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Economic Integration Agreements and the Survival of Exports

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Abstract

This study investigates how various Economic Integration Agreements between Turkey and its trading partners affected the exports of machinery during 1998~2013. In addition, it differentiates between trade in parts and components and finished products, and assesses the effects of Economic Integration Agreements separately on these two types of goods. Using a discrete-time probit model with random effects, we show that an Economic Integration Agreement increases the survival of export relations which were initiated before the agreement. It is found to be reasonably heterogeneous, that is, the effect is found to be larger for parts and components exports occurring within the Global Production Networks compared to finished products exports.

JEL Classification: F10, F14, C41

Keywords: Economic Integration Agreements, Export Duration, Fragmentation, Global Production Networks, Parts and Components, Survival Analysis

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I. Introduction

The recent dramatic rise in the number of Economic Integration Agreements (EIAs), an important parallel development in global trade has been the rapid emergence of Global Production Networks (GPNs) (Yeats 2001, Ando 2006). Blyde *et al*. (2015) argued that EIAs can foster the international fragmentation of production across countries by removing nonproduction costs such as transportation, customs clearance, and other related charges. These EIA features, therefore, are expected to increase the survival probabilities of trade in Parts and Components (P&C) because small changes in nonproduction costs have a major effect on fragmentation decisions due to the multiple border-crossings involved in a GPN.[1]

An interesting issue is the effects of EIAs on the survival of P&C trade flows linked to the rise in GPNs.[2] To address this gap, the present paper considers EIA effects on the survival of export relations and makes the following contributions. First, we estimate EIA effects on export duration by using a discrete-time probit model that controls for unobserved heterogeneity among exporters, as suggested by Hess and Persson (2011a). As indicated by Martuscelli and Varela (2015), an EIA enhances the survival chances of export relations through a reduction in policy-related trading costs and additional information regarding destination markets. To accomplish this, we use Turkey's export data on machinery and transportation products at the six-digit Harmonized System (HS) level over the period of 1998~2013. Machinery and transportation equipment (MP) is one of the most significant sectors of the Turkish economy and constituted 27.3% of the total merchandise exports in 2015 (OECD 2016).[3] In addition, the OECD-WTO Trade in Value Added (TiVA) database reports an increasing trend in foreign value-added content of gross exports from about 20% in 1995 up to 39% in 2011, indicating a high degree of global production integration in the sector.

[1] Related literature studying the role of GPNs in enhancing the survival of P&C export flows includes Obashi (2010) on intra-zone trade in East Asia, Shao *et al*. (2012) on Chinese manufacturing exports, Corcoles *et al*. (2014) on world auto exports, Corcoles *et al*. (2015) on Spain's machinery exports, and Diaz-Mora *et al*. (2015) on the exports of Spanish manufacturing firms.

[2] A few recent papers (Hayakawa and Yamashita 2011, Blyde *et al*. 2015) have made some progress in understanding the effects of EIAs on trade in P&C associated with GPNs.

[3] In this paper, MP is denoted as HS 84~92 and composed of general machinery, electric machinery, transport equipment, and precision machinery.

Second, we examine the heterogeneous effects of EIAs on the stability of export flows by including separate dummies for Non-reciprocal Preferential Trade Arrangements (NR-PTAs), Preferential Trade Arrangements (PTAs), Free Trade Agreements (FTAs), and Customs Unions (CUs). By addressing the heterogeneous nature of EIAs, we aim to show the types of agreements that are most important for enhancing the stability of export flows, as suggested by Kamuganga (2012) and Recalde *et al*. (2016). Third, as a key contribution of the present paper, we further decompose the total machinery exports into Finished Products (FPs) and P&C exports to assess the role of GPNs in determining the impact of EIAs on the probability of P&C export ceasing. We argue that by reducing trade costs, EIAs can foster the creation of GPNs, which in turn will lead to higher export survival rates in P&C compared to FPs (Obashi 2010, Blyde *et al*. 2015). Finally, as a robustness check, we re-estimate EIA effects on the duration of P&C trade associated with GPNs using an alternative proxy. However, using trade in P&C as a proxy for GPNs in empirical analyses may lead to overestimating EIA effects. Thus, we introduce an indicator of Vertical Differentiation (VD) as a GPN proxy into the duration analysis to more accurately evaluate EIA impacts on the stability of trade relations in P&C linked with GPN, using the method first proposed by Abd-el-Rahman (1991) and used by Greenaway *et al*. (1994, 1995).

Investigating the Turkish case is important for several reasons. First, Turkey has achieved a striking record of export growth since the advent of trade liberalization in the 1980s and establishment of a CU with the European Union (EU) in 1995.[4] The export volume grew at nearly 15% per year from 1998 to 2013, which is significantly higher than the world average, but lower than that of China (World Bank 2014b). During this period, Turkey has also successfully diversified its export base and much of this progress has occurred through the destination dimension (World Bank 2014b, Aldan and Çulha 2016). Meanwhile, Turkey has intensified its participation in GPNs since 1995 (Kaminsky and Ng 2006, World Bank 2014b, Gündoğdu and Saracoğlu 2016), and aggressively pursued EIAs with its recent trade partners. Currently, Turkey is negotiating 13 further trade agreements and is planning negotiations for new trade agreements with 10 further

[4] Not surprisingly, the impact of the CU between the EU and Turkey on bilateral trade flows has been extensively investigated in the literature. Examples of these studies are Antonucci and Manzocchi (2006), Nowak-Lehmann *et al*. (2007), Neyaptı *et al*. (2007), Adam and Moutos (2008), Yılmaz (2011), World Bank (2014a), Magee (2016), and Frede and Yetkiner (2017). Despite the vast literature, there is no general consensus concerning the benefits of CU for Turkey's exports. While a few studies have revealed a negative or no significant relation between the CU and Turkey's exports (World Bank 2014a, Frede and Yetkiner 2017), others suggest a positive relation of varying magnitude (Nowak-Lehmann *et al*. 2007, Neyaptı *et al*. 2007). After reviewing the existing literature, Yılmaz (2011) concluded that the CU generally has a beneficial effect on Turkey's export flows in the long run, largely by virtue of continuing improvements in productivity.

countries including the US, Canada, and Japan.[5] Overall, Turkey is a particularly appropriate country for studying EIA effects associated with internationally fragmented production, not only the noticeable improvements in its export diversification but also the increase in its ties with GPNs and the sharp rise in the number of EIAs, particularly FTAs.

We show that the survival rates of trade vary across the types of EIAs and products and EIAs have a significant effect on the likelihood of the hazard of trade ceasing. In addition, we find that EIA effects is larger on P&C trade and becomes stronger as the trade relation involves more vertically differentiated goods. This paper is organized as follows. Section II reviews the literature. Section III describes the data used. Section IV lays out the empirical methodology, and Section V presents the empirical results including robustness checks. Finally, Section VI concludes.

II. Literature Review

Existing empirical studies have investigated the impacts of EIAs on aggregate bilateral trade flows rather than directly estimating the impacts on members' welfare, because the latter cannot be easily evaluated due to data limitations. To assess EIA effects on trade between member countries, most researchers have relied on gravity models and a pair of dummy variables measuring each pair of countries' participation in EIAs. Previous studies based on gravity models have yielded various results, depending on the specification of the gravity equation, time period, sample, particular EIAs considered, and the level of data aggregation (Freund and Ornelas 2010). However, Ghosh and Yamarik (2004) found a consensus that EIAs are trade creating (Aitken 1973, Bergstrand 1985, Frankel *et al*. 1995, Clausing 2001). A number of more recent studies, including Carrere (2006), Baier and Bergstrand (2007), Magee (2008), and Egger *et al*. (2008), have addressed the endogeneity problem and reached the same conclusion as the foregoing consensus view: EIAs do increase bilateral trade flows.

While the debate concerning whether EIAs foster trade flows continues, two new lines of research have emerged that significantly deepen the understandings of these

[5] For a detailed list of the FTAs signed by Turkey, see http://www.ekonomi.gov.tr/sta/.

agreements' impact on member countries. The first line of research is based on the heterogeneous firm trade theory developed by Melitz (2003), which examines the relative contribution of the extensive margin and intensive margin to export dynamics. The increasing availability of highly detailed country-level trade statistics and firm-level trade data enables researchers to measure the role of both margins in export growth (Hummels and Klenow 2005). Subsequently, several studies have relied on disaggregated trade flows to examine EIA effects on trade flows decomposed into extensive and intensive margins. Examples include Foster *et al*. (2011), Egger *et al*. (2011), Baier *et al*. (2014), and Florensa *et al*. (2015).[6] Using the decomposition method of Hummels and Klenow (2005) and the Baier and Bergstrand (2007) approach for estimating EIA effects on trade flows, Baier *et al*. (2014) investigated the effects of various EIAs on trade margins and found that the formation of an EIA has significantly positive effects on both extensive and intensive margins. They further found that deeper EIA types have a larger impact on both extensive and intensive margins than shallower agreements. Finally, they showed that the effect of EIAs on intensive margins is higher in magnitude than that on extensive margins. Moreover, intensive margins of trade respond sooner than extensive margins for deeper EIAs.[7]

The second line of research emanated by Besedes and Prusa (2006a), which examines the duration of trade relations using survival analysis. Based on Kaplan-Meier estimates of survival functions, the authors showed that the duration of US imports is very short, with the median being 2~4 years.[8] In a follow-up paper (Besedes and Prusa 2010), the roles of extensive and intensive margins in export growth were further explored and most export relations are very short-lived, with the median being 1~2 years. More importantly, export growth mainly occurs through the survival and deepening of existing trade relations rather than the creation of new trade relations, i.e., the extensive margin.

Subsequent research has examined various factors influencing the length of trade relations. The factors considered as determinants of export duration include a range of variables from firm/product/market characteristics and search costs to the usual gravity model variables (Besedes and Prusa 2006b, Nitsch 2009, Brenton *et al*. 2010, Obashi 2010, Hess and Persson 2011b, Fugazza and Molina 2016). Besides these factors, the

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[6] Baier *et al*. (2014) provided convincing arguments to support the idea that an EIA has different effects on extensive and intensive margins.

[7] While this finding is in line with Egger *et al*. (2011) and Florensa *et al*. (2015), it contrasts sharply with the findings of Foster *et al*. (2011), who found that much of the trade creation effect of preferential trade agreements takes place along the extensive margin.

[8] These early findings were generally confirmed by more recent evidence, including Nitsch (2009) for Germany, Hess and Persson (2011b) for EU15, and Brenton *et al*. (2010), for a group of developing countries.

length of trade relations might also be affected by trade agreements. EIAs were expected to affect export flows not only through the direct effects of reductions in trade costs on demand, but also through the indirect effects of facing less competition. Therefore, the reduction in trade costs and the restriction on competition from countries outside the agreement can render the trade relations more stable, thereby substantially increasing the likelihood of survival in export markets (Besedes and Blyde 2010).

However, the literature that focuses exclusively on the role of EIAs in enhancing the survival of trading relations has only recently begun to emerge (Besedes and Blyde 2010, Kamuganga 2012, Besedes 2013, Besedes *et al*. 2015, and Recalde *et al*. 2016).[9] The first attempt to analyze EIA impacts on the duration of export relations was made by Besedes and Blyde (2010), who analyzed factors affecting the export survival of Latin American countries during 1975~2005; they showed that pairs of countries with FTAs tend to exhibit higher survival rates than those without FTAs. Kamuganga (2012) analyzed the impacts of various EIAs on the duration of export relations involving 53 African countries during 1995~2009 and found evidence supporting that intra-regional trade cooperation in Africa increases the likelihood of export survival across all types of agreements. As for specific EIAs, the results show that deeper trade agreements such as monetary unions, Common Markets (CMs), and CUs have relatively higher survival rates than shallower PTAs. Besedes (2013) assessed the effect of the North American Free Trade Agreement (NAFTA) on the hazard of export ceasing for the three-member countries using two dummy variables capturing EIA effects, instead of only one such variable. One, *NAFTA*, simply represents the presence of NAFTA membership between country pairs, while the other, *NAFTA in effect*, captures the time effect of NAFTA on export survival over time. Besedes (2013) showed that the presence of NAFTA reduces the hazard rate of Canadian and U.S. exports to fellow NAFTA members, while it has no effect on Mexican exports. Furthermore, estimation results suggest that, contrary to expectations, NAFTA, once implemented, increased the hazard rate of Mexican and U.S. exports to other NAFTA members, but had insignificant effects in the case of Canada, contrary to expectations.

In a later study, Besedes *et al*. (2015) conducted one of the most comprehensive inquiries in this area by investigating EIA effects on the duration of trade flows for a sample of 180 countries from 1962 to 2005. They argued that studies should consider the

[9] Other studies examining the impacts of trade liberalization on the hazards of trade using dummy variables for EU membership are available (Brenton *et al*. 2010, Nitsch 2009, Hess and Persson 2011b), but were unable to consider various EIAs and failed to consider the dynamic effects of EIAs.

timing of the agreement relative to that of trade relations, which can play an important role in understanding their effects on product-level patterns of trade. In doing so, several EIA dummies were added in the models to capture the dynamics associated with EIA implementation with respect to a given spell. Their results suggest that EIAs exert a dual effect on the survival of trade relations. They increase the survival of trade relations that started before the agreement, but reduce that of trade relations that started after the agreement.

More recently, Recalde *et al*. (2016) conducted research similar to that conducted by Besedes *et al*. (2015) to examine whether deeper EIAs enhance the survival of trade relations more strongly than shallow variants, using export data for 150 Latin American countries between 1962 and 2009. The signs and magnitudes of EIA impact, however, appear to differ significantly from those reported in Besedes *et al*. (2015). In particular, the results in Recalde *et al*. (2016) indicate that while the shallower EIAs reduce the survival of export relations for the spells that started before the agreement, the deeper EIAs, namely FTAs or CUs, increase the survival of export relations. In contrast, for spells that start after the agreement is enforced, the shallower agreements actually reduce the stability of export relations, while the deeper EIAs appear to exert a positive effect on the survival of export relations. Finally, their estimates suggest that survival rates increase over time after the signing of an EIA for spells commencing before and after the agreement, though the coefficient is larger in magnitude for deeper EIAs. Thus, they concluded that the formation of an EIA on the survival of trade relations may vary considerably across regions and types of EIAs.

Taken together, these studies show that EIA effects on aggregate trade flows, trade margins, and trade survival vary widely across agreements. Since the impacts of various EIAs on P&C exports have not hitherto been investigated in the literature, the remainder of this paper seeks to fill this gap.

III. Data and Analysis

Data on Turkish machinery and transportation equipment (MP) are taken from BACI, an international trade database developed by CEPII.[10] Our dataset contains bilateral trade values and quantities of exports and imports at the 6-digit HS level (revision 1996) for more than 200 trade partners from 1998 to 2013.

In this product classification, there are more than 5,000 product lines covering all articles in trade (HS chapters 1~92). Following Kimura and Obashi (2010) and Obashi (2010), we identify product lines included in any of the headings of chapters 84~92 as MP (general machinery HS 84, electric machinery HS 85, transport equipment HS 86~89, and precision machinery HS 90~92). These industries are selected because they are often considered highly fragmented. Accordingly, out of the 1124 product lines, 729 and 445 are listed as FPs and P&C, respectively. We examine exports of each product to 188 countries, which account for more than 90% of Turkey's machinery exports. The selection of the sample countries is dominated by the availability of data for bilateral trade flows and explanatory variables. The list of countries is presented in Appendix 1.

Export duration is measured by the length of spells and the number of years in which the product–country pair export relation is active. An export relation may stop and start several times over the study period, resulting in multiple spells within one export relation. The greater the number of spells, the shorter is the duration of export spells. Thus, the number of export spells may exceed that of export relations during the study period. The maximum number of spells possible for each importing country and product pair during 1998~2013 is eight.

Data on the various EIAs–our key explanatory variable–are mainly taken from Baier and Bergstrand's website,[11] and supplemented by data from the WTO's Regional Trade Agreements Information System (RTA-IS).[12] The database records the economic integration of bilateral country pairings for 195 countries annually from 1950 to 2012 and identifies six types of trade agreements by their level of economic integration, ranging in depth from NR-PTA to more extensive agreements such as PTAs, FTAs, CUs, CMs, and Economic Unions (EU). Our analysis focuses on the 1998~2013 period and considers

[10] See Gaulier and Zignago (2010) for a detailed description of this database.
[11] This dataset is available on Jeffrey Bergstrand's website: www.nd.edu/jbergstr.
[12] The database is available on the World Bank website: http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx.

only the first four types since the latter two types are not present throughout this period. The complete list of EIAs signed by Turkey is given in Appendix 2.

Table 1. Number of observations

	Finished Products		Parts and Components	
	Number of Observations	Percent of Observations	Number of Observations	Percent of Observations
No agreement	142,715	47.01	122,131	47.47
EIA	160,849	52.99	135,167	52.53
NR-PTA	13,341	4.39	12,535	4.87
PTA	23,820	7.85	17,830	6.93
FTA	46,333	15.26	36,729	14.27
CU	77,355	25.48	68,073	26.46
Total	303,564	100.00	257,298	100.00

(Note) This table reports the number of observations across product groups, broken down by the type of trade agreements. EIA denotes Economic Integration Agreement, NR-PTA denotes Non-reciprocal Preferential Trade Arrangements, PTA denotes Preferential Trade Arrangements, FTA denotes Free Trade Agreements, and CU denotes Customs Unions.
(Source) Authors ‘own calculations based on CEPII’s BACI database.

There are a total of 560,862 trade observations on MP export flows during the analysis period. Of these, about 53% (296,016) are accomplished by trade agreements and belong to the aforementioned four types of agreements (Table 1). Of the total, 303,564 observations (54%) pertain to FP exports, while the remaining 46% pertain to P&C. CU, accounting for about 26% of all observed trade agreements, can be considered the most common type of EIA for all types of products, followed by FTA with about 15% and PTA with about 7% of the observations. This is not surprising, given the deep and long-standing trade ties between Turkey and EU member states. Moreover, the shares of CU and NR-PTAs are higher for P&C trade compared to FPs.

Table 2. Average duration of exports

(Years)

	Finished Products		Parts and Components	
	Length of Spells		Length of Spells	
	Mean	Median	Mean	Median
No agreement	2.97	1	3.54	1
EIA	2.95	1	3.85	2
NR-PTA	2.60	1	3.48	1
PTA	2.51	1	2.90	1
FTA	2.99	1	3.77	2
CU	3.11	1	4.22	2
Total	2.96	1	3.67	2

(Note) This table reports the length of spells (in years) for each type of trade agreement and each product group. EIA denotes Economic Integration Agreement, NR-PTA denotes Non-reciprocal Preferential Trade Arrangements, PTA denotes Preferential Trade Arrangements, FTA denotes Free Trade Agreements, and CU denotes Customs Unions.
(Source) Authors' own calculations based on CEPII's BACI database.

Table 2 presents the length of spells for each type of trade agreement and each product group during 1998~2013. It shows that the average duration of FP export flows to EIA partners is slightly lower than those to non-EIA partners. On the other hand, Turkey's P&C exports to EIA partners have longer spells than those to non-EIA partners. This result reinforces the hypothesis that EIAs have a stronger impact on P&C than FP trade. Not surprisingly, the mean spell length is longest when the EIA is a CU type (3.11 years for FPs and 4.22 for P&C). In contrast, the lowest average spell duration is found when the EIA is a PTA type for both types of products. It seems that deeper EIAs increase the length of the export spell by reducing trade-related transaction costs. We also find that CU has had the greatest impact on the duration of P&C exports (4.22 years), because the reduction in trade costs has been greater and Turkish firms have been strongly integrated into European value chains over the past 15 years. Tables 3 and 4 show that spells of exports in P&C are longer than those in FPs. EIA increases the spell length, and the increase is higher when the EIA is a CU. The share of the observed spells of P&C (FP) trade within a year or less decreases from 51 (56)% with non-agreement to 44 (53)% with CU.

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Table 3. Distribution of spell lengths for finished product

Spell Length	Total		No Agreement		EIA		NR-PTA		PTA		FTA		CU	
	Number of Spells	Percent of Spells	Number of Spells	Percent of Spells	Number of Spells	Percent of Spells	Number of Spells	Percent of Spells	Number of Spells	Percent of Spells	Number of Spells	Percent of Spells	Number of Spells	Percent of Spells
1	56,535	55.16	32,642	56.23	23,893	53.77	2,584	57.81	3,131	54.71	6,630	53.41	11,548	52.89
2	16,464	16.06	9,008	15.52	7,456	16.78	713	15.95	1,053	18.40	2,081	16.76	3,609	16.53
3	7,635	7.45	4,017	6.92	3,618	8.14	353	7.90	513	8.96	1,022	8.23	1,730	7.92
4	4,274	4.17	2,291	3.95	1,983	4.46	225	5.03	253	4.42	498	4.01	1,007	4.61
5	2,766	2.70	1,490	2.57	1,276	2.87	107	2.39	205	3.58	337	2.71	627	2.87
6	1,960	1.91	1,004	1.73	956	2.15	75	1.68	182	3.18	282	2.27	417	1.91
7	1,721	1.68	967	1.67	754	1.70	71	1.59	49	0.86	252	2.03	382	1.75
8	1,420	1.39	873	1.50	547	1.23	47	1.05	30	0.52	172	1.39	298	1.36
9	1,251	1.22	794	1.37	457	1.03	44	0.98	35	0.61	108	0.87	270	1.24
10	1,112	1.08	651	1.12	461	1.04	36	0.81	25	0.44	127	1.02	273	1.25
11	1,268	1.24	872	1.50	396	0.89	35	0.78	47	0.82	118	0.95	196	0.90
12	1,034	1.01	646	1.11	388	0.87	20	0.45	44	0.77	156	1.26	168	0.77
13	836	0.82	469	0.81	367	0.83	22	0.49	47	0.82	141	1.14	157	0.72
14	722	0.70	410	0.71	312	0.70	21	0.47	31	0.54	90	0.73	170	0.78
15	544	0.53	285	0.49	259	0.58	21	0.47	21	0.37	93	0.75	124	0.57
16	2,952	2.88	1,637	2.82	1,315	2.96	96	2.15	57	1.00	306	2.47	856	3.92
Total	102,494	100.00	58,056	100.00	44,438	100.00	4,470	100.00	5,723	100.00	12,413	100.00	21,832	100.00

(Note) This table depicts the distribution of spell lengths for Finished Product, broken down by the type of trade agreement. EIA denotes Economic Integration Agreement, NR-PTA denotes Non-reciprocal Preferential Trade Arrangements, PTA denotes Preferential Trade Arrangements, FTA denotes Free Trade Agreements, and CU denotes Customs Unions.

(Source) Authors' own calculations based on CEPII's BACI database.

Table 4. Distribution of spell lengths for parts and components

Spell Length	Total		No agreement		EIA		NR-PTA		PTA		FTA		CU	
	Number of Spells	% of Spells	Number of Spells	% of Spells	Number of Spells	% of Spells	Number of Spells	% of Spells	Number of Spells	% of Spells	Number of Spells	% of Spells	Number of Spells	% of Spells
1	34,662	49.43	21,307	51.30	13,355	46.70	1,635	51.01	1,789	50.93	3,802	47.76	6,129	44.04
2	10,776	15.37	6,194	14.91	4,582	16.02	480	14.98	636	18.10	1,235	15.51	2,231	16.03
3	5,411	7.72	3,011	7.25	2,400	8.39	244	7.61	343	9.76	665	8.35	1,148	8.25
4	3,185	4.54	1,816	4.37	1,369	4.79	155	4.84	192	5.47	335	4.21	687	4.94
5	1,846	2.63	1,016	2.45	830	2.90	90	2.81	124	3.53	220	2.76	396	2.85
6	1,511	2.15	847	2.04	664	2.32	69	2.15	104	2.96	196	2.46	295	2.12
7	1,340	1.91	780	1.88	560	1.96	63	1.97	27	0.77	165	2.07	305	2.19
8	1,184	1.69	707	1.70	477	1.67	50	1.56	18	0.51	148	1.86	261	1.88
9	1,258	1.79	828	1.99	430	1.50	53	1.65	21	0.60	98	1.23	258	1.85
10	1,042	1.49	654	1.57	388	1.36	33	1.03	19	0.54	86	1.08	250	1.80
11	1,125	1.60	716	1.72	409	1.43	53	1.65	31	0.88	162	2.03	163	1.17
12	965	1.38	554	1.33	411	1.44	40	1.25	33	0.94	174	2.19	164	1.18
13	718	1.02	394	0.95	324	1.13	29	0.90	26	0.74	141	1.77	128	0.92
14	602	0.86	359	0.86	243	0.85	38	1.19	34	0.97	71	0.89	100	0.72
15	544	0.78	303	0.73	241	0.84	30	0.94	18	0.51	76	0.95	117	0.84
16	3,959	5.65	2,045	4.92	1,914	6.69	143	4.46	98	2.79	387	4.86	1,286	9.24
Total	70,128	100.00	41,531	100.00	28,597	100.00	3,205	100.00	3,513	100.00	7,961	100.00	13,918	100.00

(Note) This table depicts the distribution of spell lengths for Parts and Components, broken down by the type of trade agreement. EIA denotes Economic Integration Agreement, NR-PTA denotes Non-reciprocal Preferential Trade Arrangements, PTA denotes Preferential Trade Arrangements, FTA denotes Free Trade Agreements, and CU denotes Customs Unions.

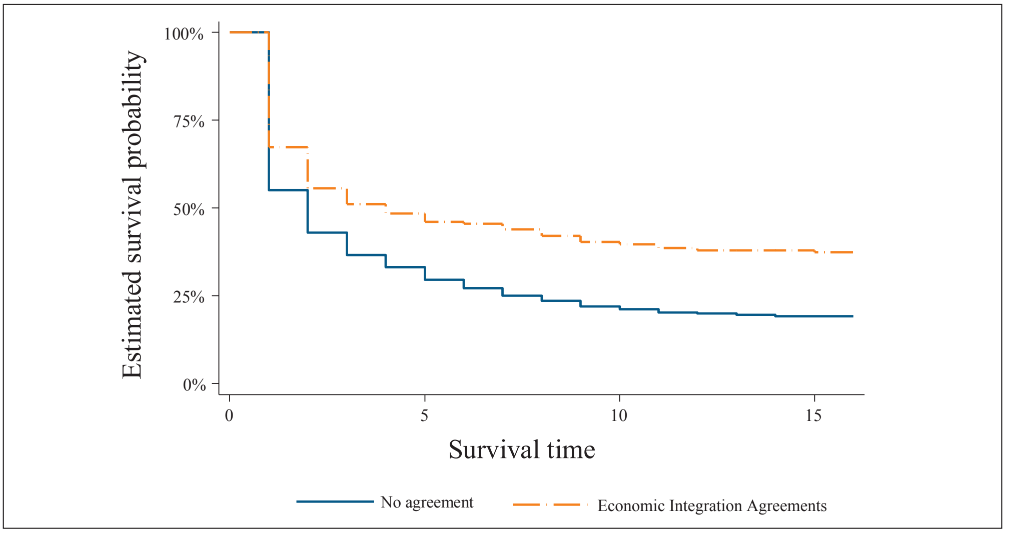
(Source) Authors' own calculations based on CEPII's BACI database.

Another method of illustrating the patterns and differences in export duration across various EIAs is to graph the survival curves using the Kaplan-Meier method to estimate the probability of export relations surviving for a given number of years. The survival curves in Figures 1 and 2 show significant differences in survival rates between Turkey's machinery exports to EIA partners and those to non-EIA partners. In particular, they confirm that exports to EIA partners exhibit higher probabilities of survival than those to non-EIA partners and the gap between those two survival curves widens over time. The gap is more pronounced in the case of P&C than in the case of FPs. Figures 3 and 4 show separate Kaplan-Meier survival curves for various EIAs with different product groups. Surprisingly, the PTA type has higher survival rates, while the FTA type has much lower survival rates. These findings are reasonably consistent across different product groups. However, this result contradicts those of previous findings in the literature, as deeper EIAs usually lead to higher survival rates. This contradictory finding may be because Turkey's PTAs (both NR-PTA and PTA)–involving key trading partners such as the US, Japan, and Australia–are long-standing, and therefore, not only promote export experience but also improve the chances of export survival. In contrast, these relatively low survival rates for the FTA type can be attributed to the fact that Turkey's FTAs mostly involve smaller countries and are too recent to have an appreciable impact on the duration of exports.

Overall, we find that the survival rates for Turkey's exports to EIA partners are significantly higher than those for its exports to non-EIA partners and this difference in survival rates is noticeably more prevalent in the case of P&C exports. In the rest of the paper, we attempt to explain these findings using formal econometric analysis.

Figure 1. Export survival for finished product

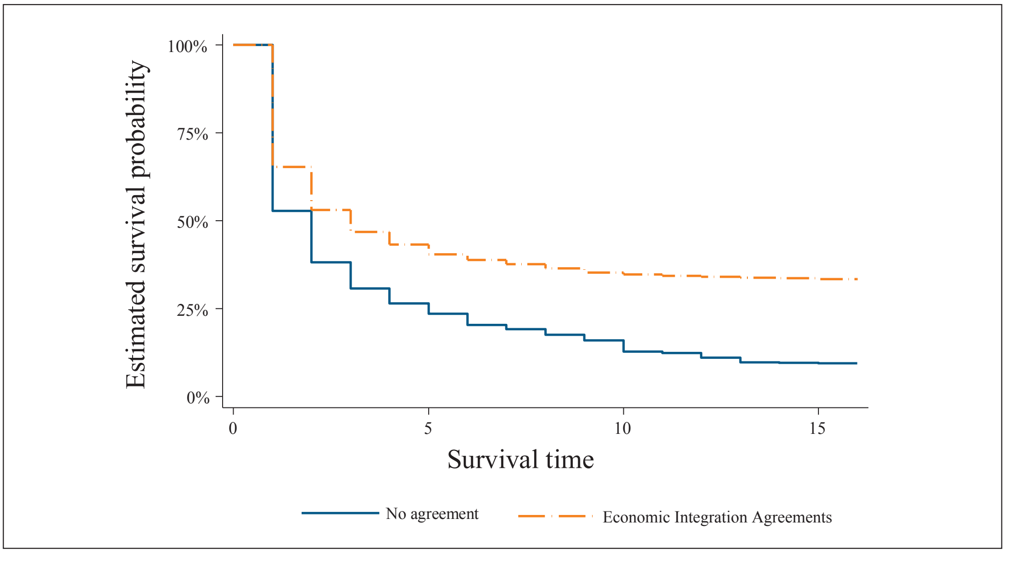
(Years)



(Source) Author's own calculation based on CEPII's BACI database

Figure 2. Export survival for parts and components

(Years)

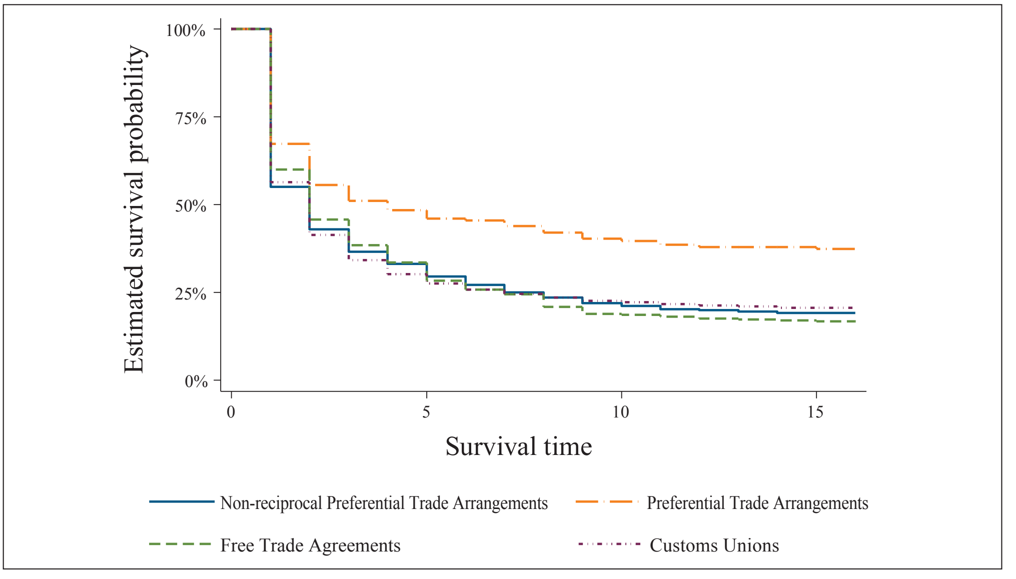


(Source) Author's own calculation based on CEPII's BACI database

http://dx.doi.org/10.11130/jei.2018.33.1.1046

Figure 3. Export survival of finished product

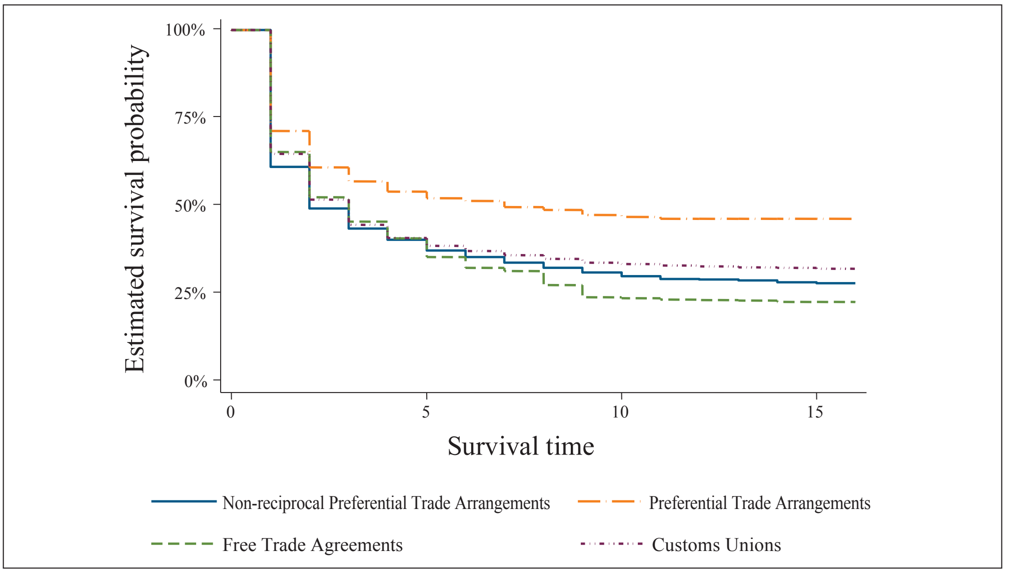
(Years)



(Source) Author's own calculation based on CEPII's BACI database

Figure 4. Export survival of parts and components

(Years)



(Note) This figure displays export survival probabilities of Parts and Components across four types of trade agreements using the Kaplan-Meier survival functions. NR-PTA denotes Non-reciprocal Preferential Trade Arrangements, PTA denotes Preferential Trade Arrangements, FTA denotes Free Trade Agreements, and CU denotes Customs Unions.
(Source) Authors' own calculation based on CEPII's BACI database

IV. Estimation Methodology

A. Methodology

Following Hess and Persson (2011a), this study employs a discrete-time probit model with random effects. Discrete-time hazard models can be specified in terms of conditional probabilities of termination of a particular trade relation in a given time interval. Using the same notation as in Hess and Persson (2011a), we define T_i as a continuous, non-negative random variable measuring the survival time of a particular trade relation. The hazard probability is then defined as the probability of terminating a trade relation within a specified time interval $(t_k, t_{k+1}), k = 1,2,\dots, k^{max}$ and $t_{1=0}$, given that failure has not occurred prior to the starting time of the interval and the explanatory variables are added to the regression model. This conditional probability can be expressed as a discrete-time hazard rate:

$$h_{ik} = P(T_i < t_{k+1} | T_i \geq t_k, x_{ik}) = F\left(x'_{ik}\beta + \gamma_k\right) \quad (1)$$

where x_{ik} is a vector of time-varying covariates that are assumed to affect the hazard rate and β is a vector of coefficients to be estimated. A positive (negative) sign of coefficients indicates a higher (lower) likelihood of terminating an export relation, and consequently, lower (higher) probability of surviving in the export market. γ_k is a function of time interval that allows the hazard rate to vary across periods, and F (.) is an appropriate distribution function ensuring that $0 \leq h_{ik} \leq 1$ for all i , k. In this study, denotes separate export spells for any given importer–product combination. In addition, since the underlying baseline hazard is unknown in practice, a set of dummy variables marking the length of each spell, denoted by γ_k , is included in the regression model.

The discrete-time proportional hazards model can be estimated by maximizing the following log-likelihood function:

$$ln\,\mathcal{L} = \sum_{i=1}^{n} \sum_{k=1}^{k_i} [y_{ik} ln(h_{ik}) + (1 - y_{ik}) ln(1 - h_{ik})] \quad (2)$$

where k_i refers to the terminal time period and subscript i indicates that it varies with the spell. y_{ik} is a binary variable and takes the value of 1 if spell is observed to cease during the kth time interval, and zero otherwise. Hence, with this specification, discrete-time hazard models can be regarded as a sequence of binary dependent variable models. This is convenient because any standard model for binary dependent variables (such as logit, probit, or cloglog) can be applied to estimate discrete-time hazard models.

Consequently, this specification of the log-likelihood function requires the underlying export database to be changed as follows. If the spell of the *i*th subject is completed, then the binary dependent variable assumes the unit value for the last time point (T_i) and zero for all other time points ($1,2, \ldots T_i - 1$) of the interval. For example, consider that Turkey exports a given product to a particular destination country from 2000 to 2004. Such an export relation thus has a spell length of four years. With this information about spell length, the binary dependent variable takes the value of zero from 2000 to 2003 and one for the fourth year. The advantage of this approach is that it allows the inclusion of time-varying explanatory variables into the regression model (Esteve-Perez *et al*. 2007).

In estimating Equation (2), it is necessary to determine the functional form of the hazard rate, h_{ik}. As discussed in Hess and Persson (2011a), logit, probit, and complementary log-log (cloglog) models are the most common specifications for the estimation of models with binary dependent variables. The cloglog model is the discrete-time counterpart of the continuous-time Cox proportional hazards model. In contrast, both logit and probit models assume non-proportional hazards. Furthermore, Hess and Persson (2011a) argued that the inclusion of random effects into the binary choice model framework is a satisfactory approach because parameter estimates are less affected by the choice of heterogeneity distribution and this approach is convenient from the computational viewpoint. We therefore estimate Equation (2) using the discrete-time probit model with random effects. However, the results remain qualitatively unchanged when using either a logit or a cloglog model.[13]

Unobserved heterogeneity can also be accounted for by including country and product fixed effects. However, there are several reasons to prefer a random-effects probit model over a fixed-effects probit model. First, a random-effects model is generally preferred if the outcome is binary or dichotomous. Second, a random-effects model can estimate time-invariant variables, such as distance or the economic integration dummy, which are dropped in a fixed-effects model. After obtaining the coefficient estimates from both models, a Hausman specification test is performed to determine whether the coefficient estimates of the two models are systematically different. Given the foregoing considerations and test results, we continue to analyze EIA effects on the duration of

[13] We omit these results here for brevity.

export flows using a discrete-time probit model with random effects.

Before proceeding to the model specifications and econometric analysis, all left-censoring spells (i.e., the export flows that are already active in the first year of the sample, namely 1998) are omitted from the analysis, reflecting common practice for handling left-censoring data (Obashi 2010, Hess and Persson 2011b, Fugazza and Molina 2016). The discrete-time probit model is estimated separately for FPs and P&C to quantify whether model estimates differ across product types. Moreover, restricting our attention to these subsamples enables us to identify the role played by GPNs in determining EIA effects on the duration.

B. Variables

1. Country and product-specific variables

While we are particularly interested in analyzing EIA effects on the duration of exports, we also include various country- and product-specific control variables in our probit analysis, which have been widely used in previous trade duration studies (Hess and Persson 2011b, Corcoles *et al*. 2015, Besedes *et al*. 2015). Country-specific variables are characterized by distance, border, common language, and importers' GDP. According to the gravity literature, trade costs tend to be lower for countries that have common borders or language and are closer geographically. The decline in trade costs may in turn increase trade relations, and therefore, decrease the probability of export ceasing. Another variable that is likely to influence the survival of export flows is the importers' GDP since it serves as a proxy for market thickness. Brenton *et al*. (2010) argued that export relations involving economically large importers are more likely to last longer. In addition, trading partners' market size increases the opportunities of fragmentation in trade and lowers the export hazard (Jones and Kierzkowski 2001, Grossman and Helpman 2005).

Product-specific variables are represented by the natural logarithm of initial export value and lagged duration. An export relation with a larger initial transaction size reflects the existence of ex-ante trust between trading partners and might reduce export hazard (Rauch and Watson 2003). The lagged duration, i.e., the number of years that a previous export spell lasted, is included to assess the impact of export experience on hazard rate. We assume that experience in exports of a specific product is negatively associated with the hazard rate (Das *et al*. 2007, Stirbat *et al*. 2015). Appendix 3 provides more information on the explanatory variables and data sources.

2. Economic Integration Agreements-related variables

Besides gravity variables, we also include several EIA dummies in the probit model to capture the effects of trade agreements on the stability of Turkish machinery exports, which is the purpose of this paper. According to Besedes *et al*. (2015), thinking about EIA effects requires being cautious of an agreement time as it relates to the spells of trade. They argued that EIAs affect a firm's decision to enter or exit an export market through a reduction in marginal and fixed costs. By reducing these costs, EIAs can be expected to have dual effects on the hazard of export ceasing; these effects may proceed in the same direction or opposite directions. First, existing exporters continue exporting after the agreement is signed as these costs drop. Consequently, this implies higher survival rates for old products already active in the export markets. Second, reductions in trade costs can reduce the costs of entry and exit, and thereby, induce firms to start exporting after the agreement comes into force. Whether such a firm will be successful and keep exporting to export markets will depend largely on its productivity as well as realized profit. When export starters are highly productive, high-quality firms, then EIAs enable them to achieve a more stable stream of profits from exporting. Such firms, in turn, tend to stay in the export market for a long time. This leads to higher survival rates in any spell for products that are not exported when the agreement is enforced. On the other hand, when new exporters have low productivity and produce low-quality products, EIAs promote the entry of these low-productive firms into export markets as they find it profitable to export. Such firms would likely choose not to export when they are hit by a demand or productivity shock, which in turn increases the likelihood of exit decisions in export markets. Therefore, EIAs might increase the hazard for any spell that commences after the agreement is signed. There are then two opposing effects, whose relative magnitude determines whether the EIA reduces or increases the stability of export spells that began after the signing of the agreement. Determining which of these two effects dominates is an empirical matter.

Accordingly, to explore EIA effects on export hazard, we follow the approach suggested by Besedes *et al*. (2015) and create three dummy variables to adequately capture the dynamics associated with the implementation of EIAs with respect to a given spell. The first dummy, *EIA exists*, defines all pairs of countries that have an agreement at some point. The second dummy, *EIA in effect*, classifies the years during which an agreement is in place. The third dummy, *Spell starts after EIA*, identifies the spells that started after the agreement was signed. Finally, in addition to these three dummies, we add another variable, *Duration of EIA*, which measures how long an agreement has been in place. While Besedes *et al*. (2015) pooled different EIA types, for our analysis, we construct these four variables not only for the pooled EIA but also for each of the specific EIAs, namely NR-PTA, PTA, FTA, and CU. This allows us to examine heterogeneous effects of EIAs on export survival and to compare our results with those of Besedes *et al*. (2015).

3. Vertical Differentiation-related variables

As mentioned above, the objective of this study is to assess whether the establishment of a trade agreement improves the survival probability of P&C export flows associated with GPNs. Yi (2003) claimed that fragmentation-based trade or vertically linked trade is more sensitive to changes in trading costs induced by trade agreements because the international fragmentation of production causes products to move across borders many times before reaching their final consumption location. Similarly, Obashi (2010) argued that the more advanced utilization of FTAs encourages cross-border sharing by facilitating network-forming multinationals to spread fragmented production processes more efficiently across the East Asian region, resulting in more stable trade relations. Likewise, Blyde *et al*. (2015) suggested that EIAs promote the formation of cross-border production networks by reducing nonproduction costs (e.g., customs procedures and technical barriers).

While the theory posits a clear relation between EIAs and the duration of fragmentation-based export flows, measurement of the international fragmentation of production is not straightforward since the required data are not readily available; thus, empirical studies need to rely on proxy measures for trade-related global production sharing activities. Several studies have attempted to measure the degree of fragmentation or production sharing. These studies can be divided into four groups based on their methods and the data sources employed. The first group uses fragmentation indicators based on input–output tables (Campa and Goldberg 1997, Feenstra and Hanson 1996, Hummels *et al*. 2001). Other studies, represented by Görg (2000), Egger and Egger (2005), and Clark (2006), employ fragmentation indicators based on outward and inward processing trade statistics. Another group of studies measures the degree of fragmentation by using intra-firm trade statistics (e.g., Andersson and Fredriksson 2000, Kimura and Ando 2005). Finally, some analysts suggest using international trade statistics to estimate fragmentation by simply calculating the volume of trade in P&C (Yeats 2001, Kimura *et al*. 2007) or the vertical Intra-Industry Trade (IIT) index (Ando 2006) in intermediate goods.

More recently, the availability and utilization of global input–output tables have led to significant methodological contributions for measuring the degree of production sharing in a particular industry. These tables have become a dominant tool for measuring international production linkages. For example, using the GTAP database, Johnson and Noguera (2012) generalized the vertical specialization concept of Hummels *et al*. (2001) by combining input–output and bilateral trade data to compute the value-added content of bilateral trade as a measure of cross-border production linkages. Currently, the most widely used global input–output tables are the TiVA database based on OECD/WTO national input–output tables released in 2013 and the World Input-Output Database (WIOD) released in 2012, which enable researchers to map and measure global trade in value-added networks. These three databases permit the tracking of intermediate inputs as they cross geographic boundaries and industrial processing stages *en route* to foreign or possibly domestic final demands. However, they have one major shortcoming that has limited the utilization of this method in the trade duration literature: they provide information only at the industry level, while what is needed for duration analysis is trade information at the product level.

Because of these limitations, we consider only two proxy measures of fragmentation-based export flows (i.e., P&C export flows associated with GPNs) on foreign trade statistics.[14] First, we follow Obashi (2010) and Corcoles *et al*. (2015) and use trade in P&C to proxy for trade linked with global production activities. We, therefore, estimate a discrete probit model for FPs and P&C separately by relying on a P&C product list based on Kimura and Obashi (2010), using the same covariates. However, the use of P&C trade may pose particular challenges in evaluating the role of GPNs in shaping EIA effects on export survival. While trade statistics are undoubtedly the most accessible data for the study of trade duration, these statistics are a rather crude proxy for global production activities since they provide no information on production network activities between countries; hence, the fragmentary nature of trade in P&C cannot be adequately

[14] Ideally, intra-firm trade statistics would be used to assess the degree of fragmentation. Unfortunately, such data are also not available at the required level of detail.

captured. Therefore, using trade in P&C as an indicator of fragmentation-based trade may lead to overestimation of the role of GPNs in assessing EIA effects on the duration of export flows.

To deal with this, in the final stage of our analysis, we offer an alternative to the conventional approach of employing trade in P&C as a proxy for global production sharing or fragmentation-based trade. More precisely, we introduce an indicator of vertical/horizontal differentiation as a proxy for fragmentation-based export flows into the probit analysis. The indicator adopted from the IIT literature is based on the decomposition of trade into vertical and horizontal flows. As Jones *et al*. (2002) and Ando (2006) suggested, international fragmentation generates IIT in P&C between countries that may exchange one P&C for another P&C, both of which are within the same industry classification. There are three possibilities that lead to two-way exchanges of P&C: horizontal trade in similar products with differentiated varieties, trade in vertically differentiated P&C distinguished by quality, and vertical specialization that involves the exchange of technologically linked P&C. Vertical IIT can be used as an indicator of international fragmentation within the same product category because it generates differences in unit values across technologically related exported and imported P&C. This approach is supported by the findings of Jones *et al*. (2002), Ando (2006), and Kimura *et al*. (2007); these authors showed that the rapid increase in vertical IIT originates primarily from vertical linkages in production, rather than trade in quality-differentiated goods. Thus, we use unit-price differentials between exported and imported P&C as a criterion for distinguishing trade in Horizontally Differentiated (HD) P&C from that in technologically linked P&C. However, note that trade flows classified as vertical IIT can also include vertical IIT with differences in quality.

The first step toward computing the Vertical Differentiation (VD) indicator is to select P&C in the bilateral trade data, following Kimura and Obashi (2010). Next, we decompose P&C exports into HD and VD products by using the method first suggested by Abd-el-Rahman (1991), and used by Greenaway *et al*. (1994, 1995). The idea therein is that price differentials between export prices and import prices outside a certain range reflect VD. More specifically, trade in P&C is considered horizontal if export and import values differ by less than 25% and vertical when the ratio of unit values falls outside the following range:[15]

[15] We also explored the robustness of results to using a 15% threshold. The results were consistent with those in the main text. For brevity, we do not report these results, but they are available from the authors upon request.

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$$\frac{1}{1.25} \leq \frac{P_{jst}^{X}}{P_{jst}^{M}} \leq 1.25 \tag{3}$$

where P_{jst}^{X} and P_{jst}^{M} represent the unit value of Turkey's exports and imports, respectively; j denotes the product, and s denotes the partner country in year t.[16] Accordingly, the dummy variable VD takes the values of 1 if the unit price ratio lies outside the range of between 0.75 and 1.25, and 0 otherwise. The choice of 25% is arbitrary. In the trade literature, two such values are commonly employed, 15% and 25%. The 15% threshold is generally used and considered appropriate when the unit value differences reflect only differences in quality. However, in the case of global production sharing, the 15% threshold can be too wide, and thus, the 25% threshold is considered more appropriate (Ando 2006). Taking these considerations into account, this paper uses a rather narrower measure of VD in P&C to more accurately identify whether trade flows relate to GPNs.

Therefore, the indicator favored in this paper may capture multi-stage trade as a result of back-and-forth transactions in vertically fragmented production networks in the same commodity heading (Ando 2006, Wakasugi 2007). Linkages between EIAs and VD are set up by including multiplications of each of the four EIA dummies and the VD dummy in the survival analysis. The results will reveal how EIAs affect the survival rate of trade when products are VD.

V. Empirical Results

A. Benchmarks

Tables 5 and 6 present probit modeling results for EIA effect on export survival. All probit estimations consider three specifications to adequately capture the dynamics associated with EIA implementation with respect to a given spell. Four EIA-related variables are used in three specifications for estimating EIA effects on the duration of

[16] Unit values at the 6-digit HS product level are constructed as the value of imports and exports of the product divided by the corresponding quantities.

exports. In this way, we allow for differential timing of EIA effects on the stability of export relations. The first specification contains two variables: *EIA exists* and *EIA in effect*. The former is intended to identify whether the hazard of trade between countries with an agreement differs from that between countries that never sign an agreement, while the latter is used to account for the differential effect of EIAs on export spells. The second specification adds a third dummy variable, *Spell starts after EIA*, which captures the differential effect on spells that starts after the agreement has been put into effect. Finally, the third specification adds a fourth variable, *Duration of EIA*, which allows us to assess whether the effect of an agreement depends on how long it has been in place.

As already noted, the effects of various EIAs on export survival may not be uniform. For this purpose, these three specifications are estimated separately for various EIAs: NR-PTAs, PTAs, FTAs, and CUs. We estimate EIA effects on export survival separately for FPs and P&C, to understand the role that fragmentation-based export flows play in determining EIA effects on the probability of P&C export ceasing. We use the same set of covariates, as delineated above, in each probit regression. Finally, as a robustness check of our measure of fragmentation-based trade flows, we add VD-related variables in the analysis for P&C (Table 7).

In general, all standard variables have the expected signs and the magnitudes are similar to those found in Besedes *et al*. (2015), except for the results for common language. The results do not significantly vary across various EIAs, but in general, the size of the coefficients is higher in case of CU. Hazard rates decrease in border, importers' GDP, initial exports, and duration, but increase in distance. The impacts of distance and border are larger on hazard rates of FP trade, while importers' GDP, initial export value, and duration have greater influence on the hazard rates of P&C trade. Accordingly, being a large country and building a long and credible relation increase the duration of P&C trade more than that of FP trade.

Interestingly, the signs and significance of the language coefficients vary depending on the type of exported products. In Table 5, for FPs, the impact is negative and significant for all types of EIAs except for Model 3 of EIA. This result is consistent with those of both Besedes *et al*. (2015) and Recalde *et al*. (2016). However, our results in Table 6 suggest that when exports involve more P&C, the statistical significance of language no longer holds, with few exceptions.[17]

[17] Nonsignificant coefficient estimates for common language in the case of Turkey's exports may also be due to the small number of its trading partners (Cyprus and Bulgaria) fulfilling these characteristics.

The results in the first three columns of Tables 5 and 6 provide strong statistical support for the notion that the existence of an EIA for a pair of countries (*EIA exists*) decreases the hazard of export ceasing. This effect generally holds across the three specifications when the other EIA-related dummies are added sequentially. Hence, country pairs that, at some point, have an EIA exhibit a lower hazard rate than those that have never had an integration agreement. These findings are in line with those of both Besedes *et al*. (2015) and Recalde *et al*. (2016). However, the impact of existing EIAs varies across product types. In Table 5, existing NR-PTAs and CUs do not have any significant impact on the hazard of FP export ceasing, while both existing PTA and FTA significantly reduce the hazard. Table 6 reports that the impact of existing EIAs on the hazard rate of P&C exports increases with the depth of agreements. While the estimated coefficients are statistically insignificant for existing NR-PTAs and PTAs, the magnitude and explanatory power of those for FTAs and CUs increase. The analysis thus confirms the intuitive argument made by Obashi (2010) that GPN benefits more from deeper trade agreements.

The sign and magnitude of the coefficient of *EIA in effect* depend on the inclusion of the other two dummies (*Spell starts after EIA* and *Duration of EIA*). Since we have significant results for the latter two dummies, we continue to interpret the results containing all EIA-related dummies, our third and preferred specification (column 3 of each part). Thereby, consistent with the findings of Besedes *et al*. (2015), the coefficients of *EIA in effect* are negative and significant across all EIA types, suggesting that the onset of an agreement reduces the likelihood of both FP and P&C export ceasing (Tables 5 and 6). This conclusion adds to the findings of Recalde *et al*. (2016), who by using aggregate data for Latin America, found that the onset of an agreement has a significant hazard-reducing effect only when the EIA is deep enough. Our results suggest that EIA effects vary depending on the type of exported goods. Coefficient magnitudes are larger for P&C. Indeed, the CU coefficient is not significant for FPs. Our results support the idea that by lowering trade costs, EIAs can help integrate domestic firms into GPNs and build long-lasting trading relations.

However, the third specification shows that, consistent with the results of Besedes *et al*. (2015), the estimated coefficient of Spells starts after EIA has either a significantly positive effect or stays neutral vis-à-vis the hazard rate. This evidence supports the view that EIAs reduce the stability of export spells that begin after the agreement is enforced. The effect differs across various trade agreements and product types, as seen in the third column of each type of EIA in both Tables 5 and 6. For FPs, the hazard rate is not affected if spells begin after the FTA agreements. Similarly, the positive effect on the hazard rate disappears when we consider EIA itself or PTA for P&C. Among the significant cases, the effect of NR-PTA on export duration across all product types is greater than the effect of deeper agreements, suggesting that shallower agreements do not provide sufficient benefits to help high-cost exporters survive in the long run.

The coefficient estimates of *Duration of EIA* from the probit output reported in the third columns of Tables 5 and 6 are positive and statistically significant, a result similar to that obtained in Besedes *et al*. (2015). With the exception of NR-PTA and PTA for FPs, this effect is consistent across various trade agreements and product types. Among the significant cases, the magnitude of the FTA (CU) coefficient is larger for FPs (P&C). This suggests that CU has a stronger effect on the stability of fragmentation-based export flows than any other type of EIA.

Taking all of our results together, we conclude that an EIA has a dual effect on the stability of export relations: it increases the survival of export relations that had already started when the agreement took place, but reduces the survival of those that started afterwards. These results are in line with the findings obtained by Besedes *et al*. (2015).

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Table 5. EIAs effect on export hazard ceasing for finished products

	EIA			NR-PTA			PTA			FTA			CU		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Log distance	0.1089	0.1148	0.1216	0.0994	0.0971	0.0972	0.1130	0.1135	0.1134	0.0957	0.0967	0.0992	0.1338	0.1344	0.1345
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Common language	-0.1122	-0.0812	-0.0576	-0.1156	-0.1200	-0.1200	-0.1152	-0.1161	-0.1164	-0.1286	-0.1280	-0.1244	-0.1839	-0.1544	-0.1264
	(0.007)	(0.054)	(0.171)	(0.007)	(0.005)	(0.005)	(0.007)	(0.006)	(0.006)	(0.003)	(0.003)	(0.004)	(0.000)	(0.000)	(0.004)
Common border	-0.1683	-0.1674	-0.1690	-0.1744	-0.1769	-0.1769	-0.1361	-0.1385	-0.1414	-0.1760	-0.1745	-0.1660	-0.1526	-0.1500	-0.1496
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log GDP(importer)	-0.0359	-0.0421	-0.0522	-0.0299	-0.0303	-0.0303	-0.0328	-0.0332	-0.0334	-0.0295	-0.0300	-0.0312	-0.0447	-0.0458	-0.0470
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log initial export value	-0.0685	-0.0686	-0.0680	-0.0694	-0.0693	-0.0693	-0.0691	-0.0692	-0.0691	-0.0695	-0.0695	-0.0692	-0.0691	-0.0692	-0.0693
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lagged duration	-0.0393	-0.0384	-0.0410	-0.0350	-0.0349	-0.0349	-0.0346	-0.0344	-0.0347	-0.0351	-0.0351	-0.0362	-0.0365	-0.0364	-0.0368
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EIA exists	-0.0732	-0.0901	-0.1357	-0.0079	-0.0264	-0.0264	-0.1210	-0.1257	-0.1276	-0.0309	-0.0335	-0.0402	0.0464	0.0289	0.0040
	(0.000)	(0.000)	(0.000)	(0.827)	(0.470)	(0.472)	(0.000)	(0.000)	(0.000)	(0.021)	(0.012)	(0.003)	(0.050)	(0.227)	(0.869)
EIA in effect	0.1124	-0.0591	-0.0571	0.0401	-0.1719	-0.1718	-0.0398	-0.0949	-0.1048	0.0153	-0.0488	-0.0921	0.1298	0.0105	-0.0259
	(0.000)	(0.004)	(0.005)	(0.315)	(0.040)	(0.041)	(0.050)	(0.003)	(0.001)	(0.287)	(0.068)	(0.001)	(0.000)	(0.780)	(0.493)

(continued)

	EIA			NR-PTA			PTA			FTA			CU		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Spell starts after EIA		0.2179	0.0734		0.2494	0.2496		0.0788	0.0611		0.0814	-0.0038		0.1468	0.0742
		(0.000)	(0.001)		(0.004)	(0.005)		(0.024)	(0.099)		(0.004)	(0.900)		(0.000)	(0.045)
Duration of EIA			0.0253			-0.0000			0.0053			0.0215			0.0162
			(0.000)			(0.992)			(0.166)			(0.000)			(0.000)
Duration dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spell no. dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ρ	0.2478	0.2503	0.2501	0.2606	0.2609	0.2609	0.2580	0.2584	0.2575	0.2603	0.2602	0.2587	0.2551	0.2560	0.2586
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	233,686	233,686	233,686	233,686	233,686	233,686	233,686	233,686	233,686	233,686	233,686	233,686	233,686	233,686	233,686
Spells	91,617	91,617	91,617	91,617	91,617	91,617	91,617	91,617	91,617	91,617	91,617	91,617	91,617	91,617	91,617
Export relations	48,397	48,397	48,397	48,397	48,397	48,397	48,397	48,397	48,397	48,397	48,397	48,397	48,397	48,397	48,397
Log likelihood	-113,927	-113,870	-113,724	-113,968	-113,964	-113,964	-113,913	-113,910	-113,909	-113,967	-113,962	-113,931	-113,863	-113,854	-113,823

(Note) All regressions include random effects at the importer-product level. *P-values* are in parentheses. ρ is the fraction of error variance that is explained by variations in the unobserved individual factors. An export relation is defined as the importer–product combination. The number of observations is computed based on the total number of years with positive export flows for all machinery products. All left-censored observations are excluded from the data used in the estimations.

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Table 6. EIAs effect on export hazard ceasing forparts and components

	EIA			NR-PTA			PTA			FTA			CU		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Log distance	0.0814	0.0852	0.0891	0.0773	0.0746	0.0733	0.0798	0.0799	0.0799	0.0517	0.0531	0.0542	0.0892	0.0894	0.0887
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Common language	0.0585	0.0752	0.1057	0.0579	0.0523	0.0497	0.0590	0.0587	0.0576	-0.0174	-0.0164	-0.0148	0.0434	0.0769	0.1257
	(0.300)	(0.184)	(0.060)	(0.309)	(0.358)	(0.382)	(0.299)	(0.301)	(0.309)	(0.761)	(0.776)	(0.796)	(0.443)	(0.176)	(0.027)
Common border	-0.0801	-0.0780	-0.0755	-0.0829	-0.0861	-0.0878	-0.0722	-0.0737	-0.0827	-0.0992	-0.0967	-0.0911	-0.0692	-0.0655	-0.0660
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.003)	(0.003)
Log GDP (importer)	-0.0354	-0.0399	-0.0468	-0.0336	-0.0342	-0.0343	-0.0332	-0.0334	-0.0340	-0.0342	-0.0349	-0.0356	-0.0385	-0.0403	-0.0422
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log initial export value	-0.0989	-0.0987	-0.0980	-0.0994	-0.0994	-0.0994	-0.0993	-0.0993	-0.0992	-0.0999	-0.0998	-0.0996	-0.0990	-0.0993	-0.0996
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lagged duration	-0.0435	-0.0433	-0.0484	-0.0424	-0.0425	-0.0427	-0.0422	-0.0422	-0.0430	-0.0436	-0.0432	-0.0443	-0.0448	-0.0452	-0.0477
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EIA exists	-0.0312	-0.0437	-0.0792	0.0054	-0.0196	-0.0288	-0.0100	-0.0126	-0.0183	-0.1255	-0.1297	-0.1342	-0.0811	-0.1103	-0.1454
	(0.051)	(0.007)	(0.000)	(0.905)	(0.670)	(0.532)	(0.641)	(0.562)	(0.399)	(0.000)	(0.000)	(0.000)	(0.005)	(0.000)	(0.000)

(continued)

	EIA			NR-PTA			PTA			FTA			CU		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
EIA in effect	0.0459	-0.0958	-0.0986	0.0148	-0.3266	-0.3455	-0.0389	-0.0700	-0.1037	0.0404	-0.0715	-0.1040	0.1566	-0.0621	-0.1247
	(0.002)	(0.000)	(0.000)	(0.768)	(0.006)	(0.004)	(0.133)	(0.079)	(0.011)	(0.023)	(0.036)	(0.003)	(0.000)	(0.163)	(0.006)
Spell starts after EIA		0.1776	0.0403		0.3887	0.2918		0.0452	-0.0143		0.1413	0.0776		0.2697	0.1505
		(0.000)	(0.154)		(0.001)	(0.019)		(0.303)	(0.760)		(0.000)	(0.045)		(0.000)	(0.001)
Duration of EIA			0.0234			0.0138			0.0178			0.0160			0.0267
			(0.000)			(0.004)			(0.000)			(0.000)			(0.000)
Duration dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spell no. dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ρ	0.2566	0.2569	0.2512	0.2600	0.2601	0.2602	0.2601	0.2601	0.2582	0.2561	0.2572	0.2548	0.2521	0.2510	0.2516
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935
Spells	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439
Export relations	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201
Log likelihood	-77,443	-77,420	-77,341	-77,448	-77,442	-77,438	-77,445	-77,445	-77,438	-77,415	-77,408	-77,397	-77,426	-77,404	-77,351

(Note) All regressions include random effects at the importer-product level. *P-values* are in parentheses. ρ is the fraction of error variance that is explained by variations in the unobserved individual factors. An export relation is defined as the importer-product combination. The number of observations is computed based on the total number of years with positive export flows for all machinery products. All left-censored observations are excluded from the data used in the estimations.

B. Robustness checks

In Table 7, we explore the robustness of our results by using an alternative measure of fragmentation-based export flows, VD. This alternative measure is particularly appealing because it enables us to accurately identify whether a P&C item is integrated in the GPN, and therefore, to isolate or differentiate EIA effects on the duration of fragmentation-based export flows from those of other non-related party transactions. In doing so, we make the VD dummy interact with the set of EIA-related variables employed in the foregoing models. First, inclusion of interaction terms between VD- and EIA-related variables does not significantly change our benchmark results for standard gravity variables in Table 7. Hazard rates decrease in border, importers' GDP, initial exports, and duration, but increase in distance. Similar to the results in Table 6, we find no significant impact of language on the hazard rate.

Considering the EIA-related variables, we continue to interpret column 3 of each panel, and find the results to be parallel to those in Table 6, with a few exceptions. First, the coefficient of VD for P&C is negative and statistically significant, revealing that hazard rates are substantially lower for intermediate products that are traded within GPNs. This result is robust across various trade agreements. This confirms that participation in GPNs reduces the probability of export exit, which is in line with extant empirical findings in the literature, for instance, Obashi (2010). Second, considering all EIAs together, we can observe that the direct impact of the EIA-related variables remains qualitatively the same and the magnitudes of the coefficients are only marginally reduced. In particular, the results in Table 7 indicate that the negative effect on the hazard rates of *EIA exists* still remains, though the effect is lower for VD products, as indicated by the significantly positive coefficient of the interaction term. When we disaggregate EIAs, we find that this result is mainly driven by the existing PTA. Furthermore, the coefficient of *EIA in effect* is consistent with those reported in Table 6, with a negative coefficient of interaction with VD. This means that the negative effect on the hazard rates of the agreement being enforced is more pronounced for the already active GPN-related export spells. Table 7 also shows that the coefficient of Spell starts after EIA is significantly positive and its interaction term with VD is significantly and strongly positive. The dual effects of EIAs on hazard rates appear to be greater for GPN-related products. The coefficients representing the duration of EIA and its interaction term with VD exert a positive and significant impact on hazard rates, which indicates that the predicted probability of export exit decreases as the duration of trade agreement increases, and this effect seems to be more prevalent for vertically differentiated P&C. Results obtained with the interaction effects thus far suggest that the presence of VD trade reduces the exit probability of already active spells while increasing it for any spell that begins after the agreement is enforced.

The role VD plays in the impacts of EIAs also varies across the type of trade agreements. First, the coefficients of the direct effect of NR-PTA and PTA become smaller and lose their statistical significance once the interaction terms with VD are added. In particular, the direct relation between the duration of NR-PTA and hazard rates is now insignificant. In addition, for NR-PTA-type trade agreements, VD increases the negative effects of existing EIA and positive effect of EIA duration on the hazard rate. However, none of the estimated coefficients on interactions between VD- and EIA-related variables are significant when trade agreements are of PTA type. These unexpected results regarding the effects of interaction terms with VD on hazard rates are attributable to the small sample size for these agreements. Nevertheless, the results suggest that export flows directed to NR-PTA or PTA partners are less prone to the lower trade costs brought by trade agreements since these transactions are probably not substantively related to GPNs.

The inclusion of interaction terms does not affect the direct impacts of FTA on hazard rates but weakens the effects for some EIA-related dummies; the coefficients are significant in all but one case. Furthermore, the results show that VD tends to intensify the negative relation between the existences of an agreement or the onset of an agreement and hazard rates when the agreement is FTA type, while it increases the adverse impact of trade agreements on spells commencing after the agreement takes effect. In the case of CU-type trade agreements, VD coefficients remain unaffected by the incorporation of interaction terms into the model (with one exception). However, the magnitudes of the coefficient estimates are reduced noticeably from those in Table 6. When we make CU-related dummies to interact with VD, we find that the hazard rate reducing impacts of *existing EIA* becomes stronger with VD. At the same time, VD does not play any significant role in the determination of the effect of the already active spells or spells starting after EIA when the agreement is a CU, but the hazard increasing impact of the duration of EIA surges.

Overall, these robustness results vis-à-vis shallower agreements suggest a limited role of VD in explaining EIA effects on the hazard rates of P&C, while VD appears to play a greater role for deeper trade agreements. Put simply, the evidence implies that trade agreements raise the odds of export survival of P&C flows if they are deep enough to support GPNs.

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Table 7. Interaction effects of EIAs with vertical differentiation

	EIA			NR-PTA			PTA			FTA			CU		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Log distance	0.0806	0.0843	0.0871	0.0710	0.0687	0.0689	0.0755	0.0756	0.0756	0.0499	0.0514	0.0526	0.0886	0.0887	0.0875
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Common language	0.0473	0.0611	0.0816	0.0369	0.0321	0.0323	0.0420	0.0416	0.0405	-0.0234	-0.0223	-0.0200	-0.0291	-0.0041	0.0307
	(0.397)	(0.274)	(0.140)	(0.512)	(0.569)	(0.566)	(0.456)	(0.460)	(0.471)	(0.682)	(0.696)	(0.725)	(0.603)	(0.942)	(0.587)
Common border	-0.0887	-0.0877	-0.0880	-0.0969	-0.0997	-0.0999	-0.0803	-0.0815	-0.0899	-0.1082	-0.1060	-0.0996	-0.0778	-0.0739	-0.0752
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Log GDP (importer)	-0.0241	-0.0287	-0.0342	-0.0215	-0.0220	-0.0218	-0.0214	-0.0217	-0.0225	-0.0243	-0.0252	-0.0260	-0.0293	-0.0315	-0.0333
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log initial export value	-0.0976	-0.0973	-0.0962	-0.0985	-0.0985	-0.0986	-0.0983	-0.0984	-0.0983	-0.0991	-0.0989	-0.0986	-0.0972	-0.0975	-0.0975
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lagged duration	-0.0453	-0.0452	-0.0520	-0.0440	-0.0439	-0.0443	-0.0430	-0.0430	-0.0437	-0.0442	-0.0440	-0.0454	-0.0476	-0.0480	-0.0515
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EIA exists	-0.0363	-0.0485	-0.0872	0.0083	-0.0111	-0.0126	-0.0201	-0.0226	-0.0278	-0.1004	-0.1052	-0.1100	-0.0147	-0.0389	-0.0732
	(0.029)	(0.004)	(0.000)	(0.863)	(0.821)	(0.796)	(0.362)	(0.310)	(0.211)	(0.000)	(0.000)	(0.000)	(0.642)	(0.221)	(0.022)

(continued)

	EIA			NR-PTA			PTA			FTA			CU		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
EIA in effect	0.0548	-0.0699	-0.0600	-0.0924	-0.2584	-0.2490	-0.0439	-0.0814	-0.1167	0.0343	-0.0395	-0.0736	0.1653	-0.0019	-0.0476
	(0.001)	(0.009)	(0.027)	(0.097)	(0.037)	(0.046)	(0.100)	(0.049)	(0.006)	(0.086)	(0.271)	(0.046)	(0.000)	(0.973)	(0.402)
Spell starts after EIA		0.1634	0.0422		0.2043	0.2225		0.0531	-0.0075		0.0984	0.0357		0.2110	0.1167
		(0.000)	(0.153)		(0.105)	(0.097)		(0.241)	(0.876)		(0.010)	(0.383)		(0.000)	(0.034)
Duration of EIA			0.0217			-0.0031			0.0181			0.0173			0.0230
			(0.000)			(0.658)			(0.000)			(0.000)			(0.000)
VD for P&C	-0.1525	-0.1478	-0.1348	-0.1149	-0.1145	-0.1147	-0.1060	-0.1059	-0.1042	-0.0768	-0.0758	-0.0734	-0.0760	-0.0728	-0.0665
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
VD*EIA exists	0.0748	0.0715	0.0777	-0.1924	-0.2087	-0.2099	0.0497	0.0521	0.0538	-0.0723	-0.0705	-0.0700	-0.1992	-0.2157	-0.2224
	(0.072)	(0.086)	(0.061)	(0.056)	(0.038)	(0.037)	(0.439)	(0.417)	(0.402)	(0.020)	(0.024)	(0.024)	(0.001)	(0.000)	(0.000)
VD*EIA in effect	-0.0152	-0.2918	-0.3390	0.3939	-4.7519	-4.8008	-0.0564	0.0541	0.0932	0.0090	-0.4055	-0.4157	0.0979	-0.0262	-0.0644
	(0.687)	(0.000)	(0.000)	(0.000)	(0.994)	(0.994)	(0.525)	(0.701)	(0.518)	(0.822)	(0.000)	(0.000)	(0.092)	(0.769)	(0.478)
VD* Spell starts after EIA		0.2725	0.1769		5.1632	4.9414		-0.1491	-0.0743		0.4387	0.4049		0.1442	0.0778
		(0.001)	(0.028)		(0.993)	(0.993)		(0.323)	(0.661)		(0.000)	(0.001)		(0.057)	(0.323)
VD*Duration of EIA			0.0100			0.0283			-0.0183			0.0017			0.0098
			(0.002)			(0.002)			(0.265)			(0.809)			(0.037)

(continued)

	EIA			NR-PTA			PTA			FTA			CU		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Duration dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spell no. dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ρ	0.2471	0.2469	0.2379	0.2515	0.2520	0.2523	0.2538	0.2538	0.2524	0.2511	0.2516	0.2484	0.2379	0.2370	0.2352
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935	176,935
Spells	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439	60,439
Export relations	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201	32,201
Log likelihood	-77,402	-77,368	-77,272	-77,398	-77,388	-77,380	-77,408	-77,407	-77,400	-77,379	-77,363	-77,349	-77,365	-77,341	-77,277

(Note) All regressions include random effects at the importer-product level. *P-values* are in parentheses. ρ is the fraction of error variance that is explained by variations in the unobserved individual factors. An export relation is defined as the importer-product combination. The number of observations is computed based on the total number of years with positive export flows for all machinery products. All left-censored observations are excluded from the data used in the estimations.

VI. Conclusion

This paper utilizes survival analysis by using 6-digit HS data to examine EIA effects on Turkish machinery products export survival. We show that an EIA has a dual effect on the stability of export relations: it increases the survival of export relations that had already started when the agreement was enforced, but reduces the survival of those that started afterwards. In addition, we find that the impact of EIA-related variables may vary across the type of EIAs and products. Second, we demonstrate that VD has a positive and statistically significant impact on the survival rates of P&C exports and the impact of trade agreements is larger if products are characterized by a vertically fragmented production process. The paper concludes that GPNs can be an effective way for developing countries to increase the potential benefits from EIAs in terms of export survival.

The paper emphasizes the importance of GPNs in the determination of export ceasing hazard. The depth, content, and duration of the agreements depend on the bargaining power of a country in foreign trade. Developing countries that desire to survive in foreign trade need to strengthen their bargaining power in this direction. Policies need to be designed in a way to enhance the competitiveness of the private sector and facilitate its participation in GPNs. Attractiveness of a country to domestic and foreign investors and traders needs to be increased by improving physical, social, and financial infrastructure; the quantity and quality of human capital; and technological capabilities. Productive factors should be supported to satisfy the needs and developments in GPNs.

In addition, improving the ease of doing business and building strong institutional capacity in Turkey plays an important role in establishing new partnerships while extending the duration of existing agreements. Reducing potential economic, political, and financial risks will enhance the investment climate and contribute to the survival of export relations.

The results in this paper also leave several issues for future research. The link between EIAs and hazard rates of fragmentation-based export flows has not been fully established. The trade data used herein only provide information on the trade values of a given product at the country-product level. Hence, with the currently available trade data, it is difficult to track a P&C once it is imported. The exported P&C can be used primarily for producing final goods by local companies rather than by firms operating in a GPN. Therefore, it may be prudent to investigate this link in more detail using firm-level data in a future study to confirm whether the finding that a strong negative relation between EIAs and the hazard rates of P&C exports truly reflects the outsourcing activities of firms operating in a GPN.

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Appendices

Appendix 1: List of countries

Afghanistan	Djibouti	Kyrgyzstan	Rwanda
Albania	Dominica	Lao PDR	St. Kitts & Nevis
Algeria	Dominican Republic	Latvia	St. Lucia
Andorra	East Timor	Lebanon	St. Vincent & Grenadines
Angola	Ecuador	Liberia	Samoa
Antigua & Barbuda	Egypt	Libya	San Marino
Argentina	El Salvador	Lithuania	Sao Tome & Principe
Armenia	Equatorial Guinea	China, Macau	Saudi Arabia
Aruba	Eritrea	Madagascar	Senegal
Australia	Estonia	Malawi	Serbia
Austria	Ethiopia	Malaysia	Seychelles
Azerbaijan	Fiji	Maldives	Sierra Leone
Bahamas	Finland	Mali	Singapore
Bahrain	France	Malta	Slovakia
Bangladesh	French Polynesia	Marshall Islands	Slovenia
Barbados	Gabon	Mauritania	Solomon Islands
Belarus	Gambia	Mauritius	South Africa
Belgium-Luxembourg	Georgia	Mexico	Spain
Belize	Germany	Micronesia	Sri Lanka
Benin	Ghana	Moldova	Suriname
Bermuda	Greece	Mongolia	Sweden
Bhutan	Greenland	Montenegro	Switzerland
Bolivia	Grenada	Morocco	Syria
Bosnia & Herzegovina	Guatemala	Mozambique	Tajikistan
Brunei Darussalam	Guinea	Myanmar	Tanzania
Bulgaria	Guinea-Bissau	Nepal	Thailand
Burkina Faso	Guyana	Netherlands	TFYR of Macedonia
Burundi	Haiti	New Caledonia	Togo
Cambodia	Honduras	New Zealand	Tonga

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(continued)

Cameroon	China, Hong Kong	Nicaragua	Trinidad & Tobago
Canada	Hungary	Niger	Tunisia
Cape Verde	Iceland	Nigeria	Turkmenistan
Central African Republic	India	Northern Mariana Islands	Tuvalu
Chad	Indonesia	Norway	Uganda
Chile	Iran	Oman	Ukraine
China	Iraq	Pakistan	United Arab Emirates
Colombia	Ireland	Palau	United Kingdom
Comoros	Israel	Panama	USA
Congo (Rep.)	Italy	Papua New Guinea	Uruguay
Congo (Dem. Rep.)	Jamaica	Paraguay	Uzbekistan
Costa Rica	Japan	Peru	Vanuatu
Côte d'Ivoire	Jordan	Philippines	Venezuela
Croatia	Kazakhstan	Poland	Vietnam
Cuba	Kenya	Portugal	Yemen
Cyprus	Kiribati	Qatar	Zambia
Czech Republic	Korea (Rep.)	Romania	Zimbabwe
Denmark	Kuwait	Russia	

Appendix 2: List of EIAs signed by Turkey

Country	Type	Entry	Phased out	Country	Type	Entry	Phased out
Afghanistan	PTA	2008		**Japan**	NR-PTA	1972	
Albania	FTA	2008		**Jordan**	FTA	2011	
Australia	NR-PTA	1974		**Kazakhstan**	PTA	2008	
Austria	NR-PTA	1972	1993	**Kyrgyzstan**	PTA	2008	
Austria	FTA	1993	1995	**Latvia**	FTA	2001	2004
Austria	CU	1995		**Latvia**	CU	2004	
Azerbaijan	PTA	2008		**Lithuania**	FTA	1999	2004
Bangladesh	PTA	2011		**Lithuania**	CU	2004	
Belarus	NR-PTA	2010		**Macedonia**	FTA	2000	
Belgium	PTA	1973	1996	**Malaysia**	PTA	2011	
Belgium	CU	1996		**Malaysia**	FTA	2016	
Luxembourg	PTA	1973	1996	**Malta**	CU	2004	
Luxembourg	CU	1996		**Mauritius**	FTA	2012	
Bosnia & Herzegovina	FTA	2003		**Moldova**	FTA	2016	
Bulgaria	FTA	1999	2007	**Montenegro**	FTA	2010	
Bulgaria	CU	2007		**Morocco**	FTA	2006	
Canada	NR-PTA	1974		**Netherlands**	PTA	1973	1996
Chile	FTA	2011		**Netherlands**	CU	1996	
Croatia	FTA	2004	2013	**New Zealand**	NR-PTA	1972	
Croatia	CU	2013		**Nigeria**	PTA	2011	
Cyprus	CU	2004		**Norway**	NR-PTA	1977	1993
Czech Rep.	FTA	1997	2004	**Norway**	FTA	1993	
Czech Rep.	CU	2004		**Pakistan**	PTA	1991	
Slovak Rep.	FTA	1999	2004	**Palestine**	FTA	2005	
Slovak Rep.	CU	2004		**Poland**	NR-PTA	1981	1990
Denmark	PTA	1973	1996	**Poland**	FTA	2000	2004
Denmark	CU	1996		**Poland**	CU	2004	
Egypt	FTA	2007		**Portugal**	CU	1996	
Estonia	FTA	1999	2004	**Romania**	FTA	1998	2007

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(continued)

Country	Type	Entry	Phased out	Country	Type	Entry	Phased out
Estonia	CU	2004		**Romania**	CU	2007	
Finland	NR-PTA	1977	1993	**Russia**	NR-PTA	2010	
Finland	FTA	1993	1996	**Serbia**	FTA	2010	
Finland	CU	1996		**Slovenia**	FTA	2001	2004
France	PTA	1973	1996	**Slovenia**	CU	2004	
France	CU	1996		**Spain**	PTA	1986	1996
Georgia	FTA	2008		**Spain**	CU	1996	
Germany	PTA	1973	1996	**South Korea**	FTA	2013	
Germany	CU	1996		**Sweden**	NR-PTA	1978	1993
Greece	PTA	1981	1996	**Sweden**	FTA	1993	1996
Greece	CU	1996		**Sweden**	CU	1996	
Hungary	FTA	1998	2004	**Switzerland**	NR-PTA	1972	1992
Hungary	CU	2004		**Switzerland**	FTA	1992	
Iceland	FTA	1993		**Syria**	FTA	2007	2012
Indonesia	PTA	2011		**Tajikistan**	PTA	2008	
Iran	PTA	1991		**Tunisia**	FTA	2005	
Ireland	PTA	1973	1996	**Turkmenistan**	PTA	2008	
Ireland	CU	1996		**UK**	PTA	1973	1996
Israel	FTA	1997		**UK**	CU	1996	
Italy	PTA	1973	1996	**USA**	NR-PTA	1976	
Italy	CU	1996		**Uzbekistan**	PTA	2008	

(Note) "Entry" refers to the year in which the EIA was enforced, while "phased out" indicates the year in which the EIA ended. Data on various EIAs is mainly retrieved from Jeffry Bergstrand's website and supplemented with additional data from the WTO's website.

Appendix 3: Variable definitions and data sources

Variable	Definition	Data source
Log distance	Log of the distance in kilometers between Turkey's capital (Ankara) and its trading partner's capital	CEPII's GeoDist database: http://www.cepii.fr
Common language	Takes the value one if Turkey and its trading partner share a common language, and zero otherwise	CEPII's GeoDist database: http://www.cepii.fr
Common border	Takes the value one if Turkey and its trading partner share a common border, and zero otherwise	CEPII's GeoDist database: http://www.cepii.fr
Log GDP (importer)	Log of importer's GDP, measured in nominal USD	World Bank's World Development Indicators (WDI)
Log initial export value	Log of the value of exports at the start of the spell, measured in USD	CEPII's BACI database: http://www.cepii.fr
Lagged duration	Number of years for which the previous spell of the same export relation lasted	CEPII's BACI database: http://www.cepii.fr
EIA exists	Takes the value one if Turkey and its partners have an agreement at some point, and zero otherwise.	Baier and Bergstrand's website: www.nd.edu/jbergstr and WTO's RTA-IS database.
EIA in effect	Takes the value one if Turkey and its partners have an agreement in the given calendar year, and zero otherwise.	Baier and Bergstrand's website: www.nd.edu/jbergstr and WTO's RTA-IS database.
Spell starts after EIA	Takes the value one if an export spell starts after the agreement is signed, and zero otherwise	BACI database, Baier and Bergstrand's website: www.nd.edu/jbergstr and WTO's RTA-IS database.
Duration of EIA	Measures how long an agreement is in place (in years)	Baier and Bergstrand's website: www.nd.edu/jbergstr and WTO's RTA-IS database.
VD	Takes the value one if the 6-digit product flow shows evidence of VD in the given calendar year, and zero otherwise	CEPII's BACI database: http://www.cepii.fr