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# Skill upgrading and trade in Italian manufacturing

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**Abstract**

This paper analyzes the effects of international trade on the relative demand for skilled workers in Italian local labor markets. We find that imports and (in part) exports generate a sizable process of quality upgrading in the labor force by increasing the average schooling of the workforce. This result is robust to controls for endogeneity and omitted variable biases and that it is stronger for white collars workers.

JEL classification: F12, J23, J24

Keywords: international trade, exports, import, labor demand, schooling, skill composition

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# 1 Introduction

A very important issue in international trade is if and how trade developments affect labor market outcomes. Since the mid 1990s, this issue has determined a heated policy debate accompanied by the intense globalization of real and financial markets. This led to the development of a vast empirical economic literature aimed at assessing the effect of increasing competition and imports from developing unskilled labor-abundant countries on advanced economies' labor markets (Lawrence and Slaughter, 1993; Sachs and Shatz, 1994; Wood, 1995).

According to traditional theory, trade with unskilled labor-abundant countries should imply, in more advanced economies, a reallocation of production and factors toward new comparative advantage goods, a rise in their relative price, and, by a standard Stolper-Samuelson effect, a rise in the relative return of the factors more intensively used in the production of such goods. Should labor markets be imperfectly competitive, part of the adjustment would occur via greater unemployment among factors that are more intensively used in the comparative disadvantaged good. In a nutshell, when faced with increased competition from unskilled labor-abundant countries, the skill premium in terms of wages and employment should increase.

Empirical tests have been mostly inconclusive, since i) the reallocation of factors has occurred across firms within sectors, rather than across sectors; ii) wage inequality has risen in the unskilled labor-abundant countries, rather then decreased as the theory predicted.

While the traditional literature has focused on trade and wage inequality, mostly through the impact of imports, the most recent developments in the international trade literature with heterogeneous firms has highlighted the role of the reallocation of market shares from non-exporting to exporting firms within sectors: according to the seminal paper by Melitz (2003), increased exports bring about changes in average productivity and wages. This put center stage the characteristics and strategies of exporting firms. Since then, and mostly based on Melitz's setup, the literature has developed in many directions, including the impact of increased exports on labor market outcomes.

In this paper we analyze the impact of both imports and exports on the skill content of employment. We improve upon already existing contributions, which we review in the next section. In particular, we adopt a focus on local labor markets, which is less precise than focus on firms, less linked to the new new trade theory based on firm selection (and related empirical applications), but it allows to use very rich data on workers' characteristics, based on the Italian Labor Force Survey, which includes a very precise measure of individual skills; furthermore, it permits us to analyze general equilibrium effects within the local labor market, instead of only within firm effects (Autor et al., 2011).

Our results show that, controlling for endogeneity, imports and (in part) exports generate a sizable process of quality upgrading in the labor force, by increasing the average schooling level of employed workers. Trade also induces a recomposition of the labor force toward more skill intensive tasks: larger exports imply an increase in the number of worked hours, in particular by white collars workers; larger imports imply a reduction of overall worked hours.

The paper is organized as follows. Section 2 briefly summarizes the main results of the most recent literature on trade and labor markets. Section 3 illustrates the theoretical predictions of trade on labor market outcomes. Section 4 presents the empirical model and describes how endogeneity concerns have been addressed. Section 5 describes the datasets used in the regression and section 6 shows the results. Section 7 concludes.

# 2 Related literature

The most recent empirical literature on the effect of trade on the labor market focuses on firm level data. A general result is provided by Bernard et al. (2006), who show that import penetration from low wage countries (LWC) has a negative impact on employment growth of US firms; such effect is larger for low capital and skill intensive plants. A bunch of papers pay specific attention to imports from China: imports penetration from China decreases employment growth in UK (more for low tech firms and least productive ones Bloom et al., 2011), in Belgium (Mion and Zhu, 2011) and in Mexico (Utar and Torres Ruiz, 2010). Álvarez and Opazo (2011) find negative effect import penetration from China on wage growth in Chile; such effect is larger in traditional industries and for smaller firms. Mion and Zhu (2011) also find a negative (but small) effect on employment growth in Belgium of outsourcing to China both final and intermediate goods.

A few contributions have tackled the analysis of the impact of trade on the labor market using sectoral-level data: Khandelwal (2010) shows that the import penetration from LWC hampers employment growth in US, more so in sectors with shorter quality ladder, while for Italy Federico (2010) shows that the effect is stronger in less capital and skill intensive industries and in those sectors where the quality ladder is shorter. Autor et al. (2011) push disaggregation a step further and base their analysis on sectoral data with a local dimension: using imputed imports U.S. local labor markets they show a negative effect of import penetration from China on manufacturing employment, labor force participation, non-manufacturing wages, household income, consumption, whereas it is positive the impact on unemployment and public transfers.

Our paper is very close to Autor et al. (2011) for what regards the breakdown of data with three novelties: i) we look at the effects of both export and import, thus closing the gap between two strands of literature. In doing so, we are able control for estimation biases due to the omission of either one of the two trade channels. ii) In terms of labor market outcomes, we look at employment composition in terms of workers' qualification and education, and we are able to assess the effect of trade on the skill content of workers within qualifications. iii) Finally unlike Autor et al. (2011), we base our analysis on true local trade data, rather than on national data imputed to local units.

# 3 Theoretical underpinnings

The empirical analysis of the relation between trade and labor market outcomes we pursue in this paper is guided by a few theoretical mechanisms, which we can broadly divide between those operating on the import side and those on the export one. Here below we provide some highlights of them.

Most of the current theoretical literature on the labor market effects of trade focuses on the analysis of (rising) wage inequality and skill premia. This literature's question is whether trade liberalizations are likely to change the relative demand for skilled workers.

On the import side, the relation between import and labor market outcomes can be rationalized as one of import competition or import substitution. Import competition occurs when an imported final good competes with locally produced ones. Import substitution occurs when an intermediate good is imported from abroad, thus replacing a locally produced intermediate. Their effects in terms of total labor demand are univocal: in both case we should observea reduction in labor demand. Their effects on the skill composition of the labor force is less straightforward. Import competition may induce an exit for less efficient firms, which are likely to employ less skilled individuals. Moreover, surviving companies may decide to escape from the foreign competition by increasing the quality of their products thus increasing the labor demand for more skilled workers. The effects of import substitution is qualitalively similar to the consequences of outward foreign direct investments. In this case, firms are likely to take abroad the less skill intensive tasks, thus inducing a tilt in the labor demand.

On the export side, the general question is whether export opportunities generate a increase in the labor demand for skilled workers.

The issue has been tackled under several institutional frameworks. In a neoclassical labor market, Yeaple (2005) shows that increased export opportunities make the adoption of new technologies more profitable, thus increasing aggregate demand for skilled workers. A similar mechanism, focusing on product quality and technology upgrading, is described by Verhoogen (2008) and Bustos (2010) for developing countries.

Helpman et al. (2010) provide a very general model with heterogeneous firms, heterogeneous workers and imperfectly functioning labor markets, and show how trade liberalization can tilt a firm's labor demand so as to increase the demand for skills.

The point of departure of Helpman et al. (2010) is the introduction of ex-post worker heterogeneity —which adds up to the usual productivity heterogeneity across firms of this class of models—and screening technology by firms. Firms get to know their productivity upon paying a sunk entry cost and engaging in a search process to hire workers, whose ability is relation specific. Since firms cannot infer a worker's productivity in their report on the history of the worker's relations, they have an incentive to screen their workers based on the observable characteristics and what they do upon paying a monitoring cost. More productive firms earn higher profits and have a greater incentive to screen workers better, thus creating a sorting equilibrium, where more productive firms hire more productive workers.

Anything implying a rise in the returns of the screening activity, such as gains from trade induced by trade liberalization, provide greater incentives to screen workers to the more productive firms. As a result more productive firms demand more and more skilled workers and ever fewer less skilled workers, thus tilting the firm's labor demand. Compared with Yeaple (2005), Verhoogen (2008) and Bustos (2010), the Helpman et al. (2010) effect is not channeled through a productivity or quality upgrading. In other words, workers' skill upgrading occurs even without a technological change within the firm.

A conceptually related strand of literature is the one on the labor market impact of offshoring. Here again the idea is that the offshoring of activities which are relatively more intensive in their use of unskilled labor has a positive impact on skill premia. Feenstra and Hanson (1995, 1999) develop a theoretical model of vertical specialization that is consistent with increased wage premia in both the North and the South. For a more comprehensive review of the empirical literature, see Crinò (2009).[1]

# 4 Empirical Strategy

In order to analyze the impact of trade on skills, we estimate the following equation:

$$\begin{aligned} \ln AS_{spt} =& \alpha + \beta_1 \ln \frac{Export_{spt-1}}{L_{spt-1}} + \beta_2 \ln \frac{Import_{spt-1}}{L_{spt-1}} + \gamma X_{spt-1} \\ &+ D_t + D_s + D_p + D_{st} + D_{pt} + \varepsilon_{spt}, \end{aligned} \tag{1}$$

where $\ln(AS_{spt})$ is log of average schooling of employees (weighted according to the hours actually worked by each individual) in sector $s$, province $p$ at time $t$. $\ln(Export_{spt-1}/L_{spt-1})$ and $\ln(Import_{spt-1}/L_{spt-1})$ the log ratios of export and import flows to the worked hours; both are computed for the same province-sector cell and are lagged of one year. $X$ includes two controls, namely the share of total hours worked by white collar employees and capital stock normalized by worked hours. $D_t$, $D_p$, $D_s$, $D_{st}$, and $D_{pt}$ represent, respectively, time, province, sector, sector x time, and province x time dummies.

The coefficients of interest are $\beta_1$ and $\beta_2$ , which are the correlations between past export and import flows and the average schooling by employed workers.[2] Variables in $X$ control for other possible confounding factors. For instance, the lagged log capital stock is meant to control for capital-skill complementarities. Extensive theoretical and empirical research (see (Krusell et al., 2000) for example) have shown that the elasticity of substitution between capital and unskilled labor is generally higher than the one with skilled workers. This implies that an exogenous increase in the capital per worker stock is likely to rise the relative demand for skilled individuals. The share or hours worked by white collars controls for the heterogenous composition of workers qualifications across sector x province x year cells.

Finally, all regressions are weighted according to the size of each cell in terms of

[1]For Italy, Federico and Minerva (2008) show that controlling for the local industrial structure and area fixed effects, outward FDI, measured at the province-sector level, is associated with faster local employment growth relative to the national industry average. However, they do not address the issue of skill-biased labor demand.

[2]Note that all the variables have been normalized by the number of worked hours, to keep size and business cycles feature into account. The standard normalization in sector- and firm-level data analysis is to use domestic demand (Álvarez and Opazo, 2011; Bloom et al., 2011; Mion and Zhu, 2011; Utar and Torres Ruiz, 2010). At the level of breakdown we use, though, turnover is noisily measured, so we prefer to use the same normalization as Autor et al. (2011).

total worked hours. This is done with the aim to minimize the effects of measurement errors, which are particularly severe in small province-sector-time cells.

### 4.1 Causality

The estimation of $\beta_1$ and $\beta_2$ is potentially biased in at least two respects. First, there could be an omitted variable bias affecting both exports and import on one side, and labor demand for skills on the other one (for example, skill-biased technical change). Second, a reverse causality bias could descend from the observation that a larger fraction of skilled workers can, in turn, affect the export performance of a firm positively or raise imports because of an income effect.

To address these concerns we resort to instrumental variable estimation. We instrument province/sector exports with the sectoral imports of destination countries. This instrument is likely to be unaffected by regional economic developments in Italy, as it isolates a pure and exogenous pull factor of Italian exports. In particular, the instrument is constructed in two steps. First, we compute a fictional sector/province export level as follows:

$$\widehat{Export}_{spt} = \sum_c Export_{scpt_0}(1+g^M_{sct}) = \sum_c Export_{scpt_0}\frac{Import_{sct}}{Import_{sct_0}}, \qquad (2)$$

where $c$ represents a destination country and $t_0$ is the year 1995. $Export_{spct_0}$ are export flows from each sector-province toward any destination country in 1995. $Import_{sct}$ are country $c$'s import flows from all other countries of goods in sector $s$ in year $t$. Therefore $g^M_{sct}$ is the (cumulated) growth rate of world imports by country $c$ in sector $s$ between $t$ and $t_0$.

In the second step we take into account the fact that the total amount of worked hours is likely to be endogenous to the regression. We cope with this problem by attributing the national industry dynamics to sector-province levels. This implies that the actual instrument is calculated as

$$\frac{\widehat{Export}_{spt}}{\widehat{L}_{spt}} = \frac{\sum_c Export_{scpt_0}\frac{Import_{sct}}{Import_{sct_0}}}{L_{spt_0}\frac{L_{st}}{L_{st_0}}}, \qquad (3)$$

where $L_{spt}$ is the total amount of worked hours in the cell sector x province x year, $L_{st}$ is the national aggregate in the cell sector x year.

The instrument for imports is constructed likewise, using world export from country $c$

$$\frac{\widehat{Import}_{spt}}{\widehat{L}_{spt}} = \frac{\sum_c Import_{scpt_0}\frac{Export_{sct}}{Export_{sct_0}}}{L_{spt_0}\frac{L_{st}}{L_{st_0}}}. \qquad (4)$$

## 5 The data

In our analysis we use various sources of data. The key dataset we use are the microdata of the Italian labor force survey (LFS), Italian trade data on exports by province and sector, and BACI-CEPII trade data on imports by all the countries of the world.

Each quarter the Italian statistical office asks a rotating sample of roughly 400,000 individuals about their current and past working conditions. LFS also provides individual information such as worked hours,[3] age and schooling level. In order to avoid breaks in the time series, we concentrate our analysis on the 1995-2003 surveys, as the ones from 2004 and after do not contain comparable data. We also restrict our scope to the manufacturing sector where we distinguish about 21 sectors (two digits of the Nace Rev. 1 classification). We include all workers (employed and self-employed, national and foreign-born) in the age range 15 to 65. From LFS we compute the dependent variable in equation (1) as the average schooling level for employed workers in the cell sector x province x year. As usual in the literature on the Mincerian equation for Italy, we attribute to each individual the lowest number of years necessary to obtain their higher degree. That is: zero years for no education (uncompleted elementary school); 5 years for completed elementary school; 8 years for completed lower secondary school; 13 years for completed upper secondary school; 18 years for completed university degree; 21 years for completed post-university degree.

Italian import and export data, in current values, disaggregated by province of origin (95 provinces), sector and country of destination are collected and published by the Italian statistical office. Firm-level data from the Company Account Data Service are used to compute province-sector-year measures of capital stock.

The instrumental variable is built on the basis of the BACI-CEPII dataset on world trade flows. Since the BACI-CEPII data are disaggregated according to the HS6 product classification, we map them into the Nace Rev. 1 classification using concordance tables between HS6 and CPA.

For our baseline regression we have information on trade and schooling level for 9 years (1995-03), 95 Italian provinces and 21 manufacturing sectors. This should leaves us with roughtly 16,000 observations. However, both LFS and regional trade flows have many gaps due to firm entry and exit in both domestic and foreign markets. As a consequence our baseline sample contains slightly more than 11,000 observations. Table 1 reports descriptive statistics for the variables used in the empirical analysis. All variables are expressed in logs. In the manufacturing industry, the average years of schooling is quite low (9.5 years, a figure between lower and higher secondary school). As expected schooling is much higher for white collars (12.0) than for blue collars (8.5). Table 1 also shows the trade patterns, expressed in log of millions of imports and exports per worked hour. In the period of analysis, each hour generated 1238 euros of exports (1031 in 1995, 1406 in 2003); these flows were mainly directed to advanced countries, which had a share of total exports slightly higher than the 70 per cent, quite stable throughout the period. Imports had a similar behavior. From 1995 to 2003 they increased by 50 per cent from 800 to 1199 euros per worked hour, averaging around 1000 euros in the entire period. As before, most of the Italian imports originated from advanced countries, without

[3]Labor economists tend to be quite skeptical on the accuracy of the worked hours in the LFS, since individuals tend to report their labor contract hours requirements. Note, however, that compared with any measure based on the headcount of workers, we have a more precise measure of the labor input, since we are able to take into account the relevance of part-time workers

dramatic changes over time. Finally, the 28 per cent of total worked hours was made by clercks and managers, a share that increased in the period of analysis by 4 percentage points (from 26 to 30 per cent).

[Table 1 about here.]

# 6 Results

## 6.1 Baseline specification

The results from the estimation of equation (1) are reported in Table 2. Columns (1) presents results from the basic OLS regression. When we aggregate all source and destination countries together, we find some positive and significant effect of imports and exports on average schooling.

As discussed in section 4.1, we are concerned that the results of such regression might be plagued by omitted variable or reverse causality bias. For such a reason we use IV estimation: when we turn to IV estimates the effect of both imports and exports on average schooling increases: in column (2) we find that a standard deviation increase in exports per worked hour raises the schooling level of the workforce by 0.5 per cent, whereas a likewise increase in imports raises it by 1 per cent.

In column (3) and (4) we distinguish source countries for imports and destination countries for exports between developed and developing ones.[4] When doing so, our IV estimates suggest that all the effect of export is driven by sales to developed countries, which represent the lion's share of Italy's foreign sales, whereas the effect of imports is mainly driven by purchases from developing countries.

The picture that these results depict is one where firms select workers so to increase the human capital of their labor force to be able to climb the quality ladder in order to compete in the markets of developed trade partners (as in Verhoogen, 2008) and escape the domestic competition of cheap imports from developing countries.

As explained in the theoretical section, international competition (that is larger import flows) may raise average schooling due to both import competition and import substitution. In the first case local producers recompose labor demand toward a larger skilled to unskilled employment ratio, with the aim to push up productivity and climb the quality ladder; in the second case, international fragmentation induce firms to shut down the more unskill intensive tasks, thus inducing the dismissal of the less educated workers. Both mechanisms are plausible but they cannot be disentangled in this kind of analysis.

Our intuition behind the positive effect of exports to developed countries on average schooling is a Verhoogen (2008)'s effect, such that exporters tilt their labor demand toward more skilled workers to increase productivity, climb the quality ladder and produces better good which sell in the more competitive market in developed countries.

In both IV specifications the F–statistics of excluded instruments from the first stage regressions is well above the threshold of 10 recommended by Bound et al. (1995) to avoid weak instrument concerns. For the rest of the analysis we only

[4] Developed countries are UE-15 members, US, Canada, Japan, South Korea, Australia, New Zealand, Switzerland and Norway, developing countries all the remaining ones.

comments upon IV estimates, whose F–statistics of excluded instruments are always well above the threshold.

[Table 2 about here.]

Table 3 suppresses controls for capital stock (columns 1 and 2), and introduces clustered standard error at sector-province level (columns 3 and 4). The exclusion of the control for the capital stock is due to the fact that both capital and worked hours are likely to be endogenous to the regression. This is not an issue for the purpose of this analysis as long as this control is uncorrelated with the instruments set. We check this issue by looking at possible changes in the coefficients of interest after the exclusion. The control for clustering is instead due to the nature of the empirical analysis. Since we have repeated cross-sections, we are concerned with the fact that the error terms are not independently and identically distributed but, at sector-province level, they are correlated in some unknow way. Results show that the effect of total imports on average schooling hold unchanged, the one of exports is estimated less precisely (p value is 11 per cent), but the point estimates are similar. Results for the splitted trade flows between developing and developed countries are substantially confirmed.

[Table 3 about here.]

Table 4 checks the robustness of our estimates with respect to the inclusion of extreme values in imports. Import data at local level are sometimes plagued by a measurement error due to the fact that they are attributed by the place of residence of the importer rather than the one of intermediate or final consumer. This imply that they may end up being very concentrated among few sector-province cells, thus biasing the overall result. In this exercise we trim the top 1, 5 and 10 per cent in the distribution of import per worked hour by sector-province-time cells and we verify that the results hold unchanged. As before import has a positive and significantly different from zero effect on average schooling, which comes from import from developing countries. Total exports have also a significantly different than zero effect on average schooling, driven by exports to developed countries.

[Table 4 about here.]

To corroborate our intuition about firms tilting their labor demand in favor of more skilled workers, table 5 checks whether the average schooling effect of imports and exports comes from increased average schooling or blue or white collars workers. The dominant effect incontestably comes effect from an increase in the average schooling of white collars, which is shown to occur also from export to developing countries, which in line with the new new trade theory we interpret as reflection of increased demand for managerial workers who set up the export network toward far away destination countries.

[Table 5 about here.]

### 6.2 The effects of trade on hours worked

We finally look at the effects of trade on more traditional labor market outcomes.

Table 6 shows that exports have a positive effect on total worked hours (columns 1), and that the effect comes mostly from adjustment on the numbers of hours worked by white collars (column 2). Imports on the contrary have a negative effect on the number of hour worked (column 1) and the burden appears to be relatively heavier on blue collars (column 3). IV estimates (column 4 to 6) confirm this pattern.

Since the burden of adjustment to increased imports is borne by (on average less schooled) blue collars, while increased exports favor a larger employment of (on average more skilled) white collars, these results support the view that international competition pushes less productive firms hiring lower human capital workers out of business, thus raising the human capital content of surviving firms.

[Table 6 about here.]

Table 7 adds to this picture the consideration of the source and destination countries. When doing so all qualitative results hold unchanged, and estimates show that the bulk of the adjustment comes from trade with developed partners which represents the major source of foreign purchase and the main destination of foreign sales for Italian firms.

[Table 7 about here.]

## 7 Concluding remarks

This paper contributes to a long-lasting, but somehow still inconclusive, debate on the effects of international trade on the relative demand for skilled workers. We find that in Italian provinces and sectors where export and import flows have been large over the period 1995-2003 the average schooling of the workforce has also increased. Through an IV specification that uses the evolution of imports in the destination markets as an exogenous pull factor for Italian exports, and the evolution of exports from the source countries as the exogenous one for Italian imports, we show that the estimated effect is of a causal nature. Our intuition is that international competition (that is larger import flows and larger export opportunities) raises average schooling possibly since local producers recompose labor demand toward a larger skilled to unskilled employment ratio, in order to push up productivity and climb the quality ladder. Our results on the effects of trade flows on worked hours also show that the burden of adjustment to increased imports is borne by (on average less schooled) blue collars, while increased exports favor a larger employment of (on average more skilled) white collars, thus supporting the alternative explanation that international competition pushes less productive firms hiring lower human capital workers out of business, thus raising the human capital content of surviving firms.

The plausibility of this result is reinforced by an estimation of the effect of trade on other labor market outcomes, which confirms results obtained by comparable analyses.

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Table 1: Statistics: average 1995-2003

| statistics | N | Mean | Sd |
|---|---|---|---|
| Log average schooling | 16507 | 2.243 | 0.123 |
| Log av. school. white collars | 13256 | 2.476 | 0.126 |
| Log av. school. blue collars | 12421 | 2.133 | 0.160 |
| Log export per hour | 16275 | -7.275 | 1.341 |
| Log import per hour | 16350 | -7.859 | 1.385 |
| Log exp. per hour (Advanced) | 16105 | -7.659 | 1.432 |
| Log imp. per hour (Advanced) | 16341 | -8.328 | 1.533 |
| Log exp. per hour (Developing) | 15909 | -8.642 | 1.444 |
| Log imp. per hour (Developing) | 15864 | -9.358 | 1.546 |
| Log capital per hour | 12085 | -1.965 | 2.159 |
| Share of white collars | 16519 | 0.281 | 0.163 |

Weighted averages according to the size of each cell in terms of worked hours. Note: the negative averages for exports and imports per hour are due to the fact that trade flows are expressed in millions of euros.

Table 2: Effect of trade on average schooling: baseline

| Dependent variable: Average schooling per worked hour | | | | |
|---|---|---|---|---|
| | Total trade | | Trade by countries | |
| | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) |
| lagged export per worked hour | 0.003*** | 0.004** | | |
| | (0.001) | (0.002) | | |
| lagged import per worked hour | 0.004*** | 0.007*** | | |
| | (0.001) | (0.002) | | |
| lagged export to dev.ed | | | 0.002* | 0.005*** |
| | | | (0.001) | (0.002) |
| lagged import from dev.ed | | | 0.005*** | 0.003 |
| | | | (0.001) | (0.002) |
| lagged export to dev.ing | | | 0.002 | -0.000 |
| | | | (0.001) | (0.003) |
| lagged import from dev.ing | | | -0.001 | 0.005** |
| | | | (0.001) | (0.002) |
| lagged capital stock | 0.003*** | 0.002*** | 0.003*** | 0.003*** |
| per hour worked | (0.001) | (0.001) | (0.001) | (0.001) |
| F.E. for time, sector, province | yes | yes | yes | yes |
| F.E. for time x sector | yes | yes | yes | yes |
| Observations | 10,357 | 9,989 | 10,183 | 9,232 |
| R-squared | 0.580 | 0.583 | 0.582 | 0.591 |
| F first step exp | | 1375 | | |
| F first step imp | | 1465 | | |
| F first step exp dev.ed | | | | 1700 |
| F first step imp dev.ed | | | | 1369 |
| F first step exp dev.ing | | | | 665.9 |
| F first step imp dev.ing | | | | 797.9 |

*Notes:* Weighted regressions according to the size of each cell in terms of worked hours. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Effect of trade on average schooling - Robustness: clustered errors and no controls for K

| Dependent variable: Average schooling per worked hour | | | | |
|---|---|---|---|---|
| | No capital stock | | Clustered errors | |
| | Total Trade (1) | Trade by countries (2) | Total Trade (3) | Trade by countries (4) |
| lagged export per worked hour | 0.003* | | 0.004 | |
| | (0.002) | | (0.002) | |
| lagged import per worked hour | 0.009*** | | 0.007*** | |
| | (0.002) | | (0.003) | |
| lagged export to dev.ed | | 0.005** | | 0.005** |
| | | (0.002) | | (0.002) |
| lagged import from dev.ed | | 0.004* | | 0.003 |
| | | (0.002) | | (0.003) |
| lagged export to dev.ing | | -0.001 | | -0.000 |
| | | (0.003) | | (0.003) |
| lagged import from dev.ing | | 0.005** | | 0.005* |
| | | (0.002) | | (0.003) |
| lagged capital stock | | | 0.002*** | 0.003*** |
| per worked hour | | | 0.000 | 0.000 |
| F.E. for time, sector, province | yes | yes | yes | yes |
| F.E. for time x sector | yes | yes | yes | yes |
| Observations | 9,989 | 9,232 | 9,989 | 9,232 |
| R-squared | 0.582 | 0.591 | 0.583 | 0.591 |
| F first step exp | 1368 | | 332.3 | |
| F first step imp | 1510 | | 446.3 | |
| F first step exp adv | | 1715 | | 565.8 |
| F first step imp adv | | 1432 | | 396.3 |
| F first step exp dev | | 666.1 | | 161.3 |
| F first step imp dev | | 826.6 | | 254.1 |

*Notes:* IV estimates. Weighted regressions according to the size of each cell in terms of worked hours. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Errors are clustered at the sector per province cell.

Table 4: Effect of trade on average schooling: Controls for outliers

| Dependent variable: Average schooling per worked hour | | | | | | |
|---|---|---|---|---|---|---|
| | 99% | | 95% | | 90% | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| lagged export per worked hour | 0.004** | | 0.003* | | 0.003 | |
| | (0.002) | | (0.002) | | (0.002) | |
| lagged import per worked hour | 0.008*** | | 0.008*** | | 0.009*** | |
| | (0.002) | | (0.002) | | (0.002) | |
| lagged export to dev.ed | | 0.005*** | | 0.005** | | 0.005** |
| | | (0.002) | | (0.002) | | (0.002) |
| lagged import from dev.ed | | 0.003 | | 0.003 | | 0.003 |
| | | (0.002) | | (0.002) | | (0.002) |
| lagged export to dev.ing | | -0.000 | | -0.000 | | -0.000 |
| | | (0.003) | | (0.003) | | (0.003) |
| lagged import from dev.ing | | 0.005** | | 0.005** | | 0.005** |
| | | (0.002) | | (0.002) | | (0.002) |
| lagged capital stock | 0.002*** | 0.003*** | 0.002*** | 0.003*** | 0.002*** | 0.003*** |
| per hour worked | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| F.E. for time, sector, province | yes | yes | yes | yes | yes | yes |
| F.E. for time x sector | yes | yes | yes | yes | yes | yes |
| Observations | 9,952 | 9,197 | 9,582 | 8,840 | 9,208 | 8,476 |
| R-squared | 0.584 | 0.592 | 0.590 | 0.598 | 0.572 | 0.581 |
| F first step exp | 1377 | | 1374 | | 1343 | |
| F first step imp | 1477 | | 1278 | | 1169 | |
| F first step exp dev.ed | | 1705 | | 1728 | | 1776 |
| F first step imp dev.ed | | 1377 | | 1200 | | 1415 |
| F first step exp dev.ing | | 664.1 | | 669.4 | | 649.8 |
| F first step imp dev.ing | | 803.4 | | 756.4 | | 684.2 |

*Notes:* IV estimates. Weighted regressions according to the size of each cell in terms of worked hours. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 5: Effect of trade on average schooling: white vs. blue collars

| Dependent variable: Average schooling per worked hour | | | | |
|---|---|---|---|---|
| | White Collars | | Blue Collars | |
| | Total trade (1) | Trade by countries (2) | Total trade (3) | Trade by countries (4) |
| lagged export per worked hour | 0.007*** | | 0.004 | |
| | (0.003) | | (0.003) | |
| lagged import per worked hour | 0.010*** | | 0.004 | |
| | (0.003) | | (0.003) | |
| lagged export to dev.ed | | 0.000 | | 0.004 |
| | | (0.003) | | (0.003) |
| lagged import from dev.ed | | 0.004 | | 0.000 |
| | | (0.003) | | (0.004) |
| lagged export to dev.ing | | 0.010** | | 0.002 |
| | | (0.004) | | (0.007) |
| lagged import from dev.ing | | 0.004 | | 0.003 |
| | | (0.003) | | (0.003) |
| lagged capital stock | 0.001 | 0.001 | 0.003*** | 0.003*** |
| per hour worked | (0.001) | (0.001) | (0.001) | (0.001) |
| F.E. for time, sector, province | yes | yes | yes | yes |
| F.E. for time x sector | | | yes | yes |
| Observations | 7,803 | 7,390 | 8,204 | 7,742 |
| R-squared | 0.250 | 0.255 | 0.224 | 0.225 |
| F first step exp | 948.9 | | 1129 | |
| F first step imp | 1016 | | 1242 | |
| F first step exp dev.ed | | 879.9 | | 1596 |
| F first step imp dev.ed | | 1125 | | 1114 |
| F first step exp dev.ing | | 526.6 | | 546.2 |
| F first step imp dev.ing | | 551.0 | | 701.6 |

*Notes:* IV estimates. Weighted regressions according to the size of each cell in terms of worked hours. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Effect of trade on worked hours: baseline

| Dependent variable: Worked hours | | | | | | |
|---|---|---|---|---|---|---|
| | OLS | | | IV | | |
| | Total | White collars | Blue collars | Total | White collars | Blue collars |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| lagged export per worked hour | 0.270*** | 0.286*** | 0.256*** | 0.282*** | 0.302*** | 0.267*** |
| | (0.011) | (0.013) | (0.011) | (0.014) | (0.017) | (0.014) |
| lagged import per worked hour | -0.429*** | -0.400*** | -0.443*** | -0.458*** | -0.420*** | -0.472*** |
| | (0.013) | (0.017) | (0.013) | (0.018) | (0.022) | (0.018) |
| F.E. for time, sector, province | yes | yes | yes | yes | | |
| F.E. for time x sector | yes | yes | yes | yes | yes | yes |
| Observations | 13,728 | 11,369 | 13,192 | 12,942 | 10,904 | 12,535 |
| R-squared | 0.737 | 0.740 | 0.722 | 0.735 | 0.740 | 0.720 |
| F first step exp | | | | 2195 | 1874 | 2135 |
| F first step imp | | | | 2196 | 1943 | 2143 |

*Notes:* Weighted regressions according to the size of each cell in terms of worked hours. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Effect of trade on worked hours: baseline

| Dependent variable: Worked hours | | | | | | |
|---|---|---|---|---|---|---|
| | OLS | | | IV | | |
| | Total | White collars | Blue collars | Total | White collars | Blue collars |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| lagged export to dev.ed | 0.191*** | 0.186*** | 0.185*** | 0.229*** | 0.217*** | 0.221*** |
| | (0.010) | (0.013) | (0.011) | (0.016) | (0.020) | (0.016) |
| lagged import from dev.ed | -0.438*** | -0.406*** | -0.448*** | -0.499*** | -0.492*** | -0.510*** |
| | (0.015) | (0.019) | (0.015) | (0.023) | (0.027) | (0.023) |
| lagged export to dev.ing | 0.084*** | 0.112*** | 0.077*** | 0.047** | 0.097*** | 0.037* |
| | (0.011) | (0.014) | (0.011) | (0.020) | (0.025) | (0.021) |
| lagged import from dev.ing | -0.046*** | -0.038*** | -0.048*** | -0.007 | 0.033 | -0.010 |
| | (0.011) | (0.014) | (0.011) | (0.022) | (0.027) | (0.022) |
| F.E. for time, sector, province | yes | yes | yes | yes | | |
| F.E. for time x sector | yes | yes | yes | yes | yes | yes |
| Observations | 13,310 | 11,149 | 12,813 | 11,604 | 10,012 | 11,282 |
| R-squared | 0.748 | 0.748 | 0.733 | 0.741 | 0.743 | 0.727 |
| F first step exp dev.ed | | | | 2326 | 2109 | 2282 |
| F first step imp dev.ed | | | | 1694 | 1544 | 1670 |
| F first step exp dev.ing | | | | 1014 | 889.1 | 996.2 |
| F first step imp dev.ing | | | | 932.8 | 839.7 | 918.2 |

*Notes:* Weighted regressions according to the size of each cell in terms of worked hours. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1