Fighting Income Inequality with International Trade

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Abstract

How does international trade affect the wage distribution across workers? We use detailed employer-employee data from Spain from 1987 to 2004 to answer this question. Using a new instrumental variable approach to disentangle trade openness's effects on the distribution of income and wages, we document that an increase in local trade exposure reduces wage inequality. Furthermore, we show that this result is associated with changes happening at the within-industry and within-firm levels. At the within-industry level, we show that trade openness reallocates workers towards small firms and low-skilled jobs. While at the within-firm level, we find that small firms increase their labor intensity and the average amount of workers, while larger firms reduce it in response to changes in trade openness. These changes are consistent with an increase in the relative demand for low-wage and low-skill types of workers.

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1 Introduction

One of the features that have characterized the economies around the world during the last 40 years is the sharp increase in income inequality. This increase in inequality created a large interest between policymakers, researchers in social science, and the general population due to the welfare and social implication that are inherent to this process. At the same time, during this period the worldwide economy has experienced dramatic technological changes, and a sharp increase in international trade flows around the globe. As a consequence, these changes have been usually pointed out as the responsible forces for the changes in inequality in both developed and developing nations.

This paper studies the impact that global integration through international trade has on income inequality. Using employer-employee data, and equipped with recent advances in econometric methods, we develop a new instrumental variable approach to disentangle the effect that international trade had on wage and income inequality in Spain between 1993 and 2004. We focus on Spain during this period because Spain entered the European Single Market (ESM henceforth) in 1993.

Spain's into the ESM is coupled with two clear features directly observed in the aggregate data. Spain presents a sharp increase in a) trade openness and b) wage inequality, as shown in figure A.1. In this paper, we estimate the impact that this trade liberalization episode had over Spanish wage distribution during this period. We show that surprisingly, and contrary to common belief, the increase in international trade flows reduced income inequality in Spain for the period under study.

Our results suggest small benefits from increased trade for workers at the bottom of the income/wage distribution and larger losses for those in the top parts of the income/wage distribution. We show that this decrease in inequality is rooted in the firm and job level changes triggered by the increase in international trade. In particular, when looking across firms, increases in international trade shifted workers from medium and large-size firms toward small firms and, while at the same time pushing workers towards low-skill jobs, to the detriment of middle and high-skill positions. Additionally, increases in trade openness exposure also generated changes in the way firms organized their production. Small firms became more labor intensive, and increased their amount of labor, while larger firms reduced it. These within and across firm-level changes increased the relative demand for low-wage and low-skill types of workers, pushing their relative wages up and reducing income inequality.

These changes in wages were partially driven by two channels operating at different

levels, one at the within-industry level, and the other at the within-firm level. Since smaller firms are more intensive in low-skill workers and tend to pay lower wages, the reallocation of workers towards these types of firms, decreased the relative demand for medium and high-skill types of workers, reducing their premium. Second, as these smaller firms became more intensive in labor, and more low-skill intensive, they increased the relative demand for workers at the bottom of the wage distribution.

From an empirical perspective, to identify the effects of Spain's entry into the ESM, the key idea of our identification strategy relies on exploiting the sequential entry of different countries into the European single market (ESM). Our main assumption is that as countries enter the ESM, the trade responses at the industry level have two types of components, one that is country and time specific and another one that is common across countries. This allows us to exploit the trade openness evolution in countries that entered the ESM after Spain as an instrument for the trade openness evolution in Spain when it entered the ESM. The underlying idea is that we are able to capture the common component that affects the countries that enter the ESM, without taking any Spanish component that may be affecting international trade and labor outcomes at the same time. For instance, changes in regulations in the labor market that may affect the demand for a certain type of worker and the firm's ability to produce and export, or sectoral productivity shocks that may also affect international trade and labor demand in a particular industry may lead to bias in the estimate of the effect that international trade has over the labor market in the absence of an instrument providing exogenous variation.

We embed this instrumental variable approach, on an otherwise standard shift-share approach, to estimate the effects on earnings and wages over their respective distributions, of changes in trade exposure for particular regions in Spain as suggested in Borusyak et al. (2022). We believe that these regions are the relevant unit of observation to observe the worker's labor market outcomes given the observed small migration of workers across regions.

These findings speak directly to a growing literature that argues that the standard Stolper-Samuelson predictions have not been observed in some trade liberalization episodes (see Goldberg and Pavcnik (2007) and Goldberg and Pavcnik (2005)) and that shows that intra-industry adjustment are important to understand the effects that international trade has over the wage distribution as in Egger and Kreickemeier (2009), Helpman and Itskhoki (2010), Egger and Kreickemeier (2012) M. Amiti and D. R. Davis (2012), Ekholm and Midelfart (2005) Grossman et al. (2017). We contribute to this literature in at least three ways. First, by causally estimating the effect that this trade liberalization episode had

over the whole distributions of wages. Second by showing the labor market responses to the changes in international trade are driven not only by changes happening at the intra-industry level but also at the intra-firm level, something absent in most of the previous studies in the literature. And third, we develop a new instrumental variable that can be applied to several other cases that presented sequential entry, together with the use of new econometric techniques to estimate the effects that trade has over the whole distribution of wages.

Interestingly, we also rule out several usual mechanisms considered in previous literature as drivers of these changes. Our results show that at, least for the Spanish case, the increased trade exposure did not have an impact on entry or exit from unemployment, and a very small negative impact on labor market churning (i.e.workers tend to change slightly less firm or industry) speaking directly to the literature that relates trade and labor churning as discussed by Davidson et al. (1999). Similarly, we do not find any evidence of systematic employment shifts from manufacturing to service jobs or vice-versa, despite the large decrease in manufacturing's share of employment observed during this period, and contrary to some recent findings for the Brazilian trade liberalization episode as in Menezes-Filho and Muendler (2011).

2 Data

Our main data source is the Spanish Social Security Registry (MCVL). The MCVL contains the labor stories of a random 4% sample of the universe of Spanish employees, self-employed, unemployed individuals, and retirees for the years 2006 to 2018. One of the main advantages of the MCVL is that the inclusion of an individual in a year sample implies the inclusion of her complete social security history, from the first moment she entered the labor market. This allows us to create a panel of workers starting as early as 1980 up to 2004, even if no representative samples are available for that period of time. This approach is similar to the approach used by Arellano-Bover (2020) in this same dataset.

Our data contains daily information on employment, including job (type of contract, skill group, hours, location, etc.) individual (age, gender, education, etc.), and firm characteristics (firm ID, industry, age of the firm, etc.). For each employment, unemployment, and retirement record, wages or benefits are observed at a monthly frequency, and top coded. We do not observe wages for self-employment records.

We combine all information by creating a yearly panel that contains information for only the main (most hours worked) job in that year, even though we calculate total income

and hourly wages using all jobs for the period. Furthermore, we discard all observations whose main yearly activity is self employment, public administration or agricultural jobs. Finally, we also discard all observations where no location or industry code is available. We keep observations where the main activity for the year is unemployment, but do not include unemployment benefits in total income or wages. We convert all income and wages to 2006 EUR using the CPI from the Spanish National Institute of Statistics (INE).

Our trade openness data comes from combining two different sources. The OECD's input output tables provide information on yearly imports, exports and output for over 30 industry groups in the period 1995 to 2016. Data from the period 1987 to 1994, for Spain, is extracted from the Spanish National Statistics Institute. Industry codes, names, classification system, and currency units vary in each data source. We manually match each industry to its post 1995 group, using the naming conventions, to construct a continuous series from 1987 to 2004.

One concern of extracting samples of workers for 1987 to 2004 looking backwards from the mid 2000's representative samples is sample selection. Potentially, the further we move from 2006 into the past, the less representative our sample might be compared to the Spanish population of that period [1]. We address these concerns from two different angles.

First, we restrict our sample to be older than 20 and younger than 55 years old at any point in time. This ensures, that no individual will be older than 74 years old by 2006, alleviating the potential sample selection due to mortality. Second, we check our sample's representativeness with aggregate Spanish labor market data from the INE for the periods 1987 to 2004. Table 1 presents multiple aggregated moments for our MCVL sample and the complete Spanish Population using INE's aggregated data for the period, restricted to those in the 20 to 54 years old range that are not employed in the agricultural sector.

We do not find large differences in the level or evolution over time, between the MCVL sample and INE's data, along most of the dimensions we analyze. As expected, we find that our sample to population ratios become smaller as we use earlier years. For 2004 we find a 4% sample to population ratio, in line with the size of the random sample selected, while in 1987 only 2.9% of the total population of interest is represented in our sample. On the positive side, the relative decrease in sample size does not seem strongly associated with a large sample selection problem.

Four main divergences are worth pointing out. First, regarding the relative employment

[1] This is possible if the informal market composition or magnitude vastly varied over the years during our period of interest, or if a vast amount of the workers in the late periods of the 80's are already deceased by the mid-2000s (thus we would not observe them in retirement when our representative samples start)

Table 1: Summary Statistics

	1987		1993		1998		2004	
	Data	Pop	Data	Pop	Data	Pop	Data	Pop
N (000's)	246	8,408	343	9,542	441	11,311	603	15,088
Pop in Data	0.029		0.036		0.039		0.040	
Female	0.295	0.306	0.348	0.346	0.377	0.368	0.420	0.413
20-29	0.406	0.351	0.376	0.323	0.369	0.315	0.329	0.294
30-39	0.359	0.367	0.363	0.381	0.364	0.382	0.377	0.390
40-49	0.232	0.283	0.257	0.295	0.263	0.303	0.290	0.316
Manufacturing	0.290	0.286	0.233	0.237	0.206	0.222	0.168	0.186
Construction	0.108	0.102	0.114	0.105	0.116	0.108	0.137	0.131
Service	0.604	0.612	0.653	0.658	0.678	0.670	0.695	0.683
Large City	0.325	0.299	0.321	0.282	0.308	0.284	0.300	0.289
Medium City	0.273	0.296	0.269	0.295	0.275	0.291	0.286	0.294
Small City	0.402	0.405	0.409	0.423	0.417	0.425	0.414	0.417
Average Earnings	15,346	16,045	17,957	18,068	16,820	18,260	17,082	17,043
Median Earnings	14,252		16,494		15,219		15,454	
Average H Wages	8.04		9.45		9.21		9.30	

in Madrid and Barcelona during the late '80s and early '90s, where the MCVL shows up to 3.5pp (or 10%) larger employment than our national representative data. This result highlights the relative differences in the importance of the informal sector across locations, paired with the decrease in the importance of the informal sector on total employment over time. Second, we find a 1.8 pp (10%) divergence in the share of employment in manufacturing for the year 2004. We attribute this divergence to our assignment of 2 digit industries into manufacturing and construction, as well as, to the conversion of industry information in different time periods into one single industry classification system that does not overlap perfectly. Third, as expected, our sample skews younger in all periods of time, but this effect is much more pronounced in the early years of our samples, becoming much closer to the INE samples during the 2000s. Primarily, we attribute this difference to the effects of mortality in our sample. Lastly, we find average total earnings to be very similar in the MCVL and INE's data for all years except 1998, which presents an 8% lower value in the former compared to the latter.

In summary, we believe our sample provides a good representation of the labor market for our period of interest (especially for the years after 1993 where most of our analysis and estimation are focused). While certain limitations exist, we find them not to pose an important threat to our conclusions in this paper.

Finally, to overcome the lack of data from the firm's side, we use data from the SEPI Foundation, a public entity linked to the Spanish Ministry of Finance and Public Administrations, in particular, we use data from the Survey on Business Strategies (Encuesta sobre Estrategias Empresariales, ESEE, in Spanish). This database provides a representative sample from firms with more than 10 employees in the manufacturing sector, with data starting in 1990. This data set had been widely used in economic research[2], and allow us to observe key variables at the firm level to identify the changes within and across firms that take place after the trade liberalization episode. For example, we can observe the location of the firms, their total sales, exports and imports, the firm's expenditure on labor, and the firm's total value added, among others variables. One of the limitations of this dataset is that it only contains information about a particular sector, manufacturing. We do not believe that this will affect our understanding of the main underlying process taking place in the economy as a response to increased trade openness. The reason is that using the MCLV dataset we do not find any significant differences in the response of the labor market to changes in the trade openness conditionally on the worker's industry.

3 Empirical strategy

Our basic equation of interest to understand the effects of trade openness (denoted as TO) on wages, earnings, and any other dimensions is presented below:

$$Y_{i,p,k,t} = +\beta_1 \ln TO_{p,t} + \beta X_{i,p,k,t} + \alpha_i + \epsilon_{i,p,k,t} \tag{1}$$

for the individual i, working in industry k, located in province p at time t.

Recovering the causal effect of openness to trade on wages directly from 8 is not feasible due to at least two reasons. First, the existence of unobserved variables affecting the evolution of trade openness of province p and wages simultaneously. For instance, if areas with larger labor supply growth tend to accumulate more trade, and labor supply growth affects wages, we would face an omitted variable bias problem. Second, the potential existence of reverse causality. Provinces with higher or lower wage growth might be more likely to

[2]see for example https://www.fundacionsepi.es/investigacion/esee/sesee_articulos.asp

engage in more international trade. To overcome these potential problems and estimate the impact of international trade on our outcomes of interest we use a shift-share instrumental variable approach, similar to the one used in Autor et al. (2016) and as described by Borusyak et al. (2022).

3.1 Shift share instrumental variable

Our original data from the OECD contains imports, exports, and output, by industry, for each year from 1987 to 2004. Our interest is to build a measure of exposure to international trade for each location and time period. We believe that a location-based measure of trade openness is the most adequate dimension to capture workers' exposure to international trade. Workers rotate industries relatively often (in our sample on average, 24% of workers change their industry from one year to the next, down to 22% when only the years after 1992 are considered), while location changes are far more uncommon (on average 17% of our sample of workers change location in a given year, and only 14%, on average, changes location from one year to the next after 1992)[3].

We measure the trade openness exposure at time t for each province, p, as the weighted sum of the period's trade openness in each industry k, where the weights are the industry's employment shares for each location.

$$TO_{p,t} = \sum_{k} \frac{N_{k,p,t}}{N_{p,t}} TO_{k,t} \tag{2}$$

Where $N_{k,p,t}$ denotes the number of employees in industry k, province p in time t; and $TO_{k,t}$ the trade openness of industry k at time t. Since the evolution of the local industry employment shares may be endogenous to the evolution of trade, the use of current employment shares could generate a bias in our estimates. To overcome this problem we lag the local industry's employment shares by 3 years. Even if the changes in trade have some degree of persistence over periods for a location, the 3-year lag allows us to minimize those concerns. Therefore, we update our measure of local exposure to trade openness to:

$$TO_{p,t} = \sum_{k} \frac{N_{k,p,t-3}}{N_{p,t-3}} TO_{k,t} \tag{3}$$

Even with the introduction of lagged industry employment shares, there is still the con-

[3]This is also motivated by the results documented by **autor˙china˙2013**, Autor et al. (2014), Autor et al. (2016), that document that import shocks have a low impact on the movements of worker across locations for the USA.

cern that today's industry trade openness $TO_{k,t}$ is not exogenous but potentially correlated with other characteristics that also affect earnings or wages. Since our values of local trade openness exposure are built from industry measures of trade openness, this could generate a bias in our estimated results. Additionally, workers can anticipate the changes in trade openness and try to change industries that can be correlated with future changes in international trade.

To circumvent these issues, we instrument the evolution of the trade openness for each industry in Spain with the evolution of trade openness in the same industry but in a set of different countries at a different point in time. Specifically, we focus on the Czech Republic, Hungary, and Poland, countries that enter the European Single Market in 2004, 11 years after Spain, but did not adopt the Euro as their currency. Regarding the timing, we match our panel such that trade openness in Spain in industry k for 1993 (Spain's first year in the ESM) coincides with the average trade openness in the Czech Republic, Hungary, and Poland in industry k in 2004 (their first year in the ESM).

The idea of instrumenting the Spanish trade openness for each industry with the countries that enter the European single after Spain lies in the assumption that the trade liberalization exposure to similar countries generates changes in the trade openness in each country that are similar. The main idea is that joining the same markets, even though at different times, generates trade dynamics that share some common component. Taking the average over the countries allows us to diminish the relevance of the characteristics of each country, rising the relevance of the common component that is present in the evolution of trade openness of each industry.

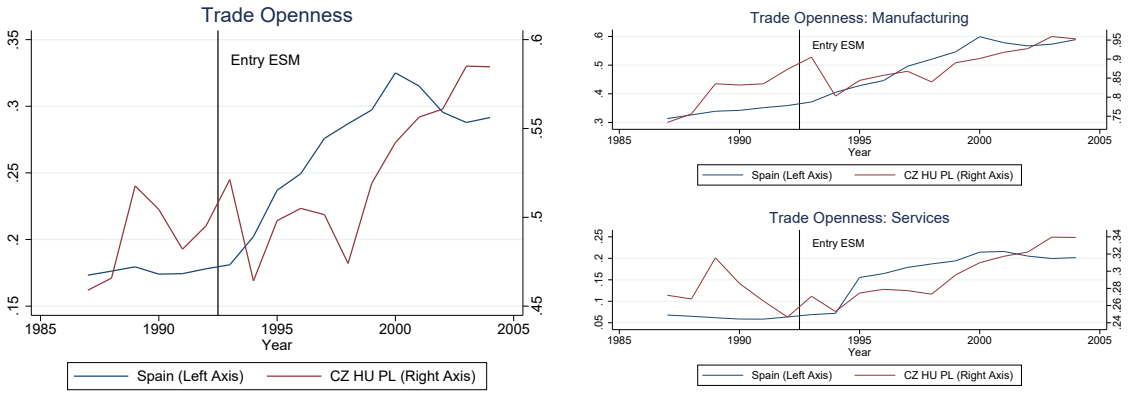
In the left panel of Figure 1 we present the evolution in the trade openness in Spain vs the mean trade openness of Poland, the Czech Republic, and Hungary, matched at their respective points of entry in the ESM. Additionally, the two panels to the right of figure 1 show how this evolution of trade openness compares when we separate sectors in service and manufacturing groups. All graphs depict a similar picture. Prior to the entry into the ESM, there was little correlation between industry's trade openness in Spain vs the later entry countries (although manufacturing already shows some similar patterns). After entering the EU, the level of trade openness shoots up with both series evolving in a much similar pattern[4].

Besides the assumption of the common component in the existence of trade openness evolution that is generated by the entry of a country into the European Union, our iden-

[4]The Great Recession shows a dip in trade openness in our group of late entry countries, corresponding to the years 1996 to 1998 in our figures.

Figure 1: Spain vs Later Entry Countries Trade Openness

All Industries *Manufacturing & Service Industries*



tification assumption relies on the fact that there are no other changes affecting the trade openness evolution by industry and the wage distribution at the same time when a country joins the European Union, once we control for the relevant characteristics. Situations in which countries are at similar points of economic development when they join the ESM, leading to a rapid increase in trade, would generate a bias in our results. Similarly, if joining the ESM generates other types of economic changes (subsidies, changes in access to credit conditions, etc.) that affect both the decision to trade and wages, this could bias our results. Finally, another threat for our empirical analyses lies in the existence of industry changes over trade that also affect wage distribution and trade openness during 1993-2004 in Spain, and that they were also present with similar relatively implications across industries for the Czech Republic, Hungary, and Poland during the period 2004 to 2015. While theoretically possible, we believe that this is relatively unfeasible, due to the differences in the ESM entry periods and the robustness of our results to different specifications that consider this possibility.

We instrument $TO_{p,t}$ using $TO^{IV}_{p,t}$, which is constructed as:

$$TO^{IV}_{p,t} = \sum_{k} \frac{N_{k,p,t-3}}{N_{p,t-3}} \left(\frac{TO^{CZ}_{k,t+11} + TO^{HU}_{k,t+11} + TO^{PL}_{k,t+11}}{3} \right) \tag{4}$$

where $TO^{j}_{k,t+11}$ is the trade openness of industry k in the country j for the time period that matches the number of years in the ESM of Spain (i.e $t + 11$ since CZ, HU, and PL enter the ESM 11 years after Spain)

First Stage Results

After following the procedure above to construct our instrument, our first stage specification will be:

$$\ln TO_{p,t} = \gamma_1 \ln TO^{IV}_{p,t} + \gamma X_{i,p,k,t} + \theta_i + e_{i,p,k,t} \tag{5}$$

The first stage estimates are presented in Table 2. We use two different specifications, that differ in the control variables used. Our *Base* specification, includes industry, year, province, age, and individual fixed effects. Similarly, our *All* specification includes all controls in the *Base* model but adds industry year fixed effects, as well as, skill and firm size trends and controls for industry and firm changes, as well as their interactions.

Looking at the first 2 columns in Table 2, the F statistic is large, ranging from 37 to 46 depending on the specification, and the estimated coefficient is in line with our expectations.

Table 2: First Stage Results

	(Post ESM Entry) (1993-2004)		(Pre ESM Entry) (1987-1992)	
	$\ln TO_{p,t}$	$\ln TO_{p,t}$	$\ln TO_{p,t}$	$\ln TO_{p,t}$
$\ln TO^{C}_{p,t}$	0.632***	0.604***	0.045	0.087
	[0.105]	[0.091]	[0.199]	[0.185]
Obs	4401114	4176277	767956	688355
R^2	0.978	0.980	0.996	0.997
Base	Yes	Yes	Yes	Yes
All	No	Yes	No	Yes

Province level clustered standard errors in brackets.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$s

Testing the Instrument

Our data and empirical strategy allow us to test some of the identification assumptions of the instrumental variable approach. Our assumption states that the entry into the European Single Market generates a common dynamic in trade openness. If this is the case, we should not observe any valid relationship between the potential endogenous variable and the instrument in the years prior to the entry into the European Single Market. Therefore, to test whether this assumption is reasonable, we reestimate our first stage but focus on the

period before entry into the European Single Market. Specifically, we rerun our first stage results for the years 1987 to 1992 in Spain, matched to the correspondent periods for later entry countries.

The results are included in the last two columns of Table 2. In line with our expectations, we find that the instrument does not satisfy the relevance condition in the years prior to the entry into the ESM, with a coefficient very close to zero and insignificant, regardless of the specification used.

3.2 Measurement of the distributional Impact

We want to understand the impact that changes in trade openness have on the unconditional distributions of wages and total income. To be able to estimate the distributional impact that international trade has over the wages and total income distributions, we use the unconditional quantile regression method developed by Firpo et al. (2009). This methods builds on recentered influence function (henceforth, RIF), and is more suited for our purpose.[5]

The idea behind this method is to transform the problem by computing the covariate's influence on income shares rather than quantiles. For instance, let us assume that we want to estimate the impact that trade has on wages at different points of the wage distribution. By estimating how a co-variate (e.g. trade openness) affects the share of the population below different wage thresholds, the semi-elasticity shows the effects of an increase in the trade openness on the cumulative distribution functions (CDF) of the wages. Then, we invert the impact of trade openness on the income's CDF to estimate the impact on an income quantile, which we achieve by using the re-centered influence function (RIF) regression approach proposed by Firpo et al. (2009).

For example, imagine we want to understand the effects on wages over the distribution of wages. The advantage of using unconditional quantile regression over conditional ones is that the latter only measures the within-group dispersion, while the former measure the impact on the overall wage dispersion. The former method (unconditional quantile regression), measures the impact within the group, (captured by the standard conditional quantile regression) plus the between-group inequality changes effects of international trade, which basically incorporate how trade can affect the conditional mean of wages [6].

[5] For a further discussion about this method we refer the reader to Firpo et al. (2009), Currie et al. (2020) and Fortin et al. (2011).

[6] See Firpo et al. (2009) for details

There are several ways methods to estimate the unconditional quantile partial effects (UAPE, henceforth). We proceed as using the RIF-OLS method as described by Firpo et al. (2009) [7]. We proceed as follows:

1. We compute the RIF for people in the τ_{th} quantile, q_τ, for the variable of interest Y:

$$RIF(y; q_\tau) = q_\tau + \frac{\tau - \mathbf{1}\{y \leq q_\tau\}}{f_Y(q_\tau)} \tag{6}$$

   Where $f_Y(q_\tau)$ is the density of Y evaluated at q_τ, which is estimated using a non-parametric kernel estimation and Epanechnikov kernel function. We denote the estimated RIF by $\widehat{RIF}(y; q_\tau)$

2. We proceed to estimate the following equation for each τ:

$$\widehat{RIF}(y; q_\tau) = \beta_1^\tau \ln TO_{p,t} + \beta X_{i,p,k,t} + \alpha_i + \epsilon_{i,p,k,t} \tag{7}$$

for the individual i, working in industry k, located in province p at time t, that belongs to the quantile of the distribution τ. As mentioned before, in this case, our main interest is to estimate β_1^τ which reflects the effects of international trade on income over the income distribution.

Following our identification strategy in the rest of the paper, we instrument our main covariate of interest $\ln TO_{p,t}$ using the trade openness of our 3 donor countries during the periods following their entry into the European Union, $\ln TO_{p,t}^{IV}$, using the exact same procedure described in the above section.

4 The labor market consequences of international trade

Using the instrumental variable approach outlined in the previous section, we analyze the effects of trade openness in a variety of outcomes variables, using both, the *Base* specification and the *All*, using the empirical specification:

$$Y_{i,p,k,t} = +\beta_1 \ln TO_{p,t} + \beta X_{i,p,k,t} + \alpha_i + \epsilon_{i,p,k,t} \tag{8}$$

Where $\ln TO_{p,t}$ is instrumented with $\ln TO_{p,t}^{IV}$, as outlined in Section 3.

[7] For this we need to assume that $Pr(Y > q_\tau | X = x)$ is linear in x. For our interest, we assume that the probability a worker's income is above the quantile τ is linear in the trade openness.

Regarding the interpretation of the results in the following sections, our *Base* and *All* specifications satisfy different purposes. The effects of trade openness on earnings or wages run through potentially multiple mechanisms. It is possible that the returns of different industries vary over time, as well as the return to skills or education. Similarly, more trade could increase or decrease job rotation, churning, or unemployment which could affect wages. Our *Base* specification leaves all those channels open to provide a complete measure of the effects of trade on earnings. On the other hand, our *All* specification tries to close as many of those channels as possible. Therefore, it controls for a variety of dimensions that are likely to be affected by trade and in turn affect earnings, as suggested by the previous literature. The comparison between both specifications also provides information, by capturing how much of the trade effect can be accounted for when we consider these multiple potential channels through which it could affect both earnings and wages. Importantly when comparing the results of each specification we can control by the channels related to reallocation and aggregate change of returns for different firms sizes or skills groups at the national level, we cannot capture differential changes over time in the returns that happen at the local level that could be driven by trade exposure. For instance, if wages for low-skilled workers increase only in areas in which there's more trade we will not be able to close that channel by our *Base* or *All* specifications, and our estimates of $\ln TO_{p,t}$ will pick it up as an effect of trade.

4.1 The distributional consequences of international trade

We now proceed to estimate the effects of trade openness to the wage distribution, we present in appendix A the effects of trade wages on average wages and total earnings. The previous literature has documented the effects that international trade has on wages over the wage distribution through the lens of models of international trade, or by documenting stylized facts. For instance, Helpman et al. (2017) finds that international trade increased wage inequality for Brazil in 1994, since trade liberalization affects wages more positively for workers in larger and exporter firms with already higher wages[8]. Similarly, Burstein and Vogel (2017) finds that trade liberalization can reallocate factors toward more productive and skill-intensive firms within sectors and toward skill-intensive sectors in all countries, leading to higher skill premiums and higher wage and income inequality for most of the countries they analyzed.

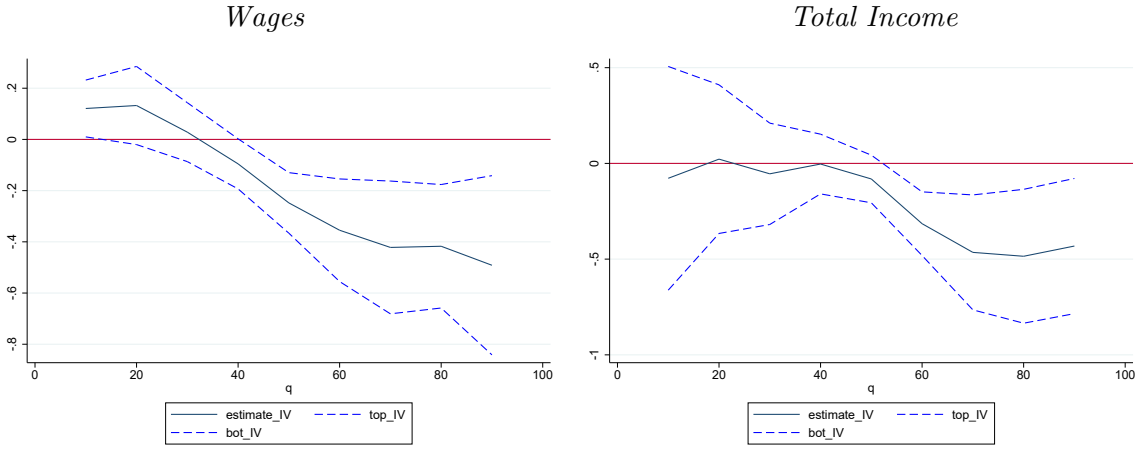
As explained in the previous section, we take advantage of a simple method originally

[8]The model of Helpman et al. (2017) can predicts a reduction in wage inequality in case the labor force is mostly concentrated in firms that engage in exports activities

proposed by Firpo et al. (2009) to estimate the distributional impact that trade has on the hourly wages and on the total income of workers. We estimate the Equation 7 as described in Section 3. The results are presented in figure 2, where we only control for our *Base* set of controls is included. On the left panel of Figure 2 we present the distributional results over hourly wages, and in the right panel, the results for total Income, the dotted line in both panels represents the confident intervals at the 95% confidence interval.

The results in figure 2 show extremely different elasticity of wages and total income at different points in the distribution. For example, for an individual in the 20th quantile of the wage distribution, a 10% increase in trade openness will increase their wages by approx. 2%, while the same increase will make a person in the 80th quantile, see a reduction in her wages by 4%.

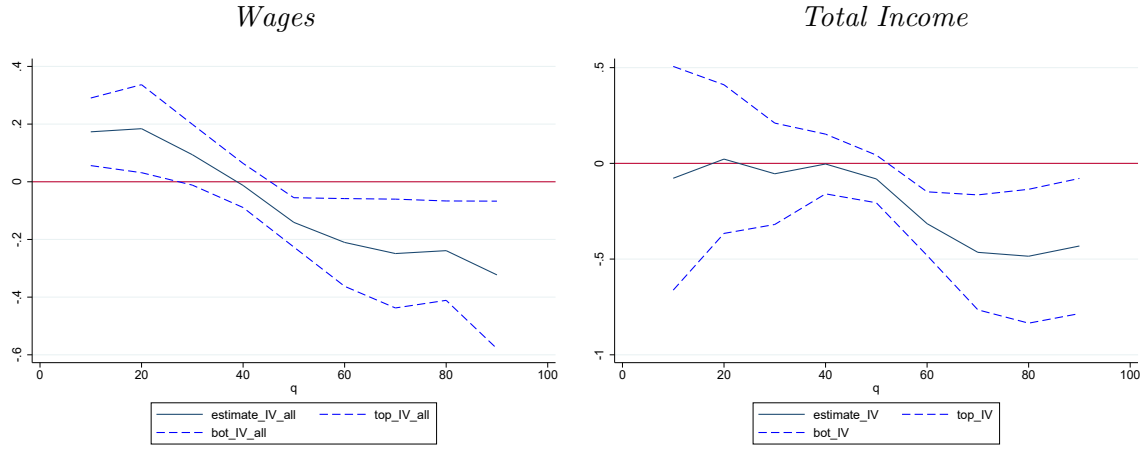
Figure 2: Distributional effects



But why is that that workers at the top of the income distribution are the ones relatively worse off? Is this due to a reallocation of workers across firms or industries, from high paying to low-paying industries or firms? We compute the relevance of these mechanisms and their interactions, running the same regression but controlling for the set of controls that are within the *All* groups, as described before. Figure 3 presents the estimation results of 7 including this broader set of controls. Interestingly, there's only so much our vast array of controls can explain regarding the distributional effects of international trade. Our complete set of controls is able to capture 30-40% of the effects for workers in the 50 to 90 percentiles of the income distribution. Our *All* specification shows that for a worker in the 80 percentile of the income distribution, a 1% increase in trade results in wage losses of 0.25%, a 40%

decrease compared to our baseline specification. On the other hand, at the bottom of the wage distribution, the inclusion of the controls magnifies the estimated effects slightly, since a 1% increase in trade openness increases the wages of a worker in the 20 percentile of the income distribution by approximately 0.2% instead of 0.12% in our *Base* specification. As previously mentioned, while we can control the channels related to workers' reallocation or aggregate changes in the returns for certain skills or firms size, we cannot rule out the mechanism through which trade is affecting wages or earnings by changing the returns at the local level for certain skills or firms types.

Figure 3: Distributional effects with additional controls



The results in Figures 2 and 3 show at least three striking features about the distributional impact of international trade. First, it shows that international trade changed labor demand and hence the income distribution towards the low-income types of workers. This result stands in contrast with the common belief that relates trade with the increase in inequality observed around the world, and it is contrary to the quantitative predictions of a wide variety of models in international trade, that predict increases in wage inequality (see A. Harrison et al. (2010) and Crozet and Orefice (2017) for more details)[9]. The second result shows that while wages are increasing for people at the bottom of the wage distribution, this is not the case when we look at the total income. While it is possible that this can be driven by an income effect, the result presented does not imply this, since people in each quantile of each distribution are not necessarily the same. Third, the effects of international

[9]This result opens the door to the possibility of a missing factor that can be affecting international trade and inequality at the same time generating the common increasing trend in inequality documented in **??** and in several works, see Crozet and Orefice (2017) for more details

trade on income or wages over the distribution of total income and wages (respectively) are highly non-linear.

In summary, these three results show the relevance and importance of applying the proposed method of unconditional quantile regression, with the instrumental variable approach to answer and understand the effects that international trade has on the distribution of hourly wages and total income. Otherwise, the results will be biased by the inability to capture the sole effect of international trade over the distribution, or by the assumption of homogeneous effects over the distributions, that are not supported by the data.

Based on these results in the next section we turn to analyze possible channels that can give raise to these results, putting the focus on the potential structural changes that trade has over labor distribution over different industries, firm's sizes, workers' skills, labor market churning and unemployment.

4.2 The channels

Now we move to analyze the channels through which international trade can affect wages. Specifically, we analyze the dimensions relating to the changes in demand of certain skills, the importance of unemployment, the effects on firm size, and the effect of trade in both firm and industry changes. The choice of these channels obeys two different reasons. First, it builds upon the efforts of previous literature, that has identified multiple channels through which trade or trade liberalization can affect the labor market. For instance, Helpman and Itskhoki (2010) studies how international trade can affect the labor market when we incorporate search and matching frictions, Helpman et al. (2017) finds that most of the wage inequality for Brazil is due to within-industry level and due to firm differences, similar to Mary Amiti and Cameron (2012) that show how firms differential exposure to import-input, import-competing or exports has differential effects over wages, and to Donald R. Davis and Harrigan (2011), Egger and Kreickemeier (2009) and Egger and Kreickemeier (2012), who show that trade liberalization may affect wages distribution due to changes in the distribution of profits across firms, and labor market churning. Additionally, Grossman et al. (2017) studies how international trade can affect sorting, matching, and the distribution of wages, and Grossman and Rossi Hansberg (2008) shows how the wage distribution can change due to the ability of firms to offshore different tasks across countries. In conclusion, in recent years the literature has focused on a set of new mechanisms that rely on within-industry effects due to heterogeneous firms, labor-market frictions, and/or offshoring of certain tasks.

Second, it is conditioned by the data available in our sample, which prevents us from studying some channels previously identified in the literature, as the exporter/non-exporter condition of the firm. Works like Donald R. Davis and Harrigan (2011), Egger and Kreickemeier (2009), Egger and Kreickemeier (2012) Mary Amiti and Cameron (2012), Helpman et al. (2017), Brambilla et al. (2019), shows how exports and imports status of firms is relevant to understand labor composition, skills intensity, and wage differentials. While this is an important restriction, it is probably remedied by focusing on the differential effects of trade over workers in firms of different sizes, since exporters and importers tend to be larger and more productive than firms not engaging in international trade as documented by Bernard and Jensen (1997) and Helpman et al. (2017).

To analyze the dimensions through which trade openness in Spain affected the labor income changes documented in the previous section, we use our *Base* econometric specification, replacing the dependent variable for our specific choice of interest. The first set of results is presented in Table 3 columns 1 to 3, which contains the estimated effects of trade openness on the demand of different skills groups in the labor market. Specifically, we divide our sample into low, medium, and high skills jobs using a proxy for occupational groups used by the Spanish Social Security Registry to calculate Social Security contributions. The results are striking, especially when considering the magnitude of the coefficients. An additional 1% increase in trade openness increases the probability of observing an employee in a low-skill job by 0.59pp while reducing the probability of observing an employee in a medium-skill job by 0.30pp and by 0.29pp in a high-skill job. While not reported in Table 3 the results are virtually identical regardless of the chosen specification (*Base* vs *All*).

Table 3: Effects on Skill Distribution and Industry Reallocation

	(IV) Low Skill	(IV) Medium Skill	(IV) High Skill	(IV) Manufacture	(IV) Service
$\ln TO_{p,t}$	0.588***	-0.299***	-0.289**	-0.002	-0.006
	[0.209]	[0.109]	[0.109]	[0.025]	[0.028]
Base	Yes	Yes	Yes	Yes	Yes
All	No	No	No	No	No
Obs	4,388,542	4,388,542	4,388,542	4,367,134	4,367,134

Province level clustered standard errors in brackets.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Are these changes in the demand for low-skill work driven by differential demand of different sector groups? Specifically, is trade openness incentivizing the movement of workers from manufacturing to service jobs? The answer is no. First, both manufacturing and service sectors have very similar shares of low-skilled labor, although service industries have more high-skilled labor vs more middle-skilled labor in manufacturing. Second, the results in columns 1 and 2 in Table 3 suggest that more trade openness does not have an effect on the amount of labor in either of those sectors nor any differential changes in the demand for different types of skills by sector. In appendix B, we explore the effect that trade exposure has on labor market churning, in particular, workers switching to unemployment, changing firms, or industries, we find small effects reducing the probabilities of workers changing firms or industries.

The recent works in the literature have started to put focus on within-industry changes to explain the observed changes in wages after a trade liberalization episode, as in Donald R. Davis and Harrigan (2011), Egger and Kreickemeier (2009), Egger and Kreickemeier (2012) Mary Amiti and Cameron (2012), Helpman et al. (2017), Brambilla et al. (2019). In general, the models in the literature agree that trade liberalizations push labor toward large exporting/importing firms, at the cost of small firms that become incapable of competing and reduce the amount of labor they represent of the total, increasing income inequality.

We explore whether this is the case during Spain's entry into the ESM. First, we divide firms based on their estimated size and look at the effects of trade openness on observing an employee in a small/medium/large firm. Second, we convert our yearly panel of workers into an annual panel of firms and repeat our estimation procedure. The results are presented in Table 4. Looking first at the worker's panel we find that a 1% increase in trade openness increases the probability of observing an employee in a small firm by 0.055pp, a 0.11% increase from the baseline probability. At the same time, the probability of observing an employee in a medium or large firm is reduced, (insignificantly) by 0.021pp (0.08%) in a medium firm and by 0.034pp (0.14%) in a large firm.

The results in the firms' panel are qualitatively similar although the magnitudes are strikingly different in some cases. In column 1, the probability of observing a small firm increases by 0.11pp, which represents a 0.12% increase over the baseline probability (87% of the firms we observe are small, 12% are medium sized and 1% are large). On the other hand, we find that a 1% increase in trade openness decreases the probability of observing a medium-sized firm by 0.094pp, which represents a 0.78% decrease over the baseline. Similar

Table 4: The response of employment by firm size and number of firms by size

	Worker's Panel			Firm's Panel		
	(IV) Small Firm	(IV) Medium Firm	(IV) Large Firm	(IV) Small Firm	(IV) Medium Firm	(IV) Large Firm
$\ln TO_{p,t}$	0.055**	-0.021	-0.034**	0.111***	-0.094***	-0.017**
	[0.021]	[0.022]	[0.016]	[0.030]	[0.025]	[0.007]
Base	Yes	Yes	Yes			
All	No	No	No			
Prov				Yes	Yes	Yes
Year				Yes	Yes	Yes
Industry				Yes	Yes	Yes
Obs	4,241,440	4,241,440	4,241,440	2,008,208	2,008,208	2,008,208

Province level clustered standard errors in brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

results are observed for large firms with an estimated effect of a 1% increase in trade openness in the probability of observing a large firm of 0.017pp, representing over a 1.7% decrease over the baseline.[10].

Taken together, the results of Table 4 suggest, that there's a 1 to 1 increase in employment in small firms and the number of small firms, suggesting that small firms did not vary their average size. On the other hand, we find a very large decrease in the amount of medium firm, while employment in these firms remain almost unchanged, suggesting that medium firms increased their size significantly. A similar conclusion can be reached for large firms, where its number decreased by much more than the number of employees in firms of this size, suggesting increases in the average size of large firms.

Heterogeneous effects of trade openness

The previous sections document the distributional impact of trade openness, it also analyzes the responses of the potential of the mechanisms through which trade affects wages, identified in the literature. We document an increased demand for low-skilled labor and potential gains from trade at the bottom of the wage distribution. One could ask whether all low-skilled workers see gains from trade regardless of the point in the income distribution they are, and that simply does not reflect in our distributional results because most workers on the bottom of the distribution are low-skill. Similarly, we observe large firms decreasing

[10]It is important to note that the size of the firm is determined by the number of employees they have, since, we can not observe total sales by firm

in number and size, and large native effects from trade at the middle-top part of the income distribution. Is it that trade has the same negative effect on all workers in large firms and this is not observed in our distributional results because there's little mass of workers in large firms at the bottom of the distribution? To tackle these questions, we focus on the distributional impact that trade has within each group.

We first adequate our empirical model to capture the heterogeneity of these effects. Specifically, we augment our empirical specification by adding the interaction term between local trade openness and the individual characteristics of our interest. We do this for two different sources of heterogeneity (i) size of the firm of the worker in separate specifications, and (ii) worker's skill level.

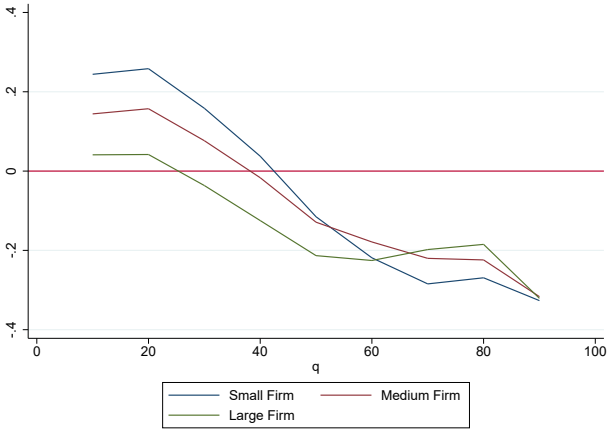
$$Y_{i,p,k,t} = +\beta_1 \ln TO_{p,t} + \beta_2 \ln TO_{p,t} \times x_{2i,t} + \beta X_{i,p,k,t} + \alpha_i + \epsilon_{i,p,k,t} \tag{9}$$

As before we instrument our measure of trade openness, $\ln TO_{p,t}$ with that of our 3 donor countries $\ln TO^{IV}_{p,t}$. Using the same reasoning, now we also instrument our interaction term $\ln TO_{p,t} \times x_{2i,t}$ with the interaction between our donor countries and the source of heterogeneity of interest, $\ln TO^{IV}_{p,t} \times x_{2i,t}$[11].

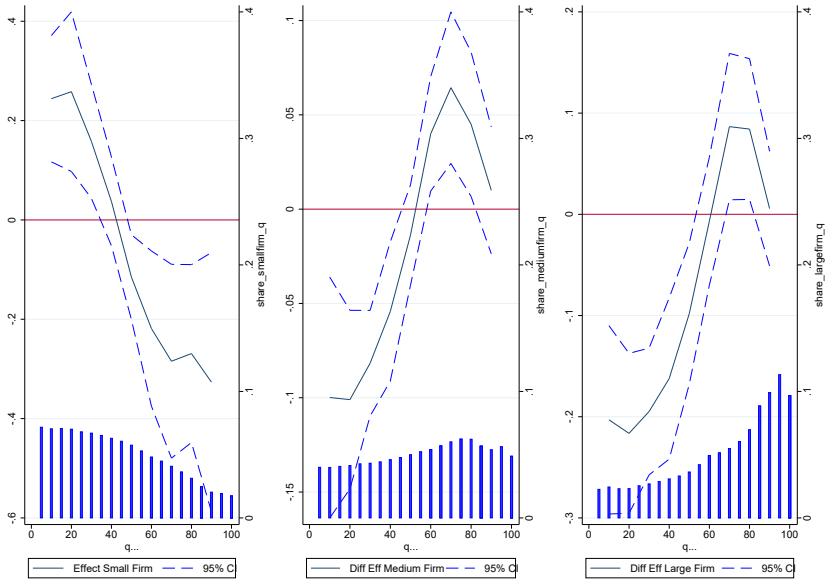
We first turn to focus on understanding if the distributional effects documented in Section 3, are different for workers in different firms. We augment 7 in the same way as we did in Equation 9. In Figures 4 and 5 we present the distributional results for individuals in small, medium and large firms. The top panel shows the distributional effects over wages, while the bottom one the distributional effects over total income. Within each panel, four figures are shown. Starting from the left, we plot the estimated effects of a 1% increase in trade openness for each point of the wage (income) distribution, for small medium, and large firm workers. For the sake of clarity, we do not include the confidence intervals. The three figures on the right show (in order from left to right), the estimated effect for the baseline group (workers in small firms) and the differential effects for each of the other groups (workers in medium and large firms). The effect is presented in the blue line, the dashed line represents the 95% confidence interval, showing whether the effect of trade openness is significantly different in that group compared to the baseline at that specific point in the distribution, and the blue bars represent the share of workers on the different quantiles conditional on the analyzed firm size.

[11] For our interaction to recover the causal effect of the trade openness in each group of interest we require the interacted variables to be exogenous, as documented in Bun and T. D. Harrison (2019), with identification of the interacting term achieved via the functional form.

Figure 4: Wages

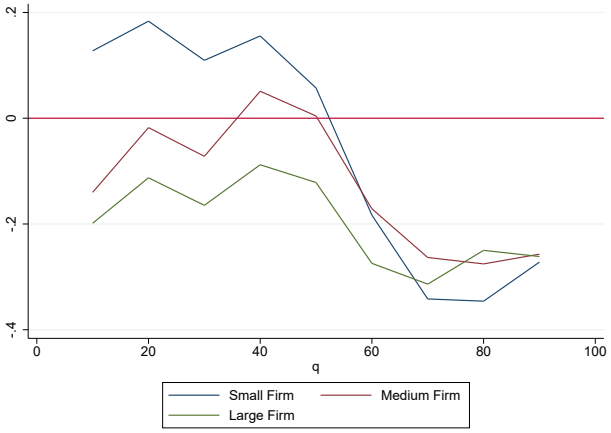


(a) Estimated Effects of Trade Openness. Small vs Medium vs Large Firm Workers

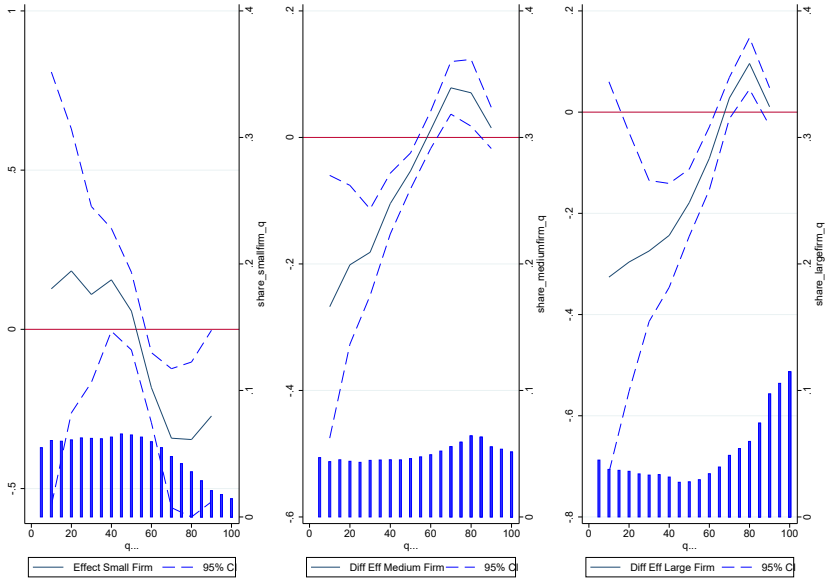


(b) Left: Baseline effect (Small Firm). Middle: Differential Effect Medium Firm. Right: Differential Effect Large Firm

Figure 5: Total Income



(a) Estimated Effects of Trade Openness. Small vs Medium vs Large Firm Workers



(b) Left: Baseline effect (Small Firm). Middle: Differential Effect Medium Firm. Right: Differential Effect Large Firm

Figures 4 and 5, shows at least three important results. First, as we increase the firm size the effect of trade over wages and total income for the workers below the 40th percentile vanishes, up to the point that for large firms the effect of trade for people below the 40th percentile is statically indistinguishable from zero. The contrary seems to be true for worker above the 60th percentile, as the firm size increases the negative effect that trade has over their wages is reduced, albeit still negative for all firm sizes. While medium firms present similar pattern as large firms, its difference with small firm are not that significant from an economic perspective. In summary, the variation of the effects we observe along the income/wage distribution is a decreasing function of the firm size, although the general pattern is similar for all firm sizes.

Additionally, these results are counterfactual with the predictions of new trade models that incorporate heterogeneous wages at firm levels (see A. Harrison et al. (2010) and Crozet and Orefice (2017) for more details). Nonetheless, the empirical results show that for workers at the top of the distribution their wage premium in large firms and medium increases relative to small ones, consistent with these types of models.

When we combine the results in Figures 4 and 5 with the results presented in Table 4, two effects appear to be driving the main distributional results presented in Figure 3. First, labor is reallocated from medium and large firms to small firms, that generally pay lower wages. Second, international trade pushes small firms to pay relatively more for workers that are at the bottom of the distribution, while relatively less for high wages workers, making the aggregate effect much closer to that of small firms than medium or large ones, amplifying the distributional effects observed. Appendix C presents the results when grouping workers by skill. Our results show that, when looking at wages, the pattern of the distributional impact of trade is similar, for workers with different skilled jobs.

4.3 Firm level responses

In the previous sections, we find that international trade increases the share of small firms relative to the amount of medium and larger firms. We also show that in locations where international growth the most, the relative wages for workers in the bottom of the distribution increase relative to other worker, and that these effects were amplified for those workers working in small firms.

In this section, we use the manufacturing firm-level data from the SEPI foundation to quantify the effects that international trade has on the way firms organized their production. We find international trade unleashes changes in the way firms organize their production

by making small firms increase their labor share in production, and increasing the amount low skill types of workers they hire.

While these results are important to shape the actual responses of the labor market in international trade, there are some potential problems with the use of these data that we need to address. First, we can only observe firms whose main activity is manufacturing. This is an important restriction, but in previous sections, we show that our results hold regardless we focus on manufacturing or services. Another important constraint in the information we have is that we can only observe firms' main location. This implies that we can not distinguish the information we have across different establishments within the same firm. We know how many establishments each firm has, but the dataset does not provide any information desegregated at the establishment level.

Finally, the nature of the dataset puts an additional constraint on our identification strategy. We can only observe the firm's location in the 17 states that are in Spain (an upper level relative to provinces). To overcome the problem of the low amount of variation that this gives us, we define a location as a state-municipality size. In the data, we can observe if a firm belongs to a large municipality or not and the state where the firm is located. We have 17 states and 2 different types of municipalities, large and small, which allow us to construct 34 different locations. Then we use the same instrumental variable approach as in the previous section, but now we construct the labor share of each location, according to this new definition of locations.

Now we proceed by estimating the effect that trade has on total sales, average wages paid by the firm, firms' profit margin, number of employees, and the labor share. Table 5 shows the results of these estimation. We find that on average firms do not change their amount of sales, the number of employees they have, or their labor share in a significant way, as reported in columns 1, 3, and 5 of table 5. The main reaction is that they increase their profit margins and they pay smaller average wages after an increase in trade, as reported in columns 2 and 4 of the same table. In particular, a 1% increase in international trade increases gross margins profits by 2.22 p.p. While a one percent increase in international trade reduces the average wage that firms pay 2%.

But while this result on average shows little reaction on the firm side, these results hide significant heterogeneity along the firm size dimension. In particular, we estimate the same equations, but now we allow the effect of international trade to be heterogeneous across the firms' sizes. We present these results in table 6.

Table 5: Firm level responses to trade openness

	ln Sales	Prof. Margin	ln Employment	ln Av. Wage	K Share
$TO_{l,t}^{esp}$	0.02	2.44***	0.02	-0.02*	-0.07
	[0.03]	[0.79]	[0.02]	[0.01]	[0.05]
Observations	19,255	19,169	19,255	19,173	19,004
Ind, Firm, Year FE	Yes	Yes	Yes	Yes	Yes
Location x Size	Yes	Yes	Yes	Yes	Yes
Size	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes

Standard errors in brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Heterogeneous firm-level responses to trade openness

	ln Sales	Prof. Margin	ln Employment	ln Av. Wage	K Share
Small $\times$ $TO_{l,t}^{esp}$	0.01	2.39**	0.05**	-0.03**	-0.13**
	[0.04]	[0.99]	[0.02]	[0.01]	[0.06]
Medium $\times$ $TO_{l,t}^{esp}$	0.04	2.52***	0.03	-0.01	-0.05
	[0.04]	[0.86]	[0.02]	[0.01]	[0.04]
Large $\times$ $TO_{l,t}^{esp}$	-0.02	2.33***	-0.06*	-0.03**	-0.06
	[0.03]	[0.76]	[0.03]	[0.01]	[0.05]
Observations	19,255	19,169	19,255	19,173	19,004
Ind, Firm, Year FE	Yes	Yes	Yes	Yes	Yes
Location x Size	Yes	Yes	Yes	Yes	Yes
Size	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes

Standard errors in brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results in table 6 show that regardless of firms' size, trade openness does not seem to affect firms' total sales and that it has a similar impact on the gross profit margins of firms as shown in columns 1 and 2, of table 6. The results are more interesting when we look at the number of employees, average wages, and the labor share. In this case, we estimate that small firms are hiring more employees, and at the same time, these firms are reducing the average wage they pay. This evidence, together with the one we find in previous sections, suggests that small firms are increasing the amount of low wage low-skill type of workers.

Column 5 of the same table, also shows that these firms are increasing their labor share, this is to say, they are becoming more labor intensive in the way they produce goods, or that they are decreasing their capital intensity.

When we focus on medium-sized firms, we find that these firms' size does not react significantly to changes in trade openness, as suggested by 6, while larger firms reduce the average wage they paid, and the number of employees they employ, as shown in column 3 and 4.

5 Conclusion

In this paper we develop a new type of instrumental variable approach to understanding the effects of increased exposure to international trade, specifically focusing on Spain's entry into the ESM. The period of Spain's entry into the European Single Marker is characterized by a sharp increase in trade openness paired with an increase in trade deficit in Spain. Our main results suggest that the increase in trade openness reduced income inequality.

Our empirical exercises allow us to characterize the effect that these changes in trade had on income and wages over the entire distribution of income and wages. We observe that changes in international trade increased wages at the bottom of the wage distribution, and decreased them for workers in the middle and top parts of the wage distribution. We find a similar conclusion when considering the effects on total income across the income distribution. Our estimated effects are not only statistically significant but economically important. We observe an average increase in trade openness of approximately 5% annually in Spain from 1993 to 2004. This change implies an estimated increase in wages of approx. 1% annually for workers at the 20 percentile of the wage distribution. On the other hand, this change also implies an estimated annual decrease in wages of approx. 2% for workers at the 70-80 percentile of the income distribution. When we focus on the heterogeneity nature of these results, our results suggested that inequality not only decreased on average but also within skill and firm size groups.

These results are in contrast with the recent quantitative predictions of international trade models analyzing the effects of trade on wages over the wage distribution. We find two main mechanisms absent in these models that may explain these differences. First, increased international trade induced a reallocation of resources towards smaller firms. Second, increased international trade changed the way certain firms organized their production, especially small firms. We find that as these firms are more exposed to international trade, they tend to increase their employment, become more labor intensive, and more intensive

in low-skill types of jobs.

We think this paper opens several opportunities for future research. First, understanding not only why firms change their labor intensity but also the quantitative impact of these changes to account for the changes in the wage distribution. Second, disentangling the effects that the increase in the trade deficit had on the labor market in this period and its relevance in accounting for the observed changes. Finally, another interesting avenue of research is to understand the quantitative relevance of these micro-level results in explaining the large drop in the total factor productivity experienced by Spain after joining the ESM.

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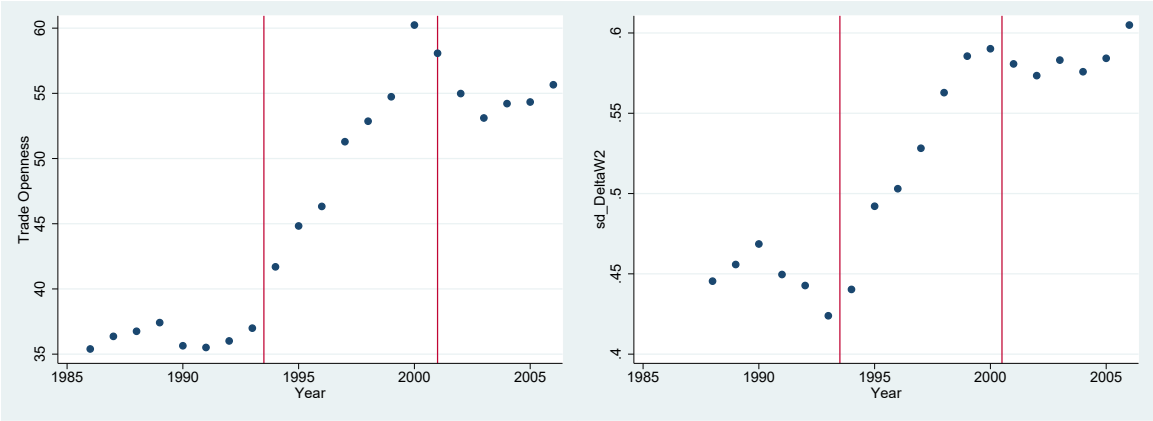
A Appendix

Figure A.1: Trade Openness (World Bank) vs SD Wages



(a) (b)

Table A.1: Aggregate effects

	(OLS) Total Earnings	(IV) Total Earnings	(IV) Total Earnings	(OLS) Hourly Wages	(IV) Hourly Wages	(IV) Hourly Wages
$\ln TO_{p,t}$	-0.054**	-0.208***	-0.112*	0.003	-0.161***	-0.065**
	[0.021]	[0.066]	[0.064]	[0.011]	[0.046]	[0.030]
Base	Yes	Yes	Yes	Yes	Yes	Yes
All	Yes	No	Yes	Yes	No	Yes
Obs	4,176,277	4,401,114	4,176,277	4,132,457	4,351,131	4,132,457

Province level clustered standard errors in brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

A The impact on average wages and total earnings

Table A.1 presents the estimated effects using both OLS and IV methods on the impact of trade exposure on both wages and total earnings. Starting with total earnings our OLS results find a small negative association between local trade openness and wages. Our IV estimates amplify the results from the OLS specification by finding a significant negative effect of trade openness on total earnings, regardless of the controls used. Specifically, we find that a 1% increase in trade openness decreases total earnings, on average, by approximately 0.12% to 0.24%, effects that are 3 to 6 times larger than the OLS estimates.

When we replace our dependent variable by hourly wages, the conclusion is similar. We find no effect of trade openness in wages when considering our OLS specification. On the other hand, the IV results show that for a 1% increase in trade openness wages decrease, on average, by 0.07% to 0.17%, depending on the specification. The comparison between the effects on total earnings and hourly wages also suggests that the former decreasing part is driven by lower pay per hour, approx 60-65% of the effect, while changes to hours worked represent the remaining 35 to 40% of the effect on earnings.

Two points are worth mentioning at this point, the first one is the relatively large increase in trade deficits that Spain experienced during this period, making these results consistent with the ones found by **autor˙china˙2013** for the USA when looking at import shocks from China. These changes in trade deficits are important to explain what may be behind the negative impact that trade exposure has on wages over the wage distribution. An additional problem of our empirical design is that we do not use price deflector by location due to the lack of data for the corresponding year-province pair. If locations with higher exposure to

international trade experience differential changes in prices, our results over real wages may be biased. While the latter point is clearly important to account for the average effect over real wages, this argument is less likely to generate a bias over the changes in the real wages distribution within particular provinces.

In summary, more trade openness affects negatively both wages and earnings. Furthermore, when we control for multiple of the mechanisms that could be driving these effects, we are able to reduce (in absolute value) our estimated coefficients by 50% to 65%. Although not documented in Table A.1, we do not find any of the channels to be the main driver of this reduction in the estimates. Our most successful controls reduce (in absolute value) the estimated coefficients by no more than 10% each, and once all controls are included, the removal of any of them does not increase (in absolute value) our estimates by more than 5-6%.

A The channels

B Labor Churning

Previous literature, as in Egger and Kreickemeier (2009) and Donald R. Davis and Harrigan (2011) show quantitatively that increased exposure to trade can increases churning in the labor market. And that this increase in churning can lead to increases in wage/income inequality. To test whether this is the case for Spain's entry into the ESM we analyze the effects of trade openness in a series of outcomes that reflect different forms of market labor "rotation". Specifically, we focus on individuals' entries into unemployment, firm changes, and industry changes.

The results are shown in Table B.1. The first two columns explore whether increases in trade openness have an effect on either the probability of entering unemployment during that year (column 1) or the following year (column 2). We find no evidence suggesting that the increased exposure to international trade may affect the probability of a worker entering unemployment neither in the current year nor in the following one. This evidence might be surprising when combined with the results on earnings and wages from Table A.1, where we find that 35 to 40% of the effects on earnings can be attributed to changes in the number of hours worked. Our results then suggest that the mechanism driving the losses in hours worked is not extended unemployment, but potentially reductions in the number of hours worked by employed individuals.

Table B.1: Churning in the labor market

	(IV) $Unemp_t$	(IV) $Unemp_{t+1}$	(IV) $Firm\ Change_t$	(IV) $Firm\ Change_{t+1}$	(IV) $Industry\ Change_t$	(IV) $Industry\ Change_{t+1}$
$\ln TO_{p,t}$	0.016	0.015	-0.060*	-0.073*	-0.038	-0.056*
	[0.021]	[0.019]	[0.034]	[0.039]	[0.026]	[0.030]
Base	Yes	Yes	Yes	Yes	Yes	Yes
All	No	No	No	No	No	No
Obs	4,388,542	3,661,770	4,388,542	4,052,150	4,300,680	4,023,563

Province level clustered standard errors in brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Even if workers are not rotating jobs faster through unemployment entry and exit, it is still possible that there's an increase in workers' mobility in the labor market through

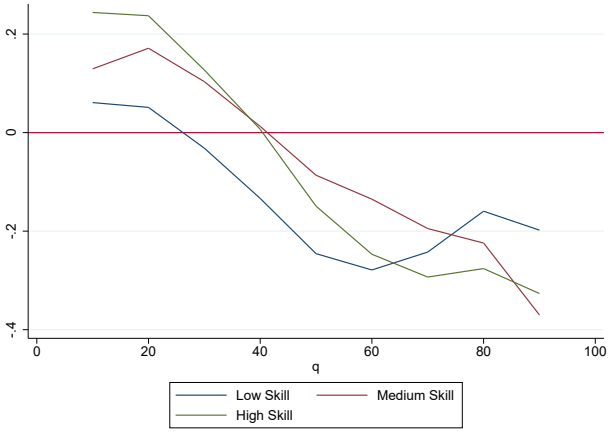
firm changes. To explore this possibility, we replace our dependent variable with a dummy that takes value one if the worker changed firm from the previous period to the current one, both unconditionally (column 3) and conditional on not entering unemployment in the current year (column 4). The results suggest that a 1% increase in trade openness decreases the probability of a firm change by 0.06-0.07pp, a decrease of 0.18-0.22% from the baseline probability of changing firms between years.

We find similar results when we replace the dependent variable for a dummy capturing industry changes between years, results shown in columns 5 and 6. A 1% increase in trade openness decreases the probability of an industry change by 0.04-0.06pp, a decrease of 0.16-0.24% from the baseline probability of changing industry between years. In summary, we find very mild effects related to labor churning effects from changes in trade openness, suggesting that, if anything, labor market rotation slightly decreases as trade exposure increases.

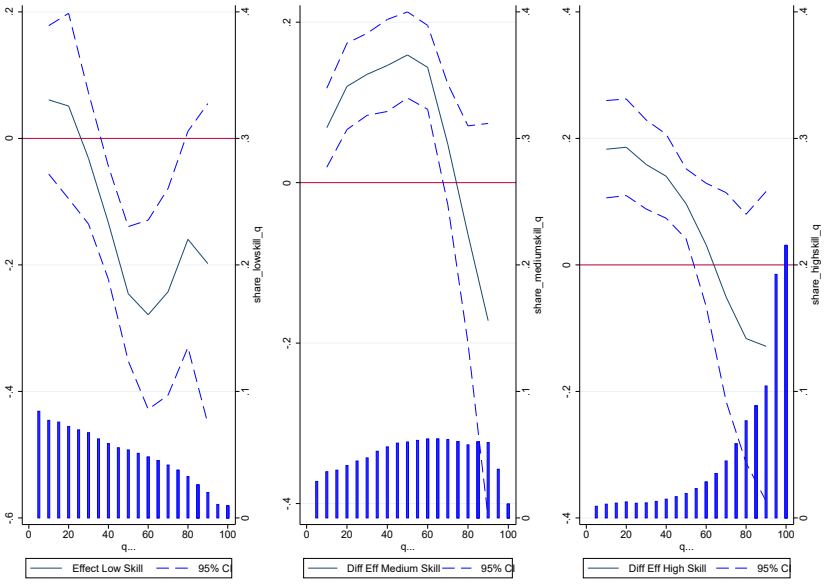
C Heterogeneous effects of trade openness: Skills differences

Now we proceed to analyze the distributional effects over wages/income based on the skill level of the worker. Are the effects of more trade exposure common across skills groups or does each skill group present its own differential returns from trade that, once weighted, generate the observed aggregate distributional results? We find the former to be the case. In Figure C.1 and C.2, we present the results for the same estimation than in Figure 4 and 5, but using three groups of skills levels as the source of heterogeneity. Our results show that, when looking at wages, the pattern of the distributional impact of trade is similar, for workers with different skilled jobs. Those at the bottom of the distribution see an increase in the hourly wages, and workers in the top quantiles of the distribution suffer a reduction in the hourly wages. Interestingly, this pattern becomes more relevant in magnitude and significance as we go from low-skill to high-skill workers. The results seem to suggest that international trade is closing the wage gaps across workers within a skilled group. The second pattern of heterogeneity can also be observed in both the income and wage results. The effect of trade openness is systematically more positive for middle-skilled workers than for anyone else at almost all points of the distribution, but especially in the part of the income distribution that agglomerates more middle-skilled jobs.

Figure C.1: Wages

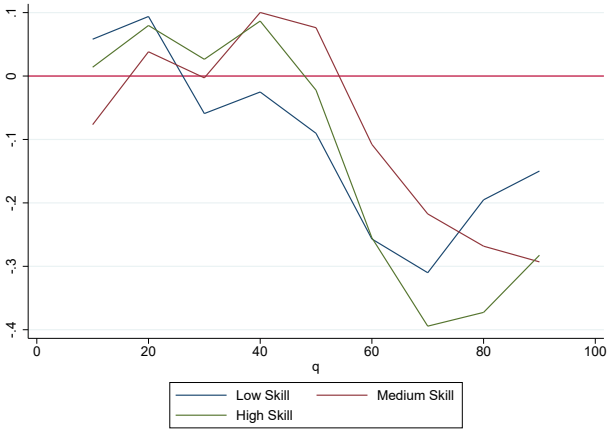


(a) Estimated Effects of Trade Openness. Low vs Medium vs High Skill Workers

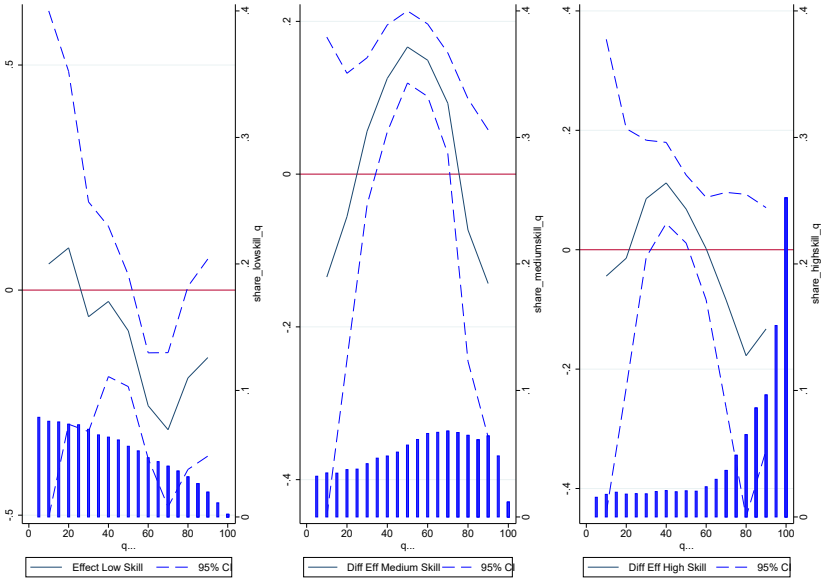


(b) Left: Baseline effect (Low Skill). Middle: Differential Effect Medium Skill. Right: Differential Effect High Skill

Figure C.2: Total Income



(a) Estimated Effects of Trade Openness. Small vs Medium vs Large Firm Workers



(b) Left: Baseline effect (Low Skill). Middle: Differential Effect Medium Firm. Right: Differential Effect Large Firm