DOCUMENTOS DE ECONOMÍA Y
FINANZAS INTERNACIONALES

Working Papers on International
Economics and Finance

DEFI 13-03
April 2013

Product sophistication: A tie that binds partners in international production sharing

David Córcoles

Carmen Díaz-Mora

Rosario Gandoy

Asociación Española de Economía y Finanzas Internacionales
www.aeefi.com
ISSN: 1696-6376

PRODUCT SOPHISTICATION:
A TIE THAT BINDS PARTNERS IN INTERNATIONAL PRODUCTION SHARING

March 2013

David Córcoles (David.corcoles@uclm.es)
Carmen Díaz-Mora♠♠ (Carmen.diazmora@uclm.es)
Rosario Gandoy (Rosario.gandoy@uclm.es)
University of Castilla-La Mancha

Abstract:

This paper focuses on the role of product sophistication in determining the permanence in international production networks. The probability of remaining in the global production chains in a changing and unstable competitive environment is expected to be higher for suppliers that provide the most sophisticated goods, i.e. goods that incorporate the most advanced economies' capabilities. In order to check this hypothesis we use discrete time duration model. Our estimates indicate that, indeed, the risk of being removed from production networks decreases not only with the complexity of the products, but also with the reduction of uncertainty in production and trade relationships and with the degree of integration in these international-scale networks.

JEL codes: F10, F14, C41.

Key words: Product sophistication, International Production Networks, Export Survival, Time-Discrete Duration Models.

♠♠ Corresponding author. Department of International Economics, Faculty of Juridical and Social Sciences, University of Castilla-La Mancha, Cobertizo de San Pedro Mártir, 45071, Toledo, Spain. Carmen.DiazMora@uclm.es, Phone +34925268878, Fax +34925268878.

1. Introduction

One of the most typical features of the present international economic order is the extension of cross-border production networks. This internationalization of production processes can no longer be considered a novel strategy of big corporations but rather a necessary condition for firms that try to survive in a globalized economy. However, the absence of detailed statistical information on phases or stages of production processes has restricted the research on the entity, characteristics and effects of production networks.

It was not until the turn of the century when this literature started to gain momentum through the analysis of the trade flows of intermediate goods and particularly of parts and components (P&C). Some papers have showed the intensity of the process of value chain fragmentation, especially in Asia (Ng and Yeats 1999; Kim 2002; Athukorala 2005; Athukorala and Yamashita 2006; and Kimura *et al.* 2007). Other papers have focused on the geographic organization of production processes promoted by the emergence of low-cost countries and by regional integration in Europe and America (Arndt, 2004; Bauman and Di Mauro, 2007, Kaminski and Ng, 2005; De Simone, 2008; Zeddies, 2011). In general, in the most advanced economies, firms have tended to expand their production chains by incorporating new partners from low-cost countries. Consequently, product and trade specialization of the oldest network members has been affected.

This reorganization of production processes has generated considerable unrest in countries that could be easily replaced by new participants with cost advantages. For this reason, the paper deals with this concern and intends to identify the factors that determine permanence in international production networks. Specifically, our hypothesis is that the probability of remaining in global production chains is (together with other factors), related to product and trade specialization of firms involved in them. Firms that supply the most "sophisticated" goods in the sense of Lall *et al.* (2006)[1] will have a better chance of keeping their position in the network than those that limit their participation to operations with fewer production requirements.

This idea is supported by the results of previous literature, especially on the analyses of trade relations duration of different types of goods. Besedes and Prusa (2006) and Brenton *et al.* (2010) find that the risk of failure of trade relations involving differentiated goods is significantly lower than the risk in the case of homogeneous goods. The large supply of the most routine goods reduces the cost of searching for new trade partners, making it easy to replace established partners with new ones with cost advantages. Although this research does not explicitly consider production networks, it is

[1] For Lall et al. (2006), the sophistication of goods goes beyond their technological complexity; it also includes the set of features that enables one company to offer a differentiated product and the production capabilities that that requires.

reasonable to think that the connection between product sophistication and trade stability must be especially tight in the networks. The literature on international fragmentation of production confirms the need for careful coordination between trade partners that participate in the value chain (Arndt and Kierzkowski, 2001). Each link within the chain must meet strict production requirements for deadlines, quality, design and technological content to fulfil the needs of the downstream production partners. These demands require specific production capabilities which define the specific nature of the product and differentiate it from other suppliers, increasing its "degree of sophistication". Naturally, in this breakdown of the production process by tasks, there coexist products with different levels of factor intensity, possibilities of fragmentation and production requirements (Grossman and Rossi-Hansberg, 2006). Our hypothesis implies that the probability of remaining in the network in view of changes in competitive conditions will depend on the contribution of each stage to the value chain: the greater the capabilities contained in the generated added value and, as such, the greater the sophistication of the contribution to the value chain, the more difficult it will be to be replaced by a new partner.

As a measure of product sophistication, the indicator proposed by Hausmann *et al.* (2007) is used. So far, this indicator has been used basically to analyse the relationship between the complexity of exports and economic growth, but, as we explain in the next section, it is well suited to our analysis.

Additionally, to define the relevance of product sophistication in network stability, we estimate discrete time duration models which control for the existence of unobservable heterogeneity. With respect to the previous literature (Obashi, 2010; Córcoles *et al.*, 2012), we introduce the "degree of product sophistication" as a new explanatory element into the determinants of stability in production networks.

The sphere of analysis is confined to the automotive industry, one of the most fragmented and globalized, and where the geographic reorganization of value chains has been the most intense after advances in regional integration agreements in North America and Europe and the eruption of emerging countries in world trade. Therefore, it is an excellent reference for the study of the factors that condition permanence in production networks. Furthermore, in comparative terms, the automotive industry is distinguished by the importance of quality, trust and proximity in localization strategies (Domanski y Lung, 2009). In industries as complex as the automotive industry, the sophistication of the product for the network must be one of the determining elements of permanence within it.

Following this introduction is a descriptive analysis that shows the duration of trade flows linked to the automotive industry and offers indications of the incidence of production characteristics of goods in the stability of exports. It also presents the indicator used to approximate these characteristics. In section 3, the econometric analysis is performed. The paper ends with a section of conclusions.

2. Duration and Survival in the Automotive Industry

2.1. Data

We use trade data at the 6-digit level of the Harmonized System (HS) from the United Nations Commodity Trade Statistics Database (COMTRADE). Although we focus on explaining export duration, data on country A's exports to country B are substituted with country B's imports from country A because imports are usually recorded more accurately than exports by custom-based trade statistics.

Following Türkcan and Ates (2011), we consider those codes from the United States International Trade Commission (USITC) relevant to the auto industry. These auto-industry codes include motor vehicles products as well as auto parts such as bodies and parts, chassis and drivetrain parts, electric and electrical components, engines and parts, tires and tubes and miscellaneous parts. Of the 97 categories that are included in our list, 80 are parts and components. That is, in this paper we consider both P&C items and final goods to take into account the last phase of the manufacturing processes (the assembly phase). The shortcoming here is that it is not possible to distinguish assembly from full manufacturing because both of them are registered as final goods exports. Table A.1 in the appendix lists the HS-6 codes relevant to the auto industry. We have established a minimum trade threshold of $1,000, a common practice in the literature which aims to eliminate any flows which, because of their limited size and high volatility, may distort the results. To perform the analysis, we examine the exports of 60 countries, which represent about 99.5 percent of the world auto trade. Table A.2 in the appendix lists the countries included in the sample. The study period is 1996-2009[2].

2.2. Estimation of the Duration and Survival of trade flows

The estimation of the duration of trade requires dividing yearly data on bilateral exports of each product into spells, that is, into periods of continuous export activity. Therefore, the length of each spell is the number of years the export flow of one item to a specific destination continues without interruption. The length of the spells varies between one, when the flow stops after the first year of

[2] The two revisions of the HS classification, in 2002 and in 2007, require a process of homogenization due to the elimination of certain headings or their reclassification in other codes and the appearance of new ones.

activity, and 14, when the product is exported in every year of the period studied. The interruption of the sale of a product to a specific destination and its resumption afterwards gives rise to the existence of multiple spells, commonly treated in the literature as independent spells.

Basic statistics about duration show two facts. The first is the reduced persistence of export relations, whose average duration is 4.9 years, with trade that lasts for a period of two years being the most common (Table 1). This short duration coincides with the results of the literature[3]. The second is the longer duration of those exports more clearly linked to shared production networks. Here, the average number of years of uninterrupted trade ties is clearly higher in P&C than in final goods (5.1 compared to 3.7). This feature is also noted in the scarce duration literature that focuses on production networks: Obashi (2010) for intra-zone trade in East Asia, and Córcoles *et al*. (2012) for Spanish manufacturing exports.

Table 1: Length of export spells in the automotive industry

	Length		No. spells	Observations
	Average	Median		
Auto Parts	5.1	2	291,586	1,500,444
Vehicles	3.7	2	45,333	167,779
All	4.9	2	336,919	1,668,223

Source: own elaboration from UN-COMTRADE data.

The duration of the spells is determined by the probability of maintaining trade relations (the survival function), which can be estimated by using non-parametric techniques based on the Kaplan-Meier model (1958). The survival function is the probability that one trade relation will last a certain number of years and is normally calculated as a complementary function of the exit rate or, in continuous terms, a function of risk or "hazard." This exit rate can be defined as the probability that the trade relation will end at a certain moment (year *t*) conditional on the trade relation having survived to time *t*. We define the exit rate as:

$$\O(t)=Pr(T=t|T\geq t)=\frac{Pr(T=t)}{Pr(T\geq t)}=\frac{h_i}{n_i} \qquad (1)$$

[3] Besades and Blyde (2010) review the main studies about export duration, a relatively new line of research. In all of the studies, which reflect different economies, the brevity of trade relations is observed.

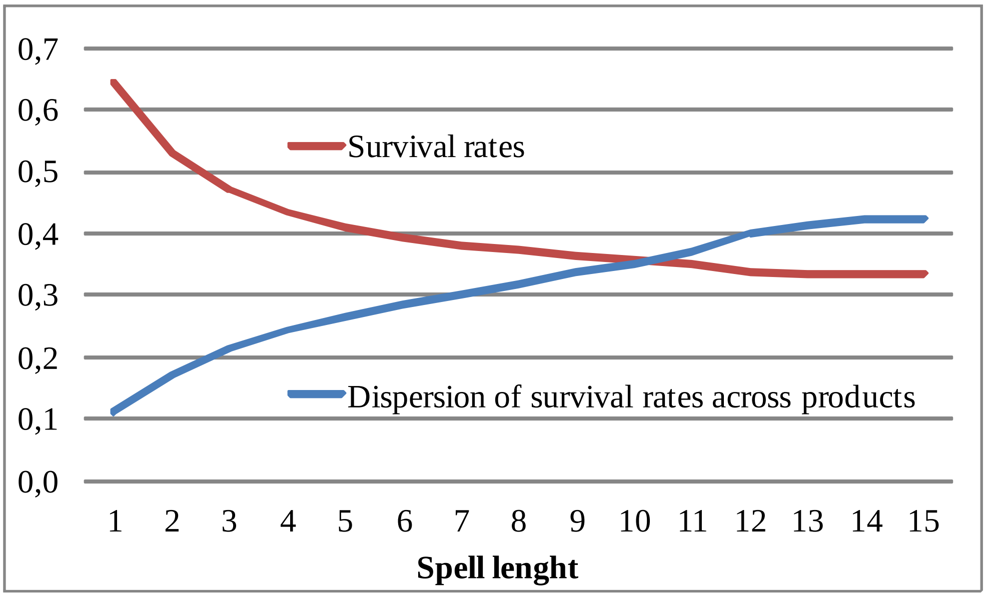
where n_i is the number of trade relations that remain active in t and h_i is the number of trade relations that end exactly in t. The survival function can, then, be calculated as the complementary distribution function of the exit rate:

$$S(t) \ = \Pi_{t(i)\leq t} \ 1\text{-}\O(t) = \ \ \Pi_{t(i)\leq t} \ \ (1- \frac{h_i}{n_i}\ ) \qquad (2)$$

According to expression (2), a situation of long-lasting export relations would be determined by low and decreasing exit rates (*Ø)* which would imply high survival rates with a tendency to reduce their negative slope over time.

The graphic representation of survival rates in the automotive industry shows how the stability of foreign sales is conditioned by the duration of the trade relation (Figure 1). It is more likely that trade relations fail in the initial years, when the possibility that exports are interrupted is considerably high. Only 64% of exports in the automotive industry last more than one year. Although the chances of survival diminish as the duration of bilateral exports continues (53% last more than two years, and 47% last more than three), the decrease in the survival rates is less the longer the trade relation is. The fact that the survival function is practically horizontal in the most prolonged export relations indicates that the risk of failure stabilizes after a certain amount of time (around 10 years).

Figure 1: Survival rates and their dispersion across products



Source: own elaboration from UN-COMTRADE data.

The low dispersion in the survival rates across products seems to indicate that during the first few years, the stability of exports is affected by factors common to all products. That is, the high mortality rate of exports in the initial years is not determined so much by the nature of the product for the automotive network as by aspects related to the common difficulty of successfully starting a trade relation with a foreign country (e.g. uncertainty, knowledge of the characteristics of the destination markets). However, as the degree of permanence of the export relations increases, the difference between the survival rates across products involved in the network grows. This behaviour shows that as the trade relation becomes consolidated, the specific characteristics of the exported products come to play a growing role in explaining the possibilities of permanence of transactions abroad.

This importance of the product characteristics as determinants of the stability of bilateral exports was already demonstrated in Besedes and Prusa (2006b). Focussing on USA imports between 1972 and 1998, they empirically show that the homogenous products have a higher risk of ceasing export activity than the differentiated products, being the foreign transactions of the former more fragile. Following this line of research, the present paper tries to analyse the factors that explain permanence in the automotive network, incorporating a broader indicator of the product characteristics in estimating the determinants of the duration of exports.

2.3. The indicator of product characteristics

In order to consider the industrial characteristics of traded goods, Lall *et al.* (2006) propose a "sophistication index" which attempts to deduce the competitive peculiarities of exported products on the basis of the degree of development of the exporting countries of each good. It is a broad indicator since it incorporates technical features as well as possibilities of differentiation, fragmentation and requirements of logistics and organization of the chain value. The basic supposition is that, in the absence of interventions which distort trade flows, exports reflect the specialization and competitive advantages of different economies. Consequently, in goods exported by countries with higher levels of per capita income, advantages associated with the capacities that distinguish these countries predominate: high technological content, higher levels of quality, skill level of the labour force, logistic capacity, and capacity for management and coordination of the production process. In other words, they will be more sophisticated goods, sophistication being understood as the inclusion of the particular skills of advanced economies.[4]

[4] Anand *et al*. (2012) econometrically establish the importance of the skill level of the labour force, the expansion to foreign markets and the development of the information society in the degree of sophistication of exports.

Hausmann *et al.* (2007) develop an indicator of the complexity of the products traded (PRODY) very similar to the one by Lall *et al.* (2006). The difference is that while Lall *et al.* (2006) weigh the per capita income of each exporting country of the good for its participation in world exports, in the Hausmann indicator, the weighting is carried out through Balassa's revealed comparative advantages index, thereby eliminating the influence of the size of both the countries and the trade flows. The algebraic expression of the indicator is:

$$PRODY_K = \Sigma_j \frac{(x_{jk}/x_j)}{\Sigma_j(x_{jk}/x_j)} GDP_{pc\,j} \qquad (3)$$

For these authors, the estimation of the indicator of product sophistication is an intermediate step to determining the degree of complexity of the export basket of different countries (EXPY). Their final goal is to analyse the relationship between the trade structure of the countries and their economic growth. This aim is shared by most of the numerous studies that have used these indicators since they came into being. The novel contribution of our paper is that for the first time, the sophistication indicator PRODY is considered one of the determinants of the stability of trade relations, specifically, of trade linked to international production networks.

This indicator turns out to be especially suitable for the analysis of stability in production networks. In accordance with the theoretical literature on international fragmentation, one of the main determinants of participation in production sharing systems is the existence of different comparative advantages between countries that justify the dispersion of the different phases of the value chain.[5] The search for greater efficiency in the process of producing goods entails firms tending to localize the separable stages in those places where these goods can be obtained at a lower cost. In general, firms in advanced economies normally offshore the most routine, least productive tasks and those which generate the least added value, relocating them into countries with lower levels of income and salaries. As Lall *et al.* (2006) note, among the production characteristics that PRODY incorporates, there is the possibility of fragmentation: high degrees of product sophistication show reduced possibilities of fragmentation and relocation in low-cost economies. From the point of view of network stability, it is reasonable to expect that the specialization of companies in product that are more susceptible to be relocated because they are more fragmentable, will entail a higher risk of non-permanence within the network.

[5] This hypothesis has been contrasted by empirical evidence. Papers on this topic have demonstrated the importance that comparative advantages has as a determining element of integration in networks, although they also highlight the incidence of other factors like geographic proximity, quality of physical and technological infrastructures, and institutions (Blázquez *et al*,. 2012).

To approximate the degree of product complexity, we use the PRODY indicator proposed by Hausmann *et al.* in accordance with formula (3).[6] The decision on the time period to be calculated is a very delicate issue. Since the countries of reference and their quotas can vary according to the moment chosen and the calculation for different countries in different years could create important biases in the indicator (Hausmann *et al.* 2007), it is essential to consider a consistent sample. Responding to this need**,** we estimate the PRODY variable for the period 1996-2007. The last two years of the period under analysis, 2008 and 2009, have been excluded to avoid biases related to the collapse of world trade associated with the international financial crisis.

Table 2 contains the main statistics referring to PRODY. We observe that there is great variability in the degree of sophistication of the products that conform the automotive industry. The index for the most complex product (road tractors) quadruples the value obtained in the least sophisticated (asbestos friction material).

It is surprising that some final goods are among the items with the greatest values. Assembly is the last phase of manufacturing process and it is less complex activity than the fabrication of technologically advanced upstream components; consequently, it is more susceptible to delocalization in countries with lower labour costs. However, the high value of the indicator denotes the predominance of the most advanced economies in the trade of these final goods.

The explanation lies in the specific features of the automotive industry**,** an industry where a high degree of internationalization of the production process coexists with regional production and marketing networks led by a few automobile manufacturers whose production strategies determine the configuration of the entire industry. There are two opposing forces that act upon the localization of final assembly plants of automobiles. First, the manufacturing of vehicles (and their main suppliers) has spread geographically through the establishment of plants in emerging markets with the goal of capitalising on the dynamism of the market, but also because of pressures to “build where they sell.” Secondly, the importance that the automotive industry takes on in the national economy, its high volumes of employment and degree of unionization generate political and social sensitivity which favours the continuity of assembly plants in advanced economies. Therefore, national

[6] Recent studies have proposed new indicators of product complexity that attempt to correct the main limitation of PRODY: the circularity that implies to construct the index on the basis of the per capita income of exporting countries when is used to obtain conclusions about the possibilities of growth of per capita income. The indicator created by Hidalgo (2009) is determined independently of the per capita income, keeping in mind the geographic diversification of each product and its “ubiquity,” that is, the number of countries that export them. In our view, this critique is not applicable to the use of the PRODY in analyses of trade duration, where there is no sign of endogeneity. Moreover, given that the empirical evidence shows that among the factors that determine the stability of production networks, market diversification stands out (Córcoles *et al*., 2012), we consider that diversification variable should be included among the explanatory variables of stability, which could pose econometric problems when Hidalgo’s complexity indicator is used.

governments' industrial policy of supporting the industry plays an important role in explaining the geographic arrangement of the automobile network.

Table 2: Main statistics of PRODY indicator in the automotive industry

	No. observations	Average	Standard Deviation	Lowest Value	Highest Value
PRODY(average 1996-2007)	1,668,223	18,228	406	7,991	29,198
	HS Codes	Product Description			
Items with the highest values	H0-870120	Road Tractors for semi-trailers (road tractors)			
	H0-842691	Cranes designed for mounting on road vehicles			
	H0-870324	Automobiles, spark ignition engine of >3000 cc			
	H0-700910	Rear-view mirrors for vehicles			
	H0-870810	Bumpers and parts thereof for motor vehicles			
Items with the lowest values	H0-854430	Ignition/other wiring sets for vehicles/aircraft/ship			
	H0-681310	Asbestos brake linings and pads			
	H0-401310	Inner tubes of rubber for motor vehicles			
	H0-401120	Pneumatic tyres new of rubber for buses or lorries			
	H0-681390	Asbestos friction material, articles except for brake			

Source: own elaboration from UN-COMTRADE data and World Development Indicators (The World Bank).

3. Empirical Model

The short duration of export relationships found in section 2 and in previous studies[7] contradicts statements of new trade theory about a persistent behaviour in exporting activity explained by the existence of sunk entry costs in serving foreign markets (Roberts and Tybout, 1997; Bernard and Jensen, 2004).

In order to explain the high rate of failure in export markets, more recent literature has introduced the role of uncertainty in the success of exporting. As Besedes (2008) notes, there is a substantial amount of uncertainty in the formation of trade relationships.

Uncertainty comes from different sources. It could come from the demand side such as informational uncertainty about the size of the market, the distribution channels or the adequacy of the firm's product to local tastes (Segura-Cayuela and Villarubia, 2008). From the supply side, firms face uncertainty about the costs of searching for an appropriate supplier (Rauch and Watson, 2003;

[7] See footnote number 3.

Besedes, 2008). These providers have to be able to fulfil the requirements in terms of deadlines, qualities, technical requirements and other production demands. Moreover, uncertainty about the feasibility of trade relationships comes from the exporter's inability to know in advance the precise costs it must incur and whether the profitability of the transaction will be sufficient to cover these costs (Freund and Pierola, 2010; Albornoz et al., 2010).

Therefore, an interesting question arises: What are the factors that may reduce this uncertainty? A pioneer in offering answers to this question was Rauch (1999), who stresses the role of proximity and common language/colonial ties in facilitating the search and matching process between buyers and sellers. Besedes (2008) suggests that higher reliability reduces uncertainty as well as the probability of trade relationship failure. Freund and Pierola (2010), Eaton *et al.* (2012), and Albornoz *et al.* (2012) emphasize prior experiences in foreign markets in determining the future success or failure of exporting.

The complex nature of the automotive networks, with high-quality requirements, high transport costs and just-in-time deliveries, makes the reliability of manufacturing partners and proximity really relevant to reduce uncertainty about the success of the production sharing system (Domanski and Lung, 2009). Previous experience is also useful in an industry where a high degree of adaptation to the needs of the production process and close collaboration among manufacturing partners at the level of design and quality are required. In fact, only a few parts are standardized in the automotive industry and specifications must be developed for every part of each vehicle model (Sturgeon et al., 2009). Moreover, the more complex the good produced within the global value chain, the more stable the trade relationship because of the difficulty of replacing the manufacturing partner. Therefore, we suggest that the degree of product complexity plays an important role in explaining the stability of trade flows in the international production network.

Taking into account these arguments, we propose an empirical model to investigate the factors that determine trade stability within cross-border value chains. Specifically, we consider the role of product sophistication as well as those factors that, according to the literature, contribute to reduce uncertainty such as proximity, reliability requirements and previous experience and also variables directly related to integration in these global-scale networks.

Proximity could be a factor that helps production sharing networks to prosper in terms of their continuity, so we incorporate a variable for geographical distance between trade partners[8]. Physical

[8] Gamberoni *et al.* (2010) argue that given that one major cost associated with distance is time, and that fulfilment of delivery deadlines of the components is necessary for the production sharing system to operate properly, it can be expected that the trade within production sharing networks is particularly sensitive to the impact of distance.

proximity is particularly important in the automotive industry because it facilitates the increasing demand of product differentiation, the reduction of transport costs, mainly in modules with higher size and weight, and the advantages of production systems like lean manufacturing (Blázquez *et al.*, 2013). This would partially explain the strong regional structure of production networks in this industry.

A second group refers to variables that consider the need of reliability to decrease the probability of export failure. All of them except one are country-level variables which are related to the ease of finding a suitable and reliable manufacturing partner: quality of the institutional framework in the partner country (measured by the Rule of Law Index), membership of a regional integration arrangement, differences in the degree of development between manufacturing partners (proxied by the absolute differences in per capita income) and their market size (measured by GDP). As noted by Nunn (2007) and Gamberoni *et al.* (2010), institutional quality is expected to have a positive impact on the value of trade in intermediate goods. We extend this argument one step further: a higher quality of the institutional environment allows better compliance with the technical, quality and deadline requirements established in the contract between manufacturing partners and therefore a greater stability of trade relationships. In a similar way, international production sharing requires close collaboration and coordination that will be easier to achieve within the same regional integration area and more difficult and more likely to encounter disruptions or restrictions among countries with big economic differences (Orefice and Rocha, 2011). These development differences could be an obstacle for production sharing activities as they increase the fragility of trade relationships. The last variable in this group is the initial value of the trade flow at spell level, which, according to previous theoretical and empirical studies (Rauch and Watson, 2003; Besedes, 2008; Brenton *et al.*, 2010; Hess and Persson, 2011a; Impulliti *et al.*, 2011), is a proxy for the degree of confidence the trading partners had *a priori* in the continuity of their relationship.

As is usual in export survival analysis, to measure prior experience in exporting activity that would reduce uncertainty, we use the duration of the previous spell, that is, the number of years that a preceding export spell lasted, expecting a positive impact on network stability.

Additionally, we expect that deeper integration in the global value chain would increase the probability of remaining within the network. This degree of participation in the network can be measured in an extensive form (product and market diversification) or intensive form (total volume of trade of a given product). Greater product and market diversification (measured by the number of products exported to a given market and the number of markets to which one product is exported, respectively) involves higher connectivity within the network and is therefore more difficult to replace with other manufacturing partners. Moreover, geographic diversification is common in specialized suppliers with a high productive capacity which provides components with greater efficiency in different markets. In this sense, diversification would summarize the exporting experience that reduces uncertainty and therefore the probability of export failing[9]. The total volume of exports of a given product could also capture the experience of exporting a specific product as well as an intensive integration in the production networks, both of them fostering the stability of trade relationships within the global value chains.

Finally, as already stated above, some characteristics of the automotive industry such as powerful lead firms and industry associations, large-scale employment and relatively high rates of unionization increase political sensitivities and help to understand political pressures to maintain a high level of production "in-house". Therefore, we expect a "headquarter effect", that is, an unusually high concentration of production and exports in countries where headquarters are located, and we control for it using a dummy variable.

Based on these arguments, we estimate a duration model in which the above variables are included to assess their impact on production network stability. The more general specification of duration models is:

$$Ø(t)=f(X) \qquad (4)$$

where X is a vector of explanatory variables and Ø(t) is the exit probability. Therefore, the dependent variable is not the unconditional probability of a given spell duration but the probability of leaving a given trade flow in a particular year (t-year) conditioned to persistence in the previous years (Kiefer, 1988) or, in other words, the hazard rate as defined in the expression (1).

Most of the previous literature has used semi-parametric Cox proportional hazard models to analyze the determinant factors of trade duration (Besedes and Prusa, 2006b; Nitsch, 2009; Besedes and Blyde, 2010; Obashi, 2010). However, recent papers point out three relevant problems inherent in the Cox model that reduce the efficiency of estimators (Brenton *et. al.*, 2010; Fugazza and Molina, 2011). First, continuous-time models (such as the Cox model) may result in biased coefficients when the database refers to discrete-time intervals (years in our case) and especially in samples with a high number of ties (numerous short spell lengths). Second, Cox models do not control for unobserved heterogeneity (or frailty). In this sense, results might not only be biased, but also spurious. The third problem lies in the proportional hazards assumption that implies similar effects at different moments of the duration spell.

[9] Brenton *et al.* (2010), Nitsch (2009), Hess and Persson (2011a).

The three problems can be solved or controlled by using discrete-time models (Hess and Person, 2011b): these models do not have problems with the number of ties; frailty can be easily controlled, and it is even possible to relax the assumption of proportional hazards by including the spell length in logarithms as an explanatory variable. In this study, we consider two different discrete-time models: clog-log and probit. In general terms, both present similar properties and they would have very similar results; nevertheless, we have to take some small differences into account. Clog-log model determines frailty with a more flexible functional form (Heckman and Singer, 1984). Since we have a large number of observations, this advantage is especially relevant in our panel data. Alternatively, a probit model is better adapted to the non-existence of the proportional hazards assumption (Sueyoshi, 1995). Considering these differences and the properties of the database, we specify a complementary log-log model to analyze the determinant factors of trade duration. To control for unobservable heterogeneity, we include product-country random effects. Additionally, as a robustness check, we present the results for probit models in the appendix.

The results of the econometric estimates from the random effects complementary log-log model can be found in Table 3. The coefficients are presented in exponential form to express the ratio in which the dependent variable (likelihood of failure) changes as the explanatory variable goes up one unit (hazard ratio): values below (above) the unit indicate a negative (positive) impact of the explanatory variable on the hazard rate. The impact will be much larger the further the coefficient is from the unit value.

The results are satisfactory in so far all the variables show the expected impact with statistical significance (column 1 of Table 3). First of all, product sophistication tends to prolong the duration of trade relationships. That is, those countries specialized in exporting more sophisticated products are more likely to remain in the production network. As such, we find support for our hypothesis: what countries produce and export matters for stability within the global production network.

The coefficients of those variables included in the model to capture the reliability requirements in order to reduce uncertainty confirm their relevance to stability in global value chains. The higher the institutional quality of manufacturing partners, the greater the likelihood that export relationships will survive (although the link is weak). We also find a positive impact of belonging to the same regional trade area on the probability of staying in the production sharing network. Moreover, the larger the market size of trading partners, the lower the hazard rate of failure. Stability also increases with higher initial value of export flows, indicating stronger confidence in that trade relationship.

Table 3. Estimation Results

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
	ALL SPELLS		Spells>=4 years	Spells<4 years	Spells starting in 1997 (new exporters)	Spells for which preceding spell length>=1
VARIABLES	All	Components	All	All	All	All
PRODY	0.907***	0.887***	0.803***	0.989	0.938***	0.934***
	(0.0110)	(0.0114)	(0.0195)	(0.0114)	(0.0111)	(0.0166)
Distance	1.198***	1.178***	1.298***	1.035***	1.120***	1.102***
	(0.0041)	(0.0044)	(0.0085)	(0.0032)	(0.0037)	(0.0053)
Institutional quality	0.998***	0.998***	1.000	1.001***	1.000	1.001***
	(0.0002)	(0.0002)	(0.0003)	(0.0001)	(0.0001)	(0.0002)
Absolute differences GDPpc	1.116***	1.108***	1.105***	1.000	1.109***	1.065***
	(0.0049)	(0.0052)	(0.0072)	(0.0029)	(0.0048)	(0.0069)
RIA membership	0.938***	0.918***	1.126***	0.804***	0.902***	0.897***
	(0.0087)	(0.0095)	(0.0193)	(0.0074)	(0.0083)	(0.0117)
GDP reporter	0.945***	0.942***	0.899***	0.963***	0.966***	0.971***
	(0.0021)	(0.0022)	(0.0038)	(0.0019)	(0.0020)	(0.0030)
GDP partner	0.970***	0.982***	0.952***	0.986***	0.984***	0.973***
	(0.0027)	(0.0031)	(0.0054)	(0.0027)	(0.0027)	(0.0041)
Initial trade value	0.824***	0.822***	0.895***	0.921***	0.882***	0.888***
	(0.0018)	(0.0021)	(0.0028)	(0.0016)	(0.0019)	(0.0024)
Duration previous spell	0.909***	0.909***	0.910***	0.867***	0.910***	0.896***
	(0.0019)	(0.0022)	(0.0045)	(0.0016)	(0.0018)	(0.0029)
Market diversification	0.800***	0.802***	0.889***	1.021***	0.943***	0.976***
	(0.0039)	(0.0043)	(0.0067)	(0.0044)	(0.0044)	(0.0069)
Product diversification	0.713***	0.698***	0.803***	0.984***	0.823***	0.863***
	(0.0034)	(0.0038)	(0.0054)	(0.0035)	(0.0034)	(0.0054)
Total product exports	0.872***	0.863***	0.840***	0.943***	0.895***	0.912***
	(0.0014)	(0.0015)	(0.0024)	(0.0012)	(0.0013)	(0.0017)
Headquarters	0.933***	0.916***	0.926***	1.066***	0.959***	0.947***
	(0.0072)	(0.0079)	(0.0131)	(0.0081)	(0.0075)	(0.0107)
Final goods	2.508***		2.749***	1.400***	1.954***	1.859***
	(0.0273)		(0.0505)	(0.0115)	(0.0199)	(0.0235)
Duration spell	0.471***	0.467***			0.389***	0.390***
	(0.0043)	(0.0047)			(0.0039)	(0.0027)
Observations	1,586,653	1,427,619	1,305,768	280,885	412,388	298,112
Number of spells	325,143	281,791	130,658	194,485	137,764	109,36

Notes: Coefficients are expressed as hazard ratio. Standard errors in brackets. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. All the variables, except dummies and Rule of Law, are expressed in logarithms. All models include time dummies. The clog-log model includes random effects on the exporter-product level.

Additionally, our results suggest that low participation in the cross-border production network (in an extensive or intensive form) implies fragile integration since the lower the product and market diversification and total export value are, the higher the probability that an export spell dies. Hence, a greater degree of geographic and product connectivity within the network encourages stability of trade relationships.

The model estimates also show that geographical proximity, hosting the company's headquarters and previous experience measured by the length of the preceding spell have a positive impact on the continuity of exports. Lastly, in the estimates we have incorporated a dummy variable to consider the different behaviour of final goods in terms of export length, finding higher failure rates compared to components.

We have estimated three additional regressions. In a first step, taking into account that for final goods we are not able to distinguish assembly from full manufacturing and the last one would not be part of cross-border production sharing, we re-estimate the model only for P&C trade. With this narrower definition of trade involved in production networks, the results are unchanged (column 2 of Table 3).

In a further step, we distinguish between short-duration relationships and long-term relationships. Our descriptive analysis has suggested that when the trade relationship stabilizes, the specific product characteristics become more relevant in explaining the probabilities of remaining within the production networks. Here, we want to investigate whether that would be the case of product complexity. Taking into account the average length of trade flows in the automotive industry, we re-estimate the model for spells shorter than four years and for spells equal to or more than four years (columns 3 and 4, respectively). As a matter of fact, we are interested not in short-duration flows, unstable by definition, but in more permanent export relationships. Our estimates confirm that for longer export flows product complexity is a guarantee of the continuity of trade relationships. Moreover, only in stable exports does the sophistication of the products move exports to greater duration. For short-term relationships, the complexity of the products exported by the country has no statistically significant impact on trade duration.

The only remarkable change for long-term relationships is the effect of regional integration agreement membership. It is an unexpected result: belonging to the same trade integration area increases the risk of failure in more stable trade flows. This conclusion opposes the idea that trade relationships are easier in an integrated market where uncertainty is reduced by proximity and a better acknowledgement of suppliers, buyers and market rules[10]. It also disagrees with the regional structure of the automotive industry. In fact, if we isolate the effect of each regional agreement, such a counterintuitive result is obtained only in the case of the European Union. During our study period, since the mid-1990s, the deepening of the EU integration process and the accession by twelve new member states have promoted extensive changes in the geographical organization of production within the region (Baldwin and Venables, 2011). The automotive industry is not an exception. Relocation of value chain activities to the new members might crowd out long-term trade flows in senior countries. Therefore, this result may reflect the reshaping of the European automotive network in favour of the most recent members.

Furthermore, we perform several alternative estimates as robustness checks. First of all, we exclude the left-censured observations from the sample, that is, those trade flows that already existed at the beginning of the period analysed and whose starting year we do not know. We thus re-estimate the model only bearing in mind the new country-product export flows (column 4). The outcomes remain unchanged, except for the variable for institutional quality, which turns out to have no impact on export survival.

Secondly, in order to improve the measure of the variable duration of the previous spell, we eliminate those spells for which we do not know the duration of that preceding spell and then a zero value is assigned. This would imply removing not only the left-censured observations from the sample, as in the prior estimates, but also other spells that are the first of several spells observed during the period. Again the results are analogous (column 5).

Finally, we perform the estimates using a probit model with frailty in order to relax the proportional hazard assumption[11]. The conclusions obtained in terms of the positive or negative impact of the explanatory variables on the hazard rate are not altered (Table A.4). Therefore, the more complex the product exported, the lower the risk of export failure.

4. Concluding Remarks

Our research has demonstrated that what countries produce and export matters for stability within the global production network. In a context marked by great changes in the competitive environment and

[10] A few previous studies also find a negative effect of free trade agreements on export survival (Brenton *et al.*, 2010; Carrere and Strauss-Kahn, 2012). The explanation given in the first paper is that these agreements encourage exports to more hazardous partners and the argument in the later paper is that these agreements, allow exporters to enter and re-enter in export markets resulting in a process of trial and error that affect positively the hazard rate in the short run but negatively in the long run through experience.

[11] Hess and Persson (2011a; 2011b) argued that the use of probit is preferable for estimating a duration model for three reasons: it does not assume proportional hazard; it controls properly for unobservable heterogeneity; and it is a discrete-time model.

ample opportunities for geographic expansion of production processes, the type of good with which different countries contribute to the generation of global added value has come to be one of the main determinants of permanence in the network. In particular, our findings show that those participants which contribute with the most sophisticated products, in that they incorporate the specific production capacities of the most advanced economies, are at a lower risk of having their trade relation interrupted, that is, of being excluded from the network.

To solve the problem entailed by the absence of statistics that allows considering the production characteristics of trade flows, the “sophistication index” proposed by Hausmann *et al*. (2007) has been adopted as an indicator. This is an extension of the purpose for which it was designed that has proven to be especially useful for differentiating products included in global production chains.

The results obtained let us to extract some recommendations for industrial policy. The relationship between the degree of product sophistication and the probability of remaining in the network, as well as the fact that this occurs especially in the most stable trade relations, offers a guideline for action for those economies that, as part of a network, face the possibility of being replaced by new localizations. This risk is quite common in the automotive industry which in the last few decades has been subjected to an intense process of spatial reorganization whereby some of the traditional locations, generally in advanced economies, have been removed from the network. In accordance with the estimations made**,** the likelihood of continuing in the network, moreover with the complexity of the products, improves with the reduction of uncertainty in trade and with deeper integration in the global-scale networks. As such, actions in this direction like improving the institutional quality, diversifying markets and products or progress towards more complex products, with greater technical requirements and a more skilled labour force, seem especially appropriate to attempt to ensure continuity in established production networks.

Acknowledgement: Financial support from the Castilla-La Mancha Regional Ministry of Education and Science under the project PPII10-0154-9251 (co-financed by *FEDER funds)* is gratefully acknowledged.

References

Albornoz, F., Calvo Pardo, H.F., Corcos, G. and Ornelas, E. (2012). "Sequential Exporting". Forthcoming in *Journal of International Economics*.

Anand, R., Mishra, S. and Spatafora, N. (2012): "Structural Transformation and the Sophistication of Production". IMF Working Paper No. 12/59.

Arndt, S.W. (2004). "Global production networks and regional integration", in M.G. Plummer (ed.), *Empirical Methods in International Trade* (Northampton, MA: Edward Elgar).

Arndt, S.W. and Kierzkowski, H. (2001). *Fragmentation: New Production Patterns in the World Economy* (Oxford: Oxford University Press).

Athukorala, P. (2005). "Product Fragmentation and Trade Patterns in East Asia". *Asian Economic Papers*, 4(3), 1-27.

Athukorala, P. and Yamashita N. (2006). "Production Fragmentation and Trade Integration: East Asia in a Global Context". *The North American Journal of Economics and Finance,* 17(3), 233-256.

Baldwin, R. and Venables, A. (2011). "Relocating de value chain: off-shoring and agglomeration in the global economy". Discussion Paper No. 544, University of Oxford.

Baumann, U. and Di Mauro, F. (2007). "Globalization and the euro area trade. Interactions and challenges". European Central Bank, Occasional Paper Series No. 55.

Blázquez, L., Díaz-Mora, C. and Gandoy, R. (2012). "EU Integration and production networks". *Revista de Economía Aplicada*, 60 (XX), 5-24.

Blázquez, L., Díaz-Mora, C. and Gandoy, R. (2013). "Production Network and EU enlargement: Is there room for everyone in the automotive industry". Forthcoming in *Eastern European Economics*.

Bernard, A.B. and Jensen, J.B. (2004). "Why Some Firms Export". *Review of Economics and Statistics*, 86 (2), 561-569.

Besedes, T. (2008). "A Search Cost Perspective on Formation and Duration of Trade". *Review of International Economics,* 16 (5), 835-849.

Besedes, T. and Blyde, J. (2010). "What drives Export Survival? An analysis of export duration in Latin America". Inter-American Development Bank, mimeo.

Besedes T. and Prusa, T.J. (2006a). "In, Outs, and the duration of trade". *Canadian Journal of Economics*, 39(1), 266-294.

Besedes T. and Prusa, T.J. (2006b). "Product differentiation and duration of U.S. import trade". *Journal of International Economics*, 70, 339-358.

Brenton, P., Saborowski, Ch. and von Uexkull, E. (2010). "What Explains the Low Survival Rate of Developing Country Export Flows?". *The World Bank Economic Review,* 24 (3), 474-499.

Carrere, C. and Strauss-Kahn, V. (2012): "Exports dynamics: raising Developing countries exports survival through experience", available in http://www.cepr.org/meets/wkcn/2/2451/papers/strauss-kahn.pdf.

Córcoles, D., Díaz-Mora C. and Gandoy, R. (2012). "Export survival in global value chains". Working Papers on International Economics DEFI No. 12-03.

De Simone, G. (2008). "Trade in Parts and Components and the Industrial Geography of Central Eastern European Countries". *Review of World Economics,* 144(3), 428-457.

Domanski, B. and Lung, Y. (2009). "The Changing Face of the European Periphery in the Automotive Industry". *European Urban and Regional Studies,* 16(1), 5-10.

Eaton, J., Kortum, S. and Sotelo, S (2012). “International trade: linking micro and macro”. NBER Working Paper No. 17864 .

Freund, C. and Pierola, M. (2010). “Export Entrepreneurs: Evidence from Peru”. Policy Research Working Paper No. 5407, The World Bank.

Fugazza, M. and Molina, A.C. (2011). “On the determinants of exports survival”, FREIT Working Paper No. 311.

Gamberoni, E., Lanz, R. and Piermartini, R. (2010). “Timeliness and Contract Enforceability in Intermediate Goods Trade “, Policy Research Working Paper Series No. 5482, The World Bank.

Grossman, G. M. and Rossi-Hansberg, E. (2006). “The Rise of Offshoring: It’s not Wine for Cloth Anymore”, *Proceedings,* Federal Reserve Bank of Kansas City, 59-102.

Hausmann, R., Hwnag J. and Rodrik, D. (2007). “What You Export Matters”. *Journal of Economic Growth,* 12 (1), 1-25.

Heckman, J.J. and Singer, B. (1984). "Econometric Duration Data". *Journal of Econometrics,* 24, 63-132.

Hess, W. and Persson, M. (2011a). “Exploring the Duration of EU Imports”. *Review of World Economics,* 147(4), 665-692.

Hess, W. and Persson, M. (2011b). "The Duration of Trade Revisited. Continuous-Time vs. Discrete-Time Hazards". Forthcoming in *Empirical Economics.*

Hidalgo, C.A. (2009). “The Dynamics of Economic complexity and the Product Space over a 42 year period”. Working Paper No. 189, Center for International Development at Harvard University.

Impullitti, G., Irarrazabal, A. and Opromolla, L. (2011). “A theory of entry into and exit from export markets”. Bank of Portugal, Mimeo, available in https://files.nyu.edu/ldo202/public/hyst2.pdf.

Kaminski, B. and Ng, F. (2005): “Production Disintegration and Integration of Central Europe into Global Markets”. *International Review of Economics and Finance,* 14(3), 377-390.

Kaplan, M.L. and Meier, P. (1958). “Nonparametric Estimation from Incomplete Observations”. *Journal of the American Statistical Association*, 53, 457-481.

Kim, Ch. (2002). "Production Sharing and Comparative Advantage: The Cases of East Asia and Mexico". *Economía Mexicana* XI(2), 409-430.

Kimura, F., Takahashi, Y. and Hayakawa, K., (2007). "Fragmentation and Parts and Components Trade: Comparison between East Asia and Europe". *The North American Journal of Economics and Finance* 18(1), 23-40.

Lall, S., Weiss J. and Zhang J. (2006). “The ‘Sophistication’ Of Exports: A New Trade Measure”. *World Development,* 34, 222-237

Ng, F., Yeats, A. (1999). “Production Sharing in East Asia: Who Does What for Whom and Why?”. *Policy Research Working Paper* No. 2197, The World Bank.

Nitsch, V. (2009). “Die Another Day: Duration in German Import Trade”. *Review of World Economics,* 145(1), 133-154.

Nunn, N. (2007). "Relationship-Specificity, Incomplete Contracts and the Pattern of Trade". *The Quarterly Journal of Economics*, 122(2), 569-600.

Obashi, A. (2010). “Stability of production Networks in East Asia: Duration and survival of trade”. *Japan and the World Economy*, 22, 21-30.

Orefice, G. and Rocha, N. (2011). “Deep Integration and Production Networks: an Empirical Analysis”. WTO Working Paper No. 2011-11.

Rauch, J.E., 1999. “Networks versus Markets in International Trade,” *Journal of International Economics*, 48, 7-35.

Rauch, J.E. and Watson, J. (2003). "Starting small in an unfamiliar environment". *International Journal of Industrial Organization*, 21(7), 1021-1042.

Roberts, M.J. and Tybout, J.R. (1997). "The Decision to Export in Columbia: An Empirical Model of Entry with Sunk Costs". *American Economic Review*, 87 (4), 545-564.
Segura-Cayuela and Villarubia, (2008). " Uncertainty and entry into export markets". Bank of Spain Working Paper No. 0811.
Sturgeon T.J., Memedovic, O., Van Bieserbroeck, J. and Gereffi, G. (2009). "Globalization of the Automotive Industry: Mean Features and Trends". *International Journal of Technological Learning, Innovation and Development*, 2, 1/2: 7-24.
Sueyoshi, G. T. (1995). "A class of binary response models for grouped duration data". *Journal of Applied Econometrics*, 10(4), 411–431.
Türkcan K. and Ates A. (2011). "Vertical Intra-industry Trade and Fragmentation: An Empirical Examination of the US Auto-parts Industry". *The World Economy*, 34(1), 154-172.
Zeddies, G., 2011. "Determinants of International Fragmentation of Production in the European Union". *Empirica*, 38(4), 511-537.

Statistical Annex:

Table A.1. HS-6 codes for Auto Industry.

381900; 382000; 400950; 401120; 401210; 401220; 401310; 401699; 681310; 681390; 700711; 700721; 700910; 732010; 732020; 830120; 830210; 830230; 840734; 840820; 840991; 840999; 841330; 841391; 841459; 841520; 842123; 842131; 842139; 842549; 842691; 843110; 848210; 848220; 848240; 848250; 848310; 850710; 850790; 851110; 851120; 851130; 851140; 851150; 851180; 851190; 851220; 851230; 851240; 851290; 852520; 852721; 852729; 853180; 853641; 853910; 854430; 870120; 870210; 870290; 870322; 870323; 870324; 870331; 870332; 870333; 870390; 870421; 870422; 870423; 870431; 870432; 870490; 870600; 870710; 870790; 870810; 870821; 870829; 870831; 870839; 870840; 870850; 870860; 870870; 870891; 870892; 870893; 870894; 870899; 871690; 902910; 902920; 902990; 910400; 940120; 940190; 940390.

Table A.2. Countries included in the sample.

Argentina, Australia, Austria, Belgium-Luxemburg, Brazil, Bulgaria, Canada, Chile, China, Croatia, Cyprus, Czech Rep., Denmark, Estonia, Egypt, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Iran, Israel, Ireland, Italy, Japan, Latvia, Lithuania, Malaysia, Malta, Mexico, Morocco, Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Rep. Korea, Rep. South Africa, Sri-Lanka, Rumania, Russia, Serbia, Singapore, Slovakia, Slovenia, Sweden, Switzerland, Thailand, Tunisia, Turkey, Ukraine, United Kingdom, Uruguay, USA, Vietnam.

Table A.3. Explanatory variables: definition and sources.

Variable	Definition	Source
Product Sophistication Level	Hausmann et al. (2007) sophistication index: PPRODY, calculated as a weighted average of the GDP per capita in PPA dollars of the countries that export the product and the weight is the relative comparative advantage of each country in exporting the good.	COMTRADE (United Nations) and World Development Indicators (The World Bank).
Institutional Quality: Rule of Law	Index that captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. The values range from 0 to 100.	Worldwide Governance Indicators (The World Bank).
Absolute differences GDPpc	Absolute differences in per capita incomes between trading partners (in nominal US dollars). The conversion to dollars is done using the Atlas method.	World Development Indicators (The World Bank).
RIA Membership	Dummy variable, which is unity if the reporter and partner countries belong to the same regional integration area (EU, NAFTA, MERCOSUR and ASEAN) and zero otherwise.	
GDP	Gross Domestic Product, expressed in nominal US dollars.	World Development Indicators (The World Bank).
Initial value	Value of export in the first year of the spell, expressed in nominal USA dollars.	COMTRADE (United Nations)
Market diversification	Number of markets to which one product is exported	COMTRADE (United Nations)
Product diversification	Number of products exported to a given market	COMTRADE (United Nations)
Total product exports	Value of the exports of a given product to all the partners, expressed in nominal USA dollars.	COMTRADE (United Nations)
Distance	The Great Circle distance between capital cities of the trading partners,	CEPII : http://www.cepii.fr
Duration previous spell	Number of years that the previous spell lasted	COMTRADE (United Nations)
Hosting Headquarters	Dummy variable, which is unity if the reporter country hosts the headquarters of at least one automotive company and zero otherwise.	Companies information

Table A.4. Estimation Results: probit model (marginal effects).

	ALL SPELLS	
VARIABLES	All	Components
PRODY	-0.0084*** (0.0009)	-0.0086*** (0.0009)
Institutional quality	-0.00001 (0.00001)	-0.00002 (0.00001)
Absolute differences GDPpc	0.0062*** (0.0002)	0.0053*** (0.0002)
RIA membership	0.0001 (0.0006)	-0.0006 (0.0006)
GDP reporter	-0.0024*** (0.0002)	-0.0014*** (0.0002)
GDP partner	-0.0053*** (0.0001)	-0.0050*** (0.0001)
Initial trade value	-0.0139*** (0.0001)	-0.0127*** (0.0001)
Market diversification	0.0881*** (0.0015)	0.0881*** (0.0015)
Product diversification	0.0784*** (0.0013)	0.0784*** (0.0013)
Total product exports	-0.0118*** (0.0001)	-0.0114*** (0.0001)
Distance	0.0156*** (0.0002)	0.0129*** (0.0002)
Duration previous spell	-0.0099*** (0.0001)	-0.0090*** (0.0001)
Headquarters	-0.0046*** (0.0005)	-0.0053*** (0.0005)
Final goods	0.1223*** (0.0019)	
Duration spell	-0.0308*** (0.0007)	-0.0262*** (0.0007)
Observations	1,586,653	1,427,619
Number of spells	325,143	281,791

Notes: Standard errors in brackets. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. All the variables, except dummies and Rule of Law, are expressed in logarithms. All models include time dummies and random effects on the exporter-product level.