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What determines export survival to the US market? An analysis of the impact of product quality and sophistication

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Abstract

Using product-level data at the six-digit level of the HS classification, we examine the impact of product characteristics, namely quality and sophistication on the survival of exports to the United States over the period 1995-2017. Unlike previous studies, we derive econometrically a measure of product quality based on Khandelwal, Schott and Wei (2013)'s approach and show that exporting higher quality goods decreases the probability of failure. We also find that exporting highly sophisticated products decreases the probability of leaving the US market. However, if the level of sophistication is abnormally high compared to that of the exporter's average export basket, the negative effect of product sophistication on the probability of failure is reduced. The robustness checks confirm our findings.

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1. Introduction

Over the past decades, a substantial literature on the duration of trade relationships has emerged. It starts with the pioneering paper by Besedeš and Prusa (2006a), who highlight the very low survival of United States (US) imports. They find that 67% of US imports from 1989 to 2001, originating from 180 countries, survive only one year and approximately 80% of these imports last less than 5 years. This innovative and surprising result was subsequently validated in a burgeoning literature, albeit on different periods and samples. Nitsch (2009) studies the survival of German imports over the 1995-2005 period. The author finds that the average trade relationship lasts only about 3 years and the median duration is 2 years. Similarly, Hess and Persson (2011) find that EU imports from the rest of the world over the 1962-2006 period are very short-lived: their median duration is 1 year. Carrère and Strauss-Kahn (2017) show that over the 1962-2009 period, more than half of all exports originating in developing countries do not survive the first year in the OECD market. As a result of these findings, a consensus has appeared in the literature: it is necessary to analyze the determinants of the survival of exports to better understand how to increase trade flows (see also Cadot *et al*. 2013, Albornoz *et al*. 2016, Esteve-Pérez 2021). We contribute to this literature by providing an original analysis of the impact of product characteristics on the survival of exports to the US market.

Our paper aims to examine whether exports of some types of goods have a longer lifespan in the US market and therefore deserve special attention for industrial policies. To this end, we focus on two complementary characteristics at the product level: the quality of goods and their level of sophistication.

Previous research has mainly focused on the impact of product differentiation on export survival using Rauch (1999)'s classification. Indeed, many studies have shown that exports of differentiated goods have a higher survival rate than homogeneous goods (Besedeš and Prusa 2006b, Hess and Persson 2011, Fugazza and Molina 2016). These empirical analyses have contributed to a better understanding of the impact of product characteristics on export survival, but they do not capture the direct impact of product quality due to the lack of an appropriate measure. Görg *et al*. (2012) attempt to overcome the latter by using relative unit values and price dispersion as a proxy for product quality. Despite being easy to calculate and having a straightforward interpretation, unit values suffer from a major drawback. Indeed, higher unit values do not necessarily reflect higher quality. They could be the result of higher margins or higher production costs (Khandelwal 2010). To overcome this issue and produce more precise estimates of product quality, we derive the quality of exported products following the methodology developed by Khandelwal, Schott, and Wei (2013) based on the straightforward intuition that conditional on price, higher qualities are assigned to higher quantities. In a recent study, Galera and Fraga (2022) also use an econometric-driven measure of quality to study its impact on export probability (i.e. the probability of entering a market) for developing countries. However, their work is more closely related to the literature on the extensive margin of trade rather than on export survival. To the best of our knowledge, we are the first to analyze the impact of product quality on export survival based on a more accurate demand-driven measure.

Another important product characteristic is the level of sophistication. The notion of sophistication was first introduced by Hausmann *et al.* (2007) and revisited by Hausmann *et al.* (2011). The sophistication index ranks the diversity and complexity of the productive know-how required to produce a product (Hausmann *et al.* 2011). The authors propose therefore a hierarchical ranking of goods according to their level of sophistication. Studies using international or subnational data have shown that the sophistication of a country's export basket is a significant predictor of economic growth and development (Hausmann *et al*. 2007, Poncet and Waldemar 2013). Others have examined the relationship between economic complexity and income inequality and concluded that complexity mitigates inequalities in the presence of good underlying market conditions (Chu and Hoang 2020). Therefore, this dimension should be taken into account in the design of industrial policies (Hidalgo 2021). While most studies have focused on the impact of sophistication on economic growth and development, only two papers have examined its impact on export survival. They are however restricted to one exporting country (China in Zou *et al.* 2023) or one sector of activity (the auto industry in Córcoles *et al.* 2014). We complete these previous analyses by questioning the impact of product sophistication on export survival to the US market.

In our view, quality and sophistication are two complementary measures. The former makes it possible to control for diversity (in terms of quality) within each product code; this is an intra-product differentiation. The latter controls for technological disparity between products, it is thus an inter-product differentiation.

The remainder of this paper is organized as follows. Section 2 presents the data. Section 3 presents the determinants of export survival. Section 4 details the econometric strategy. Section 5 gives the results. Finally, section 6 concludes.

2. Data

Our empirical analysis focuses on the survival of exports to the US as one of the biggest destination markets. We use annual trade data at the six-digit level of the HS classification (HS6) over the period 1995-2017. Our analysis covers around 4 800 products and 175 exporting countries. The data come from CEPII's BACI database[1]. To carry out the survival analysis, for each product and country of origin (i.e. trade relationship) of our dataset we created *spells* indicating uninterrupted exports to the US. A specific trade relationship may be characterized by multiple spells over the period of study. For instance, if the United States imports product k from country i from 1995 to 2000 and then again from 2005 to 2007, there are two different spells whose lengths are 6 and 3 years, respectively. In this paper, we seek to understand why a spell to the US ends at a given point in time; in survival analysis, this event is considered a "failure". Thus, we aim to identify the variables that affect the probability of this failure occurring.

An important step in survival analysis is dealing with left-censored spells (i.e. spells whose first observed year coincides with the first year of reported data) (Carrère and Strauss-Kahn 2017). For instance, we do not know if a spell that has been observed since 1995 began in fact in 1995 or any year before 1995. Left-censoring may lead to biased parameter estimates (Hess and Persson 2012), therefore we follow common practice and exclude such spells from our baseline estimation.[2] We also have no information about the continuation of the spells after 2017 but this right-censoring is not problematic (Hess and Persson 2012). Finally, following Carrère and Strauss-Kahn (2017) we have dropped from the database products belonging to the petroleum and weapons sectors (chapters 27 and 93 of the HS classification). Our final panel consists of 726 342 spells that have an average duration of 3 years and a median duration of 1 year. Additional summary statistics are shown in Table A1 in the Appendix.

[1]The CEPII's BACI database that we use provides uniformized trade data according to the HS6-digit version of 1992.

[2]As a robustness check, we also run the estimations including the left-censored data (see section 5).

3. Determinants of export survival

3.1 Product quality

The impact of product quality on export survival can be analyzed through the lens of at least two theoretical frameworks with different mechanisms at play. The first possible explanation of this relationship lies in the model by Bernard *et al.* (2011) cited in Görg *et al.* (2012) in a multi-product heterogenous-firms setting with endogenous choice of the product range and a firm-product-specific consumer taste parameter. For a given productivity level, a firm produces a good if its consumer taste parameter is above a certain threshold (i.e. the zero-profit cutoff), otherwise, that good is dropped to avoid negative profits. Consumer taste parameters may change over time as a result of random shocks leading firms to add products that rise above the cutoff and drop those that fall below that threshold. It is plausible to argue that higher quality products are associated with higher consumer taste parameters, reducing therefore their likelihood of being dropped. Based on this model we can expect a longer lifespan for exports of high-quality products. A second explanation of the relationship between product quality and the duration of trade can be derived from dynamic models with sunk costs and heterogenous firms (Békés and Muraközy 2012, Albornoz *et al*. 2016). These models predict that exports of products that involve higher sunk costs relative to fixed costs or variable costs have a higher probability of being long-lasting. If we consider that quality upgrading involves a sunk cost component that is paid only once allowing firms to serve similar high-income countries (Albornoz *et al.* 2016), then exports of high-quality products are expected to have a higher probability of survival in the US market.

To test this hypothesis, we rely on a demand-driven measure of product quality derived through an econometric approach that uses information on both quantities and unit values. More precisely, we adopt the methodology developed by Khandelwal, Schott, and Wei (2013). Relying on a CES utility function where quality acts as a demand shifter, the authors' approach is straightforward: conditional on prices, higher quality is attributed to the variety with higher quantity. The quality of product *k* (at the HS6-digit level) exported by country *i* to the US at year *t* is estimated as the residual of the following OLS regression:

$$\ln q_{ikt} + \delta \ln uv_{ikt} = \chi_{it} + \mu_k + \varepsilon_{ikt} \quad (1)$$

Where $ln\, q_{ikt}$ and $ln\, uv_{ikt}$ denote respectively the quantity and unit value (in natural logs) of product *k* (at the HS6-digit level) exported by country *i* to the US at year *t*. χ_{it} is an exporter-year fixed effect that controls for time-varying observable and unobservable characteristics for each exporter. μ_k is a product fixed effect that was included because quantities and prices are not necessarily comparable across different product categories. The estimated quality (in natural logs) depends on the error term ε_{ikt} and the elasticity of substitution δ: $ln\, \widehat{quality}_{ikt} = \widehat{\varepsilon_{ikt}} / (\delta - 1)$.

Equation (1) is estimated separately for each HS2-digit level sector. We rely on sector-specific elasticities of substitution for the US reported by Broda *et al.* (2006). We thus obtain quality estimates specific to each HS6-digit level product within a given HS2-digit level sector.[3] Data on quantities and unit values by product and exporting country come from CEPII's BACI database.

The measure of quality thus obtained is integrated as an explanatory variable in the econometric specifications in section 4. This measure allows us to go further than previous

[3]The estimated parameters of equation 1 are thus sector-specific. Since we run separate regressions, product quality estimates cannot be compared across HS2-digit level sectors. To account for this, we follow Amiti and Khandelwal (2013) and include appropriate HS2-digit fixed effects in the following regressions (section 4).

studies on export survival that based their analysis either on unit values or on a simple classification of goods (homogeneous and differentiated).

3.2 Product sophistication

An additional and complementary product characteristic whose effect on export survival has not been previously studied is the level of sophistication. The concept of sophistication was introduced by Hausmann *et al.* (2007)[4] who proposed a taxonomy of products based on the PRODY index which is the implied productivity of products. Hausmann *et al.* (2011) subsequently proposed a more elaborate sophistication indicator "The Product Complexity Index" (PCI) which is the one we use in our article. The sophistication or complexity level of product *k* is measured by its ubiquity level, that is the number of countries exporting product *k*, corrected by the diversity of the export basket of those countries exporting product *k*. In other words, this indicator indirectly captures the diversity and complexity of the productive know-how required to produce a product. As countries develop, they accumulate productive knowledge and develop the capacity to make a larger variety of products of increasing complexity. The methodology used to identify product complexity can be read in terms of Vernon (1966)'s product life-cycle theory. At the start of the cycle, product ubiquity is low. At the end of the cycle, once production has become accessible to poorer economies, ubiquity becomes high[5]. The less sophisticated the product, the more exporters there are and the easier it is to replace established partners with new ones with cost advantages (Córcoles *et al*. 2014). In a similar vein, Zou *et al.* (2023) argue that more sophisticated products have a lower demand-price elasticity, which reduces substitution possibilities. The lifespan of more sophisticated exports should therefore be longer, as they face less competition. Córcoles *et al.* (2014) also argue that richer countries demand more sophisticated products. The higher the sophistication level of imported goods, the more likely they are to align with the demand of a high-income country such as the US. Carrère and Strauss-Kahn (2017) refer to a theoretical literature that assumes uncertainty about foreign demand. They explain that "*any information reducing this uncertainty results in a lower rate of failure*." Product-specific characteristics such as quality, appeal, popularity, or in our case, sophistication, may affect the profitability of exporters abroad and thus impact their probability of survival. Drawing on the literature presented above, we assume that product sophistication has a positive impact on the probability of export survival to the US market. The annual data on the PCI index at the HS6-digit level were retrieved from the Atlas of Economic Complexity website.

3.3 Other determinants

Following the empirical literature on export survival (Besedeš and Prusa 2006b, Nitsch 2009, Brenton *et al.* 2010, Hess and Persson 2011, Fugazza and Molina 2016, and Carrère and Strauss-Kahn 2017) we include a set of control variables to account for the exporters' and spells' characteristics.

To control for the economic size of exporting countries we include their GDP ($ln\ gdp_{it}$) into our analysis[6]. To account for the GDP of the US as the single importing country, we add year-fixed effects. We also control for time-invariant "gravity-type" variables (such as contiguity,

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[4]Lall *et al.* (2005) have also developed a similar measure that they call the sophistication level of exports.

[5]In Vernon's theory, there is a migration of production from developed to developing countries, which should impact the probability of survival. However, as Besedeš and Prusa (2006a) point out, this phenomenon is very slow.

[6]While Besedeš and Prusa (2006b), Nitsch (2009) and Brenton *et al.* (2010) find that exporters' GDP increases the probability of survival, Hess and Persson (2011) and Fugazza and Molina (2016) find the opposite.

distance, common language, and colonial links) using exporter-specific fixed effects. Trade costs are taken into account through import tariffs (*ln* $tariffs_{ikt}$) and exchange rate movements (Δ *ln exch* $rate_{it}$). We also include a dummy variable to account for whether or not exporter *i* and the US are members of a regional trade agreement at year *t* (RTA_{it}). We also control for the export diversification level of exporters through the number of products exported worldwide for each exporter-year (*ln nbr* $exports_{it}$).

Past export experience may also impact the probability of survival. To control for its effect, we include in our estimation the number of previous spells (*nbr prev* $spell_{ikt}$), the number of years that a preceding export spell lasted (*lag* $duration_{ikt}$), the distance in years from the previous spell (*dist prev* $spell_{ikt}$), as well as the duration in years of the current spell (*trade* $duration_{ikt}$). We also control for the initial export value of a spell (*ln value* $year0_{ikt}$). The detailed list of all explanatory variables and their sources, the summary statistics, and the correlation matrix are provided in Tables A2, A3, and A4 in the Appendix, respectively.

4. Empirical model

Following Albornoz *et al.* (2016) and Carrère and Strauss-Kahn (2017), we assess the impact of product characteristics on the probability of failure (i.e. the hazard rate) by estimating a linear probability model using the following specification:

$$Prob(Y_{ikt} = 1) = \alpha_1 \, ln \, quality_{ikt} + \alpha_2 pci_{kt} + X_{i(k)t}\beta + \lambda_i + \lambda_t + \lambda_{HS2} + u_{ikt} \quad (2)$$

where Y_{ikt} equals 1 if the spell that originated in country i of product k and destined to the US ends at year t, 0 otherwise. $ln \, quality_{ikt}$ is the estimated quality (in natural logs) for each product k exported by country i to the US at year t derived in section 3.1. pci_{kt} is the sophistication index (see section 3.2). $X_{i(k)t}$corresponds to a vector of covariates at the exporter (and product) level (see Table A2 in the Appendix). λ_i denotes the exporter fixed effects while λ_t the year fixed effects. λ_{HS2} is a sector fixed effect at the HS2-digit level. Finally, u_{ikt} corresponds to the error term.

Using a linear probability model is convenient because it allows us to include the necessary set of fixed effects to control for observable and unobservable characteristics at the country, year, and sector level. Recent empirical studies in survival analysis have highlighted the need to use discrete-time duration models to estimate the determinants of export survival (Hess and Persson 2012, Peterson *et al.* 2018). These models can be estimated using probit or logit estimators. In our case, given the magnitude of the panel and the number of fixed effects, the use of such estimators becomes impossible due to convergence problems. Therefore, the linear probability model constitutes our baseline estimation.

5. Results

Table I reports the estimation results of the linear probability model. As expected, the estimated coefficient of product quality (*ln* $quality_{ikt}$) is significant and negative, meaning that an increase in product quality decreases the probability of a spell's failure, for all else equal. If we consider that exporters face uncertainties or random shocks associated with foreign demand, it can be easily argued that exporting higher quality goods for which consumers' preference at destination markets is higher, reduces the probability of being unsuccessful. Hence, we validate empirically that higher-quality products are associated with improved export survival.

The estimated coefficient of the product sophistication level (pci_{kt}) is significant and surprisingly positive which means that the more sophisticated the exported good, the higher the probability of failure (column 1 of Table I). We investigate a possible explanation for this result that seemingly contradicts our initial hypothesis. As previously defined, the level of sophistication or complexity reflects the productive capacities required to produce a good. However, economies may export goods requiring productive capacities they do not - or only partially - possess (Lin and Chang 2009, Lectard and Rougier 2017). This may be the result of being integrated into global value chains (Lectard and Rougier 2017), of a deliberate industrial policy (Amsden 1992), or because technological capabilities are gradually accumulated through production experience as underlined by Chang (Lin and Chang 2009). While there may be several causes for the distance between factor endowments and the production factor intensity, Lin (2009) stresses the importance of exporting products in perfect line with comparative advantages to be competitive on the global market. We therefore hypothesize that the impact of the level of sophistication of product k (exported by country i to the US) on its probability of survival is conditioned by its conformity/non-conformity with country *i*'s productive capacities**.** In other words, the estimated positive effect of the sophistication level is due to an export specialization incompatible with the exporter's productive capacity. A proxy for measuring this conformity/non-conformity is to calculate the distance between the sophistication level of product k exported from country i to the US and the average sophistication level of the global export basket of country i at year t ($pcidiff_{ikt}$)[7]. The greater this difference, the further product k is from the average export basket of country i in terms of productive capacities. The results displayed in column 2 of Table I are particularly interesting. When we control for the distance to the average sophistication level ($pcidiff_{ikt}$), the product sophistication level (pci_{kt}) has a negative effect on the probability of exit. In contrast, the distance has a positive effect: the further the sophistication level of product k from the average sophistication level of the export basket, the higher the probability of exiting the market. This result validates our hypothesis. Furthermore, we add the interactive term ($pcidiff_{ikt} * pci_{kt}$) in column 3 of Table I. The results show that the negative impact of product sophistication on the probability of exit is mitigated by the distance to the average sophistication level. We have refined the last estimation by incorporating binary*pci_{kt} interaction terms (column 4 of Table I). The binary variables correspond to the quartiles of distribution by product for the $pcidiff_{ikt}$ variable. $Q2\_pcidiff_k$, $Q3\_pcidiff_k$, $Q4\_pcidiff_k$ refer to the second, third, and fourth quartiles respectively, with the first quartile serving as our reference category. Our findings validate the negative impact of the product sophistication level on the probability of exiting the US market and the diminishing effect of the $pcidiff_{ikt}$ variable. More interestingly, the effect of product sophistication on the probability of leaving the market reverses when the distance to the average sophistication level is high (fourth quartile).[8] Our results therefore confirm those of Zou *et al.* (2023) that more sophisticated products are more likely to survive in destination markets. However, we provide new evidence that when the level of sophistication is abnormally high compared to the average export basket, the effect is reversed. There is a non-linear relationship between the level of sophistication and the probability of leaving the US market when the non-conformity with country *i*'s productive capacities is taken into account.

[7]We conducted further estimations using the $pcidiff\_US_{ikt}$ calculated as the distance between the sophistication level of product *k* exported from country *i* to the US and the average sophistication level of the export basket of country *i* at year *t* to the US. We find qualitatively similar results as those of our baseline estimation. They are available upon request.

[8]The estimated coefficient of $pci_{kt}$for the first quartile (i.e., reference category) is significant and negative (column 4, Table I), indicating that the sophistication level negatively affects the probability of exit from the US market when the distance to the average sophistication level is small. This negative effect diminishes as the distance increases (with positive and significant estimated interaction term coefficients) and is completely reversed for the fourth quartile (i.e., the sum of the estimated coefficients of pci_{kt} and $Q4\_pcidiff_k * pci_{kt}$ is positive).

Our control variables have the expected effects on the probability of failure, except for the GDP of exporting countries (*ln* gdp_{it}). The latter is found to increase the probability of a spell's failure. This counter-intuitive result is nevertheless found in the empirical literature (Hess and Persson 2012, Fugazza and Molina 2016). A possible explanation is that for all else equal, an increase of exporters' GDP may increase domestic expenditures, redirecting exports towards home markets. This could influence the probability of ending a trade relationship as exporters become "*less eager to stay in international markets*" (Fugazza and Molina 2016, p. 10).

The yearly difference in the relative exchange (Δ *ln exch* $rate_{it}$) rate has a positive estimated coefficient meaning that an appreciation of the exporter's currency increases the probability of failure, thus confirming previous results (Besedeš and Prusa 2006b, Hess and Persson 2011). Import tariffs (*ln* $tariffs_{ikt}$) are shown to have a negative and significant impact on the probability of failure. This result could be explained by considering the time-series and cross-section variation of tariffs (Besedeš and Prusa 2006b). On the one hand, for a given product an increase in tariffs over time corresponds to an increase in the cost of exporting and should therefore lead foreign firms to exit the US market (i.e. time-series effect). On the other hand, higher tariffs across products (or industries) mean that incumbent firms face less competition and thus a lower hazard (i.e. cross-section effect). As in Besedeš and Prusa (2006b) the cross-section effect dominates the time-series effect, thus explaining that higher tariffs decrease the probability of failure.

Our results suggest that the higher the number of products exported (*ln nbr* $exports_{it}$), the lower the probability of a spell dying. Export diversification in terms of products increases the chance for exporters to have access to more information regarding how to do business in the destination market, increasing the likelihood of success (Hess and Persson 2011). We also find, unsurprisingly, that being a member of a regional trade agreement with the US (RTA_{it}) lowers the probability of a spell to the US dying.

Looking at the spells' characteristics, we find that the number of previous spells (*nbr prev* $spell_{ikt}$) and their duration (*lag* $duration_{ikt}$) which capture learning effects have a negative impact on the probability of exit. Moreover, the probability of exit decreases with the duration of the current spell (*trade* $duration_{ikt}$), and therefore with experience. However, the further the current spell is from the previous one (*dist prev* $spell_{ikt}$), the higher the probability of failure; experience is thus lost over time. Finally, unsurprisingly, the spell's initial value (*ln value* $year0_{ikt}$) increases its probability of survival.

We conduct two robustness checks and estimate equation (2) by i) excluding the biggest exporters to the US (Canada, Mexico, and China) (columns 1 and 2 of Table A5 in the Appendix) and ii) by including left-censored observations (columns 3 and 4 of Table A5 in the Appendix). Our findings are qualitatively similar to the ones of our baseline estimation.

6. Conclusion

In this paper, we provide unprecedented empirical evidence of the importance of product characteristics as a determinant of export survival to the US market. We contribute to the literature by studying the impact of an intra-product characteristic - quality and an inter-product characteristic - sophistication. Our results suggest that both of these characteristics reduce the probability of leaving the US market. However, if the level of sophistication is abnormally high compared to that of the average export basket, the negative effect of product sophistication on the probability of failure is reduced. Economies should, on the one hand, diversify towards highly sophisticated products (those they can produce competitively, i.e. which reflect their productive knowledge), and, on the other hand, improve the quality of their exports to increase their probability of export survival.

Table I: Baseline estimation results

	(1) LPM model	(2) LPM model	(3) LPM model	(4) LPM model
ln $quality_{ikt}$	-0.00384***	-0.00383***	-0.00382***	-0.00410***
	(0.00012)	(0.00012)	(0.00012)	(0.00012)
pci_{kt}	0.00268***	-0.01309***	-0.01398***	-0.01783***
	(0.00053)	(0.00246)	(0.00246)	(0.00073)
$pcidiff_{ikt}$		0.01578***	0.01598***	
		(0.00240)	(0.00240)	
$pcidiff_{ikt}$ * pci_{kt}			0.00257***	
			(0.00030)	
Q2_$pcidiff_k$* pci_{kt}				0.00407***
				(0.00086)
Q3_$pcidiff_k$* pci_{kt}				0.01378***
				(0.00092)
Q4_$pcidiff_k$* pci_{kt}				0.03325***
				(0.00102)
ln gdp_{it}	0.02179***	0.02578***	0.02562***	0.03221***
	(0.00296)	(0.00305)	(0.00305)	(0.00298)
Δ ln exch. $rate_{it}$	0.00535***	0.00540***	0.00542***	0.00520***
	(0.00115)	(0.00115)	(0.00115)	(0.00114)
ln $tariffs_{ikt}$	-0.00546***	-0.00536***	-0.00534***	-0.00507***
	(0.00050)	(0.00050)	(0.00050)	(0.00049)
ln nbr $exports_{it}$	-0.19670***	-0.19417***	-0.19492***	-0.19498***
	(0.00515)	(0.00517)	(0.00517)	(0.00515)
RTA_{it}	-0.04282***	-0.04180***	-0.04176***	-0.04082***
	(0.00351)	(0.00352)	(0.00352)	(0.00351)
nbr prev $spell_{ikt}$	-0.03938***	-0.03939***	-0.03937***	-0.03842***
	(0.00043)	(0.00043)	(0.00043)	(0.00043)
dist prev $spell_{ikt}$	0.00784***	0.00782***	0.00784***	0.00778***
	(0.00023)	(0.00023)	(0.00023)	(0.00023)
lag $duration_{ikt}$	-0.01341***	-0.01343***	-0.01341***	-0.01315***
	(0.00018)	(0.00018)	(0.00018)	(0.00018)
trade $duration_{ikt}$	-0.02683***	-0.02683***	-0.02681***	-0.02613***
	(0.00010)	(0.00010)	(0.00010)	(0.00010)
ln value $year0_{ikt}$	-0.01419***	-0.01418***	-0.01413***	-0.01364***
	(0.00014)	(0.00014)	(0.00014)	(0.00014)
Q2_$pcidiff_k$				0.02459***
				(0.00104)
Q3_$pcidiff_k$				0.04842***
				(0.00135)
Q4_$pcidiff_k$				0.07972***
				(0.00181)
Year *t* FE	Yes	Yes	Yes	Yes
Exporter *i* FE	Yes	Yes	Yes	Yes
Sector *HS2* FE	Yes	Yes	Yes	Yes
N	1155004	1155004	1155004	1155004
adj. R^2	0.181	0.181	0.181	0.183

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Appendix

Table A1: Summary statistics

Total number of spells	Spell length (in years)			Trade relationships	
	Mean	**Std. Deviation**	**Median**	**Total number**	**Multiple spells (% of trade relationships)**
726 342	3.07	4.62	1	319 301	60

Note: A spell denotes uninterrupted exports of product *k* from exporter *i* to the US, while a trade relationship refers to each exporter-product (*ik*) pair in our database. If a trade relationship ends at a certain point only to reappear in subsequent years, it has multiple spells, indicating more than one period of uninterrupted exports. The last column in the table shows the share of trade relationships with multiple spells.

Total number of spells	Completed spells by duration (% of total spells)					Ongoing spells (% of total spells)	Total (% of total spells)
	1 year	**2 – 5 years**	**6 – 10 years**	**11 – 15 years**	**16 – 21 years**	**in 2017**	
726 342	52.90	24.70	3.82	1.01	0.24	17.33	100

Table A2: List of all explanatory variables, their definitions, and sources

Variable	Definition	Source
ln $quality_{ikt}$	Estimated quality of product *k* exported by country *i* at year *t* (in natural logs) at the 6-digit level of the HS classification (HS6)	Authors' estimations based on KSW (2013)'s methodology. Trade data come from CEPII's BACI database
pci_{kt}	Sophistication level of product *k* at year *t* at the 6-digit level of the HS classification (HS6)	Atlas of Economic complexity website: https://oec.world/en/rankings/legacy/pci/hs4/hs92
$pcidiff_{ikt}$	Difference between the sophistication level of product *k* and the average sophistication level of the global export basket of each country *i* at year *t*	Authors' calculations based on data from the Atlas of Economic complexity website: https://oec.world/en/rankings/legacy/pci/hs4/hs92
ln gdp_{it}	Real GDP (Purchasing Power Parity) of exporting country *i* at year *t* (in natural logs)	World Bank's WDI database
Δ ln exch. $rate_{it}$	Yearly difference in (the natural log of) the relative real exchange rate. The real	Methodology based on Hess and Persson (2012). Nominal exchange rates and CPI data were retrieved from World Bank's WDI dataset

	exchange rate is equal to the nominal exchange rate (US dollars per foreign currency) multiplied by the ratio of consumer price indices (CPI) between the two countries (exporter *i*/US). The real exchange rate was normalized by the average real exchange rate of all exporting countries against the US. An increase in the relative exchange rate means that the exporter's currency has appreciated relatively more than its competitors'.	
ln $tariffs_{ikt}$	US ad-valorem import duty for each product *k* exported by country *i* at year *t* (in natural logs). To deal with zero duties, we take ln ($tariffs_{ikt}$ + 1)	World Bank's WITS database
ln nbr $exports_{it}$	Number of products exported worldwide by country *i* at year *t* (in natural logs)	Trade data come from CEPII's BACI database
RTA_{it}	Dummy variable equal to 1 if country *i* is a member of a regional trade agreement with the US at year *t*, 0 otherwise	CEPII's Gravity database
nbr prev $spell_{ikt}$	Number of previous spells for a given exporting country *i* and product *k* at year *t*	Authors' calculations. Trade data come from CEPII's BACI database
dist prev $spell_{ikt}$	Number of years between current and previous spell for a given exporting country *i* and product *k*	Authors' calculations. Trade data come from CEPII's BACI database
lag $duration_{ikt}$	Number of years that a previous spell lasted for a given exporting country *i* and product *k*	Authors' calculations. Trade data come from CEPII's BACI database
trade $duration_{ikt}$	Length of current spell (in years) of product *k* exported by country *i*	Authors' calculations. Trade data come from CEPII's BACI database
ln value $year0_{ikt}$	Value of exports at the beginning of the spell of product *k* exported by country *i* (in natural logs)	Authors' calculations. Trade data come from CEPII's BACI database

Table A3: Summary statistics (explanatory variables)

	Observations	Mean	Std. deviation	Min	Max
ln $quality_{ikt}$	1155004	.0389064	2.970497	-60.96337	53.18592
pci_{kt}	1155004	-.0835838	1.046414	-4.941	3.398
$pcidiff_{ikt}$	1155004	.2958161	1.157288	-5.456487	4.737844
ln gdp_{it}	1155004	19.49536	1.685351	12.0605	23.78746
Δ ln exch. $rate_{it}$	1155004	.0158107	.3526823	-1.529496	10.07807
ln $tariffs_{ikt}$	1155004	.7748193	1.01131	0	8.006701
ln nbr $exports_{it}$	1155004	8.234873	.3553809	4.304065	8.516393
RTA_{it}	1155004	.0701669	.2554281	0	1
nbr prev $spell_{ikt}$	1155004	1.220262	1.197172	0	9
dist prev $spell_{ikt}$	1155004	1.441782	1.99038	0	21
lag $duration_{ikt}$	1155004	1.208591	2.088999	0	20
trade $duration_{ikt}$	1155004	5.71464	5.129635	1	22
ln value $year0_{ikt}$	1155004	2.833929	2.594034	-6.907755	16.1592

Table A4 : Correlation matrix

	ln $quality_{ikt}$	pci_{kt}	$pcidiff_{ikt}$	ln gdp_{it}	Δ ln exch. $rate_{it}$	ln $tariffs_{ikt}$	ln nbr $exports_{it}$	RTA_{it}	nbr prev $spell_{ikt}$	dist prev $spell_{ikt}$	lag $duration_{ikt}$	trade $duration_{ikt}$	ln value $year0_{ikt}$
ln $quality_{ikt}$	1.0000												
pci_{kt}	0.0091	1.0000											
$pcidiff_{ikt}$	0.0363	0.8042	1.0000										
ln gdp_{it}	-0.0726	0.1193	-0.0803	1.0000									
Δ ln exch. $rate_{it}$	0.0010	0.0002	-0.0052	-0.0146	1.0000								
ln $tariffs_{ikt}$	-0.0315	-0.2972	-0.3267	0.0369	0.0127	1.0000							
ln nbr $exports_{it}$	-0.0372	0.1655	-0.1853	0.7196	0.0123	0.0575	1.0000						
RTA_{it}	0.0034	0.0110	0.0600	-0.0149	-0.0108	-0.1949	-0.0279	1.0000					
nbr prev.$spell_{ikt}$	-0.0945	0.0113	0.0221	0.0586	-0.0152	-0.0449	0.0104	0.0466	1.0000				
dist prev $spell_{ikt}$	-0.0311	-0.0080	0.0305	-0.0224	-0.0070	-0.0340	-0.0540	0.0186	0.2934	1.0000			
lag $duration_{ikt}$	-0.0479	0.0007	0.0063	0.0453	-0.0131	-0.0251	0.0156	0.0212	0.3404	0.1408	1.0000		
trade $duration_{ikt}$	0.1017	0.0194	-0.0350	0.2224	-0.0204	0.0008	0.1593	0.0406	-0.2563	-0.2037	-0.1771	1.0000	
ln value $year0_{ikt}$	0.1998	0.1222	0.0318	0.1911	-0.0149	-0.0893	0.1476	0.0598	-0.1801	-0.1206	-0.0693	0.1471	1.0000

Table A5: Robustness estimation results excluding biggest exporters (CHN, CAN, MEX) (columns 1 and 2), and including left-censored observations (columns 3 and 4)

	(1) LPM model (excl. CHN, CAN, MEX)	(2) LPM model (excl. CHN, CAN, MEX)	(3) LPM model (incl. left-censored)	(4) LPM model (incl. left-censored)
ln $quality_{ikt}$	-0.00377^{***}	-0.00376^{***}	-0.00391^{***}	-0.00390^{***}
	(0.00012)	(0.00012)	(0.00007)	(0.00007)
pci_{kt}	-0.01176^{***}	-0.01278^{***}	-0.00622^{***}	-0.00671^{***}
	(0.00260)	(0.00261)	(0.00140)	(0.00140)
$pcidiff_{ikt}$	0.01456^{***}	0.01484^{***}	0.00659^{***}	0.00680^{***}
	(0.00255)	(0.00255)	(0.00137)	(0.00137)
$pcidiff_{ikt}$ * pci_{kt}		0.00265^{***}		0.00219^{***}
		(0.00031)		(0.00017)
ln gdp_{it}	0.01240^{***}	0.01214^{***}	-0.04713^{***}	-0.04720^{***}
	(0.00338)	(0.00338)	(0.00150)	(0.00150)
Δ ln exch. $rate_{it}$	0.00540^{***}	0.00542^{***}	0.00249^{***}	0.00249^{***}
	(0.00115)	(0.00115)	(0.00044)	(0.00044)
ln $tariffs_{ikt}$	-0.00573^{***}	-0.00572^{***}	-0.00619^{***}	-0.00615^{***}
	(0.00051)	(0.00051)	(0.00027)	(0.00027)
ln nbr $exports_{it}$	-0.18217^{***}	-0.18290^{***}	-0.26403^{***}	-0.26492^{***}
	(0.00524)	(0.00524)	(0.00347)	(0.00347)
RTA_{it}	-0.03935^{***}	-0.03930^{***}	-0.04219^{***}	-0.04233^{***}
	(0.00352)	(0.00352)	(0.00238)	(0.00238)
nbr prev $spell_{ikt}$	-0.04032^{***}	-0.04030^{***}	-0.04923^{***}	-0.04917^{***}
	(0.00044)	(0.00044)	(0.00043)	(0.00043)
dist prev $spell_{ikt}$	0.00774^{***}	0.00775^{***}	0.00800^{***}	0.00802^{***}
	(0.00023)	(0.00023)	(0.00023)	(0.00023)
lag $duration_{ikt}$	-0.01399^{***}	-0.01397^{***}	-0.01783^{***}	-0.01779^{***}
	(0.00018)	(0.00018)	(0.00013)	(0.00013)
trade $duration_{ikt}$	-0.02749^{***}	-0.02746^{***}	-0.02476^{***}	-0.02473^{***}
	(0.00010)	(0.00010)	(0.00010)	(0.00010)
ln value $year0_{ikt}$	-0.01468^{***}	-0.01463^{***}	-0.01064^{***}	-0.01060^{***}
	(0.00015)	(0.00015)	(0.00008)	(0.00008)
Year *t* FE	Yes	Yes	Yes	Yes
Exporter *i* FE	Yes	Yes	Yes	Yes
Sector *HS2* FE	Yes	Yes	Yes	Yes
N	1092649	1092649	2433268	2433268
adj. R^2	0.182	0.183	0.199	0.199

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$