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Firm-level export and import survival over the business cycle*

Gregory Corcos[†], *Silviano Esteve-Pérez*[‡], *Salvador Gil-Pareja*[‡] *and Yuanzhe Tang*[†]

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Abstract

This paper examines how the duration of new exporters' spells depends on business cycle conditions, using micro-level data on all spells initiated by French firms over the period 1998-2015. First, we find that exporters' and importers' hazard rates of leaving foreign markets are counter-cyclical. Second, new spells initiated during recessions face a lower hazard of leaving export/import markets (cohort effect), suggesting downturns have long-lasting effects on participation in foreign trade. Third, hazard rates are high at entry but fall sharply with spell age, both for cohorts 'born' at good and bad times. Fourth, using the *Full sample*, approximately 2/3 (1/2) of aggregate negative age dependence in exports (imports) is related to "true" age dependence, and 1/3 (1/2) is related to sorting. Finally, the estimation of a bivariate duration model confirms these patterns and reveals a positive association between the duration of import and export spells. Overall, our results suggest that business cycle conditions affect trade participation both in the short- and long-run, with both 'cleansing' and 'scarring' effects of recessions at work.

Keywords: firm export and import survival; business cycle; inflow heterogeneity

JEL Codes: F14, C41, E32

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1 Introduction

The extant literature concerning the relationship between the business cycle and trade dynamics has mostly focused on the short-run effects of recessions, especially the 2008-2009 Great Recession. The evidence suggests that the 2008-09 trade collapse[1] mainly occurred on the intensive margin (i.e., falling trade volumes among continuing exporters) with little impact on the extensive margin (i.e., exit out of exporting) of trade.[2] However, these studies have overlooked the important long-lasting implications of economic crises on trade due to effects channeled through the extensive margin. Indeed, despite high hazard rates suffered by new exporters (that typically start small), export survival is a key driver of long-run export dynamics.[3] Likewise, Bellas and Vicard (2014) argue that the extensive margin is an important source of the large long-run response of trade volumes to the business cycle. Despite the importance of entry in and exit from foreign markets in trade fluctuations, little is known about the role of post-entry trade dynamics in the propagation of economic shocks over time.

Furthermore, the literature on business cycle and (domestic) firm dynamics has long emphasized the effects of recessions on resource allocation. On the one hand, recessions eliminate obsolete techniques and out-of-date products, and thus free resources for more productive uses (i.e., cleansing effects).[4] Hence, recessions change the composition of firms as entry and exit selection get tougher, thus raising the entry and exit productivity cutoffs. On the other hand, recessions also have long-lasting effects (i.e., scarring effects) through their effect on the tougher entry conditions.[5] That is, conditions at birth have persistent effects, mainly driven through the extensive margin.

In this paper, we examine the persistent effects of the business cycle conditions at entry on export/import survival. Our empirical analysis relies on customs data documenting annual disaggregated exports and imports, matched with data on firm characteristics. More specifically, we examine the hazard of leaving export/import markets, accounting for conditions at birth, age dependence (i.e., age-of-spell), and business cycle effects. That is, we consider inflow heterogeneity, which refers to the variation over the business cycle in the composition of the new export/import spells with respect to their survival chances.

First, we find that gross exit rates are higher than gross entry rates during downturns, leading to a fall in foreign market participation. In good times, both gross rates are rather similar, such that net entry rates are very small. Second, we assess whether some firm-level characteristics (namely, number of employees, total factor productivity, and total sales) of firms that start exporting/importing during recessions differ from those of firms that begin foreign market participation during expansions. We further make these comparisons for export/import exiters and continuers. The results suggest that

[1] World trade in manufactures abruptly fell about 30% in nominal terms between the first quarter of 2008 and the second quarter of 2009 (World Trade Organization, 2009), which was disproportionately higher than the drop in aggregate output, breaking a steady growth since WWII. Several scholars have pointed out the impact of the financial crisis on the shortage of trade finance (Amiti and Weinstein, 2011; Bricongne et al., 2012; Chor and Manova, 2012; Paravisini et al., 2015) and the disproportionate slowdown in demand for imported goods, in part due the product composition of imports (Levchenko et al., 2010; Eaton et al., 2016; Bems et al., 2010; Abiad et al., 2014)).

[2] Wagner (2016) provides an excellent survey of transaction-level data empirical studies. These studies confirm that short-run export dynamics are dominated by the intensive margin, that is, new exporters or firms that stop exporting are much less important for year-to-year changes in exports. For instance, Bernard et al., 2009, for US; Amador and Opromolla, 2010, for Portugal; Álvarez and Fuentes, 2011, for Chile; De Lucio et al., 2011, for Spain; Bricongne et al., 2012, and Behrens et al., 2013, for France; Wagner, 2014, for Germany; and Cebeci and Fernandes, 2015, for Turkey.

[3] See (among others) Besedes and Prusa (2011), Eaton, Eslava, et al. 2007 and Albornoz et al. (2012)

[4] See Caballero and Hammour (1994); Campbell (1998); Bilbiie et al. (2012); Clementy and Palazzo (2016); Gomis and Khatiwada (2016); Ayres and Raveendranathan (2021), among others

[5] See Haltiwanger et al. (2013); Moreira (2016); Sedlacek and Sterk (2017); Vardishxvili (2022), among others.

entrants at bad times are smaller but more productive. Besides, the productivity threshold for exiters is higher during recessions. Third, we dig deeper into the role of productivity (also employment and sales) in shaping the entry to export/import decisions at good and bad times. The probit regressions on the transition to entry confirm the increase in the productivity cutoff during downturns. Fourth, relying on Moreira (2016) we estimate age-period-cohort regression that allows us to assess the existence of persistent effects of conditions at birth. Hence, we find support for the cleansing hypothesis given that exit rates are counter-cyclical, entry rates pro-cyclical, and higher productivity entry and exit cutoffs during recessions. Besides, we find evidence of persistent effects of recessions on some firm-level characteristics over their export/import lifetimes.

Fifth, as the main novelty and contribution of the paper, we estimate survival models to assess whether and how the hazard of leaving export/import differs across cohorts that face different business cycle conditions at birth. To this end, we use annual information on firm-level export spells initiated (i.e., "fresh" spells) during the period 1998-2015 relying on both Customs Data (*Full Sample*) and the sample of firms with the full set of firm-level characteristics (*Restricted Sample*). This analysis allows us to uncover insights on how the business cycle conditions when firms begin to export and/or import affects their survival chances over their export/import lifetimes, accounting for spell-specific age-dependence (i.e., ongoing experience or duration dependence) and the state of the economy (overall business cycle effects).

In our context, there arise some concerns about the identification of individual contributions to the average survival probability of the baseline hazard, the unobserved heterogeneity, the covariates, and the business cycle. Following Cameron and Trivedi (2005), we deal with these issues through the estimation of several specifications of: (i) a flexible duration model (i.e. a piecewise-constant exponential hazards model), using robust standard errors clustered by firm to account for intra-firm correlation across spells; and (ii) a discrete time proportional hazards model (i.e., a Mixed Proportional Hazards Model) that include a discrete mixture distribution with finite support to summarize unobserved exporter-level heterogeneity (Heckman and Singer, 1984). The export hazards are estimated by maximum likelihood. Furthermore, the identification of the parameters of interest (i.e., duration dependence, business cycle, and inflow heterogeneity effects) is improved due to both the presence in the dataset of multiple spells per firm (i.e., about 33.1% of firms in the data experience more than one spell -repeated spells, and 92.8% of these repeated spells are complete), and the use of business cycle and inflow heterogeneity indicators.[6] Besides, our results are robust to several binary and continuous business cycle measures.

Furthermore, our methodology permits us to analyze the pattern and sources of duration dependence (i.e., sorting or "spurious dependence" vs "true" duration dependence), business cycle, and inflow heterogeneity effects, and whether and how the period of birth of export/import spells shapes both the pattern of duration dependence and the relationship between spell characteristics and export/import survival. That is, we examine whether spells initiated under different entry conditions face a one-off difference in their hazard rates and/or they further differ in their patterns of duration dependence.

Rather interestingly, we find that while the overall hazard of leaving export/import markets is higher during downturns, new exporters/importers at bad macroeconomics conditions have lower hazard of ending their export/import spells. That is, firms that start exporting and/or importing during downturns are intrinsically fitter to survive than those spells initiated during upturns. This finding is robust to the use of different business cycle measures (binary indicators, continuous variables, GDP-

[6] Heckman and Robb (1985) also discuss potential solutions to the age-period-cohort effect identification problem in earning equations. They argue that one possibility is to group a sequence of adjacent years (e.g., recessive period) to proxy "cohort" effects and/or year effects

related and GDP-growth related dummy and continuous variables). Furthermore, we find negative duration dependence. Our results confirm the existence of "true" negative age-dependence effects that account for 2/3 (1/2) of the observed aggregate negative export (import) duration dependence using the *Full sample*. The pattern of negative duration dependence does not differ between firms that start exporting at bad and good times, suggesting the existence of a one-off drop in the hazard of leaving foreign participation for firms that start exporting during recessions. However, the pattern differs between firms that start importing at bad and good times. Finally, we estimate bivariate duration models which suggest that the joint pattern of firm's export and import duration tends to be either long-long or short-short. The results are robust to different business cycle indicators (using either binary or continuous variables).

Related Literature Our paper contributes to the scarce empirical literature that relates the extensive margin of trade and macroeconomic conditions. The extant literature has mainly focused on the relationship between the number of exporters/importers and the business cycle (e.g., Alessandria and Choi, 2007, 2019). To the best of our knowledge, no previous studies have examined exporters' and/or importers' differences in long-run performance, namely survival, accounting for business cycle conditions at birth over their export/import lifetime.[7]

Our paper is related to two main strands of the literature. First, it is related to the empirical firm dynamics literature that examines the relationships between initial macroeconomic conditions at birth and firm characteristics over their lifetime (Caballero and Hammour, 1994; Campbell, 1998; Haltiwanger et al., 2013; Lee and Mukoyama, 2015, 2018; Moreira, 2016; Sedlacek and Sterk, 2017; Vardishvili, 2022). These studies find robust evidence of persistent effects of entry conditions. Second, our work is related to export participation dynamics (Dixit, 1989, 1991; Roberts and Tybout, 1997; Melitz, 2003; see also the survey by Alessandria et al., 2021). Our findings that hazard rates out of exporting fall along an exporter's life cycle, are in line with existing work, e.g. Bernard and Jensen (2004, 2012); Volpe and Carballo (2007); Eaton et al. (2008); Lawless (2009) Iacovone and Javorcik (2010); Amador and Opromolla (2013); Esteve-Pérez et al. (2013, 2021); Albornoz et al. (2016); and Araujo et al. (2016).

The idea of strong and long-lasting effects of recessions on resources has been long emphasized since Schumpeter (1934), who advanced the concept of cleansing effect of recessions. They eliminate outdated techniques and products, thus enhancing productivity through the exit of low-productive firms and the entry of new ones. Both credit constraints and market fundamental forces (supply, productivity, demand) are suggested as the key drivers of reallocation. This literature has been strongly revived in the last decade when a number of studies have pointed out the important effects of macroeconomic conditions at birth on firm dynamics. Some studies find that firm/plant entry is pro-cyclical while exit is counter-cyclical (e.g., Bilbiie et al., 2012; Clementi and Palazzo, 2016; Gomis and Khatiwada, 2016; Tian, 2018; and Ayres and Raveendranathan, 2021) thus suggesting cleansing effects of recessions. Moreover, a number of studies (e.g., Caballero and Hammour, 1994; Haltiwanger et al, 2013; Lee and Mukoyama, 2015, 2018; Moreira, 2016; Sedlacek and Sterk, 2017; Vardishvili, 2022) point out that macroeconomic conditions at birth have persistent effects (i.e., scarring effects of recessions) that operate through the composition of newborn cohorts (i.e., inflow heterogeneity). Interestingly, Ouyang (2009) points out the existence of a trade-off between cleansing and scarring effects of recessions in a model with demand fluctuations and learning about idiosyncratic

[7] The few studies that have examined export survival under financial constraints (Berman and Hericourt, 2010; Besedes et al., 2014) conclude that credit constraints are an important barrier to start exporting, with a decreasing or even no effect as the duration in export markets increases. Yet, although these studies consider market dynamics, they do not account for re-entry possibility in a dynamic framework with more than two (either consecutive or distant) periods. In this setting, entry barriers become exit barriers so an option value of staying in arises.

productivity. The infant mortality of potentially good firms during recessionary periods may lead to lower productivity in the long run. We discuss below on the underlying propagation mechanisms related to export/import dynamics.

The literature on export (and import) participation dynamics relies on Dixit-type framework (Dixit, 1989, 1991; Dixit and Pindyck, 1994). In this setting, firms make investment decisions under ongoing uncertainty about their future profitability and costly reversibility (sunk costs). That entails a range of the state variable where inaction (i.e., no entry, no exit) is optimal. Recently, Alessandria et al. (2021) present a canonical model considering that firms make dynamic decisions to participate in export markets that relies in Melitz (2003). Heterogeneous firms decide whether to enter to export markets in presence of sunk costs and uncertainty on their future benefit from exporting. A firm's uncertainty may arise due to its unawareness about destination markets regulations and legal requirements, the evolution of foreign demand, and the adequacy of its products to local tastes. Moreover, exporting is costly as it involves extra costs to enter foreign markets (e.g., for studying the foreign market; for setting up a distribution network; for product customization to foreign standards, regulations, or local tastes; for marketing and red tape) that often must be paid upfront and that, to a large extent, are sunk costs.

Our paper further contributes to the previous two strands through the discussion on the broad economic forces that can explain the observed differences in export/import survival across cohorts. We discuss them below.

First, profit flows tend to be pro-cyclical, which is commonly driven by demand fluctuations, leading to expect less entry and more exit at recessions. This mechanism is compatible with cleansing and stronger entrants. In this line, Caballero and Hammour (1994) develop a vintage model of creative destruction (of firms/plants) to consider the business cycle effect, which is proxied by demand fluctuations, which confirms the cleansing effects of recessions. Besides, by the same token, Moreira (2016)'s model that features demand fluctuations and high uncertainty at recessions, and a demand accumulation disadvantage for entrants, allows explaining that establishments born during recessions are not only smaller than those born during booms but also remain smaller over long periods of time. In this model, persistent effects (i.e., differences in firm dynamics across cohorts) are related to selection at entry and demand-side channels. The former refers to the existence of systematic differences in the quality of business entering during economic booms and recessions which could lead to differences in initial investments and growth patterns, while the economic constraints at recessions limit the ability of businesses to adjust their size following an initial investment (e.g., building a customer base). Hence, entrants at recessions are smaller and remain so after entry, while they are more productive due to the tougher selection at entry during recessions. Ouyang (2009) argue that recessions create a scarring effect in addition to the conventional cleansing effect by interrupting businesses' learning of their unobservable idiosyncratic productivity. The lower demand during recessions reduces profitability in general so that firms exit younger, which creates two countervailing forces: cleansing effects as resources concentrate to younger and more productive forces; yet, it may truncate the learning process that leads resources toward firms with higher idiosyncratic productivity, creating a scarring effect that reduces average productivity.

Second, some studies on firm dynamics assume counter-cyclical sunk entry costs (Bilbiie et al, 2012; Clementi and Palazzo, 2016; Alessandria and Choi, 2019). Lee and Mukoyama (2018) make the same assumption but argue that this could be explained by both higher costs in equipment and structures and financial constraints during recessions. However, that would lead us to expect less entry and less exit at recessions, which is not compatible with cleansing effects as exit rates should not be higher during recessions. Re-entry costs get higher leading to expect less exit -even for ongoing spells.

Third, some authors emphasize the dynamic effects of financial constraints on firm and export dynamics. On one hand, Ayres and Raveendranathan (2021) report less firm entry and higher exit during the Great Recession (i.e., years 2008, 2009, and 2010), primarily concentrated among young firms (among them, new entrants). The mechanism is that the credit crisis constrained the ability of firms to borrow and accumulate capital, leading to a much slower process of capital accumulation and therefore a slower rate of growth for profits. It disproportionately affected potential entrants and young incumbents that are borrowing to accumulate capital. The negative shock reduces their value of operating, so that potential entrants choose not to enter, and young incumbents choose to exit. On the other hand, some authors argue that credit constraints lead to counter-cyclical sunk entry-to-export costs. Manova (2013), Manova et al. (2015), and Chaney (2016) point out that credit constraints raise entry barriers to foreign markets making the selection-into-exporting mechanism tougher. Thus, the productivity cut-off to enter export markets increases. Hence, credit constraints can hamper or even prevent exporting.[8] In this line, Impullitti et al. (2013) extend Melitz (2003) setting relying on Dixit and Pindyck (1994) model of investment decisions under uncertainty. In this model, financial constraints increase entry barriers that turn out to be exit barriers when re-entry, which entails sunk entry costs, is a possibility and upfront investment in market access rapidly depreciates. This introduces an option value in the decision to enter or exit the export market leading to an increase of a firm's export status persistence. Current exporters wait longer to leave the export market to avoid re-paying the entry costs later on. Similarly, non-exporters wait for higher efficiency levels before entering the export markets. Therefore, during downturns we could expect a tougher selection mechanism leading to fitter-to-survive new exporters that survive longer in exporting after entering and overcoming the initial phase of high infant mortality. Yet, in this setting we would expect both less entry and less exit during bad times. The latter would be explained by the increased option value of waiting as re-entry costs increase.

Fourth, recently Vardishvili (2022) develops a model that embeds procyclical profit flows and demand accumulation disadvantage for entrants, as in Moreira (2016), and counter-cyclical cost of entry due to a value of delay that operates only for potential entrants (and not for ongoing firms). The value of waiting arises due to the higher overall failure risks during recessions. The effects operate through two channels. A direct channel through procyclical profit flows. And, an indirect (option value to delay) channel that arises because during recessions the risk of post-entry failure raises in line with the overall risk of failure, which creates a positive value of waiting and increases the relative cost of entry today. Thus, the model can simultaneously explain the observed lower entry and higher exit, together with fitter-to-survive (over their entire lifetime) entrants during recessions.

We argue that our results are compatible with a toughening of entry conditions during downturns as current macroeconomic conditions are worsened off. These traits are featured in Vardishvili (2022) model. In this line, we find that the overall risk of failure is higher during recessions. Both entry to export/import productivity thresholds rise, and the hazard rate of leaving export/import markets is persistently lower for export/import spells initiated during downturns.

The rest of the paper is organized as follows. The next section describes the data and presents some evidence on firm export/import dynamics and the business cycle. Section 3 briefly outlines the empirical methodology on duration models and presents the main results. Section 5 discusses our main results and related them to the existing literature on firm dynamics and business cycles. Finally, Section 6 concludes and proposes some policy implications from our findings.

[8] Berman and Hericourt (2010), and Wagner (2014); Mûuls (2015); Jaud et al. (2018) find that credit constrained firms are less likely to become exporters.

2 Empirical evidence on firm export/import dynamics and business cycle

In this section, we present the dataset used in this paper, define some key variables for the analysis, and provide some evidence on the relationship between firm export/import dynamics and the business cycle.

2.1 Data and variables

Our analysis is carried out using two main datasets that span over the period between 1997 and 2016.[9] First, the *Full Sample* consists of annual firm-level export and import data from French Customs. This dataset includes detailed information on all transactions (in euros) by firm, HS6 product, destination country and year.[10] To handle revisions of the HS classifications, we concord product categories using data from Van Beveren et al. (2012), who use a version of the Pierce and Schott (2012) algorithm. Our paper focuses on the study of export/import spells. A firm export (import) spell is defined as a set of years where firm exports (imports) consecutively. As most of our analyses are conditional on the initial characteristics of export/import spells, we exclude those export/import spells of which the information on main destination's gravity variables is missing in the first year of the spell.[11] The resulting *Full sample* contains both left-censored and non left-censored export/import spells. Regarding non left-censored export spells, the *Full sample* consists of 403,821 export spells (about 89.3% of them complete) that correspond to 307,498 firms leading to 994,199 (spell-year) observations between year 1998 and 2015. Regarding non left-censored import spells, the *Full sample* consists of 365,865 import spells (about 86.0% of them complete) that correspond to 296,823 firms leading to 1,052,992 (spell-year) observations between year 1998 and 2015.

The second dataset (*Restricted sample*, hereafter) has been built after matching the *Full sample* with balance sheet data from the French tax authority's (FICUS/FARE dataset) and financial linkage data (LIFI dataset). This dataset includes firm-level information on sales, value-added, employment, capital stock, cost of materials, its primary industry, foreign ownership, etc, which is not available when relying on Customs Data only. As with the *Full sample*, the cleansing criterion is based on the initial characteristics of export/import spells. Namely, we further exclude those export/import spells that are micro firms or in distribution sectors in the first year of the spell. Regarding non left-censored export spells of which the first year observation can be matched with balance sheet data, the *Restricted sample* consists of 202,209 export spells (about 85.7% of them complete) that correspond to 157,026 firms leading to 485,651 (spell-year) observations between year 1998 and 2015. Regarding non left-censored import spells, the *Restricted sample* consists of 190,311 import spells (about 82.3% of them complete) that correspond to 156,485 firms leading to 498,661 (spell-year) observations between year 1998 and 2015. In some subsections, we rely on subsamples of the *Restricted sample*,

[9] Year 1997 is used to identify left-censored export/import spells and year 2016 is used to identify whether export/import spells are right-censored or failed by the end of 2015.

[10] See Bergounhon et al. (2019) for a detailed presentation of this dataset. Following these authors, we keep valid firm identification numbers and valid destination countries. Moreover, we drop both special product codes and countries that account for a tiny share of all French exports (imports) over the sample period. We further drop "sporadic export and import relationships", which comprise firm-level export relationships with a value of sales abroad below 1500€ in a particular year. Yet, we correct for "accidental or false exits" that arise as a result of the previous threshold, which could lead to "false repeated spells" in our survival analysis. Therefore, if exports/imports of a firm-level export/import relationship in one year lie below 1500€ but both in t-1 and t+1 its value exceeds that level, then it is not considered as two different spells, one ending in t-1 and a second one starting at t+1, but as one ongoing spell from t-1 to t+1. That is, one-year-gaps due to our export/import threshold are not considered as exits and re-entry.

[11] For import spell, main destination refers to main sourcing country. For a given firm-year, main destination(sourcing country) is the one with the highest export (import) value.

which will be explained therein in detail.[12]

These two datasets depict two interesting features that make them particularly suitable for the analysis of the relationship between the business cycle and export survival. First, on foreign market participation (either exporting or importing) they have been built using information on annual export transactions over the period 1997-2016. Hence, they comprise either the population of firms that entered or re-entered export markets (i.e., exporters inflow), or a subset of it, over a long time span, including prerecession years and the recession years, and initial years of subsequent recovery. Second, their long time spans allow for examining a large number of new export/import spells over time with a long follow-up period (see section 3).

Furthermore, we also include additional control variables relying on OECD country-risk data, COMTRADE and standard gravity variables from the CEPII Gravity dataset used in Head et al. (2010).[13]

We now turn to the definitions of some key variables for our analysis; namely, entry to export/import, exit from export/import, business cycle indicators. First, a firm begins exporting (importing) in year t, when it had no exporting (importing) value in $t-1$, but it has a positive value in year t. Second, a firm exits from exporting (importing) in year t, when it has a positive export (import) value in year t, but has no export (import) value in $t+1$.

The business cycle indicator we use in our main text is $p8910$ and $dyrgp8910$. $p8910$ is business cycle indicator at birth which equals to 1 if export/import spells started in year 2008, 2009 or 2010. $p8910$ represents those export/import spells that were born during the financial crisis. $dyrgp8910$ is business cycle indicator in the current year which equals to 1 if the current year is 2008, 2009 or 2010. $dyrgp8910$ captures the effect of the financial crisis on all ongoing spells between 2008 and 2010. Ayres and Raveendranathan (2021) and Vardishvili (2022) also consider years 2008, 2009 and 2010 as bad years. In survival analysis, ideally, we would like to use both annual cohorts dummies and year dummies so as to capture cohort effects and year effects of business cycle exhaustively. However, as spell age dummies are also included as a covariate, there exists perfect collinearity between annual cohorts dummies, year dummies and age dummies. Following the literature, our business cycle measures are either binary indicators or continuous variables. We build alternative business cycle indicators for robustness check. In appendix A, we show the results of survival analysis using several different business cycle indicators, which include (1) a financial crisis dummy that covers a longer duration from 2008 to 2015, (2) a bad-times indicator that equals to 1 if detrended GDP is smaller than 0, (3) a bad-times indicator that equals to 1 if the difference between country's GDP growth and world GDP growth is smaller than the mean of the difference across sample years, (4) log of country's TFP, (5) log of country's GDP and (6) the difference between country's GDP growth and world GDP growth. In terms of the choice of business cycle indicators, Fort, Haltiwanger, Jarmin and Miranda (2013, IMF Econ Review) argue that it is better to use growth rate variables, e.g., GDP growth, rather than level-based variables, e.g., GDP value, as business cycle indicators. Using the business cycle indicators other than general financial crisis dummies, for export/import spells, we are able to distinguish between the effects through France business cycle and the effects through age 1 main destination's business cycle.

In what follows, we will primarily discuss the results relying on our $p8910$ business cycle binary indicator. Therefore, unless otherwise stated, "Bad" refers to year 2008, 2009 and 2010, whereas "Good" refers to the other years. The results using alternative binary and continuous business cycle indicators are presented in Appendix A. In all our regression results standard errors are clustered at

[12] Appendix B gives the summary statistics of some covariates of the *Restricted sample*.
[13] See Table 3 in Appendix B for variable definitions.

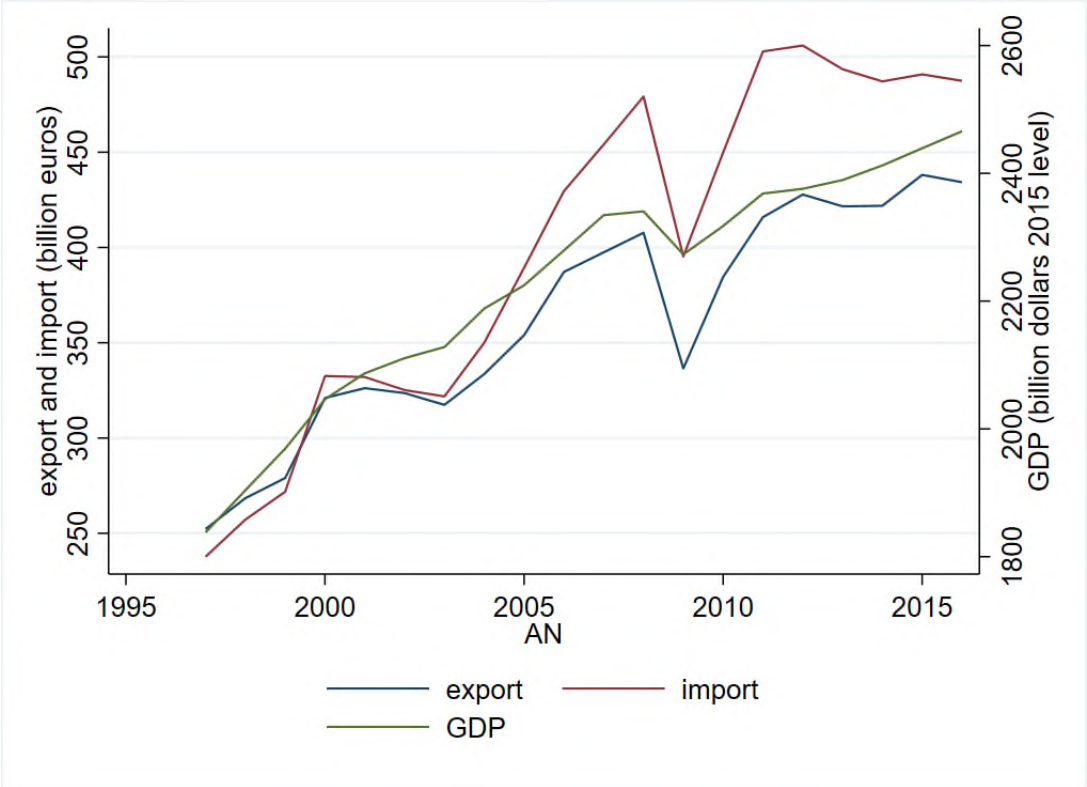
firm level.

2.2 Evidence: export/import entry and exit over the business cycle

In this section, we present some evidence on exporters' and importers' performance over business cycle from different perspectives.

2.2.1 Trade is cyclical & extensive margin importance in the long-run

In this subsection, using the *Full sample* we provide some evidence on the correlation between trade and the business cycle. Figure 1 plots France export and import values and GDP between 1997 and 2016. At first glance, there exists a clear co-movement between trade values and business cycle (GDP). The Great Recession prompted by the financial crisis of 2008 is associated with the Great Trade Collapse. Hence, this figure suggests that trade flows are highly cyclical.

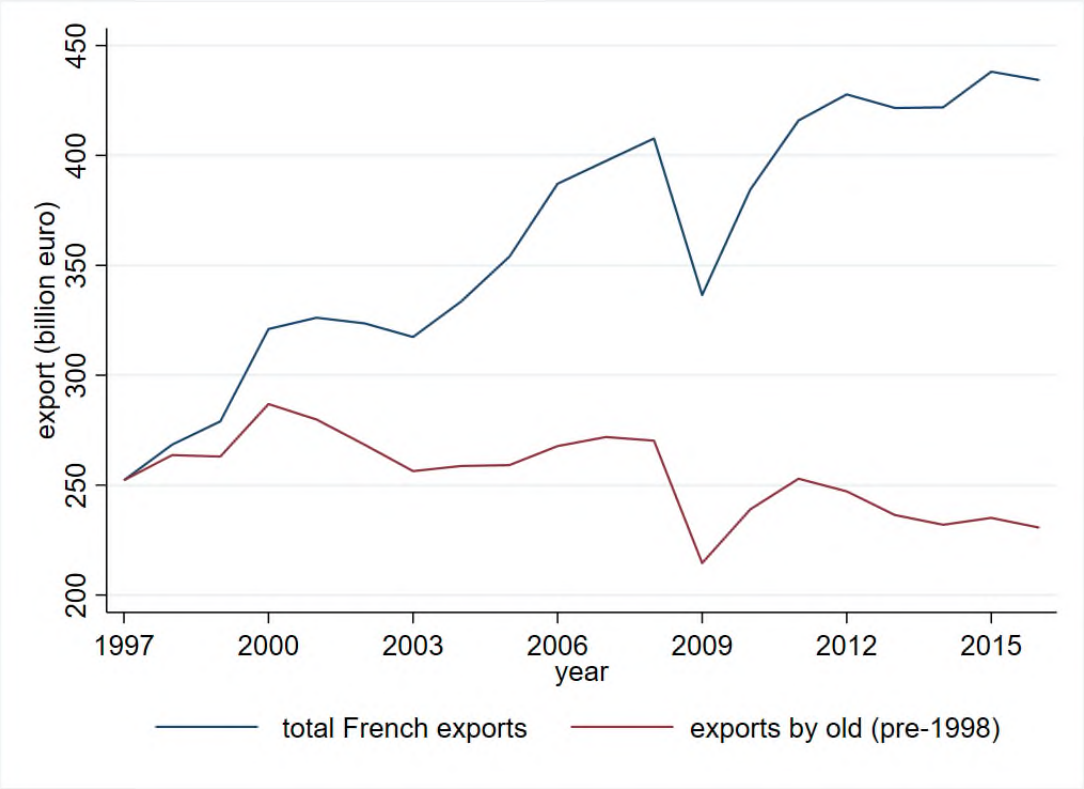


Note: The sample coverage is between 1997 and 2016. Those export/import spells of which the information on the main destination's/sourcing country's gravity variables is missing in the first year of the spell are also included.

Fig. 1: France export, import and GDP value

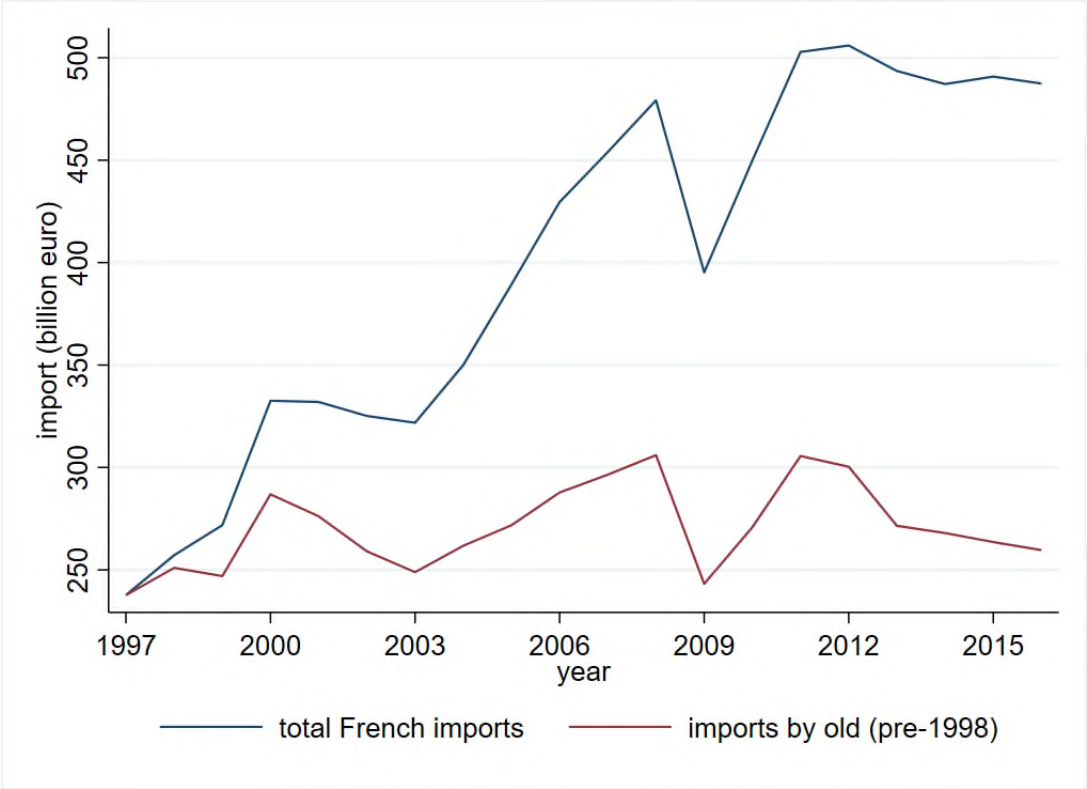
Figure 2 plots France yearly export value which is divided into export value of cohorts that exported in 1997 (old) and export value of cohorts that didn't export in 1997 (new). In the long run, the export value of new cohorts accounts for around 50% of yearly export value. Figure 3 plots the yearly value of import and the pattern is similar to that of export. From these two figures, we can

conclude that extensive margin (i.e., the new exporters and their survival and growth) matters in the long run, which implies that study exporters'(importers') entry and exit is important to explain the evolution of aggregate trade flows.



Note: The sample coverage is between 1997 and 2016. Those export spells of which the information on the main destination's gravity variables is missing in the first year of the spell are also included.

Fig. 2a: French total exports and exports by old (pre-1998) exporters



Note: The sample coverage is between 1997 and 2016. Those import spells of which the information on the main sourcing country's gravity variables is missing in the first year of the spell are also included.

Fig. 2b: French total imports and imports by old (pre-1998) importers

2.2.2 Entry/exit rates and the business cycle

Relying on the *Full sample*, Table 1 provides evidence on the relationship between entry and exit rates, and the business cycle. As previously explained, an entrant in year t means that a firm's exports (imports) are positive in t and nill in $t-1$. An exiter in year t occurs when the firm's exports (imports) are positive in t and nill in $t+1$. For a firm that belongs to both entrant and exiter in a given year t, it is considered as 0.5 entrant and 0.5 exiter. Furthermore, we define the Entry (Exit) rate at bad times as the ratio between the mass of entrants (exiters) and the mass of all exporters/importers at bad times. For instance, export entry rate at bad times equals to the mass of entrants between 2008 and 2010 divided by the mass of exporters during this period.

We can observe that entry rates are pro-cyclical while exit rates are counter-cyclical. This pattern holds for both exports and imports. Thus, during bad times (i.e., years 2008, 2009, and 2010) entry rate is lower and exit rate is higher. In other words, during bad time, fewer firms are selected in and more firms are selected out of foreign markets, which suggests that there exists cleansing effect on both potential entrants and incumbents. By studying some firm-level characteristics of entrants, continuers and exiters, we can get a better idea about how the selection mechanism works.

In addition, the last row of Table 1 suggests that the number of exporters/importers tends to fall during recessionary periods, with a little change at good times. More specifically, during non-recessionary periods, there is a mild increase in the number of importers and a slight fall in the number of exporters.

	Exports		Imports	
	Good (%)	Bad (%)	Good (%)	Bad (%)
Entry rate	18.6	17.4	16.2	15.2
Exit rate	18.6	19.7	16.0	19.2
Net entry	-0.076	-2.366	0.216	-4.030

Note: The sample coverage is between 1998 and 2015. Bad if year 2008, 2009 or 2010. Entrant in year t means export (import) in t and not in $t-1$. Exiter in year t means export(import) in t and not in $t+1$. For a firm that belongs to both entrant and exiter in a given year, it is considered as 0.5 entrant and 0.5 exiter. Those export/import spells of which the information on the main destination's/sourcing country's gravity variables is missing in the first year of the spell are also included.

Tab. 1: Entry and exit rates

2.2.3 Differences in firm-level characteristics of entrants, exiters and continuers over the business cycle

In this section, we explore whether there are differences in performance of entrants, continuers and exiters between good and bad times. By doing so, we aim to get a better idea about how the selection mechanisms we discussed in previous section work over the business cycle. To that end, we now rely on the *Restricted sample* given that it provides firm-level characteristics on exporters and importers that are not available in the *Full sample*.

Table 2 presents median values on some firm-level characteristics (namely, number of workers -labor force-, total factor productivity -TFP-, and total sales) of entrants, continuers and exiters for both exporters (Table 2a) and importers (Table 2b) across good and bad times. The last column indicates whether the differences for each variable within each group of firms between good and bad times are statistically significant.[14]

We follow our previous definitions of entrants (a firm with exports/imports in t but not in $t-1$) and exiters (a firm with exports/imports in t but not in $t+1$).[15] Those exporters (importers) that are not classified as entrants or as exiters are considered as continuers. For entrants, continuers and exiters in year t, we use their characteristics in t. The sample coverage is from 1998 to 2015 and left-censoring spells are included.[16] It is important to bear in mind that exiters and continuers include some left-censored export/import spells (i.e., firms that were already exporting/importing in 1997), which probably include a disproportionate share of well established experienced exporters/importers that might bias upwards some of these firm-level characteristics. By construction, these exporters and importers are not included in the group of entrants.

Table 2a shows the results for exporters. In terms of labor force, entrants and exiters have lower median labor force during bad times. The median labor force of continuers is similar across bad and good times. However, the share of observations with labor force greater than the median is lower during bad times and the difference test is significant at 5% level. Regarding TFP, during bad

[14] We perform the default median test by group in STATA. When values for an observation are equal to the sample median, they are added to the group below the median.

[15] We use this definition of entrant and exiter as it is consistent with that in survival analysis. Notice that, in a given year t, a one-year spell would be considered both as an entrant and an exiter.

[16] For the left-censoring spells that we observe from 1997 onwards, which can only be classified as continuers or exiters at their first appearance in the data, year 1997 is considered as their first year.

times, all the types of exporters have a significantly greater median performance. This may suggest that the selection criteria become tougher for both entry and exit during recessionary periods. More productive firms are selected in and some relatively productive incumbents are selected out. In order to stay in their export markets during bad times, firms need to have a higher TFP. These findings are compatible with the hypothesis of the cleansing effects of recessions. With regard to total sales, entrants have difficulty in achieving high total sales during bad times as the market condition is worse. Meanwhile, some relatively large firms are selected out and only large incumbents succeed in surviving in foreign markets.

	median	Good	Bad	Diff
labor	entrants	5	4	***
	continuers	18	18	**
	exiters	5	4	***
TFP	entrants	431.4	520.1	***
	continuers	959.5	1 074.3	***
	exiters	414	515.8	***
total sales	entrants	742 085	722 535	***
	continuers	3 191 085	3 367 657.5	***
	exiters	713 000	776 455	***

Note: The sample coverage is between 1998 and 2015. Bad if year 2008, 2009 or 2010. Entrant in year t means export in t and not in $t-1$. Exiter in year t means export in t and not in $t+1$. Continuer in year t is the one that exports in t and doesn't belong to entrant or exiter. Left-censored spells are included. We drop those export spells of which the gravity information of their main destination is missing, that are micro firms or in distribution sectors at age 1. Unit of total sales is euro. * p<0.10, ** p<.05, *** p<.01

Tab. 2a: Exporters' firm-level characteristics (median)

Table 2b shows the median performance of entrants, continuers and exiters between good times and bad times regarding labor force, TFP and total sales for importers. The results are broadly consistent with those for exporters. Entrants and exiters at bad times are smaller in terms of labor. Regarding entrants' median TFP, even if it is significantly greater at bad times, the difference is not large. In terms of median total sales, there is no difference for continuers and median total sales of exiters are significantly smaller during bad times.

	median	Good	Bad	Diff
labor	entrants	5	3	***
	continuers	18	17.75	***
	exiters	5	4	***
TFP	entrants	412.3	427.5	***
	continuers	1 053.8	1 163.7	***
	exiters	393.2	464.4	***
total sales	entrants	681 314	512 525	***
	continuers	3 491 160	3 493 380	
	exiters	667 000	649 610	**

Note: The sample coverage is between 1998 and 2015. Bad if year 2008, 2009 or 2010. Entrant in year t means import in t and not in $t-1$. Exiter in year t means import in t and not in $t+1$. Left-censored spells are included. Continuer in year t is the one that imports in t and doesn't belong to entrant or exiter. We drop those import spells of which the gravity information of their main sourcing country is missing, that are micro firms or in distribution sectors at age 1. Unit of total sales is euro. * p<0.10, ** p<.05, *** p<.01

Tab. 2b: Importers' firm-level characteristics (median)

To sum up, we find that new exporters and importers during recessionary periods are smaller, but more productive. Firms quitting exporting and importing tend to smaller in terms of employment, but have higher productivity.

2.2.4 Entry to export/import probability

In this subsection, we look at the correlation between export/import entry probability and some firm-level characteristics. More specifically, we look for further evidence for the role of selection mechanisms on entry to export/import decisions. To do so, we use a subset of our *Restricted sample*. In particular, our sample consists of two-year observations of entrants and non-entrants given that we want to examine the association between these firm-level characteristics and the probability of occurrence of a transition from being non-exporter (importer) in year $t-1$ to make the transition to being an exporter (importer) in year t. Therefore, an Entrant in t is defined as a firm exporting (importing) in t but not in $t-1$. Similarly, a Non entrant in t is defined as a firm not exporting (importing) neither in $t-1$ nor in t.[17] In the regressions, we use the characteristics in $t-1$ (i.e., one-year lagged values) to predict entry in t, which implies that firms must exist the year before they begin exporting (importing).

We proceed by running separate probit regressions of the probability of an entry transition on the log of three measures of firm-level performance and our entry conditions dummy (i.e., macroeconomic conditions at birth of the export/import spell) with no other controls (cols. 1, 3 and 5); including sector fixed effects (cols. 2, 4, and 6). The entry conditions dummy is $p8910$, which equals to 1 if export/import spells started in year 2008, 2009 or 2010. L is labor force and *catotal* is total sales. Notice that, among entrants, there are no left-censoring spells as they were already exporting in the first year of our sample period.

[17] For non entrants in t, we drop those which belong to micro firms and are in distribution sectors in $t-1$. The results in this subsection are still robust to the use of our *Restricted sample* without any selection.

The results are reported in Table 3a for exporters and Table 3b for importers. Our specification is similar to Equation (6) in Moreira (2016) and includes the business cycle indicator and its interaction with each firm-level performance variable to examine the role of these performance indicators on the selection mechanism during bad times.[18] A positive estimate of the interaction term suggests that an increase in that characteristic is positively associated with a higher probability of starting to export/import. For instance, a positive estimate for TFP suggests that the average productivity of entrants at bad times is higher (compared to that of non-entrants), suggesting that the average quality of entry cohorts is counter-cyclical.

(1) Exporters

The results of Table 3a show that bad macroeconomic conditions at birth reduced the expected probability of initiating an export relationship. That is, export entry becomes more difficult at bad times. Moreover, the correlation between export entry and TFP/labor force/total sales becomes stronger at bad times, which suggests that, to start export, firms' TFP, labor size and total sales become more crucial at bad times.

	(1) lnTFP	(2) lnTFP_nace	(3) lnL	(4) lnL_nace	(5) lncatotal	(6) lncatotal_nace
p8910	-1.832	-1.753	-0.275	-0.243	-2.968	-2.669
	(0.014)***	(0.016)***	(0.004)***	(0.004)***	(0.018)***	(0.019)***
p8910_lnTFP	0.334	0.32				
	(0.002)***	(0.003)***				
p8910_lnL			0.214	0.2		
			(0.002)***	(0.002)***		
p8910_lncatotal					0.241	0.216
					(0.001)***	(0.001)***
nace		yes		yes		yes
N	14538981	14538981	15910467	15910467	32710594	32710594
ll	-755550.22	-702375.096	-789599.462	-729708.113	-1055181.861	-969290.194

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if year 2008, 2009 or 2010. Entry in year t means export in t and not in $t-1$. No entry in t means not export in $t-1$ and t. We drop those entrants in t of which the gravity information of their main destination is missing, that are micro firms or in distribution sectors in t. We drop those non entrants in t that are micro firms or in distribution sectors in $t-1$. Unit of total sales is euro. Standard errors are clustered at firm level. * p<0.10, ** p<.05, *** p<.01

Tab. 3a: Export entry probability

(2) Importers

The results reported in Table 3b are broadly consistent with those reported in Table 3a. That is, there is a positive association between starting to import at bad times and these firm-level characteristics. Moreover, the probability of initiating an import relationship is lower at bad times.

Both tables suggest that entry conditions matter and the selection mechanism is associated with firm-level characteristics.

[18] Moreira (2016) regresses the demeaned log change in the number of entrants in market segment in a given year on the change of business cycle indicator and the interaction between the change of business cycle indicator and market characteristics.

	(1) lnTFP	(2) lnTFP_nace	(3) lnL	(4) lnL_nace	(5) lncatotal	(6) lncatotal_nace
p8910	-1.571	-1.528	-0.227	-0.206	-2.574	-2.326
	(0.015)***	(0.016)***	(0.004)***	(0.005)***	(0.019)***	(0.020) ***
p8910_lnTFP	0.294	0.287				
	(0.003)***	(0.003)***				
p8910_lnL			0.198	0.187		
			(0.002)***	(0.002)***		
p8910_lncatotal					0.213	0.192
					(0.001)***	(0.002)***
nace		yes		yes		yes
N	14495221	14495221	15865605	15865605	32659403	32659403
ll	-665629.29	-632858.824	-697497.441	-660557.069	-940615.138	-882926.349

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if year 2008, 2009 or 2010. Entry in year t means import in t and not in $t-1$. No entry in t means not import in $t-1$ and t. We drop those entrants in t of which the gravity information of their main sourcing country is missing, that are micro firms or in distribution sectors in t. We drop those non entrants in t that are micro firms or in distribution sectors in $t-1$. Unit of total sales is euro. Standard errors are clustered at firm level. * p<0.10, ** p<.05, *** p<.01

Tab. 3b: Import entry probability

2.2.5 Persistent effects of conditions at birth

In the current subsection, we study the persistent effect of birth conditions on export (import) value, TFP, labor force and total sales using a subset of our *Restricted sample*. From the latter, we drop left-censored export/import spells and focus on new export/import spells over the period 1998-2015. More specifically, we examine whether there are persistent differences (over export/import spells' lifetimes) in firm-level characteristics between exporters (importers) starting to export (import) at different stages of the business cycle. That is, we investigate the effect of initial aggregate conditions on the export/import cohort's life cycle characteristics.

Columns 1 of Table 4 (exports) and Table 5 (imports) report the results from the OLS regressions of the log of firm export (import) spells' time-varying performance variables on their birth business cycle conditions $p8910$, age-of-spell dummies, sector dummies at entry. Column (2) reports the results when adding year fixed effects to the previous specification. Finally, column 3 displays the results when we add other control variables measured at the onset of the spell. We bin age 8 or more into age 8.[19] Full initial control means we control certain initial (age 1) conditions of firm export (import) spell other than business cycle which include trade-related, main-destination specific and firm characteristics.[20]

(1) Exporters

We first look at persistent effects for exporters. Table 4a illustrates the effect of macro condition at birth $p8910$ on firm's export value over the spell's lifetime. Column (1) is the baseline specifications where we only control age dummies, and sector dummies at age 1. Column (2) further includes year dummies. In column (3), we add full initial control which includes trade-related, main-destination specific and firm characteristics at age 1. Without controlling year dummies, column (1) examines the persistent effect of birth macro conditions across the 2 cohorts - those born during the crisis years

[19] Since $p8910 = 1$ if export (import) spells start in 2008, 2009 or 2010, one caveat is that the maximal age of cohort 2008, cohort 2009 and cohort 2010 are 8, 7, and 6, respectively.

[20] See appendix B for variable definition.

2008-2010 and those born in other years. Year dummies in column (2) capture the effect of current macro conditions across entrants, continuers and exiters within the current year. In this case, $p8910$ only captures the effect of birth macro conditions net of the effect of current macro conditions. For instance, between 2008 and 2010, all export entrants, continuers and exiters experienced tougher market conditions. Therefore, their export value fell. In table 4a, year dummy 2008, 2009 and 2010 capture the average decrease of export value among all three groups. A comparison between the $p8910$ estimate in columns (1) and (2), shows that this coefficient is more negative (i.e., higher absolute value) in column (2), which suggests that the percentage fall of export value for entrants between 2008 and 2010 is higher compared to that for continuers and exiters that were born before 2008. Column (1) and (2) examine the effect of birth conditions at a "macro" level as we compare the performance across cohort-age-sector-(year) groups.

As we add very disaggregated covariates in column (3), we examine the effect of birth conditions at a "micro" level. More precisely, we try to compare two similar export spells with the difference that one was born during the crisis period while the other was born in a different period. Hence, we aim to compare between two export spells with similar initial characteristics, e.g., labor force, except for their period of birth. In column (3), we find $p8910$ insignificant. Does it mean that there is no scarring effect for cohorts that were born during crisis at a "macro" level? The answer is no. During the financial crisis, the entrants are more likely to start with lower labor force compared to their level of employment at normal times. Thus, the result of column (3) is conditional on this initial disadvantage for cohorts at bad times. Column (3) in table 4a tells us that conditional on all these disadvantages, there would be no extra difference between cohorts born at bad times and the ones born at good times. Taken altogether, the results reported in Column (1), (2) and (3) suggest that, on average, bad birth macro condition has a persistent negative effect over the firm export lifetime.

	(1)	(2)	(3)
	lnv_base	lnv	lnv_full
p8910	-0.032	-0.07	-0.003
	(0.014)**	(0.018)***	(0.015)
age dummy	yes	yes	yes
nace	yes	yes	yes
year		yes	yes
full initial control			yes
N	485651	485651	377063
ll	-1031624.68	-1031489.47	-702488.68
r2	0.964	0.964	0.979

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if export spells started in year 2008, 2009 or 2010. Left-censored spells are excluded. We drop those export spells of which the gravity information of their main destination is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of covariates of full initial control. Unit of export value is euro. Standard errors are clustered at firm level. * p<0.10, ** p<.05, *** p<.01

Tab. 4a: Export Value and Business Cycle Conditions at Export Entry

Table 4b demonstrates the correlation between macro condition at birth and persistent effects on a firm's TFP (over their export spell lifetime). Column 1 shows that exporters born at bad birth times tend to have a high performance on TFP that persists over time. Nevertheless, when we add year

dummies, the estimate capturing the birth effect turns into negative. In the previous section, we study the temporary performance of entrants, continuers and exiters and find that all of the three have high TFP at bad times. Therefore, the year dummies in our specification capture the joint upward movement of TFP at bad times due to tougher selection criteria across these three groups (i.e., export starters, continuers, and exiters). Hence, in column 2, the bad birth condition dummy only captures the birth effect net of this upward co-movement and negative $p8910$ implies that, compared to continuers and exiters, the selection on entrants are relatively looser, which is consistent with our previous results.[21] Once full control is introduced, the effect of bad birth conditions becomes positive, which suggests that cohorts born at bad times are intrinsically and persistently stronger (i.e., more productive).

	(1) lnTFP_base	(2) lnTFP	(3) lnTFP_full
p8910	0.022	-0.043	0.027
	(0.010)**	(0.011)***	(0.008)***
age dummy	yes	yes	yes
nace	yes	yes	yes
year		yes	yes
full initial control (age 1 lnTFP excluded)			yes
N	389081	389081	364610
ll	-616469.207	-615787.079	-425961.278
r2	0.968	0.968	0.986

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if export spells started in year 2008, 2009 or 2010. Left-censored spells are excluded. We drop those export spells of which the gravity information of their main destination is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of covariates of full initial control. Standard errors are clustered at firm level. * p<0.10, ** p<.05, *** p<.01

Tab. 4b: Total Factor Productivity and Business Cycle Conditions at Export Entry

Table 4c depicts the correlation between macro conditions at birth and persistent effects on a firm's labor force. The first two columns suggest that the cohorts of exporting relationships initiated during bad macro conditions have a lower level of labor force. However, as full control is introduced in column (3), the birth effect becomes insignificant. It doesn't mean that cohorts born at bad times catch up with cohorts born at good times in terms of labor force performance. It just implies that conditioning on certain initial conditions other than business cycle, the effect of business cycle condition at birth vanishes. Column (1) and (2) study the effect of birth macro conditions at an aggregate level as firm-export-spell level covariates are not controlled for, except for age-of-export-spell effects. Column (3) studies the effect of birth macro conditions once we take into account a number of firm-export-spell level covariates.

[21] It is also because the effect of bad birth conditions keeps decreasing as age increases using the specifications without year dummy.

	(1) lnL_base	(2) lnL	(3) lnL_full
p8910	-0.149	-0.147	-0.005
	(0.012)***	(0.014)***	(0.011)
age dummy	yes	yes	yes
nace	yes	yes	yes
year		yes	yes
full initial control (age 1 lnL excluded)			yes
N	398115	398115	363498
ll	-718793.349	-718128.287	-515023.235
r2	0.731	0.732	0.877

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if export spells started in year 2008, 2009 or 2010. Left-censored spells are excluded. We drop those export spells of which the gravity information of their main destination is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of covariates of full initial control. Standard errors are clustered at firm level. * p<0.10, ** p<.05, *** p<.01

Tab. 4c: Labor Force and Business Cycle Conditions at Export Entry

Table 4d illustrates the correlation between macro condition at birth and firm's total sales accounting for the possibility of persistent effects of this firm-level characteristic. Columns (1) and (2) provide evidence on the existence of scarring effect at level when we do not control for other export-spell characteristics. Yet, column (3) shows that the net effect of bad birth conditions are positive once we account for export-spells characteristics. As we have mentioned above, the latter results of column (3) do not involve that cohorts born at bad times catch up with cohorts born at good times.

	(1) lncatotal_base	(2) lncatotal	(3) lncatotal_full
p8910	-0.041	-0.069	0.076
	(0.013)***	(0.015)***	(0.007)***
age dummy	yes	yes	yes
nace	yes	yes	yes
year		yes	yes
full initial control			yes
N	471807	471807	370200
ll	-947384.729	-946999.914	-355859.242
r2	0.984	0.984	0.998

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if export spells started in year 2008, 2009 or 2010. Left-censored spells are excluded. We drop those export spells of which the gravity information of their main destination is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of covariates of full initial control. Unit of total sales is euro. Standard errors are clustered at firm level. * p<0.10, ** p<.05, *** p<.01

Tab. 4d: Total Sales and Business Cycle Conditions at Export Entry

(2) Importers

Tables 5a to 5d present the results for the effect of the initial aggregate conditions (i.e., business cycle conditions when the import spell was initiated) on the firm's persistent characteristics (over its import spell's lifetime). Table 5a shows the effect of bad birth conditions on import value over the spell's lifetime. Unlike exporters born at bad times, importers born at bad times tend to have a higher import value during their lifetime. Hence, we find no evidence of scarring effect on import value.

	(1)	(2)	(3)
	lnv_base	lnv	lnv_full
p8910	0.128	0.101	0.082
	(0.014)***	(0.017)***	(0.014)***
age dummy	yes	yes	yes
nace	yes	yes	yes
year		yes	yes
full initial control			yes
N	498661	498661	377644
ll	-1069567.414	-1068036.555	-687351.595
r2	0.965	0.966	0.983

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if import spells started in year 2008, 2009 or 2010. Left-censored spells are excluded. We drop those import spells of which the gravity information of their main sourcing country is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of covariates of full initial control. Unit of import value is euro. Standard errors are clustered at firm level. * p<0.10, ** p<.05, *** p<.01

Tab. 5a: Import Value and Business Cycle Conditions at Import Entry

Table 5b illustrates the correlation between bad birth conditions and differences in importers' TFP performance over their spells' lifetimes. Columns (1) and (2) give results when we only control for age-of-spell, industry and year effects. Our results suggest that importers born at bad times persistently have lower TFP performance. It is possible that low productivity firms rely more on external suppliers. During the financial crisis, they had difficulty in finding domestic suppliers as some of the domestic suppliers could struggle and exit. Therefore, they had to look for suppliers in foreign markets and rely more on foreign markets. In addition, the above results on import value give suggestive evidence that importers born at bad times rely more on foreign markets. Column (3) provides results when we control for the full set of covariates (measured at entry). Conditional on other importer's initial characteristics, importers born at bad times actually have a higher TFP.

	(1) lnTFP_base	(2) lnTFP	(3) lnTFP_full
p8910	-0.051	-0.064	0.027
	(0.010)***	(0.011)***	(0.008)***
age dummy	yes	yes	yes
nace	yes	yes	yes
year		yes	yes
full initial control (age 1 lnTFP excluded)			yes
N	393489	393489	364838
ll	-630881.341	-630502.386	-444533.478
r2	0.967	0.967	0.985

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if import spells started in year 2008, 2009 or 2010. Left-censored spells are excluded. We drop those import spells of which the gravity information of their main sourcing country is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of covariates of full initial control. Standard errors are clustered at firm level. * p<0.10, ** p<.05, *** p<.01

Tab. 5b: Total Factor Productivity and Business Cycle Conditions at Import Entry

Table 5c demonstrates the correlation between bad birth conditions and importers' labor force performance over time. In all three specifications (with and without the full set of control variables) we find that the cohorts born at bad times have a lower performance in terms of labor force persistently. If they don't catch up with cohorts born at good times even if many different firm-level characteristics are controlled for.

	(1) lnL_base	(2) lnL	(3) lnL_full
p8910	-0.266	-0.219	-0.045
	(0.013)***	(0.014)***	(0.011)***
age dummy	yes	yes	yes
nace	yes	yes	yes
year		yes	yes
full initial control (age 1 lnL excluded)			yes
N	403403	403403	363377
ll	-728809.18	-726789.792	-532907.161
r2	0.741	0.743	0.87

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if import spells started in year 2008, 2009 or 2010. Left-censored spells are excluded. We drop those import spells of which the gravity information of their main sourcing country is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of covariates of full initial control. Standard errors are clustered at firm level. * p<0.10, ** p<.05, *** p<.01

Tab. 5c: Labor Force and Business Cycle Conditions at Import Entry

Table 5d displays the results for firms' total sales. The results indicate that the cohorts born (i.e., import spells initiated) at bad times have persistently lower total sales. However, this effect turns positive once we control for the full set of import-spell level initial characteristics. That is, those spells initiated at bad times persistently outperform those that were born at good times, once we restrict the comparison to spells with similar initial firm-level characteristics. Recall that the cohorts born at bad times have persistently higher import value. Although the cohorts born at bad times rely more on import markets, they don't really have extra advantages on the sales side.

	(1)	(2)	(3)
	lncatotal_base	lncatotal	lncatotal_full
p8910	-0.142	-0.100	0.076
	(0.013)***	(0.015)***	(0.007)***
age dummy	yes	yes	yes
nace	yes	yes	yes
year		yes	yes
full initial control			yes
N	481195	481195	370165
ll	-974676.372	-972802.247	-388400.622
r2	0.983	0.984	0.998

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if import spells started in year 2008, 2009 or 2010. We drop those import spells of which the gravity information of their main sourcing country is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of covariates of full initial control. Unit of total sales is euro. Standard errors are clustered at firm level. * p<0.10, ** p<.05, *** p<.01

Tab. 5d: Total Sales and Business Cycle Conditions at Import Entry

2.3 Remarks on trade dynamics and business cycle

To sum up, we have uncovered the following results:

1. (Export/Import) entry rates are pro-cyclical and exit rates are counter-cyclical.

Moreover, the number of exporters and importers tends to fall during recessions, with (relatively) less variation during upturns.

2. Recessions change the ***composition of exporters and importers****.*

New, continuing and quitting exporters/importers tend to be smaller in size (labor force), but more productive during bad times than during good times. This suggests tougher selection both at entry and at exit.

3. The entry selection mechanism gets tougher during bad times.

We find a higher entry productivity threshold at bad times. This result is consistent with the view that new entrants during bad times must overcome the overall/general negative macroeconomic conditions.

4. Persistent effects of macro conditions at birth.

The results indicate that there are persistent differences (over export/import spells' lifetimes) in firm-level characteristics between exporters (importers) starting to export (import) at different stages of the business cycle.

Taken altogether, our results are consistent with the hypothesis on the cleansing effect of recessions given that both entry and exit productivity cutoff levels are higher during recessions. Moreover, this also points to the importance of accounting for inflow heterogeneity to better understand the dynamics of trade flows over the business cycle.

In the next section, we explore how the state of the economy when firms start exporting and/or importing is associated with their the post-entry survival performance. To that end, we will try to disentangle the overall business cycle effects from macro conditions at entry, accounting for the role of sorting as well as for potential differences across cohorts in the pattern of negative duration dependence commonly reported in the literature.

3 The hazard rate of leaving export/import markets

This section is devoted to examine the relationship between the business cycle and the hazard of leaving export/import markets, accounting for age-of-spell effects (i.e., duration dependence) and individual heterogeneity. More specifically, we investigate whether and how the macro conditions at birth of spells affect the expected duration of export/import spells.

3.1 Empirical methodology

This section presents the empirical methods and includes a brief discussion of some identification issues. We use survival models that examine the association between risk factors and time-to-an event since the onset of the spell (i.e., duration until the end of a new firm-level export/import spell). Survival models depict some interesting features that make them suitable for analysis. First, they account for whether and when an event takes place, so it allows controlling for both the evolution of hazard rate with spell age (i.e., duration dependence) and the business cycle. Secondly, these methods appropriately deal with right-censored observations, which arise when export/import spells are incomplete (i.e., spells that are ongoing at the end of the sample period). These methods use the information on the time of survival up to the censoring point but do not make any inference about the subsequent survival time of the spell. Thirdly, the long-time span of our dataset allows for examining a large number of new spells over time with a long follow-up period, which permits us to overcome some drawbacks of previous studies on trade and firm survival that examine a few cohorts over short follow-up periods after entry.[22]

We proceed through the estimation of flexible semi-parametric survival models that allow us to uncover long-run effects of different stages of the business cycle, accounting for entry, exit and re-entry of export/import spells. Our empirical methodology permits us to disentangle the pattern of duration

[22] In such studies, the robustness of their results critically depends on the representativeness of the cohorts considered. In this line, Audretsch (1991) points out that the determinants of entrants' survival crucially depend on the length of the follow-up period. Besides, Wagner (1994) underlines the need to investigate several entrant cohorts given that the year of birth of a particular cohort may be an important factor that shapes its survival fates.

dependence, overall business cycle effects, and whether and how the general macro conditions at birth of export/import spells shapes both the pattern of duration dependence and the relationship between spell characteristics and export survival. Furthermore, we also make an attempt to empirically disentangle the relative importance of genuine/"true" negative duration dependence and sorting (i.e., unobserved heterogeneity, such as managerial capabilities) in driving the observed (aggregate) duration dependence and to analyse whether the pattern of "true" duration dependence differs for spells born during an upswing and a downturn.[23]

We apply survival models using both the *Full dataset* and the *Restricted dataset* that were previously described in Section 2.1. The unit of observation is an export/import flow by a firm i in year t. From the annual data, we define a new firm-level export/import spell relying on the number of periods t (years) of consecutive exporting/importing activity (i.e., transactions) by a firm since it started or re-started to export/import (i.e., "fresh" export/import spell). Since the focus on this section lies on survival in export/import markets of new exporting/importing firms, a clear definition of when both entry and exit occur is required. A firm's export/import spell starts in year t (i.e., birth year t) if the firm did not export/import in year $t-1$ but it does export/import in year t. Therefore, the information in 1997 is only used to identify new export/import spells in 1998. A spell ends in year t when the firm was engaged in exporting/importing in year t but not in year $t+1$. The duration of a firm's export/import spell is defined as the number of consecutive years in which a firm is exporting (since it started). Hence, information in year 2016 is only used to determine whether ongoing spells in year 2015 end in that year or are right-censored (i.e., they continue beyond 2015).

Therefore, the *Full sample* consists of the following information. First, for export spells, it comprises all firm-level export spells initiated over the period 1998-2015 (i.e., population of "fresh spells"). The maximum length of a spell is eighteen years.[24] After cleansing the data, the dataset consists of 403,821 export spells (about 89.3% of them complete) that correspond to 307,498 firms leading to 994,199 (spell-year) observations. Hence, it includes sporadic, regular, as well as multi-spell exporters. Second, for import spells, the *Full sample* consists of all firm-level import spells initiated over the period 1998-2015 (i.e., population of "fresh spells"). The maximum length of a spell is eighteen years. After cleansing the data, the dataset consists of 365,865 import spells (about 86.05% of them complete) that correspond to 296,823 firms leading to 1,052,992 (spell-year) observations. Hence, it includes sporadic, regular, as well as multi-spell importers.

The non-parametric Kaplan-Meier estimates of the export/import survivor functions[25] confirm the commonly found pattern of aggregate negative duration/age dependence. That is, the hazard rate is very high immediately after entry, and it drops off quickly with the duration of the flow.

In the survival analysis, we exclude left-censored spells (i.e., export/import spells that were running at the start of the sample period - initiated on or before 1997) given that we do not know their exact entry-date.[26] That is, we do not know whether the first observed year of the spell (start of sample

[23] The commonly observed (aggregate) negative duration dependence in exporting/importing can be related to either sorting or "true" age dependence. The former refers to the selection mechanism that leads to an over-representation of "fitter-to-survive" spells as a given cohort ages. The latter refers to an intrinsic fall in the hazard of leaving export/import markets with the spell's age, commonly related to sunk costs, learning, or success-breeds-success effects (Roberts and Tybout, 1997; Clerides, 1998; Rauch and Watson, 2003; Das et al., 2007; Albornoz et al., 2012; Albornoz et al., 2016).

[24] While the data source is comprehensive, our sample ends in 2015 for all export and import relationships, regardless of their starting time, which involves that the maximum potential age that individual spells can reach is different across cohorts. Whereas a spell initiated in 1998 can reach a maximum of 18 years of life, those initiated since 2008 can reach, at most, 8 years of service.

[25] Not reported for brevity, but available from the authors upon request.

[26] Notice that the sample with export/import relationships in 1997 is left-truncated because we only observe those

period) is in fact the first year of the relationship or the trade relationship had begun in some prior year. If we overlook that, duration estimates would be biased. Therefore, we focus on" fresh spells" (i.e., those spells born from 1998 onwards). Yet, we will add a dummy variable to control for those trade relationships that existed in 1997.

To analyze the relationship between business cycle conditions (both current and at birth) and the hazard of leaving export/import markets, we estimate the following discrete-time proportional hazards model specification with a non-parametric characterization of the frailty distribution.

$$h_{zt} = 1 - exp\left(-exp\left(m_z + \beta_{b0} bad_0 + \beta_b bad_t + \sum_{a=1}^{8+} \beta_a \mathbb{1}_{age\, a=t} + \beta_c charac_{i0}\right)\right) \tag{1}$$

Where the dependent variable is the hazard rate, which is the probability of leaving export markets at a given duration/age conditional upon survival up to that age. Moreover, the model includes a discrete mixture distribution with finite support to summarize unobserved exporter/importer level heterogeneity. The distribution is characterized by two mass points m_z, where $z = 1, 2$ refers to mass points that characterized the two unobserved types.[27] We assume there exist 2 unobserved types. With probability $p1$, a spell belongs to type 1 with mass point value equal to $m1$. With probability $1 - p1$, a spell belongs to type 2 with mass point value equal to $m2$. $m1$ is normalized to 0. The unobserved heterogeneity (or frailty) parameter is assumed to be constant over time (across spells of the same firm) and independent of observed characteristics. It controls for both omitted variable bias (i.e., unobserved individual heterogeneity not fully accounted for after including the full set of explanatory variables) and measurement errors in observed survival times and regressors (Jenkins, 2005).

In addition, in equation (1) t is current year and a is the value of age of the spell. bad_0 is macro condition at birth and bad_t is macro condition in the current year.[28] $charac_{i0}$ is spell-specific (time-invariant) initial conditions other than business cycle and i represents an individual spell index.[29] Using the *Full sample*, $charac_{i0}$ includes trade-related (value quantile, comparative advantage, two-way trader, previous export/import experience, multiple products, multiple destinations) and main destination/sourcing country specific characteristics (OECD country risk; gravity controls) for export/import spells. Using the *Restricted sample*, we further control for additional firm-level characteristics (namely, a firm's TFP, age, labor force, wage per labor force, foreign-owned, foreign affiliate, sector, region).[30] The estimation of Equation (1) allows us both to mitigate the bias associated with overlooking unobserved heterogeneity and to disentangle the relative importance of genuine duration dependence and sorting in driving the observed (aggregate) duration dependence.

firm-level export/import spells born before 1997 that have survived long enough to be ongoing in 1997, therefore excluding high-risk export/import spells initiated before 1997.

[27] We follow a non-parametric frailty distribution (Heckman and Singer, 1984). The model is estimated using Stephen Jenkins' *hshaz* program (Jenkins, 1995).

[28] In the equation, for simplicity, we give the specification using a dummy of bad macro conditions. For the specifications where we distinguish between France macro conditions and main destination macro conditions, bad dummy is replaced by covariates of France and main destination macro conditions. For the specifications where we use continuous measures, bad dummy is replaced by continuous variables. Appendix A provides the main results using these alternative measures of business cycle.

[29] The use of time-invariant covariates measured at the onset of the spells helps to mitigate the potential simultaneity problem between a firm's export/import status and the explanatory variables that may arise in survival analysis (Van den Berg, 2001).

[30] See Table 3 in Appendix B for detailed variable definitions.

Finally, in our context there arise an important concern related with the identification of the link between the business cycle and the hazard of leaving export/import markets. More specifically, in a survival model we cannot include annual cohort dummies and year effects to account for macro conditions at birth and current economic conditions at once. As discussed by Imbens and Angrist (1994), the identification of duration and calendar effects is problematic. Following Kalwij (2010), we use either binary indicators or continuous variables to account for business cycle effects and for conditions at birth effects to identify these time effects.[31]

In next sections, we present our main results that allow us to investigate the association between macroeconomic conditions at birth of an export/import spell and its expected duration, accounting for overall risk associated to the current state of the economy. We estimate the hazard of leaving export, import, and jointly for export-import spells controlling for age-of-spell, business cycle and inflow heterogeneity (i.e., cohort) effects using frailty survival models. In all our specifications, our results point out the existence of unobserved heterogeneity given that we reject the null hypothesis that mass point 2 is equal to zero (i.e., equal to mass point 1 that is normalized to 0). The tables included in next section report the estimated hazard ratios ($exp(\beta)$). The reported coefficients indicate the effect on the hazard for a shift from 0 to 1 for a dummy variable or a one-unit increase in a continuous variable. Thus, a hazard ratio smaller (greater) than 1 indicates a reduction (increase) in the hazard and a longer (shorter) duration. A hazard ratio of 1 indicates that the corresponding covariate has no effect the baseline hazard. The percentage change in the hazard produced by a change in a covariate by one unit (or from 0 to 1 for dummy variables) is obtained as $(exp(\beta) - 1) \times 100$. We discuss our main results in turn.

3.2 Export duration: entry conditions and business cycle

In this section, we aim to examine the link between the business cycle and the hazard of leaving export markets, accounting for duration dependence and individual heterogeneity. More specifically, we examine the role on these relationships of inflow heterogeneity or cohort effects, which refers to the variation over the business cycle in the composition of the new export spells with respect to their survival chances.

Table 6 presents a summary of the main regression results obtained from the estimation of equation (1) using our *Full sample* and *Restricted sample*.[32] The estimates for *current bad* and *birth bad* constitute our main results and uncover the differential effect on survival of current macroeconomic conditions and macroeconomic conditions at birth of new firm-level export spells. On the one hand, general macroeconomic conditions of the economy (i.e., business cycle effects) are driven by aggregate demand and supply shocks that are common to all exporters in a particular year and lead to higher risk of failure of all ongoing export spells. On the other hand, new exporters may be especially affected by business cycle conditions at entry, which may lead to tougher selection-at-entry mechanisms shaping the entry decisions of potential entrants and their subsequent survival probability after entry.

The lack of controlling for their heterogeneous effects would lead to a mixed up of their effects. When we disentangle the role of these two factors, some interesting results stand out. First, the risk of failure, that is, the risk of leaving export markets is significantly higher during downturns, once we control for age-of-spell effects, and unobserved heterogeneity. More specifically, our results indicate

[31] Heckman and Robb (1985) also discuss potential solutions to the age-period-cohort effect identification problem in earning equations. They argue that one possibility is to group a sequence of adjacent years (e.g., recessive period) to proxy "cohort" effects and/or year effects.

[32] The full set of estimates is reported in tables included in Appendix D.

that the overall hazard rate during recessions is about 20.4-20.8% higher than the overall risk during upturns. Second, firms that begin to export during bad times endure better survival prospects, *ceteris paribus*, than that faced by new exporters at good times. In particular, the cohorts of new exporters during recessionary periods endure a 10-10.7% lower hazard of leaving export markets, once we control for age-effects, as well as for observed and unobserved heterogeneity. Rather importantly, our results are robust to different specifications (i.e., with or without including the full set of covariates), to the use of our *Full sample* or *Restricted sample*, and to the use of alternative business cycle indicators (for instance, the results of $p8910$ are still robust when we use year dummies instead of $dyrgp8910$).

	full sample	restricted sample
current bad (dyrgp8910)	1.204	1.208
	(0.009)***	(0.014)***
birth bad (p8910)	0.893	0.900
	(0.008)***	(0.012)***
initial size	−	−
two-way trader	−	−
country risk	+	+
french speaking	−	0
border	+	+
TFP		−
age dummy	yes	yes
trade related	yes	yes
main destination	yes	yes
firm level	no	yes
N	994199	377063

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if export spells started in year 2008, 2009 or 2010. $dyrgp8910 = 1$ if current year is 2008, 2009 or 2010. Left-censored spells are excluded. We drop those export spells of which the gravity information of their main destination is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of all the covariates. "+" represents significantly positive relation; "-" represents significantly negative relation and 0 represents no significant relation. * p<0.10, ** p<.05, *** p<.01

Tab. 6: Export duration

Moreover, Table 6 also provides some interesting insights about the relationship between the explanatory variables and export survival.[33] The initial size of the spell, as well as the number of products and destination markets are negatively related with the hazard rate of leaving export markets. Experience in international markets, acquired either through simultaneous involvement in import activities, or by having exported previously also are positively related with survival. Several features of destination markets also matter for survival. Export spells initiated with neighboring countries are expected to be shorter. In particular, starting to export to high-risk countries is positively related with the risk of ending an export spell. Finally, exporting a product for which France holds comparative advantage is positively associated with survival.

[33] Notice that the association between the explanatory variables and the hazard of leaving export markets remain almost unchanged throughout the different specifications estimated as robustness checks (see Appendix D).

Finally, our results confirm the existence of aggregate negative duration dependence or negative age-effects. That is, as a cohort ages, the hazard rate falls. Yet, as previously discussed, this result may arise from two different mechanisms that have different important implications. First, it could arise due to a dynamic selection mechanism (i.e., sorting) that as a cohort ages leaves a disproportionately large share of those spells that are intrinsically fitter to survive (due to factors not controlled by the researcher) as the more "frail" spells are cleaned off. The second mechanism is related to a true feature of the process at work. That is, there may be factors leading to improve the survival prospects of exporters as they accumulate experience ("learning by exporting" or "success-breeds-success" effects), due to the presence of sunk entry costs that become exit barriers when re-entry is a possibility (Roberts and Tybout, 1997; Clerides et al., 1998; Rauch and Watson, 2003; Albornoz et al., 2012; Albornoz et al., 2016; Araujo et al., 2016). Following Kalwij (2010), we make an attempt to disentangle the relative importance of individual genuine duration dependence and sorting in driving the observed negative duration dependence. Our results suggest that 2/3 of the observed negative duration dependence is related to "true" age-dependence (1/3 due to unobserved heterogeneity) using the *Full sample*.[34]

Finally, we further explore whether the observed pattern of "true" negative age dependence differs across cohorts born under different business cycle conditions. That is, we investigate whether in addition to having a direct association with export survival, birth-during-downturn also has an indirect effect by shaping the pattern of duration dependence. We do so by interacting the inflow-heterogeneity dummy with the age-of-spell dummies. Our preliminary findings suggest that there are no significant differences in how it operates across cohorts of exporters born under different macroeconomic conditions. This is an interesting finding given that it suggests that the better survival prospects of cohorts of exporters born at bad times consist of a one-off fall in the hazard without affecting the pattern of "true" negative age-dependence (i.e., it would be an intercept effect with little impact on the slope of the hazard over a spell's lifetime).

3.3 Import duration: entry conditions and business cycle

In this section, we examine the hazard of leaving import relationships. The variable *current bad* captures the common risk of leaving export market that all ongoing spells endure at recessionary periods. The variable *birth bad* tries to capture the role of conditions at birth of import relationships for subsequent survival of these relationships. More specifically, we wish to assess if import spells initiated during downturns are intrinsically fitter to survive than those born in good times

[34] See appendix E for more details.

	full sample	restricted sample
current bad (dyrgp8910)	1.241	1.274
	(0.008)***	(0.015)***
birth bad (p8910)	0.991	0.95
	(0.009)	(0.014)***
initial size	−	−
two-way trader	−	−
country risk	−	+
french speaking	+	+
border	+	+
TFP		−
age dummy	yes	yes
trade related	yes	yes
main destination	yes	yes
firm level	no	yes
N	1052992	377644

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if import spells started in year 2008, 2009 or 2010. $dyrgp8910 = 1$ if current year is 2008, 2009 or 2010. Left-censored spells are excluded. For import spells, main destination refers to main sourcing country. We drop those import spells of which the gravity information of their main sourcing country is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of all the covariates. "+" represents significantly positive relation; "-" represents significantly negative relation and 0 represents no significant relation. * p<0.10, ** p<.05, *** p<.01

Tab. 7: Import duration

The results of $p8910$ are still robust when we use year dummies instead of $dyrgp8910$.[35] See Section 2.1 for a discussion on entry conditions and business cycle indicators.

Finally, we make an attempt to disentangle the relative importance of genuine/"true" duration dependence and sorting in driving the observed aggregate negative duration dependence. For imports, we find that unobserved heterogeneity accounts for 1/2 of the observed aggregated negative duration dependence using the *Full sample*. The latter may help explain why our results for imports are less accurate and it might suggest that there may be some important variables to understand import survival that are not fully accounted for in our specification.[36]

We further check whether inflow heterogeneity, that is, cohort effects associated with the different macroeconomic conditions at entry, shapes both the pattern and the relative importance of these two sources of duration dependence. After controlling for frailty, there exists negative age-dependence for cohorts born at good times while the negative age-dependence is slightly weaker for cohorts born at bad times.

[35] Using the *Full sample*, $p8910$ coefficient becomes significant.
[36] See appendix E for more details.

3.4 Bivariate duration

In this section, we discuss the results obtained when we jointly estimate the hazard of leaving export and import markets. To to that, we estimate a multi-level mixed effects logit model. In this specification, we account for unobserved firm-specific factors (constant across both spells and the transitions considered -i.e., exporting and importing) that affect the hazard of an event for all spells and transitions (e.g., managerial capabilities of firms not captured by the included explanatory variables). In this setting, we allow for correlation between time-invariant factors that influence each transition.

In previous Sections 3.2 and 3.3., we implicitly assumed that two transitions (i.e., export and import spells by the same firm) as independent processes and model them with two separate equations (one for the export spell and another for the import spells). However, in this sections, we estimate the equations for the two transitions jointly using a two-state duration model. The state-specific unobserved heterogeneity components of these transition processes are allowed to be correlated across the two states (i.e., exporting and importing). Indeed, there may be time-invariant individual-specific unobservable factors that affect each type of transition.

Our results indicate that the two processes are positively correlated. This suggests that we can split firms into two groups. Firms experiencing both long episodes of exporting and importing, and firms more prone to experience short spells of both exporting and importing (i.e, high churning).

	full sample		restricted sample	
	Export	Import	Export	Import
current bad	1.272	1.363	1.280	1.391
	(0.011)***	(0.011)***	(0.017)***	(0.019)***
birth bad	0.861	0.988	0.887	0.948
	(0.009)***	(0.010)	(0.014)***	(0.016)***
cov(ex,im)	2.165		1.889	
	(0.024)***		(0.031)***	
age dummy	yes		yes	
trade related	yes		yes	
main destination	yes		yes	
firm level	no		yes	
N	2047191		754707	

Note: The sample coverage is between 1998 and 2015. $p8910 = 1$ if export/import spells started in year 2008, 2009 or 2010. $dyrgp8910 = 1$ if current year is 2008, 2009 or 2010. Left-censored spells are excluded. For import spells, main destination refers to main sourcing country. We drop those export/import spells of which the gravity information of their main destination/sourcing country is missing, that are micro firms or in distribution sectors at age 1. See appendix B for the definition of all the covariates. * p<0.10, ** p<.05, *** p<.01

Tab. 8: Joint duration

Interestingly, our main results are broadly consistent with those obtained in sections 3.2 and 3.3. Some interesting findings stand out. First, during recessionary periods, the overall hazard of leaving export and import markets is significantly higher than during expansionary periods. More specifically,

the higher risk is about 27.2-28% and 36.3-39.1% for exports and imports, respectively. Second, conditions at birth matter and have long-lasting effects. Firms that start exporting at bad times face a 11.3-13.9% lower hazard of leaving export markets, while those firms that start importing during recessionary periods also seem to endure a lower hazard (between 1.2-5.2% lower, yet not statistically significant when we use our *Full sample*).

3.5 Summary of results

To sum up, this section has uncovered the following results:

1. The exporters' (importers') hazard rate of leaving foreign markets is higher at bad times [overall business cycle effects].

2. The (Export/Import) new spells born during recessions face a lower hazard of leaving export/import markets than those initiated during good times over their lifetime [cohort effect].

That is, exporters/importers born during bad times survive longer than those born during good times. That is, conditions at entry have long-lasting effects on expected duration.

Therefore, new exporters that are born during downturn have an intrinsically lower hazard of leaving export markets, despite the (overall) higher hazard rate during bad times. The evidence on new importers is less compelling.

3. The hazard rate is high at entry and drops off quickly with the spell's age for cohorts born at good and bad times [aggregate negative duration dependence].

4. Approximately 2/3 (1/2) of aggregate negative age dependence in exports (imports) is related to "true" age dependence, and 1/3 (1/2) is related to sorting

For export spells, there are no significant differences in the pattern of "true" negative age dependence (the hazard of quitting exporting falls with ongoing experience) between cohorts born at good times and cohorts born at bad times. Hence, we find a one-off fall in the hazard of leaving exporting for spells initiated at bad times, with no additional effect on the slope of the hazard over a spell's lifetime. For import spells, there are some differences in the pattern of "true" negative age dependence between cohorts born at good times and cohorts born at bad times.

5. The bivariate duration model allows us to identify 2 groups of firms according to the expected duration of their export and import spells: either long-long or short-short.

The results of the estimations of a bivariate duration model are broadly consistent with our results from the separate analysis of the hazard of exporting and importing. During recessionary periods, the overall macroeconomic conditions raise the overall risk of failure, although new export/import spells initiated during these difficult times are intrinsically "fitter-to-survive" compared to those born at expansionary periods. Yet, the positive and statistically significant covariance suggests a positive firm-level association in the duration of export and import episodes. Hence, firms can be split into two types, such that firms' export and import duration tend to be either long-long or short-short.

This results adds to the previously found complementarity in export and import participation (Kasahara and Lapham, 2013; Bernard et al., 2018). Our results point towards strong positive complementary effects in export/import duration.

4 Discussion of results

The findings of this paper support the view that export/import spells born at bad times face tougher entry conditions (associated to an overall higher risk of failure during recessions). That is, the selection mechanisms at entry gets tougher, so that only "stronger/fitter to survive" start to export/import initiate export/import relations at bad times.

We find less entry and more exit during bad times (i.e., entry rates are pro-cyclical and exit rates are counter-cyclical). Moreover, the higher entry productivity (also higher exit productivity) cutoff point suggests a tightening of market conditions during recessionary periods. Our regression analysis further confirms an overall higher risk of ending ongoing trade relationships. However, we find that cohorts of new exporters/importers born during recessionary periods endure better survival prospects.

Our results (both for exports and imports) are compatible with the mechanisms emphasized by Vardishvili (2022). The overall risk of failure is higher during bad times and even dominates the cohort effect (e.g., 1.204 is larger than 0.893), but export/import relationships initiated by firm during recessionary periods are intrinsically fitter-to-survive than those born during expansionary periods, that is, they face a (persistent) lower hazard rate given that they probably face higher entry costs. Hence, the entry selection-into exporting/importing gets tougher. In fact, Vardishvili (2022) points out an asymmetry between potential entrants and incumbent exporters/importers. First, the worsening of overall economic conditions have a negative effect on the net present value of flow profits for all firms (incumbent exporters/importers and potential entrants). Second, firms making a decision on whether or not to start exporting or importing have a value of delay during bad general conditions so that only the best firms will decide to start an export/import spell, increasing the inaction zone for intermediate (productive) firms. This finding is compatible with our preliminary results in section 2 about the increase to the productivity cutoff points for entrants and exiters during bad periods. The recessionary period may have led to a stronger self-selection-into-export forces leading to fitter-to-survive new exporters (as discussed by Manova, 2013; Impullitti et al., 2013; and Chaney, 2016).

Furthermore, and rather interestingly, our results suggest that after entry, for exporters, the "true" negative age dependence effects operate similarly independently of the macro-conditions at birth while they are different for importers.

5 Conclusions

This paper examines the relationship between the business cycle and the firms' export/import survival, accounting for duration dependence, individual heterogeneity and inflow heterogeneity (i.e., cohort effects).

Our findings confirm that recessionary periods have important and long-lasting effects for aggregate trade. In contrast to most previous studies that have analyzed these periods through the lens of the intensive margin, we focus on the extensive margin. We argue that our approach adds new insights that are relevant to get a better understanding of aggregate trade dynamics over long periods.

More specifically, our results confirm that recessions change the composition of exporters/importers. These recessionary periods trigger cleansing effects through the rise in entry to and exit from foreign markets productivity cutoffs. The worsening of overall economic conditions may lead to tougher

selection at entry. Thus, entrants (i.e., firms starting to export and/or import) during recessionary periods tend to be more productive than entrants during expansionary periods, despite the fact that they may be smaller due to weaker demand conditions or capital accumulation constraints, and remain so over long periods after entry. Thus, the composition of exporters and importers changes over the business cycle. The average quality of the pool of entrants to exporting/importing are found to be counter-cyclical. Hence, recessions have permanent effects on trade dynamics through the extensive margin. The estimation of frailty duration models confirm that conditions at entry are very relevant and have persistent effects. In particular, we find that firms that start to export/import during recessionary periods fare much better survival prospects than their counterparts born at expansionary periods, despite the overall higher risk at bad times. Moreover, our results suggest that the better survival prospects of cohorts born at bad times results from a one-off drop in the hazard of leaving export/import markets for all spell ages.

Rather tentatively, we discuss some policy implications of our findings. First, if entry selection is too strong at bad times, there may be some potential export(import) relationships that cannot be created when they should be. For instance, Arkolakis, Papageorgiou, and Timoshenko (2018) argue that age-dependent subsidies help young firms to overcome the early high exit risk. This is particularly important in presence of "true" negative duration dependence and during recessionary periods, especially if the latter are brought about by sudden, unexpected and transitory negative shocks (e.g., credit crunch; COVID-19), that depart from traditional "efficiency cleansing" associated with recessionary periods. In this setting, there may arise an argument for short-lived support for new potential exporters/importers during downturns (driven by transitory negative shocks). Furthermore, the results of the bivariate duration models suggests the existence of two types of firms according to their expected export and import duration: either short-short or long-long. Therefore, from a policy standpoint it may be interesting to make an effort to identify those firms' characteristics that make firms more likely to "belong" to each group. The short import/export spells are related to more churning, trial and error, and foreign experimentation, which may be more related to some firm and/or product, or even market characteristics. Likewise, firms characterized by long export/import spells involve persistent trade relationships associated to specific firm-, product-, and/or destination market-level characteristics.

We plan to extend the analysis in several dimensions. First, we want to carefully explore the case of two-way traders. For these firms, the business cycle of import sourcing country can affect export survival and vice versa. Second, we aim to further explore the product-country dimensions. So far, we have merely considered the export/import decisions at the firm level looking at characteristics at the time of firm-level entry, while there may be important considerations related to the product and country level dimensions. By doing so, we could better control for co-movement of economic conditions between France and the destination/source country to explain export/import survival. Third, we will further consider the inclusion of lead and lags on business cycle indicators to account for anticipation and lagged effects on export/import decisions.

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A Survival regression: robustness check

bad dummy	2008-2015		detrended GDP <0		GDP g (country - world) <mean across years	
	full	restricted	full	restricted	full	restricted
current bad fr	1.102***	1.15***	1.022***	1.025***	1.073***	1.081***
current bad des			1.022***	1.02**	1.019***	1.025***
birth bad fr	0.838***	0.766***	0.974***	0.963***	0.958***	0.976*
birth bad des			0.955***	0.962***	0.974***	0.969***

continuous	ln(country TFP)		ln(GDP)		GDP g (country - world)	
	full	restricted	full	restricted	full	restricted
current fr	1.169	1.021	0.659***	0.364***	0.961***	0.954***
current des	0.773***	0.826	0.892**	0.802**	0.997***	0.990***
birth fr	12.281***	65.166***	1.230	2.102***	1.028***	1.009
birth des	1.263**	1.151	1.085	1.231**	1.003**	1.013***

Tab. 1: Robustness check: export survival

bad dummy	2008-2015		detrended GDP <0		GDP g (country - world) <mean across years	
	full	restricted	full	restricted	full	restricted
current bad fr	1.235***	1.28***	0.995	1.019*	0.894***	0.875***
current bad des			1.015**	1.017*	1.021***	1.022**
birth bad fr	0.881***	0.747***	0.946***	0.944***	1.116***	1.104***
birth bad des			0.967***	0.962***	0.993	0.975**

continuous	ln(country TFP)		ln(GDP)		GDP g (country - world)	
	full	restricted	full	restricted	full	restricted
current fr	0.106***	0.136***	0.503***	1.498	0.973***	0.959***
current des	0.395***	0.363***	0.659***	0.610***	0.997*	1.006**
birth fr	10.723***	84.533***	3.077***	0.788	1.003	1.023***
birth des	2.603***	2.066***	1.493***	1.598***	0.994***	0.984***

Tab. 2: Robustness check: import survival

B Variable definition

business cycle indicators	
p8910	=1 if export/import spells started in 2008, 2009 or 2010
dyrgp8910	=1 if current year is 2008, 2009 or 2010
p22	=1 if export/import spells started between 2008 and 2015
dyrgp22	=1 if current year is between 2008 and 2015
b_dgdp0_fr	=1 if France detrended GDP < 0 at age 1
b_dgdp0_d	=1 if main destination detrended GDP < 0 at age 1
b_dgdpt_fr	=1 if France detrended GDP < 0 in the current year
b_dgdpt_d	=1 if main destination detrended GDP < 0 in the current year
bad0_fr	=1 if (France GDP growth - world GDP growth) at birth < mean (France GDP growth - world GDP growth) between 1998 and 2015
bad0_d	=1 if (main destination GDP growth - world GDP growth) at birth < mean (main destination GDP growth - world GDP growth) between 1998 and 2015
badt_fr	=1 if (France GDP growth - world GDP growth) in current year < mean (France GDP growth - world GDP growth) between 1998 and 2015
badt_d	=1 if (main destination GDP growth - world GDP growth) in current year < mean (main destination GDP growth - world GDP growth) between 1998 and 2015
lntfp0_fr	ln(France TFP) at age 1
lntfp0_d	ln(main destination TFP) at age 1
lntfpt_fr	ln(France TFP) in current year
lntfpt_d	ln(main destination TFP) in current year
ln_gdp0_fr	ln(France GDP) at age 1
ln_gdp0_d	ln(main destination GDP) at age 1
ln_gdpt_fr	ln(France GDP) in current year
ln_gdpt_d	ln(main destination GDP) in current year
diff0_fr	France GDP growth - world GDP growth at age 1
diff0_d	main destination GDP growth - world GDP growth at age 1
difft_fr	France GDP growth - world GDP growth in current year
difft_d	main destination GDP growth - world GDP growth in current year

Note: For import spells, main destination refers to main sourcing country. Main destination(sourcing country) is the one with the highest export(import) value at age 1 and it's unvarying within export(import) spell. GDP price is at 2015 level (billion dollars). Detrended GDP is obtained using HP filter following the Ravn-Uhlig rule and a sample between 1998 and 2015. GDP growth is obtained from the World Bank data. Country-level TFP is obtained from Penn World Table and TFP is at constant national prices (2017=1).

Tab. 3a: Business cycle indicators

age dummies	
age1 - age7	year 1 - year 7 of a spell
age 8	year 8 or after
trade related characteristics	
dini1, dini2, dini3	initial value quantile (tierce) at age 1
dpto1, dpto2, dpto3	comparative advantage quantile (tierce) of France product (main product at age 1)
dimp	= 1 if import at age 1 for export spell
dexp	= 1 if export at age 1 for import spell
d_lc1997_fpc_ex	= 1 if firm exported in year 1997 (export left censored)
d_lc1997_fpc_im	= 1 if firm import in year 1997 (import left censored)
lnpre_ex_exp	ln(firm previous export experience at age 1 + 1)
lnpre_im_exp	ln(firm previous import experience at age 1 + 1)
n_pre_spell_ex	number of previous completed export spells at age 1
n_pre_spell_im	number of previous completed import spells at age 1
repeated_spell	if the current spell is a repeated spell within a firm
gap_spell	number of year gap between the current spell and the last spell
r_lngap_spell	repeated_spell * ln(gap_spell)
dpto	= 1 if multiple products at age 1
dcou	= 1 if multiple destinations at age 1
main destination characteristics	
dcou1, dcou2, dcou3	1 high risk, 2 medium risk and 3 low risk (main destination at age 1)
border	= 1 if main destination at age 1 shares border with France
french	= 1 if language of main destination at age 1 is french
eu_eea	= 1 if main destination at age 1 in eu eea
euro	= 1 if main destination at age 1 in euro
firm characteristics	
lnTFP	ln(TFP) at age 1
lnage	ln(firm age) = ln(current year - firm creation year +1) at age 1
lnL	ln(labor force) at age 1
lnwpL	ln(wage per labor force) at age 1
FO	owned by foreign at age 1
FA	have foreign affiliate at age 1
nace	1-digit NACE sector at age 1
region	geographic region at age 1

Note: For import spells, destination means sourcing country. Trade related characteristics, main destination characteristics and firm characteristics refer to characteristics at age 1 for each export/import spell. For export(import) spells, initial value is firm export(import) value at age 1. Quantile (tierce) is taken among all age 1 observations including left-censored spells. Main product/destination/sourcing country is determined based on value. dimp(dexp) is export(import) spell specific covariate. Previous export(import) experience is the number of years of exporting(importing) from 1997. gap_spell is not included as a covariate. There are 17 sectors which include Agriculture, Fishing, Mining, Manufacturing, Energy and Water, Construction, Trade, Tourism, Transportation and Communication, Finance, Real Estate and Prof. Activities, Government, Education, Health, Other Services, Household Services and Nonresident. There are 15 regions which include Auvergne-Rhône-Alpes, Bourgogne-Franche-Comté, Bretagne, Centre-Val de Loire, Grand Est, Hauts-de-France, Île-de-France, Normandie, Nouvelle-Aquitaine, Occitanie, Pays de la Loire, Provence-Alpes-Côte d'Azur, Département 20, Département 97, Département 99.

Tab. 3b: Definition of covariates (for persistent effects and survival analysis)

Characteristic	Mean	Median	N
TFP	2309.6	777.4	724,055
value-added per labor	66066.4	50085.7	739,657
labor force	81.7	12	825,282
wage per labor	32303	27678.8	739,709
total sales	2.25×10^7	2,035,707	838,755
export value	5,052,536	69,047	838,755
foreign owned (dummy)	0.099	0	838,755
have foreign affiliates (dummy)	0.0105	0	838,755
firm age	17.6	14	798,260

Note: The sample coverage is between 1998 and 2015. Both left-censored and non left-censored export spells are included. Firm age of the observations with year of creation less than 1901 is taken as missing as their date of creation looks abnormal. Number of observations varies across characteristics as some of them are missing.

Tab. 4a: Summary statistics by export-year (Restricted sample)

Characteristic	Mean	Median	N
TFP	2465.8	846.1	749,174
value-added per labor	67681.5	49904.6	765,811
labor force	93.6	12	857,827
wage per labor	32485.3	27448.5	765,906
total sales	2.49×10^7	2,192,000	875,950
import value	4,299,550	148718.5	875,950
foreign owned (dummy)	0.107	0	875,950
have foreign affiliates (dummy)	0.0104	0	875,950
firm age	16.08	12	837,456

Note: The sample coverage is between 1998 and 2015. Both left-censored and non left-censored import spells are included. Firm age of the observations with year of creation less than 1901 is taken as missing as their date of creation looks abnormal. Number of observations varies across characteristics as some of them are missing.

Tab. 4b: Summary statistics by import-year (Restricted sample)

C Differences in firm-level characteristics of entrants, exiters and continuers over the business cycle

In this section, we provide additional evidence on the differences in firm performance of entrants, exiters and continuers between good and bad times. Table 5 displays performance differences for entrants, exiters and continuers using our *Restricted sample*. We carry out simple OLS regressions of the log of three measures of firm-level performance (namely, employment -labor force-, total factor productivity, and total sales) on a dummy capturing whether t is a "bad year" (i.e., 2008, 2009, 2010) including sector fixed effects.[37] In the columns of this table, we report the results for each measure of firm performance, for each group of firms (entrants on the top, continuers at middle, and exiters at the bottom part of the table).

The regression results for exporters (Table 5a) confirm our previous findings in section 2.2.3 in most

[37] There are 17 sectors in total. L is labor force and *catotal* is total sales.

of the cases. Firms that begin exporting during recessionary periods are more productive (and smaller) than those starting to export during upturns. However, for entrants' total sales, we get a different result. During bad times, their total sales are actually higher. In addition, continuers have higher labor force during bad times, which is different from our previous result using median. The slight inconsistency may be related to the use variables in logs rather than levels, the use of median performance in Table 2, or it may suggest that there exists some heterogeneity across sectors.

	(1)	(2)	(3)
	InTFP_ent	InL_ent	Incatotal_ent
year 8910	0.059	-0.104	0.022
	(0.008)***	(0.009)***	(0.010)**
nace	yes	yes	yes
N	153299	157837	199441
ll	-243543.439	-279826.836	-404290.963
r2	0.048	0.038	0.029
	(1)	(2)	(3)
	InTFP_con	InL_con	Incatotal_con
year 8910	0.079	0.021	0.076
	(0.005)***	(0.006)***	(0.007)***
nace	yes	yes	yes
N	507394	515775	551965
ll	-815532.538	-951746.332	-1108365.812
r2	0.031	0.102	0.05
	(1)	(2)	(3)
	InTFP_ext	InL_ext	Incatotal_ext
year 8910	0.113	-0.041	0.082
	(0.008)***	(0.009)***	(0.010)***
nace	yes	yes	yes
N	147054	152516	193522
ll	-227230.655	-266777.408	-388376.069
r2	0.058	0.034	0.031

Tab. 5a: Exporters' performance

Note: The sample coverage is between 1998 and 2015. *year* 8910 = 1 if year 2008, 2009 or 2010. Entrant in year t means export in t and not in $t-1$. Exiter in year t means export in t and not in $t+1$. Continuer in year t is the one that exports in t and doesn't belong to entrant or exiter. Left-censored spells are included. We drop those export spells of which the gravity information of their main destination is missing, that are micro firms or in distribution sectors at age 1. Unit of total sales is euro. * p<0.10, ** p<.05, *** p<.01

In table 5b, we conduct the same analysis for importers. Concerning TFP, there is no significant differences between entrants at bad times and entrants at good times. In the previous analysis of medians reported in Table 2b, although the difference is significant, the magnitude is actually small. Regarding total sales, continuers have higher total sales at bad times which is different from the finding using median (no statistically different). For exiters, the coefficient becomes significantly positive once log form is applied, which suggests that the negative coefficient using simple value could be driven by some extreme value.

	(1) InTFP_ent	(2) InL_ent	(3) Incatotal_ent
year 8910	-0.008	-0.208	-0.06
	(0.009)	(0.009)***	(0.011)***
nace	yes	yes	yes
N	138796	143559	186155
ll	-228944.619	-255449.19	-387345.022
r2	0.036	0.056	0.04
	(1) InTFP_con	(2) InL_con	(3) Incatotal_con
year 8910	0.061	-0.023	0.033
	(0.005)***	(0.006)***	(0.007)***
nace	yes	yes	yes
N	543632	552665	594619
ll	-866774.696	-1019242.187	-1194134.78
r2	0.039	0.144	0.097
	(1) InTFP_ext	(2) InL_ext	(3) Incatotal_ext
year 8910	0.11	-0.084	0.059
	(0.008)***	(0.009)***	(0.011)***
nace	yes	yes	yes
N	134189	139633	181158
ll	-211972.416	-243566.505	-370419.725
r2	0.043	0.053	0.043

Tab. 5b: Importers' performance

Note: The sample coverage is between 1998 and 2015. *year* 8910 = 1 if year 2008, 2009 or 2010. Entrant in year t means import in t and not in $t-1$. Exiter in year t means import in t and not in $t+1$. Continuer in year t is the one that imports in t and doesn't belong to entrant or exiter. Left-censored spells are included. We drop those import spells of which the gravity information of their main sourcing country is missing, that are micro firms or in distribution sectors at age 1. Unit of total sales is euro. * p<0.10, ** p<.05, *** p<.01

D Detailed regression results

D.1 Export survival

	full sample	restricted sample
age1	0.579	0.420
	(0.010)***	(0.054)***
age2	0.402	0.321
	(0.008)***	(0.041)***
age3	0.353	0.281
	(0.007)***	(0.036)***
age4	0.328	0.264
	(0.007)***	(0.034)***

age5	0.311	0.254
	(0.007)***	(0.033)***
age6	0.299	0.238
	(0.007)***	(0.031)***
age7	0.278	0.219
	(0.007)***	(0.029)***
age8	0.249	0.197
	(0.005)***	(0.025)***
dyrgp8910	1.204	1.208
	(0.009)***	(0.014)***
p8910	0.893	0.900
	(0.008)***	(0.012)***
dini2	0.829	0.845
	(0.005)***	(0.008)***
dini3	0.579	0.613
	(0.004)***	(0.007)***
dpto2	0.935	0.941
	(0.005)***	(0.008)***
dpto3	0.828	0.889
	(0.005)***	(0.009)***
dcou2	0.899	0.892
	(0.007)***	(0.011)***
dcou3	0.713	0.729
	(0.007)***	(0.012)***
dimp	0.587	0.685
	(0.004)***	(0.007)***
d_lc1997_fpc_ex	1.012	0.992
	(0.009)	(0.014)
d_lc1997_fpc_im	1.013	0.975
	(0.009)	(0.014)*
lnpre_ex_exp	0.773	0.728
	(0.006)***	(0.009)***
lnpre_im_exp	1.192	1.112
	(0.007)***	(0.009)***
n_pre_spell_ex	1.043	1.036
	(0.006)***	(0.008)***
n_pre_spell_im	0.982	0.969
	(0.005)***	(0.007)***
repeated_spell	1.001	1.04
	(0.012)	(0.019)**
r_lngap_spell	1.121	1.078
	(0.007)***	(0.009)***
dpto	0.666	0.666
	(0.004)***	(0.006)***
dcou	0.521	0.573
	(0.003)***	(0.006)***
border	1.053	1.043
	(0.009)***	(0.016)***
french	0.984	1.014

	(0.005)***	(0.009)
eu_eea	0.897	0.936
	(0.009)***	(0.017)***
euro	0.913	1.001
	(0.008)***	(0.015)
InTFP		0.895
		(0.005)***
Inage		1.262
		(0.006)***
InL		0.996
		(0.004)
InwpL		1.057
		(0.008)***
FO		0.916
		(0.018)***
FA		0.775
		(0.045)***
nace		yes
region		yes
m2_cons	5.067	4.696
	(0.062)***	(0.095)***
logitp2_cons	4.571	3.658
	(0.109)***	(0.160)***
N	994199	377063
ll	-517110.131	-192305.111

Tab. 6: Export Survival

D.2 Import survival

	full sample	restricted sample
age1	0.289	0.692
	(0.005)***	(0.097)***
age2	0.222	0.588
	(0.004)***	(0.083)***
age3	0.214	0.577
	(0.004)***	(0.081)***
age4	0.201	0.535
	(0.004)***	(0.076)***
age5	0.189	0.505
	(0.004)***	(0.072)***
age6	0.193	0.503
	(0.004)***	(0.072)***
age7	0.192	0.491
	(0.005)***	(0.070)***
age8	0.192	0.486
	(0.004)***	(0.069)***
dyrgp8910	1.241	1.274

	(0.008)***	(0.015)***
p8910	0.991	0.95
	(0.009)	(0.014)***
dini2	0.682	0.704
	(0.004)***	(0.008)***
dini3	0.375	0.409
	(0.003)***	(0.006)***
dpto2	0.984	1.011
	(0.006)***	(0.011)
dpto3	0.955	0.939
	(0.006)***	(0.010)***
dcou2	1.040	0.901
	(0.014)***	(0.028)***
dcou3	1.089	0.897
	(0.016)***	(0.029)***
dexp	0.636	0.699
	(0.004)***	(0.008)***
d_lc1997_fpc_ex	1.055	0.968
	(0.012)***	(0.016)*
d_lc1997_fpc_im	1.011	1.017
	(0.011)	(0.018)
lnpre_ex_exp	1.151	1.108
	(0.008)***	(0.011)***
lnpre_im_exp	0.799	0.745
	(0.008)***	(0.011)***
n_pre_spell_ex	0.988	0.967
	(0.006)**	(0.008)***
n_pre_spell_im	1.011	1.011
	(0.008)	(0.012)
repeated_spell	1.117	1.065
	(0.017)***	(0.025)***
r_lngap_spell	1.101	1.074
	(0.008)***	(0.011)***
dpto	0.617	0.617
	(0.004)***	(0.007)***
dcou	0.645	0.654
	(0.004)***	(0.008)***
border	1.063	1.056
	(0.009)***	(0.015)***
french	1.149	1.115
	(0.007)***	(0.013)***
eu_eea	0.876	0.981
	(0.010)***	(0.019)
euro	0.941	1.014
	(0.008)***	(0.015)
lnTFP		0.881
		(0.005)***
lnage		1.246
		(0.007) ***

lnL		0.995
		(0.004)
lnwpL		1.044
		(0.008)***
FO		0.796
		(0.018)***
FA		0.827
		(0.047)***
nace		yes
region		yes
m2_cons	6.418	6.565
	(0.075)***	(0.126)***
logitp2_cons	4.021	3.21
	(0.070)***	(0.085)***
N	1052992	377644
ll	-533903.334	-186106.054

Tab. 7: Import Survival

D.3 Bivariate duration

	full sample		restricted sample	
	export	import	export	import
ex/im	5.882	2.808	3.045	8.398
	(0.087)***	(0.058)***	(0.529)***	(1.563)***
age2	0.569	0.710	0.652	0.745
	(0.005)***	(0.006)***	(0.009)***	(0.011)***
age3	0.475	0.675	0.547	0.707
	(0.005)***	(0.008)***	(0.010)***	(0.014)***
age4	0.433	0.626	0.512	0.64
	(0.006)***	(0.009)***	(0.012)***	(0.015)***
age5	0.409	0.588	0.496	0.602
	(0.007)***	(0.010)***	(0.013)***	(0.017)***
age6	0.397	0.611	0.469	0.606
	(0.007)***	(0.012)***	(0.015)***	(0.019)***
age7	0.370	0.618	0.435	0.596
	(0.008)***	(0.013)***	(0.016)***	(0.022)***
age8	0.348	0.651	0.413	0.62
	(0.006)***	(0.013)***	(0.013)***	(0.020)***
dyrgp8910	1.272	1.363	1.28	1.391
	(0.011)***	(0.011)***	(0.017)***	(0.019)***
p8910	0.861	0.988	0.877	0.948
	(0.009)***	(0.010)	(0.014)***	(0.016)***
dini2	0.760	0.577	0.796	0.634
	(0.006)***	(0.005)***	(0.010)***	(0.009)***
dini3	0.468	0.275	0.533	0.33
	(0.004)***	(0.003)***	(0.008)***	(0.006)***
dpto2	0.905	0.977	0.924	1.01

	(0.007)***	(0.008)***	(0.011)***	(0.014)
dpto3	0.764	0.937	0.85	0.922
	(0.006)***	(0.008)***	(0.011)***	(0.013)***
dcou2	0.853	1.013	0.835	0.844
	(0.009)***	(0.020)	(0.015)***	(0.035)***
dcou3	0.604	1.064	0.64	0.825
	(0.008)***	(0.021)***	(0.014)***	(0.035)***
dimp/dexp	0.559	0.621	0.658	0.707
	(0.005)***	(0.006)***	(0.009)***	(0.011)***
d_lc1997_fpc_ex	0.949	0.854	0.975	0.859
	(0.013)***	(0.014)***	(0.019)	(0.020)***
d_lc1997_fpc_im	0.800	0.975	0.877	1.019
	(0.011)***	(0.016)	(0.017)***	(0.025)
lnpre_ex_exp	0.993	1.382	0.808	1.184
	(0.012)	(0.013)***	(0.014)***	(0.015)***
lnpre_im_exp	1.413	1.160	1.178	0.902
	(0.011)***	(0.017)***	(0.013)***	(0.018)***
n_pre_spell_ex	0.830	0.851	0.894	0.883
	(0.008)***	(0.007)***	(0.011)***	(0.010)***
n_pre_spell_im	0.847	0.724	0.885	0.797
	(0.007)***	(0.009)***	(0.009)***	(0.013)***
repeated_spell	0.853	0.837	0.907	0.864
	(0.014)***	(0.017)***	(0.022)***	(0.025)***
r_lngap_spell	1.170	1.137	1.134	1.119
	(0.009)***	(0.010)***	(0.013)***	(0.015)***
dpto	0.610	0.547	0.611	0.56
	(0.005)***	(0.004)***	(0.008)***	(0.008)***
dcou	0.457	0.603	0.515	0.625
	(0.004)***	(0.005)***	(0.007)***	(0.009)***
border	1.051	1.086	1.043	1.066
	(0.012)***	(0.012)***	(0.020)**	(0.019)***
french	0.980	1.216	1.019	1.139
	(0.007)***	(0.011)***	(0.012)	(0.017)***
eu_eea	0.887	0.862	0.918	1.004
	(0.012)***	(0.013)***	(0.022)***	(0.024)
euro	0.927	0.911	1.031	1.033
	(0.011)***	(0.011)***	(0.020)	(0.020)*
lnTFP			0.847	0.834
			(0.006)***	(0.006)***
lnage			1.396	1.364
			(0.010)***	(0.010)***
lnL			0.995	0.981
			(0.005)	(0.006)***
lnwpL			1.078	1.05
			(0.011)***	(0.011)***
FO			0.889	0.756
			(0.023)***	(0.022)***
FA			0.699	0.771
			(0.054)***	(0.057)***

nace		yes	yes
region		yes	yes
var(ex[firm])	2.586	2.421	
	(0.047)***	(0.067)***	
var(im[firm])	3.654	3.332	
	(0.085)***	(0.119)***	
cov(ex[firm]im[firm])	2.165	1.889	
	(0.024)***	(0.031)***	
N	2047191	754707	
ll	-1055898.777	-379934.62	

Tab. 8: Bivariate Duration

E "True" age dependence versus sorting (the Full sample)

In this section, we plot normalized coefficients of age dummies for both specifications with/without controlling for frailty using the *Full sample*. Age 1 coefficient is normalized to 1. Recall that business cycle indicators $p8910$ and $dyrgp8910$, trade-related characteristics at age 1, main destination/sourcing country characteristics at age 1, and firm characteristics at age 1 are included as covariates for export/import duration analysis.

E.1 Export duration

Figure 1 plots normalized coefficients of age dummies of export duration analysis. The blue(red) curve depicts normalized age coefficients of specification without(with) controlling for frailty. The green curve captures the difference between the two.

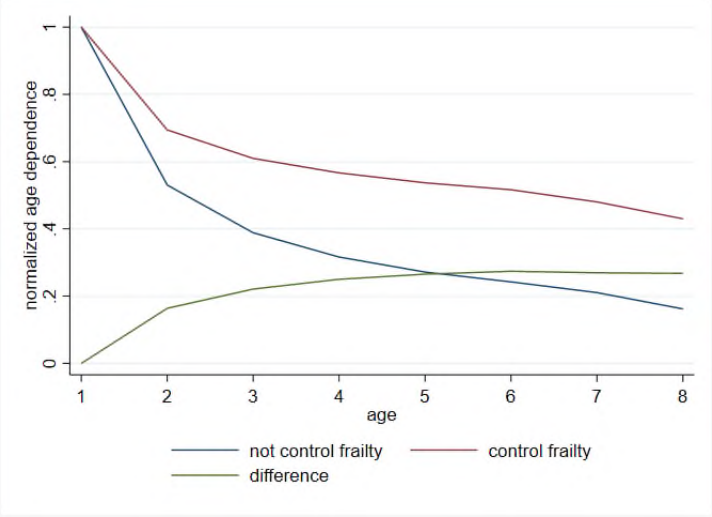

Fig. 1: Export age dependence: frailty vs non-frailty

E.2 Import duration

Figure 2 plots normalized coefficients of age dummies of import duration analysis. The blue(red) curve depicts normalized age coefficients of specification without(with) controlling for frailty. The green curve captures the difference between the two.

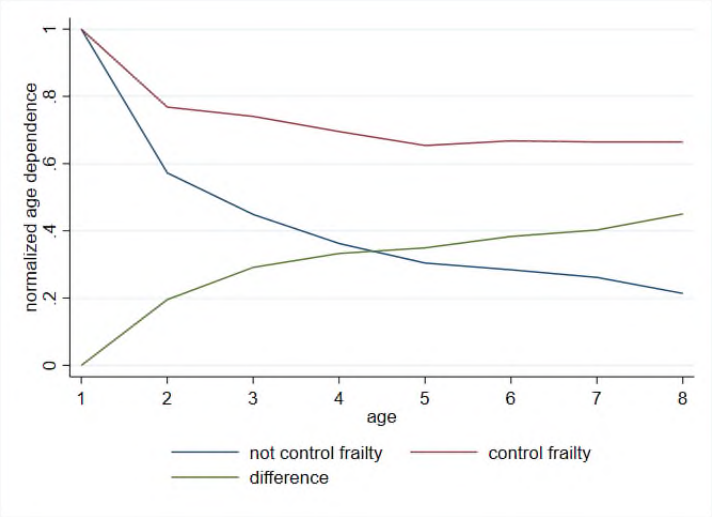

Fig. 2: Import age dependence: frailty vs non-frailty

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