age (or duration). A natural way to examine this result is to estimate a hazard model using the specification given by equation (11), without economic integration variables. We also include the standard gravity variables, GDP of both the importer and the exporter, distance between the two, as well as a dummy indicating the existence of a common border and a common language that the two countries share. Result 4 states that the growth rate is decreasing in size conditional on duration and decreasing in duration conditional on size.

To estimate the growth rate we use the specification given by equation (12),without the economic integration variables. In the growth regression, instead of using standard gravity variables, we use country-pair, origin-year, and destination-year fixed effects in order to fully control for unobserved multilateral resistance terms. Our theoretical model predicts that both growth and duration depend on the current size of the spell, not the initial one (see equation 9 in the case of growth). The standard size variable used in the literature is the initial value of trade. Our specification for the growth regression is similar to Muûls (2014), who also includes the volume of trade in period t to explain the growth of firm-level trade from t to $t+1$.

Results collected in Table B.1 are consistent with the predictions of our model and are in line with the literature. Both the hazard and the growth rate are decreasing in duration, indicating that longer lived spells are less likely to cease and also grow less. Both are also decreasing in size, indicating that larger spells are less likely to cease and also grow less. Our results for growth are consistent with Muûls (2014) who examines firm-level growth and finds it to be decreasing in age as well as size.

	Hazard (RE probit)	Growth (OLS)
Duration (ln)	-0.433***	-0.055***
	(0.001)	(0.001)
Size (ln)	-0.126***	-0.253***
	(0.000)	(0.000)
Importer GDP (ln)	-0.013***	
	(0.000)	
Exporter GDP (ln)	-0.086***	
	(0.000)	
Distance (ln)	0.123***	
	(0.001)	
Contiguity	-0.110***	
	(0.002)	
Common language	0.000	
	(0.001)	
Constant	1.328***	3.722***
	(0.006)	(0.023)
Observations	24,510,480	17,555,604
Relationships	3,109,593	1,871,657
R^2	.	0.143
ρ	0.168***	

Robust standard errors in parentheses, with *, **, *** denoting significance at 10%, 5%, and 1%.

Table B.1: **Hazard and Growth Regressions**

B.2 Pure effects on hazard

As we discussed in the paper, agreements affect trade outcomes through several different mechanisms. We present in Figure B.1 the impact of each of the four agreement related variables used in column 4 of Table 3, the dynamic specification, and summarize their magnitudes in Table B.2. In each panel we plot the estimated hazard with each agreement-related variable set to zero and its appropriate agreement value (either one in the case of the two dummies or a count of how long the agreement has been in place) in turn, while keeping the other three variables at zero. Thus, the relevant comparison is to the hazard in the absence an agreement. These plots allow us to clearly illustrate the effect of each variable.

The pure effect of an agreement is to reduce the hazard by an average of 25.9%

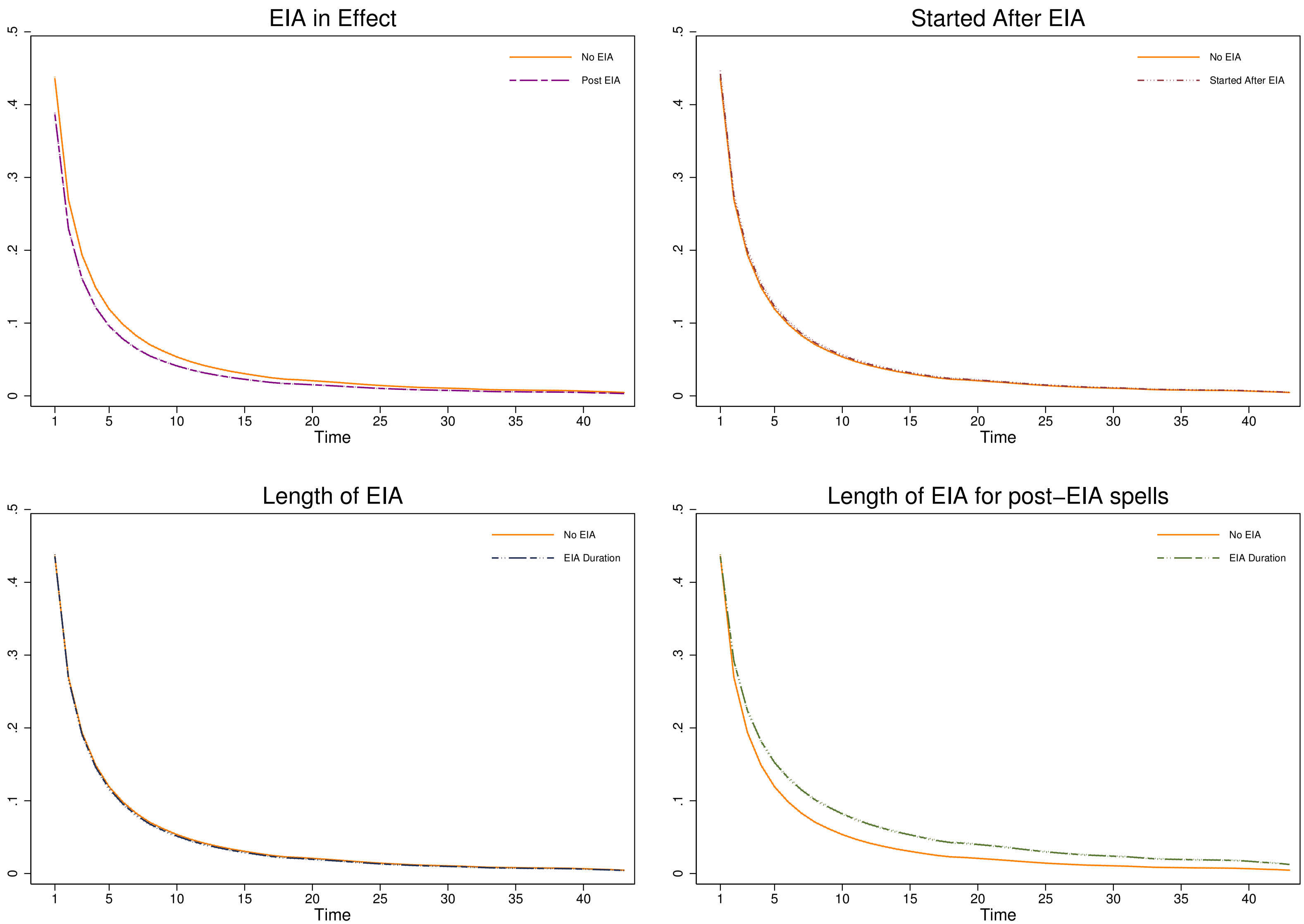

Figure B.1: **Pure Effects of EIAs on Hazard for the Dynamic Specification** over the course of an entire spell relative to the hazard in the absence of an agreement. The magnitude of this effect varies from a reduction of 16.1% over the first five years to a 27.9% reduction between years 21 through 30 of a spell. This is the effect most beneficial to pre-agreement spells. These spells also benefit the longer the agreement is in place with the hazard being an additional 1.3% lower over the first five years and 7% lower for years 21 through 30, averaging to a 5.9% lower hazard over the entire spell. Spells which start after the agreement, however, have on average a 4.1% higher hazard, the effect which ranges from 2.4% higher hazard over the first five years and 4.5% higher hazard for years 21 through 30. The longer the agreement is in place, the higher is the hazard of spells which start after an agreement. Over the first five years of an agreement, spells which started after the agreement face a 14.5% higher hazard. Between years 21 and 30 this effect increases to a 110.2% larger hazard, more than double the hazard faced in the absence of an agreement. Across all years of a spell, this effect averages to a 94% higher hazard.

Spell years	EIA in effect	Spell started after EIA	Duration of EIA	Duration of EIA for post-agreement spells
1-5	-16.1%	2.4%	-1.3%	14.7%
6-10	-21.9%	3.4%	-3.4%	43.4%
11-20	-25.4%	4.0%	-5.3%	75.5%
21-30	-27.9%	4.5%	-7.0%	110.2%
All years	-25.9%	4.1%	-5.9%	94.0%

Table B.2: **Pure Hazard Effects of Agreement-Related Variables**

B.3 Simulated Effects for the Static Specification

Figures B.2 and B.3 illustrate the estimated effects corresponding to estimates of the static specifications for the hazard of spells ceasing and the growth rate (columns (3) and (5) of Table 3, evaluated at the average of our data.

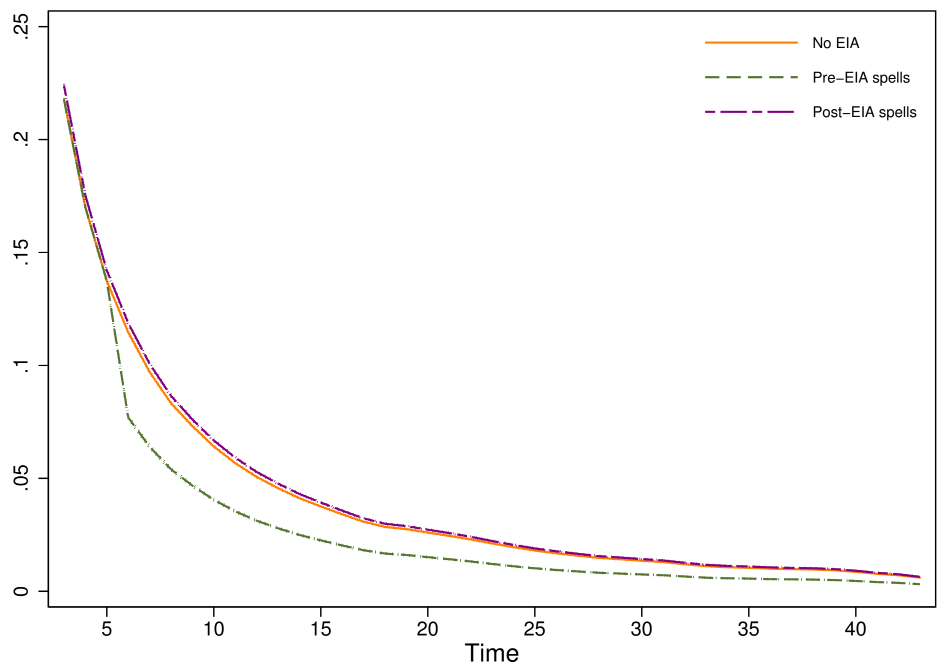

Figure B.2: **Simulated Effects of EIAs on Hazard using the Static Specification**

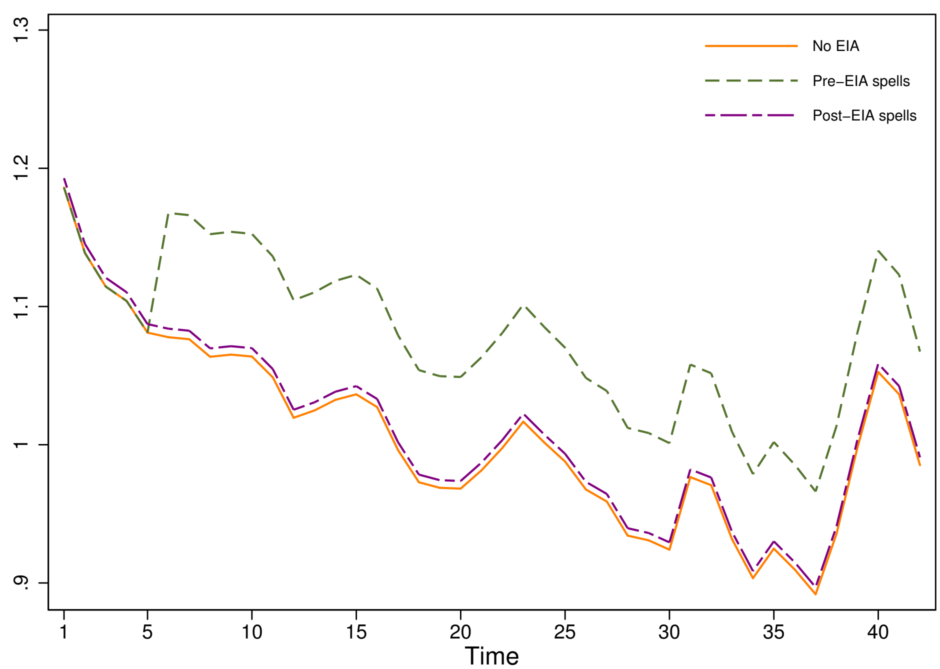

Figure B.3: **Simulated Effects of EIAs on Growth using the Static Specification**