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Firms' Exports, Volatility and Skills: Evidence from France *

Maria Bas[†] Pamela Bombarda[‡] Sebastien Jean[§] Gianluca Orefice[¶]

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Abstract

This paper studies the effects of globalization on the employment growth volatility by investigating the relationship between firms' export intensity and labor demand volatility across skills. Based on detailed firm-level administrative French data for the period 1996-2007, we show that firms with intense export activity exhibit lower volatility of labor demand for skilled, compared to unskilled workers. Both the theoretical and empirical analysis point to the importance of skill-intensive fixed export costs in explaining this effect. Our identification strategy is based on an instrumental variable approach to provide evidence of causal effects. Our findings show that a higher level of export intensity increases the employment growth volatility for unskilled relative to skilled workers.

Keywords: Export intensity, employment volatility, skilled labor, firm-level data.

JEL classification: F1, F16, I25, I60.

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[†]University of Paris 1, Centre d'Economie de la Sorbonne (CES). E-mail: maria.bas@univ-paris1.fr.

[‡]CY Cergy Paris University, THEMA. E-mail: pamela.bombarda@cyu.fr.

[§]CEPII and INRAE. E-mail: beatrice.postec@cepii.fr.

[¶]University Paris-Dauphine, PSL. E-mail: gianluca.orefice@dauphine.psl.fr.

1 Introduction

Globalization has been often claimed to enhance inequalities between skilled and less skilled workers in the labor market. Firms engaged in international trade tend to be skill intensive and pay higher wages (Bernard et al., 2007), with consequences for within- and between-firm wage inequality. In many developed countries, job opportunities for unskilled workers declined over the last globalization wave, while internationalization fueled new job opportunities for high-skilled workers. At the same time, the skill premium grew either because wages of skilled workers rose more rapidly than those of unskilled workers, or simply because the wages of unskilled workers decreased over time. These stylized facts concern the labor markets of both developed and developing countries, and were related in the literature to globalization shocks, and in particular to the export dynamics of firms.

Several theoretical models show that firms' export activity has an unequal effect on skilled *vs.* unskilled labor demand and wages (examples include Burstein and Vogel, 2017; Harrigan and Reshef, 2015; Brambilla et al., 2012; Verhoogen, 2008; Yeaple, 2005). In addition, recent micro-econometric evidence highlights that exporting firms facing idiosyncratic shocks in their destination markets exhibit higher domestic sales volatility (Berman et al., 2015; Vannoorenberghe, 2012) and total employment growth volatility (Kurz and Senses, 2016). However, whether such foreign shocks affect differently the firm's employment growth volatility of skilled *vs.* unskilled workers remains unexplored. This paper aims at filling this gap by studying the consequences of foreign demand shocks on French firms' employment growth volatility of workers with different skills over the period 1996-2007. We focus on the employment growth volatility of firms because it is related to the probability and cost of displacement (as well as to the uncertainty and income risk), and has therefore important consequences for welfare of workers. Hence, this paper provides evidence on a new dimension of the skill-based inequalities potentially induced by globalization shocks.

Firms' export dynamics may affect skill-based inequality in the volatility of employment growth through different mechanisms. The main channel relates to the different way in which skilled *vs.* unskilled labor demand affect the cost structure of firms.¹ Specifically, we model fixed export costs as skill intensive (reflecting the adaptation to foreign market's taste and standards, as well as coordination needs).² Since each exporting firm needs a fixed amount of skilled labor independently of the volume of foreign sales, the skilled labor adjustment to foreign shocks is expected to be unambiguously smaller than the adjustment on unskilled labor. As a result, the effect of foreign demand shocks on the employment growth volatility is

¹We are aware of other mechanisms potentially at play. These are presented and discussed in Section 3.

²Artopoulos et al. (2011), and Cavusgil and Zou (1994) highlight that a large part of fixed export costs are composed of logistical, coordination and distributional operations, which are usually more skill intensive.

heterogeneous across skills.

Descriptive statistics based on French firms over the period 1996-2007 qualitatively support this reasoning. The volatility of unskilled labor demand is positively correlated with export performance (measured either as total exports or as number of destinations served), while the opposite is true for skilled labor. In addition, the skill intensity of firms is positively related to both the number of destinations reached and total exports, supporting the intuition that export activity is intensive in skilled workers. This stylized fact is consistent with the theoretical discussion reported in section 3 in which exporting to a foreign market implies a skill-intensive fixed cost. In Online Appendix A.1, we present a simple theoretical framework that illustrates the consequences of skill-intensive fixed export costs on the labor demand volatility by skill level. We show that, for a given firm's size, higher levels of export intensity imply a smaller ratio between the volatility of skilled over unskilled labor demand. In what follows, we refer to this ratio as the *relative volatility of skilled labor demand*.

In the empirical analysis we test such a theoretical intuition by combining administrative French employer-employee data from the *Déclaration Annuelle des Données Sociales* (DADS) with firm level export data from the French Customs and firms' total sales from *FICUS/FARE*. Our baseline identification strategy relies on the variation of firm's export intensity (exports over total sales) and relative volatility of skilled labor demand across firms within a 4-digit sector, conditional on firms' size. We address possible endogeneity concerns that may arise in this context. Firms' export intensity and employment volatility may be determined by the same (unobserved) firm's supply and demand factors. In particular, skill-biased technological shocks may affect both export sales and the volatility of a specific type of worker.³ We address such a potential endogeneity problem using instrumental variables estimation based on exogenous demand shocks faced by firms in their export markets. More specifically, firm level export intensity is instrumented by foreign demand shocks (as in Hummels et al., 2014, Hummels et al., 2018, and Berman et al., 2015). To limit further any omitted variable concern, we also control for firms' import intensity instrumented by foreign supply shocks. As a robustness check, we adopt an alternative identification strategy and exploit the panel dimension of our data. Namely, we compute the relative volatility of skilled labor demand and export intensity over 4-year and 6-year time windows (3-period and 2-period panel respectively). This econometric strategy enables us to include both firm and industry-by-period fixed effects. By doing so, we fully control for any unobservable time-invariant firm characteristics and industry-time specific shocks. This, along with the IV strategy depicted above, allows us to conclude on the causal effect of globalization shocks on the skill-specific employment growth volatility of firms' labor

³In our empirical framework, technological shocks (or other unobserved factors) affecting skilled and unskilled workers in the same way are controlled by taking the ratio of volatility between skilled and unskilled workers.

demand. Both the cross-section and the within-firm instrumental variable estimations point to a negative effect of firm export intensity on the relative volatility of skilled labor demand: larger (or increased) volumes of exports over total sales exacerbate the volatility of low-skilled labor demand relative to high-skilled labor.

Finally, we explore the transmission channels. To do so, we decompose total firm's export intensity into its *intensive* and *extensive* margin components, and show that the latter plays a dominant role: an increase in the number of destinations served by the firm, rather than a larger volume of exports *per* destination, is what matters the most in reducing the relative volatility of skilled labor demand of exporters. This suggests that the entry-exit dynamics of firms to/from foreign markets play a central role. We confirm this result by showing that firms' export intensity towards destinations served intermittently during the period (*churning destinations*) affects negatively the relative volatility of skilled labor demand, while firm's export intensity towards destinations served continuously (*continuous destinations*) has a milder impact.

Our empirical analysis shows that, for given firm's characteristics, higher export intensity increases the employment growth volatility for unskilled workers, and reduces the employment growth volatility for skilled workers. According to our preferred specification: exporting more intensively, or to a larger number of foreign destinations, increases the volatility of unskilled compared to skilled employment. In particular, compared to a firm with zero or negligible export intensity, a firm with average level of export intensity has a 4% lower level of relative volatility of skilled labor demand of the sample mean.

This paper relates to several strands of research. It contributes to the micro-econometric literature that focuses on the effects of international trade on employment and in particular on employment volatility. Using trade and transactions data for the U.S. manufacturing sector, [Kurz and Senses \(2016\)](#) show that, on average, exporting firms are less volatile than domestic firms, while on the contrary importing firms are more volatile. However, they find high share of exports and imports to be associated with high levels of *total* employment volatility. Our paper focuses on the *heterogeneous* effect of firms' export activity on the employment growth volatility of workers with different skills. Differently from [Kurz and Senses \(2016\)](#), we rely on French administrative employer-employee and custom data to analyze how firms' exporting activity affects the volatility of employment growth for *skilled* relative to *unskilled* workers. Furthermore, we empirically investigate one of the possible explanations (fixed costs channel) behind the higher (lower) employment growth volatility of unskilled (skilled) workers. Finally, we address possible endogeneity concerns that may arise in this context, and use instrumental variables estimation to establish the causal link between foreign demand shocks and employment growth volatility. The contribution of our work is to propose novel insights

on the *heterogeneous* and *causal* effect of firm’s foreign demand shocks on the relative volatility of skilled over unskilled labor demand, and uncovering one of the possible underlying mechanism. On this respect, our findings reinforce and enrich the evidence of the previous literature studying the effect of international trade on inequalities in labor markets across employment with different skills (e.g. [Burstein and Vogel, 2017](#), and [Biscourp and Kramarz, 2007](#) among others).

This paper also contributes to the growing literature on the relationship between different measures of firm’s volatility and trade. [Krebs et al. \(2010\)](#) propose a two-step estimation linking the volatility of income at the sectoral level to trade policy. [Kalemli-Ozcan et al. \(2014\)](#) document a positive relationship between the foreign ownership of firms and both firm- and region-level output volatility. Other papers focus on macroeconomic volatility and openness. For example, [di Giovanni and Levchenko \(2009\)](#) show that trade raises aggregate volatility by making aggregate national output more dependent on idiosyncratic shocks. [Cunat and Melitz \(2012\)](#) study the relationship between volatility, labor market flexibility, and openness, and show that countries with relatively flexible labor markets export more intensively in sectors with higher volatility. [Caselli et al. \(2015\)](#) point out the importance of geographic diversification to mitigate country-specific shocks. Other recent works assess the importance of the firm-specific components to micro and macro fluctuations. [Vannoorenberghe \(2012\)](#) shows that the share of exports in the total sales of a firm has a positive and substantial impact on the volatility of its sales and a negative impact on the volatility of export sales; while [di Giovanni et al. \(2014\)](#) study the role of individual firms in generating aggregate fluctuations.

The rest of the paper is organized as follows. Section 2 highlights some stylized facts on the skill intensity and relative employment growth volatility of firms with increasing export performance and describes the main labor market institutions in France. Section 3 presents the theoretical intuition. Section 4 describes the data. Section 5 presents our measure of volatility, and aligns our analysis to previous studies. Section 6 lays out our baseline estimation strategy and discusses potential endogeneity concerns. Section 7 presents different sets of results, using a cross-section and panel approach respectively. Section 8 explores possible channels of transmission. The last section concludes.

2 Prima facie evidence and institutional context

Before moving to a more detailed analysis, in section 2.1 we present some stylized facts motivating our research question and econometric exercise. Then, in section 2.2 we discuss the institutional framework concerning the French labor market.

2.1 Skills and the employment growth volatility of firms

Relying on administrative French firm-level data for the period 1996-2007, we derive the following two stylized facts that motivate our main econometric exercise: (i) the volatility of employment growth of skilled (unskilled) workers is decreasing (increasing) with the export activity of firms, and (ii) export-intensive firms are skill-intensive (in line with Bernard et al. 2007).⁴

We start by investigating the correlation between firm exports and the employment growth volatility of skilled and unskilled workers. Following Kurz and Senses (2016), the employment growth volatility is measured as the standard deviation of the residual component of an employment growth rate estimation over the period 1996-2007 - see Section 5.1 for a detailed description. Since the French employer-employee database does not provide information on the education level of workers, we infer the skill level of individuals (*skilled* vs. *unskilled*) using their occupation. We consider *skilled* those workers employed in occupations whose initial (average) wage is above the median wage in the sample, and *unskilled* the others.⁵ To characterize firms' export performance, for this descriptive analysis, we rank firms by two alternative measures: (i) total exports of the firm, and (ii) number of destinations served. The average firm-level employment growth volatility (conditioned on size) is then compared across deciles for each of these two rankings. Whatever the measure, the volatility of firms' demand for unskilled labor appears to be clearly larger for firms with high export performances (Figures 1a and 1b). For a given firm size, the volatility of unskilled employment increases with exports: it is approximately 2 percentage points larger for firms beyond the 9th decile than for firms around the median of the export sales distribution, who in turn have larger volatility of unskilled employment than firms at the first decile.⁶ Strikingly, the opposite is true for the volatility of skilled labor demand which, for a given firm size, is approximately 5 percentage point lower for firms with high export sales than for those with a low to medium exports (Figures 1c and 1d). This clear-cut contrast is suggestive of the opposite influence of export activity (i.e. foreign demand) on the labor demand volatility for skilled *vs.* unskilled workers.

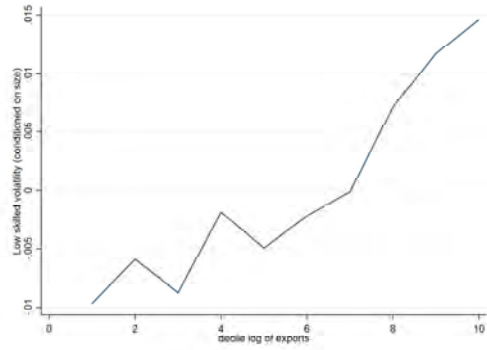
We then turn to the link between export activity and average skill intensity of firms, measured as the difference in the (log) number of skilled and unskilled workers in the firm, conditioned on firm's size. As shown in Figure 2, the skill intensity of firms is positively correlated with both total exports and number of foreign destinations served. While simple and unsurprising, this correlation is consistent with the idea that exporting requires skilled

⁴A detailed description of the data used in this manuscript is reported in section 4.

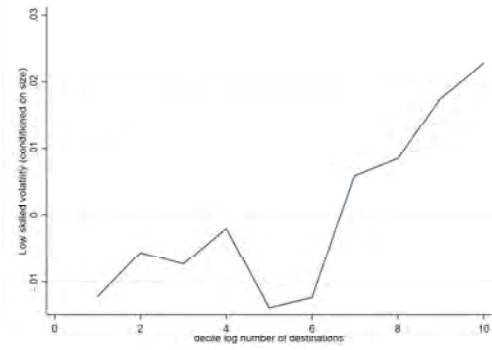
⁵Section 5 provides further details about our classification and methodology to compute the volatility of skilled and unskilled workers. Alternative proxies for the skill level of workers are discussed in Section 5.

⁶Volatility measures are conditioned on firm size. This explains the negative values in the vertical axis.

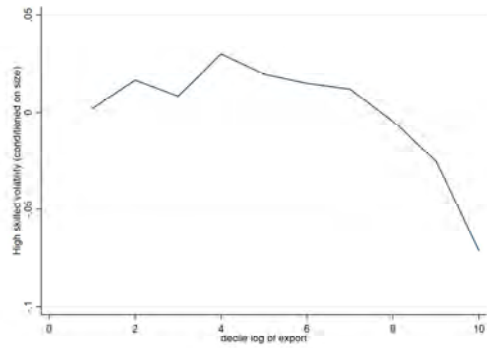
Figure 1: Export activity and the employment volatility of labor demand.



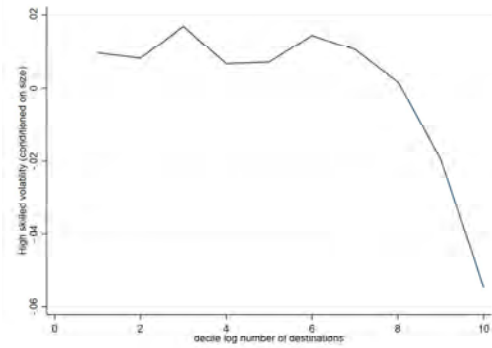
(a) Export and unskilled emplo. volatility



(b) N. dest. and unskilled emplo. volatility



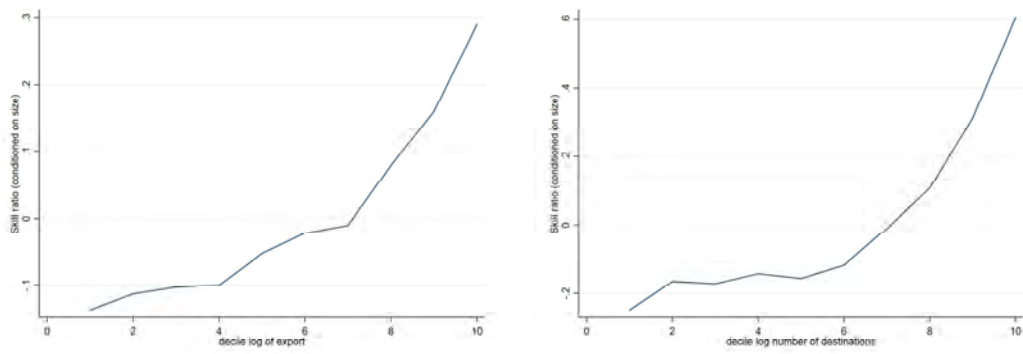
(c) Export and skilled employment volatility



(d) N. dest. and skilled employment volatility

Source: Authors' calculation using French DADS and Custom data for the period 1996-2007. *Note:* deciles of export intensity (horizontal axis) are based on firm's total exports (ln) and number of served markets (ln). The employment volatility measures for skilled and unskilled workers (vertical axis) are calculated as in Kurz and Senses (2016) and discussed in Section 5.1.

Figure 2: Export and skill intensity



(a) Total export and skill intensity

(b) N. dest. and skill intensity

Source: Authors' calculation using French DADS and Custom data for the period 1996-2007. *Note:* deciles of export intensity (horizontal axis) are based on firm's total exports (ln) and number of served markets (ln). The firm's skill ratio (vertical axis) is calculated as the difference in the (log) number of skilled and unskilled workers in the firm (averaged within export activity decile).

workers. This is at the core of the theoretical intuition discussed in Section 3.

2.2 Labor market institutions in France

Job market regulations are crucial in shaping firms' decisions regarding employment and wages. A brief description of the rules governing the French labor market during the period of 1995-2007 will give some context to our results.⁷ Thus, in this section we focus on specific aspects of the French labor market institutions that influence the volatility of employment by skill level and firms' characteristics.

The previous literature points to a broad range of institutional factors that contribute to wage rigidity in the French labor market (Cahuc and Kramarz, 2004, Barthélemy and Cette, 2010, and Avouyi-Dovi et al., 2013). These include costly and uncertain dismissal procedures, restrictions on firm-level bargaining, skill mismatches and inadequate training programs to address them. Additionally, the cost of hiring and firing employees is related to the type of contract signed. French labor laws allow firms to hire workers on two types of regular employment contracts: fixed-term contracts (CDD), and permanent contracts (CDI).⁸ Fixed-term contracts are supposed to be used only to address temporary needs, and their duration (including possible renewals) cannot exceed 18 months under the general rule. Except under special circumstances (grave misconduct, *force majeure*), dismissal is only an option at the end of the trial period. Otherwise, in case of early end of the working relation, the employer has to pay the employee at least as much as the amount of wages that the employee would have received until the end of the contract.

In practice, dismissal procedures concern mainly CDI contracts. In this case, firing costs depend on the nature of the dismissal and on whether it concerns individual or collective terminations. Dismissals are governed by different rules, and firms often try to reach agreements in order to limit both the amount of firing costs and the associated legal uncertainty. Individual dismissal rules fall under two main categories: dismissal for personal reasons (mainly grave misconduct, professional incompetence, or refusal of a substantial changes of the labor contract), and for economic reasons. The minimum legal severance pay is 20% of a month's salary per year of seniority up to ten years of service. Beyond ten years of service, severance pay to the employee is 33% of the monthly wage. Collective terminations for economic motives are subject to other conditions, which are more constraining if more than ten persons are concerned. Such conditions include a redundancy plan, with actions of professional re-training and, when possible, internal reconversion, as well as obligations of negotiations with representatives of employees and additional constraints on notification and delays.

Thus, firing costs are often very relevant for French firms. Kramarz and Michaud (2010)

⁷French labor market institutions have been reformed substantially in 2008 and 2017.

⁸DADS data do not allow to account for the type of worker contract in our analysis because of a very large number of missing observations.

estimate the structure of hiring and firing costs in France. While the hiring costs tend to be small and economically relevant only for CDD contracts, the firing costs are economically relevant for both types of contracts (CDI and CDD). Interestingly, the authors show that firing costs exhibit a concave shape with respect to the number of dismissed persons. Other job protection rules, such as those concerning the years of seniority of employees, have also an impact on the firing cost of firms. For example, employers with more than eleven employees have to pay severance payments in case of unfair dismissal when the employee has more than two years of service (Cahuc et al., 2019, and Cahuc et al., 2021).⁹

Kramarz and Michaud (2010) conclude that “*the more skilled the labor force, as measured by the share of managers, engineers and other professionals, the higher the fixed cost for both collective and individual terminations.*” Their finding suggests that firing costs tend to be larger for skilled than for unskilled workers, which may contribute to explain why labor adjustments vary across skills. This conclusion is in line with the results in Blatter et al. (2012), who use administrative Swiss employer-employee data to show that hiring and training costs are generally higher for skilled than for unskilled workers. These findings are in line with our research question. Another reason (on top of the skilled intensive fixed export cost channel) for why firms more exposed to foreign shocks tend to adjust more easily the unskilled than the skilled labor demand is because firing and hiring costs are higher for skilled workers.

3 Theoretical motivation

While this paper is primarily an empirical analysis, we describe here a plausible theoretical mechanism underlying the link between export activity and employment growth volatility across skills. The mechanism we have in mind is related to the structure of firm’s export costs in terms of skilled and unskilled workers. The existence of significant sunk costs associated with exporting is widely documented (Das et al., 2007), and the corresponding fixed export costs are composed in large part of logistical, coordination and distributional operations, which are usually more skill intensive than production activities (Artopoulos et al., 2011; Cavusgil and Zou, 1994). Fixed export costs reflect the adaptation to foreign standards, regulations, and taste of consumers, requiring mainly skilled workers to cover these tasks (e.g. lawyers, engineers, marketing experts). The idea that fixed export costs are skill intensive is related to the fact that these costs involve services and tasks that require more skilled labor such as marketing, research, communication with clients or intermediaries and distribution. This idea is in line with the model developed by Matsuyama (2007) and the evidence presented

⁹Other employers’ obligations are related to organizing elections of staff representatives (above eleven employees), and to ensuring additional rights regarding hygiene, safety, employment and training (above fifties employees).

in Brambilla et al. (2012), Verhoogen (2008), as well as the descriptive evidence presented in Section 2 of this paper.

This simple characterization of the firm’s costs structure, according to which the fixed export cost is paid in units of skilled labor, may explain the heterogeneous effect of export shocks on employment volatility across skills. Let us consider how exporting affects a firm’s labor demand: it requires investing *ex ante* in such fixed export costs, and then producing to meet demand in export markets. The first component of labor demand is then fixed and determined *ex ante*, while the second one is variable and depends on foreign demand fluctuations. If the first one is indeed more skill-intensive than the other costs, it will act like a stabilizer on the firm’s demand for skilled labor. Thereby, the volatility of skilled labor will be lower in comparison to the volatility of unskilled labor in presence of a foreign demand shock. In other words, if the fixed export cost is paid in units of skilled labor, any shock in the foreign demand will translate relatively more intensively to unskilled than to skilled workers, so that the skilled labor adjustment will be smaller than the adjustment on unskilled labor. Online Appendix A.1 formalizes this mechanism based on skill-intensive fixed export costs, and shows that export intensive firms experience a greater employment growth volatility of unskilled than skilled workers. We also extend this prediction to a setup with multiple destinations.¹⁰

Related mechanisms. Other channels can explain the relationship between relative employment volatility and foreign demand shocks. For instance, the volatility of export demand is also related to the low probability of survival of some firms in the export market (Hess and Persson, 2011, Besedeš and Prusa, 2006a,b, Albornoz et al., 2012). This implies that entry and exit dynamics in export markets are likely to play a significant role on the employment volatility of firms.¹¹ Assuming export shocks to be uncorrelated across destination markets within a firm, a larger number of export markets implies a larger amount of “diversification” and reduces firm’s volatility of production-related employment. Nevertheless, production costs remain more volatile than (skill-intensive) fixed export costs (which are not destination specific). As a result, firms more diversified in terms of export destinations are characterized by lower relative volatility of skilled labor demand. It must be noticed that this framework explains the lower volatility of skilled labor demand for export-intensive firms under the im-

¹⁰We show that reaching a larger number of export markets makes the firm benefiting from portfolio diversification which can reduce firm’s volatility of production-related employment. But still, since the fixed export costs are skilled intensive (and skilled workers are not destination specific), more diversified exporters experience a relatively lower volatility of skilled than unskilled workers. This result will be also tested in our empirical exercise, Table 7, when we analyse the relationship between relative employment volatility and the number of destinations reached by exporting firms.

¹¹Section 8 will test this mechanism relying on two measures of firm’s export sales. The first measure is based on exports to destinations always served by the firm over the entire period 1996-2007 (*continuous* destinations). The second measure captures firm’s exports to *churning* destinations, which are computed over destinations where the firm enters/exits during the period.

explicit assumption that the stability of fixed export costs more than compensates the impact of exports on total sales volatility.

Another possible mechanism is linked to the fact that a higher share of exports in total sales has a positive and substantial impact on the volatility of total firm's sales, as shown by [Vannoorenberghe \(2012\)](#). The consequences for labor demand may be heterogeneous across workers' categories because of the above-mentioned differences in firing, hiring and training costs across skill categories. Under a setting where labor markets are characterized by Diamond-Mortensen-Pissarides-type search and matching frictions ([Pissarides, 1974](#); [Davidson and Matusz, 1999](#)), such differences across skills in hiring and training costs affect the way in which firms adjust to output fluctuations: employers should proceed more smoothly when adjusting employment to output for skilled than for unskilled workers.¹² This line of reasoning delivers a smaller induced volatility for skilled than for unskilled employment. Importantly, though, if this was the only mechanism at play, it would always result in a positive relationship between export activity and employment volatility, whatever the skill category. This would be inconsistent with the stylized fact reported in [Figures 1c and 1d](#) and with the negative relationship between export intensity and skilled employment growth volatility reported in [Section 7](#). Although testing for such a specific channel is beyond the scope of this paper, the inclusion of firm fixed effects in the econometric panel approach allows us to control for the unobserved time-invariant firm's characteristics and therefore for the time-invariant differences in the fixed costs of hiring skilled and unskilled workers for firms.

Finally, while our main interest lies in the influence of export intensity of firms, we are aware that importing may also affect the employment decisions of firms. If on the one hand importing may expose the firms to foreign markets' shocks, on the other hand it may offer a way to cushion domestic shocks. We are agnostic *a priori* about the expected effect of import intensity of firms on their labor demand volatility, but it is worth controlling for, and we do so in our econometric estimations. This is all the more true when analyzing the difference between skilled and unskilled employment. Indeed, the degree of substitutability between imported inputs and local employment may differ significantly across labor categories.

¹²The works of [Helpman et al. \(2010\)](#) and [Helpman et al. \(2017\)](#) introduce search frictions in the heterogeneous firm trade models with workers of different skills. They show that in presence of firing and hiring costs, exporters will be not only more productive but also more skilled intensive and pay higher wages. When hiring and training costs are higher for skilled workers relative to unskilled ones, exporters facing foreign demand shocks may adjust more easily their labor demand for unskilled than skilled workers. Introducing this type of labor market frictions allows explaining why export sales have a larger impact on the volatility of unskilled than skilled workers.

4 Data

Our empirical analysis combines three main sources of French administrative firm-level data for the period 1995-2007: the *Déclaration Annuelle des Données Sociales* (DADS), the French Customs Data and FICUS/FARE. DADS is an administrative dataset of matched employer-employee information collected by the INSEE (*Institut Nationale de la Statistique et des Études Économique*). It contains information on the employment and wage structure at the level of the firm, and the occupation category of its workers (4-digit PCS classification). DADS also provides information on the firm's main industry of activity (NAF700, 4-digit industry classification). The data are based on mandatory reports of gross earnings, completed by employers to comply with French payroll taxes. All wage-paying individuals and legal entities established in France are required to file payroll declarations. Since in the present paper we are interested in the effect of foreign demand shocks, we select only the firms belonging to the manufacturing (*tradable*) sector.¹³

To disentangle the effects of export intensity across employment skills, we classify employees into two main categories according to their occupation's wage. Since we do not have direct information on the education of the worker, we consider as *skilled* those workers employed in occupations whose initial (average) wage is above the median wage in the sample.¹⁴ The others are classified as unskilled. This definition of skills reflects firms' appreciation of workers' qualifications. We also consider two alternative measures for skills. The first is based on the type of occupations rather than on their average wage. More specifically, we distinguish between production and non-production workers according to the type of occupation covered in the firm. Second, we resort again to the occupation's average wage to classify skilled and unskilled workers, but computed on workers' wage purged by the individual's experience (age) and firm fixed effects.¹⁵ This alternative measure controls for the fact that workers' wages are affected by individual experience and firm characteristics, and the resulting occupation average wage can be somehow imprecisely measured.

Trade data come from the French Customs, which provides annual export and import data for French manufacturing firms by product and country of destination and origin over the period 1995-2007. This database is quasi-exhaustive. Although reporting of firms having trade values below 39,000 euros (within the EU destination) or 1000 euros (extra-EU destinations) is

¹³Even if some firms also export services, we do not have this information from French Custom data, and the foreign shock cannot be computed for French exporters of services.

¹⁴We computed the average wage by occupation category (pcs 4-digit) in 1995 and classified *skilled* workers, those employees in occupations with average wage above the median.

¹⁵First, we condition individual wage on worker's age and firm fixed effects. Then, based on such purged wage, we calculate the occupation average and classify workers into skilled or unskilled category. Results using alternative definitions of workers' skills are reported in the Online Appendix in Table A5.

not mandatory, there are in practice many observations below these thresholds. This suggests the quasi-exhaustive nature the French Customs data used here.¹⁶ Customs data are provided at the product level (8-digit Combined Nomenclature). We aggregate them at the firm-year level in order to match with the employer-employee DADS data. Firms with employment structure (i.e. present in the DADS data) but not appearing in the French Custom data are considered domestic firms. Finally, we combine these two data sources with balance sheet information on French firms called FICUS/FARE, that provides the total sales of firms, and allows us to compute firm’s export (import) intensity as exports (imports) over total sales.

Our sample covers both exporters and pure domestic firms. We first present evidence using the full sample of firms, and control for the export and import status of firms besides their export and import intensity. This allows us to test whether the export (or import) status of firms matters in affecting their labor demand volatility. In the second part of our empirical analysis we focus on exporting firms (i.e. firms exporting at least one year over the period 1995-2007),¹⁷ and specifically test the effect of *foreign* shocks on the labor demand volatility of firms directly involved in international transactions (pure domestic firms are only indirectly affected by foreign demand shocks). The choice of focusing only on exporting firms is supported by the empirical findings on the full sample specification (null effect of export and import status on labor demand volatility) as well as by the theoretical model reported in Online Appendix A.1. Moreover, considering both the export (import) *status* and *intensity* of firms in the same regression implies a selection bias in estimation; and the need for two additional instrumental variables for the export and the import status of the firm. This leads to an identification problem as it is extremely hard to find an IV that predicts uniquely the export (or import) status and not the intensity of the firm (and vice-versa).¹⁸

As discussed in detail in the next section, for a proper calculation of the volatility measure we select a sub-sample of firms with non-missing information on employment measures over the period 1996-2007.¹⁹ By doing so we rely on a sub-sample of 41,920 firms with non-missing information on employment level and volatility. The sample shrinks to 33,394 firms when the skills of workers is considered because of missing information on the workers’ occupation code

¹⁶The different thresholds in compulsory custom declaration of export volumes is not an issue here. First, even if not compulsory, firms declare intra-EU export sales even if below the threshold. Second, we are interested here in the *total* exports of the firm independently of the specific destination, making the thresholds for compulsory declaration less binding.

¹⁷We run sensitivity checks using alternative definition for the export status of the firm (i.e. exporting at least six years) and results remain qualitatively unchanged. Results are available upon request.

¹⁸Having two valid instrumental variables dedicated respectively to the export status and export intensity of firms is extremely complicated. Indeed, the majority of all possible IVs are likely to explain at the same time the export status and the export intensity of firms, with a consequent unclear identification (i.e. poor identification of the first stage regression with the two IVs predicting at the same time both endogenous variables).

¹⁹Indeed, calculating the volatility measure on firms active over different time spans would imply an important measurement error.

(PCS) in the DADS data. See Online Appendix Table A1 for in-sample descriptive statistics.

5 Employment growth volatility and exports: measurement and preliminary estimates

5.1 Measuring employment growth volatility

When defining employment volatility at the firm level it is necessary to deal with differences in trend growth. Stability in level is not an appropriate benchmark to measure volatility. A firm with a stable employment growth rate cannot be characterized as exhibiting less volatile employment than a firm experiencing a stable but increasing trend in employment growth. For this reason, we follow Kurz and Senses (2016) and measure the employment volatility as the standard deviation of the residual component of the growth rate of firms' employment over the period 1996-2007, conditioned on firm (and sector-year) fixed effects.²⁰ The underlying assumption is that each firm is expected to follow a stable employment growth trend over the period; deviations from this trend can then be interpreted as volatility. This measure of volatility is also used in other studies, such as Vannoorenberghe (2012) and Kurz and Senses (2016) among others.

The residual growth rate comes from the following estimation which uses as a dependent variable the logarithm of growth rate of employment for skilled and unskilled workers respectively, in firm i at time t :

$$\gamma_{it} = \ln(E_{it}) - \ln(E_{it-1}) = \phi_i + \mu_{kt} + v_{it} \quad (1)$$

where γ_{it} is the (ln) employment growth rate, for skilled and unskilled labor respectively, of firm i producing in 4-digit industry k and time t . E_{it} refers to employment of the considered labor category in firm i , ϕ_i are firm fixed effects and μ_{kt} are sector-year fixed effects. The estimated residual, \hat{v}_{it} , thus measures the component of employment growth that deviates from what can be inferred from firms' average trends and sector-level yearly shocks. For each labor category, the employment volatility is then computed as the standard deviation of this estimated residual of growth rate for the period 1996-2007:

$$\sigma_i = \sqrt{\frac{1}{T} \sum_t \hat{v}_{it}^2} \quad (2)$$

Notice that the measure of volatility in equation (2) is not year-specific; the standard deviation

²⁰Although data are available for the period 1995-2007, our estimation sample starts in 1996 as we lose the initial year in computing the growth rate of employment.

is computed across years for every firm with non-missing employment information over the period 1996-2007.²¹ Our baseline identification strategy is thus based on a cross-sectional approach. Tables A1 and A2 in Online Appendix report in-sample descriptive statistics for the main variables used in the empirical exercise.

As a robustness check, we compute the standard deviation of the estimated residual employment growth, \hat{v}_{it} , over shorter time periods: either 4-year windows (1996-1999, 2000-2003, and 2004-2007) or 6-year windows (1996-2001, and 2002-2007). While the short time span makes the measurement of volatility less accurate for each of these sub-periods, this panel approach allows analyzing the longitudinal variation in employment growth volatility, making it possible to control of any time-invariant firm characteristics through fixed effects, in addition to industry-period fixed effects.

5.2 Trade and employment growth volatility

We first analyze the effect of firm’s export intensity on *total* employment growth volatility of French firms, abstracting from the skills of workers. Following an econometric specification similar to Kurz and Senses (2016), we regress firm total employment growth volatility on firm’s export and import intensity over the period, export and import status, firm size, and 4-digit industry fixed effects. Export status is defined using a dummy variable, which equals one if the exports of firm i are strictly positive at least one year over the period 1996-2007. The export intensity of each firm is measured as the ratio of its exports over total sales, averaged over the period 1996-2007, and expressed in percentage points.²² Similar definitions apply to imports. To control for firm size, we use the logarithm of total employment in 1996.²³ Finally, to account for unobservable industry specific factors, we control for 4-digit industry fixed effects.

The results are presented in Table 1. As expected, firm size is negatively related to volatility of employment growth. Differently from Kurz and Senses (2016), we do not find the volatility of total employment growth to differ between domestic firms and globally engaged firms (exporting or importing), as suggested by dummies for export and import status of firms (columns 1 and 2). However, intensity matters: employment growth volatility is found to increase with import intensity, but to decline with export intensity (see column 2). The latter finding is opposite to Kurz and Senses (2016), and can be related to the different employment

²¹The standard deviation must be computed on a homogeneous time span. For this reason we only retain firms with non-missing employment data over the entire period 1996-2007.

²²The sample mean for export intensity is 10.3 among exporters. Table A1 in Online Appendix reports summary statistics.

²³We use employment in the initial year to reduce endogeneity concern for this control variable. Results are qualitatively identical if we use the average employment of the firm over the period.

structures of firms. Specifically, export intensity can play a different role for the volatility of skilled relatively to unskilled workers.

Therefore, to account for the heterogeneous effect across skills, columns (3) and (4) of Table 1 focus separately on skilled and unskilled employment. Status continues to be insignificant, with the only exception of exporter status, which is positive and significantly associated to the volatility of skilled employment growth. Interestingly, intensities matter in a different way across labor categories: the labor demand volatility of *skilled* workers is negatively affected by export and import intensity, while the labor demand volatility of *unskilled* workers is positively affected by import intensity. The different effect of export (and import) intensity on the labor demand volatility of skilled and unskilled workers is consistent with the stylized facts proposed in section 2.1 and with the theoretical motivations discussed in section 3. This heterogeneous effect of firms' trade involvement on the employment volatility deserves more in-depth analysis and investigation of the underlying mechanisms. Thus, in what follows we study the heterogeneous effect of firms' export and import intensity on employment growth volatility across skills.

Table 1: Total and skill-specific employment volatility.

	Std. Dev. of residual employment growth			
	<i>Total employment</i>		<i>Skilled</i>	<i>Unskilled</i>
	(1)	(2)	(3)	(4)
Export status	-0.0008 (0.001)	-0.0005 (0.001)	0.0112*** (0.003)	0.0019 (0.002)
Import status	0.0019 (0.001)	0.0015 (0.001)	-0.0047 (0.003)	-0.0023 (0.002)
Export intensity		-0.0001*** (0.000)	-0.0013*** (0.000)	0.0001 (0.000)
Import intensity		0.0001*** (0.000)	-0.0009*** (0.000)	0.0004*** (0.000)
Firm's size (ln)	-0.0388*** (0.001)	-0.0387*** (0.001)	-0.0183*** (0.001)	-0.0732*** (0.001)
Sample	Full	Full	Full	Full
Industry FE	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	OLS	OLS
Observations	33,379	33,379	33,379	33,379
R-squared	0.233	0.233	0.059	0.302

Notes: The dependent variable is the volatility of labor demand. Columns (1) and (2) do not distinguish across skills, while columns (3) and (4) distinguish between skilled and unskilled employment growth volatility. All estimations show cross-section OLS results on the full sample of firms (i.e. including non-exporting firms). Firm level volatility of employment is computed as the standard deviation of the estimated residual of employment growth rate on firm and sector-year fixed effects for the period 1996-2007 - see Section 5.1 for detailed discussion on how employment volatility measures are calculated. Firm's export intensity (and import intensity) is measured by the ratio of exports (imports) over total sales of the firm and then averaged over the period 1996-2007. Firm's size is measured as the logarithm of total employment of the firm in the initial year. All estimations include 4-digit industry fixed effects. Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

6 Empirical methodology

6.1 Baseline specification

To analyze further the heterogeneous effect of firms' export (and import) intensity on skilled and unskilled employment growth volatility, we focus on the ratio between volatilities for these two categories, using the following empirical equation:

$$\frac{\sigma_{is}}{\sigma_{iu}} = \beta_0 + \beta_1 \frac{Exports_i}{Tot. sales_i} + \beta_2 Exporter_i + \beta_3 \frac{Imports_i}{Tot. sales_i} + \beta_4 Importer_i + \beta_5 Size_i + \alpha_k + \epsilon_i \quad (3)$$

where σ_{is}/σ_{iu} is the *relative volatility of skilled labor demand*, defined as the ratio between skilled (σ_{is}) and unskilled (σ_{iu}) employment growth volatility in firm i , calculated as in equation (2). Focusing on this ratio is consistent with the theoretical framework in Online Appendix A.1. It also contributes to cleaner identification, by allowing any firm-specific factor affecting simultaneously the firm's skilled and unskilled labor demand to be cleaned out. $Exporter_i$ and $Importer_i$ represent export and import status respectively. $Exports_i/Tot. sales_i$ and $Imports_i/Tot. sales_i$ represent export and import intensities respectively. These variables are measured as discussed in section 5.2. Firm's size, $Size_i$, and industry fixed effects (α_k) complete our econometric model. Thus, the specification in equation (3) explains variations in the relative volatility of skilled labor demand across firms within 4-digit sector. The coefficient of interest, β_1 , shows the effect of firms' export intensity on the relative volatility of skilled labor demand, conditional on firm size and import intensity. In the first part of the analysis our sample includes both domestic and globally engaged firms, which allows us to control for the export and import status of firms. Then, for the reasons we discuss below, we examine only the sample of exporting firms.

6.2 Endogeneity issues

A potential endogeneity concern arises when studying the relationship between firms' export intensity and the volatility of employment (omitted variable bias). While skill-neutral technological change affecting the volatility of labor demand irrespective of the skill level is purged by taking the ratio of volatility, the existence of skill-biased technical change is well documented in the literature (*e.g.*, Autor et al., 2003) and may introduce a bias in our estimations. Indeed, a skill-biased technological shock can affect both firms' exports and the relative volatility of skilled labor. As many different patterns may arise, we remain agnostic as to the ensuing bias, and rely upon an instrumental variable approach to correct for it, using instruments that are correlated with the export intensity of firms, but are uncorrelated with firms' volatility in

employment growth.²⁴ We adopt a similar strategy to tackle the issue of endogeneity of firm level imports, when included in estimations.

To construct our instruments, we rely on a procedure that has become widely adopted in the trade literature since the work of Hummels et al. (2014), and Hummels et al. (2018): firm-level export intensity is instrumented by the firm-level foreign demand computed as follows. First, for each HS6 product p and destination market j served by a French firm in year t , we compute the total imports from all trading partners (excluding purchases from France), $Imports_{jp,t}^{noFRA}$, expressed in current dollars (at market exchange rates).²⁵ Second, we compute firm's time-invariant destination-product weights, ω_{ijp} , by using the average share of firm i exports to destination j in product p over the period 1996-2007. Third, we compute the foreign demand FD_{it} as a weighted average of foreign import demand shocks:²⁶

$$FD_{it} = \sum_{j,p} \omega_{ijp} Imports_{jp,t}^{noFRA} \quad (4)$$

$$\text{where } \omega_{ijp} = \frac{\sum_t Exports_{ijpt}}{\sum_t Exports_{it}}$$

Using a similar procedure to the one described above, we build the instrument for firm import intensity. In this case, we use foreign supply to French importing firms FS_{it} . For each HS6 product and sourcing market from which a French firm is importing in a year t , we compute the sum of foreign exports (excluding exports to France), $Exports_{jp,t}^{noFRA}$, weighted by the average share of product p and origin j in firm i 's imports over the period 1996-2007, η_{ijp} .²⁷ This yields:

$$FS_{it} = \sum_{j,p} \eta_{ijp} Exports_{jp,t}^{noFRA} \quad (5)$$

$$\text{where } \eta_{ijp} = \frac{\sum_t Imports_{ijpt}}{\sum_t Imports_{it}}$$

We rely on time-invariant weights (i.e over-the-period shares) to compute these instruments since they are free of composition and reverse causality problems related to the change of weights over time. As a robustness check, we also present estimates using weights ω_{ijp} and

²⁴The validity of the exclusion restriction is qualitatively supported by the non-significant effect of the IVs on the relative skilled volatility after controlling for the firm's size and export intensity.

²⁵HS6 import data are taken from BACI database (CEPII).

²⁶Additional details on the construction of the instrumental variable adopted in this paper can be found also in Berman et al. (2015) Appendix A.

²⁷HS6 export data are taken from BACI database (CEPII).

η_{ijp} based on the export (import) portfolio of firms in the starting year.²⁸ In the cross-section estimations, the two Bartik instruments, i.e. FD_{it} and FS_{it} , are averaged over the period 1996-2007. In the panel estimations the same Bartik instruments are averaged for every sub-period.

The IVs discussed above belong to the shift-share (or Bartik) type of instruments widely used in the previous literature.²⁹ Recently, this type of IVs received great attention, with a focus on the exclusion restriction hypotheses to be satisfied for being exogenous. In particular, the recent paper by Goldsmith-Pinkham et al. (2020) stresses the importance of the exogeneity of the weights (share component) used to allocate the aggregate shocks (shift component), and proposes a test based on the relative importance (Rotemberg weights) of each specific component of the weight (origin- or sector-specific share) in explaining the overall power of the IV. Applying the methodology proposed by Goldsmith-Pinkham et al. (2020) at firm level, in our framework, is extremely complicated. Indeed, potentially each firm has its own Rotemberg weights, and concluding on which market-product combination drives the most the IV estimations may be misleading. At the same time, this is the strength of our IV: given the high heterogeneity in the firm specific origin-product portfolio composition, it is unlikely that a given origin-product composition is responsible for the overall identification of the 2SLS estimation. Moreover, the inclusion of firm fixed effects in the panel estimations, by capturing any firm time-invariant characteristics (and so the weights ω_{ijp} and η_{ijp}), reassures us on the validity of the IV when estimated on a within variation. As discussed in Borusyak et al. (2021), the validity of the IV in our empirical framework is challenged by the presence of unobserved common component driving both world supply or demand (shift component of the IVs) and the labor demand volatility of firms. The removal of French export and imports respectively from the shift component in equations (4) and (5) reduces such a concern.

7 Results

This section presents our baseline results using both cross-section and panel approach. Our dependent variable is the ratio between skilled and unskilled employment growth volatility as shown in equation (3).

²⁸Building weights ω_{ijp} and η_{ijt} based on the export (import) portfolio of firms in the starting year would guarantee higher validity (exogeneity) of the IV. However, this would imply assigning null weight, and therefore null IV, to firms with zero export (import) in the starting year, implying less precise IV. For this reason, we use the ω_{ijp} and η_{ijt} weight in the starting year only as a robustness check.

²⁹This type of IV is often resorted when it comes to allocate aggregate shocks (country or country-sector specific) to smaller geographic areas (region or local labor markets). The shift-share approach is also widely used in the migration literature to instrument the immigrant labor supply shocks in a specific local labor market.

7.1 Cross-Sectional approach

We first estimate equation (3) using the universe of firms in our sample. To test the difference in the labor demand volatility faced by skilled and unskilled workers hired by exporters (or importers) *versus* domestic firms, we also control for export and import status. Table 2 presents OLS results on the full sample. We always control for firm’s size, which is associated with a significantly higher relative volatility of skilled labor demand.

Similarly to Table 1, here again, the coefficients associated to export and import status of the firm are not statistically significant: export and import status do not affect the relative volatility of skilled labor demand. Columns (2) and (3) show that for both export and import activity, a higher intensity is significantly associated with a lower relative volatility of skilled labor demand.

Table 2: Relative volatility of skilled labor demand.

	S.D. residual employment growth skilled/unskilled		
	(1)	(2)	(3)
Export status	-0.074 (0.088)		-0.034 (0.085)
Import status	0.003 (0.088)		0.066 (0.087)
Export intensity		-0.007*** (0.002)	-0.007*** (0.001)
Import intensity		-0.007*** (0.002)	-0.007*** (0.002)
Firm’s size (ln)	0.181*** (0.065)	0.215*** (0.058)	0.209*** (0.064)
Sample	Full	Full	Full
Industry FE	Yes	Yes	Yes
Estimator	OLS	OLS	OLS
Observations	33,379	33,379	33,379
R-squared	0.011	0.011	0.011

Notes: The dependent variable is the relative volatility of skilled labor demand, defined as the ratio between skilled and unskilled employment volatility. Firm level volatility of employment is computed as the standard deviation of the estimated residual of employment growth rate on firm and sector-year fixed effects for the period 1996-2007. Firm’s export intensity (and import intensity) is measured by the ratio of exports (imports) over total sales of the firm and then averaged over the period 1996-2007. Firm’s size is measured as the logarithm of total employment of the firm in the initial year. All estimations include 4-digit industry fixed effects. Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

All results so far suggest that export and import status have no effect *per se* on the relative volatility of skilled labor demand. Thus, in what follows we exclude domestic firms and focus on the sample of exporting firms (at the core of our theoretical intuition - see Online Appendix

section A.1). This will also be helpful because, as discussed in Section 4, considering the full sample of firms would require additional instrumental variables for export and import *status* besides export and import *intensity*. This can be problematic for three reasons. First, for pure domestic firms we cannot obtain weights ω_{ijp} and η_{ijp} , and the Bartik type IVs as in eq. (4) and (5) cannot be used to capture the export (import) participation margin of domestic firms.³⁰ Second, even by adapting the IVs presented in the previous section to cover also purely domestic firms, such IVs would likely affect at the same time the export (import) status and intensity of firms, and the resulting 2SLS will be imperfectly identified (i.e. with the same IV predicting at the same time both the export/import intensity and status). Finally, the theoretical framework proposed in section A.1 of the Online Appendix applies specifically to exporting firms only. For all these reasons, in what follows we prefer to focus on the sample of exporting firms.

Table 3 shows our cross-section results based on the sample of exporting firms. The OLS results are similar to the ones presented so far, with a slightly lower magnitude: a higher export or import intensity is associated with a lower relative volatility of skilled labor demand (Table 3, columns 1 and 2). As discussed above, OLS estimates cannot be interpreted as causal, due to the possible endogeneity bias related to the potential omitted variable problem. Therefore, in columns (3) to (6) we rely on the IV estimations discussed in Section 6.2. Specifically, columns (3) and (4) use over-the-period weights (ω_{ijp} and η_{ijp}), and columns (5) and (6) initial year weights (as robustness check). Similarly, firm level import intensity is instrumented by foreign supply. First-stage results, reported at the bottom of columns (3) to (6), support the relevance of these instruments and the absence of any problem of weak instrument (F-statistics above ten). Second-stage results, reported in the upper part of columns (3) to (6), do not exhibit any significant impact of import intensity. In contrast, they show that a higher export intensity results in significantly lower relative volatility of skilled labor demand, with a magnitude consistent with the one found previously.³¹ Using the point estimates reported in columns (4) and (6) of Table 3, we can conclude that, compared to a firm with zero or negligible exports, an exporter with mean level of export intensity (10.3 in Online Appendix Table A1) experiences 0.07 to 0.08 lower level of relative volatility of skilled labor demand. This corresponds to 3.7 to 4.2% reduction from the sample mean volatility ratio (1.98 in Online Appendix Table A1). While not negligible, this is not a big impact in itself, meaning that export intensity has to

³⁰In other words, we do not know which are the relevant foreign supply/demand shocks that apply to domestic firms. Moreover, notice that sector-average of Bartik IVs cannot be used to instrument export/import status of domestic firms as perfectly collinear with fixed effects.

³¹Table A4 in Online Appendix proposes a robustness test using the logarithm of the relative volatility of skilled labor demand as a dependent variable. Results are qualitatively the same. Online Appendix Table A5 shows robustness checks using alternative definition of workers' skills and results remain unchanged.

reach a rather high level to alter significantly the relative volatility of labor demand.³²

Detailed first stage results for the baseline specifications in columns (3) and (4) of Table 3 are reported in Online Appendix Table A3. These show the overall relevance of our IVs and the absence of weak IV problem, but a small identification concern: the instrumental variable for the export intensity (FD_{it}) predicts also the import intensity of the firm. Symmetrically, the instrumental variable for import intensity (FS_{it}) predicts the export intensity of the firms. For this reason, in what follows we focus on specifications including export intensity only, and consider the specifications with both import and export intensity (instrumented) as a robustness check.

Table 3: Export intensity and relative volatility of skilled labor demand. Sub-sample of exporting firms.

S.D. residual employment growth skilled/unskilled						
	(1)	(2)	(3)	(4)	(5)	(6)
Export intensity	-0.006*** (0.001)	-0.005*** (0.001)	-0.007 (0.004)	-0.008** (0.003)	-0.008*** (0.003)	-0.007** (0.003)
Import intensity		-0.004*** (0.001)		-0.000 (0.015)		0.005 (0.014)
Firm's size (ln)	0.151** (0.070)	0.158** (0.070)	0.156* (0.082)	0.092 (0.118)	0.163** (0.071)	0.082 (0.109)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	2SLS	2SLS	2SLS	2SLS
IV Export intensity			8.419***	10.848***	5.065***	6.171***
IV Import intensity				8.616***		3.575***
F-Stat first stage			1315.9	209.9	2433.1	567.6
IV weights ω_{ijp}, η_{ijp}			Average period		Initial year	
Observations	20,173	20,173	20,171	15,905	20,171	15,905

Notes: The dependent variable is the relative volatility of skilled labor demand, defined as the ratio between skilled and unskilled employment volatility. Firm level volatility of employment is computed as the standard deviation of the estimated residual of employment growth rate on firm and sector-year fixed effects for the period 1996-2007. Firm's export intensity (and import intensity) is measured by the ratio of exports (imports) over total sales of the firm and then averaged over the period 1996-2007. Firm's size is measured as the logarithm of total employment of the firm in the initial year. Columns (3) to (6) show IV results instrumenting export and import intensity relying on world foreign demand and supply faced by French firms. Columns (3) and (4) use constant weights over the period, and columns (5) and (6) use weight based on the initial year to build the IV. All estimations include 4-digit industry fixed effects. Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

7.1.1 Heterogeneity by firm size

Since export intensive firms tend to be larger (Bernard et al., 2007), the effect of export intensity on the relative volatility of employment growth (skilled *vs.* unskilled) may depend upon the initial size of the firm. To assess whether this is the case, we classify firms into two size

³²However, this is not a rare event in our sample, with a standard deviation of export intensity equal to 17.35.

bins measured by total employment of the firm in the initial year. We define as *big* those firms with initial total employment above median size, and *small* those firms with initial total employment below median size. Table 4 shows cross-sectional results. Columns (1) to (4) show OLS and IV results using sub-samples, i.e. big and small firms. Columns (5) and (6) show OLS and IV results using the entire sample, where we interact firm export intensity with the two size bins (binned model).³³ The results show that the effect of export intensity on the relative volatility of skilled labor demand is significant only for large firms. A possible interpretation is that the mechanisms proposed in section 3 characterize more closely the behavior of large firms, while smaller firms tend to have less leeway to adapt differentially across skill categories.

Table 4: Export intensity and relative volatility of skilled labor demand. Results by firm size. Sub-sample of exporting firms.

	S.D. residual employment growth skilled/unskilled					
	(1)	(2)	(3)	(4)	(5)	(6)
Export intensity	-0.008*** (0.001)	-0.013*** (0.003)	-0.002 (0.002)	-0.002 (0.005)		
Exp. int. × big					-0.008*** (0.001)	-0.010*** (0.003)
Exp. int. × small					-0.002 (0.001)	-0.004 (0.005)
Big size dummy					0.455*** (0.046)	0.476*** (0.077)
Sample:	Big exporters		Small exporters		All exporters	
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Estimator	OLS	2SLS	OLS	2SLS	OLS	2SLS
IV Export Intensity		14.149***		6.289***		
IV Exp. int. × big						15.485***
IV Exp. int. × small						6.433***
F-stat first stage		498.6		790.7		448.6
Observations	9,129	9,129	11,026	11,024	20,173	20,171

Notes: Sample of exporting firms. The dependent variable is the relative volatility of skilled labor demand, defined as the ratio between skilled and unskilled employment volatility. Firm level volatility of employment is computed as the standard deviation of the estimated residual of employment growth rate on firm and sector-year fixed effects for the period 1996-2007. Columns (1) and (2) consider big firms, while columns (3) and (4) focus on small firms. Finally columns (5) and (6) use binned model regression. Big *versus* small size bins are based on whether the firm's initial size is above or below the sample median. All estimations include 4-digit industry fixed effects. Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

³³In Table 4 we do not control for the import intensity of firms to reduce the omitted variable concern. However, results in Table 4 are qualitatively identical after controlling for import intensity. Results available upon request.

7.1.2 The effect on wage volatility

Beyond employment, adjustment to foreign shocks may also affect wages. We thus apply our estimation framework to wages instead of employment: the whole structure is unchanged, except for the dependent variable, which is now constructed using the volatility of wage growth, instead of employment growth. Here, the dependent variable is thus the relative volatility of the wage growth of skilled labor (compared to unskilled ones). Table 5 reports OLS and 2SLS estimates. Results show that export and import intensity are both significantly associated with a lower relative volatility of skilled wages. However, this relationship vanishes when we include both export and import intensity (instrumented) in column (4). One possible reason could be related to the significant stickiness of wages in the French labor market, as discussed in Section 2.2.

Table 5: Export intensity and relative volatility of skilled labor wage. Sub-sample of exporting firms.

	S.D. residual wage growth skilled/unskilled			
	(1)	(2)	(3)	(4)
Export intensity	-0.004*** (0.001)	-0.003* (0.001)	-0.010** (0.005)	-0.009 (0.006)
Import intensity		-0.006*** (0.002)		-0.008 (0.009)
Firm's size (ln)	0.111*** (0.025)	0.119*** (0.025)	0.139*** (0.034)	0.096** (0.040)
Industry FE	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	2SLS	2SLS
IV Export intensity			8.419***	10.848***
IV Import intensity				8.615***
F-Stat first stage			1315.9	209.9
Observations	20,173	20,173	20,171	15,905

Notes: Sample of exporting firms. The dependent variable is the relative volatility of skilled wage, defined as the ratio between skilled and unskilled workers' wage volatility. Firm level volatility of wages is computed as the standard deviation of the estimated residual of wage growth rate on firm and sector-year fixed effects over the period 1996-2007. Firm's export intensity (and import intensity) is measured by the ratio of exports (imports) over total sales of the firm and then averaged over the period 1996-2007. Firm's size is measured as the logarithm of total employment of the firm in the initial year. Columns (3) and (4) show IV results instrumenting export and import intensity relying on world foreign demand and supply faced by French firms. Columns (3) and (4) use constant weights over the period. All estimations include 4-digit industry fixed effects. Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

7.2 Panel approach

As mentioned above, a different empirical strategy is possible, whereby various sub-periods (two 6-year periods or three 4-year periods) are considered separately.³⁴ At the cost of evaluating the volatility of employment growth over shorter time periods (and therefore with less accuracy), this approach allows to analyze the effect of *changes* in export intensity on *changes* over time in the relative volatility of skilled labor demand of firms. The panel estimation presents two main advantages but also some drawbacks. First, it allows firm fixed effects to be introduced, making it possible to control for unobservable, time-invariant firm characteristics. Second, it allows using time-varying instruments for foreign demand faced by firms. The average size of the firm, now captured by firm fixed effects, is not included anymore. Similarly, the 4-digit industry fixed effect are subsumed by firm fixed effect, and 2-digit sector-by-period fixed effects introduced to control for sector specific shocks in different time periods. The main drawback of this specification, however, is the lack of accuracy in the calculation of volatility over short time period. For this reason, in what follows we rely on estimates based on two 6-year periods panel (see Table 6), and report in Online Appendix Table A6 those based on 4-year sub-periods panel (whose results are however fully consistent with those based on the 2-period panel).

Based on this specification, OLS estimates show a negative (but imprecisely estimated) effect of export intensity on the relative volatility of skilled labor demand - see column 1 in Tables 6 and A6 in Online Appendix. The negative coefficient on export intensity turns to be significant when using 2SLS estimates - see columns (2)-(4) in Tables 6 and A6. Interestingly, the exploited variability from panel approach (*within* identification) produces much larger point estimates than in the cross-section approach (*between* identification). According to the specification reported in columns (3) and (4) of Table 6, a firm that moves from zero or negligible export intensity, to an average level of export intensity (10.3 in Online Appendix Table A1) experiences 0.9 to 1.1 lower level of relative volatility of skilled labor demand. Considered the distribution of relative volatility reported in Online Appendix Table A2, this corresponds to the difference between the first decile and the median, or between the median and the 80th percentile in the relative volatility of skilled labor demand. The large magnitude of the *within* effect of export intensity on the relative volatility of skilled labor demand, in particular if compared with the small point estimates based on cross-sectional data (*between* identification), suggests the policy relevance of our results. It is indeed a *change* in the foreign exposure of firms that affects the employment outcomes of firms over time.

³⁴To introduce temporal variation in our dependent variable, we compute volatility measures using two samples. The first sample is over two 6-year windows: 1996-2001 and 2002-2007. The second sample is over three 4-year windows: 1996-1999, 2000-2003, 2004-2007.

Table 6: Export intensity and the relative volatility of skilled labor demand. Two-period panel estimation. Sub-sample of exporting firms.

	S.D. residual employment growth skilled/unskilled			
	(1)	(2)	(3)	(4)
Export intensity	-0.010 (0.006)	-0.112* (0.059)	-0.112* (0.061)	-0.093* (0.053)
Import intensity			-0.001 (0.042)	0.068 (0.056)
Firm FE	Yes	Yes	Yes	Yes
Industry-time FE	Yes	Yes	Yes	Yes
Estimator	OLS	2SLS	2SLS	2SLS
IV Export intensity		3.260***	3.001***	3.976***
IV Import intensity				4.755***
F-Stat first stage		305.9	267.3	66.3
Observations	28,212	28,208	28,208	21,768

Notes: Sample of exporting firms. The dependent variable is the relative volatility of skilled labor demand, defined as the ratio between skilled and unskilled employment volatility. Firm level volatility of employment is computed over two different sample periods. Each specification includes firm and sector-by-period fixed effects (at the 2-digit). Columns (2) and (3) show IV results when instrumenting export intensity, while column (4) shows the IV results when instrumenting both export and import intensity. Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

8 Testing the mechanisms at play

Our theoretical framework reported in Section 3 suggests that the main source of the heterogeneous effect of export intensity on the volatility of employment growth across skill categories comes from skilled-labor specific requirements in fixed export costs. In order to assess the relevance of this hypothesis, we take advantage of the fact that fixed export costs are likely to affect more the extensive (i.e. export participation and number of markets served) than the intensive margin of trade (i.e. average volume of sales *per* market).³⁵ Indeed, the cost to adapt the product to a specific destination (i.e. consumers taste and/or technical standards) is fixed, and not directly proportional to the volume of sales on the market. Thus, the impact of export intensity on the relative volatility of skilled labor demand should be mainly driven by the extensive rather than by the intensive margin of exports. In case of many destination markets, if the same set of skilled workers can be used to reach such destinations (economies of scale in the knowledge of commercial laws and taste of consumers), we should expect that firms reaching a larger portfolio of destinations experience a lower relative volatility of skilled labor demand.

³⁵In a monopolistic competition model of trade with heterogeneous firms, the fixed export costs affect mainly the extensive rather than the intensive margin of trade. In Chaney (2008), section III, a change in the fixed costs of exports affects aggregate foreign sales only *via* the extensive margin of trade.

Empirically, the extensive margin is measured by the average number of destinations served by the firm over the period, while the intensive margin is measured as the ratio between firms' export intensity and the number of destinations (average over the period). Since it is difficult to instrument and properly identify the intensive and the extensive margin of exports, in this section we cannot use the IV strategy adopted so far and rely on OLS estimates using both a cross-section and a panel approach. The results in Table 7 confirm the hypothesis that it is the extensive margin that shapes the impact of export intensity on the relative volatility of skilled labor demand. Once again, 2-period panel (within) estimates point to much larger coefficients than cross-section based identification.³⁶ Specifically, a firm that reaches a larger set of destinations experiences a lower relative volatility of skilled workers. This happens because fixed costs (paid in units of skilled labor) are not destination specific (i.e. the firm uses the same set of know-how to reach several locations). According to column (7), doubling the number of destination served (*i.e.* adding 0.7 to its logarithm) decreases the relative volatility of skilled labor demand by approximately 0.24, or around 15% of the median of the relative volatility of labor demand (1.6 in Online Appendix Table A2). In contrast, the intensive margin is not found to have any statistically significant impact, a finding consistent with the hypothesis that the influence of exports on employment volatility is mainly linked to fixed export costs.

Another way to assert the importance of fixed export costs is to investigate whether the impact of export intensity varies across types of destinations. Because of the EU Single Market, we expect EU-destinations to be more easily accessible for French firms than non-EU destinations. Indeed, within-EU the export formalities are much simplified, from both an administrative and technical point of view. So, the fixed export costs (i.e. need for skilled workers) should be lower for within-EU than for extra-EU destinations. Accordingly, we decompose the export intensity of firms into EU and extra-EU destinations and apply our baseline cross-section approach. Results in Table 8 show that the relative volatility of skilled labor demand is more (negatively) affected by export intensity in extra-EU than EU destination. This confirms the intuition that the underlying mechanism works through the fixed export cost channel.

Finally, we show the importance of the fixed export costs mechanism by noticing that, due to the ensuing needs in terms of coordination, marketing and technical adaptation, entry and exit to/from export markets is more costly in terms of fixed costs than exporting continuously to a same set of destinations. Hence, we decompose the export intensity variable into two different categories: export intensity to *continuous* destinations (*i.e.*, destinations served

³⁶Results using 3-period panel are reported in Online Appendix Table A7.

without interruption over the whole period), and export intensity to *churning* destinations (*i.e.*, destinations served intermittently over the period). Results in column (2) of Table 8 support once again the fixed export cost channel in affecting the relative volatility of skilled labor demand: the magnitude of the export intensity effect to churning destinations is larger than for continuing destinations.³⁷

³⁷In Table 8 we do not control for the import intensity to reduce endogeneity concern. Results in Table 8 remain qualitatively identical after controlling for the import intensity of firms (available upon request).

Table 7: Extensive vs. intensive margin channel in affecting the relative volatility of skilled labor demand. Sub-sample of exporting firms.

	Cross-section				2-period panel			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Export intensity per dest.	-0.002 (0.002)		-0.001 (0.002)	-0.000 (0.002)	-0.010 (0.010)		-0.009 (0.010)	-0.007 (0.012)
# destinations (ln)		-0.040* (0.024)	-0.040* (0.024)	-0.029 (0.026)		-0.349** (0.154)	-0.349** (0.154)	-0.320*** (0.120)
Import Intensity				-0.005*** (0.002)				-0.025 (0.040)
Industry FE	Yes	Yes	Yes	Yes	No	No	No	No
Firm FE	No	No	No	No	Yes	Yes	Yes	Yes
Industry-time FE	No	No	No	No	Yes	Yes	Yes	Yes
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Observations	20,173	20,173	20,173	20,173	28,212	28,212	28,212	28,212

Notes: Sample of exporting firms. The dependent variable is the relative volatility of skilled labor demand, defined as the ratio between skilled and unskilled employment volatility. Firm level volatility of employment is computed as the standard deviation of the estimated residual of employment growth rate on firm and sector-year fixed effects for the period 1996-2007. Intensive margin is measured as the ratio between export intensity and the number of destinations (mean over the period). The number of destinations is the average number of destinations served by the firm over the period. Columns (1) to (4) include the logarithm of total employment of the firm in the initial year (as a proxy for firm's size). Columns (5) to (8) include firm and sector-by-period fixed effects (at the 2-digit). Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table 8: Export intensity by type of destination and relative volatility of skilled labor demand. Sub-sample of exporting firms.

	S.D. residual employment growth skilled/unskilled	
	(1)	(2)
Export intensity (EU)	-0.004*** (0.001)	
Export intensity (extra EU)	-0.008*** (0.003)	
Export intensity (continuous)		-0.004*** (0.001)
Export intensity (churning)		-0.008*** (0.002)
Firm's size (ln)	0.150** (0.069)	0.149** (0.069)
Industry FE	Yes	Yes
Estimator	OLS	OLS
Observations	20,173	20,173
R-squared	0.017	0.017

Notes: Sample of exporting firms. The dependent variable is the relative volatility of skilled labor demand, defined as the ratio between skilled and unskilled employment volatility. Firm level volatility of employment is computed as the standard deviation of the estimated residual of employment growth rate on firm and sector-year fixed effects for the period 1996-2007. Firm's export intensity is measured by the ratio of exports over total sales of the firm and then averaged over the period 1996-2007. EU and non-EU firm export intensity refer to EU and non-EU destination country exports, respectively. Continuous destinations are those in which the firm exports continuously over the period, while churning destinations are those in which the firm occasionally exports. Firm's size is measured as the logarithm of total employment of the firm in the initial year. Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

9 Conclusion

This paper investigates how globalization shapes labor markets, and in particular how foreign demand shocks affect the volatility of employment for workers with different skill levels. Relying on an econometric strategy that deals with endogeneity concerns, our results show that firms with higher export intensity, and in particular those exporting to a large number of destinations, have a higher volatility of unskilled labor demand relative to the volatility of skilled labor demand. In other words, unskilled workers are more affected than skilled workers by the additional volatility entailed by export shocks.

These findings suggest that international trade might affect differentially skilled and unskilled workers not only in terms of employment or wage levels, but also by increasing inequalities in terms of volatility of employment. Given the importance of the concerns related to precariousness on the labor market, employment volatility by skill level is an important additional dimension, which would deserve further analysis to better understand the mechanisms at stake, their consequences, and potential remedies. Our study takes a first step in this direction.

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