The Effect of Trade on Skill Requirements: Evidence from Job Postings

Fabrizio Colella*

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Abstract

This paper examines the extent to which changes in international market prices lead to shifts in firms' skill requirements through trade. On January 15, 2015 the Swiss National Bank unexpectedly abandoned the exchange rate floor with the Euro, causing a 15% increase in the value of the Swiss franc, which remained relatively stable in the subsequent years. This unforeseen appreciation immediately impacted the relative price of trade, creating new incentives for import, while simultaneously reducing expected profits for firms exposed to foreign competition. I study how this sharp change in trade conditions affected skill requirements in Switzerland using novel data on trade and labor demand. Specifically, I merge trade data containing information on each import or export transaction made by Swiss firms to firm-specific job postings data. I find that, in the two years after the shock, firms with a workforce more exposed to offshorability and automation increased imports, and posted more job ads for highly skilled workers. For these firms, a 10 percent increase in monthly import translates into a 2.1 percent reduction in the routine intensity of the tasks associated with their labor demand.

JEL: E24, E32, F14, J24, J63, L23, O24, O33.

Keywords: Exchange Rate, Trade, Skill Requirements.

*Department of Economics, HEC University of Lausanne - fabrizio.colella@unil.ch - fabriziocolella.com
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1 INTRODUCTION

Labor markets are evolving rapidly, encompassing dramatic changes in the tasks that individuals perform at work and an unprecedented increase in wage differentials across jobs (Autor and Dorn, 2013).[1] A growing line of research documents how international trade affects the labor demand, generating important changes in employment and wages (Hummels et al., 2014). There is indeed a common consensus that the opening of the domestic market to new countries has led to higher unemployment in import-competing sectors in the United States (Autor et al., 2013; Autor et al., 2014) and in Europe (Goos et al., 2014; Dauth et al., 2014).

Exchange rate movements have a strong bearing on export and import prices, impacting firm decisions toward trade and consequently employment, wages (Campa and Goldberg, 2001), and skill requirements (Kaiser and Siegenthaler, 2016). When a country experiences a currency appreciation, domestic firms become less competitive in both internal and foreign markets. The consequent contraction of the market share generates detrimental effects on employment in exposed sectors. On the other hand, the adoption of foreign inputs and technology becomes cheaper, creating incentives for a reorganization of the production chain that incorporates more imported inputs. Currency shocks provide a suitable setting to study these dynamics (e.g. Verhoogen, 2008). While the pass-through effect of a currency appreciation or devaluation to prices has been largely investigated, little is known on how exogenous exchange rate shocks impact firm trading decisions and the composition of their labor demand.

In this paper, I take advantage of a sudden and unexpected appreciation of the Swiss franc to provide evidence of the short term effects of this exogenous change in trade opportunities on skill requirements for Swiss manufacturing firms. September 2011, the Swiss National Bank introduced an exchange rate floor of 1.20 Swiss francs per Euro, and the rate was almost always binding in the subsequent years. On January 15, 2015 this floor was unexpectedly abandoned and the Swiss franc appreciated by more than 20% instantaneously, and then stabilized around a 15% higher value for the following years. In one

[1] An extensive literature documents how part of the shift in the labor demand toward highly skilled workers is related to the emergence of new machines (Krusell et al., 2000; Autor et al., 2003). This literature coined the concept of skill biased technological change (SBTC), defined as a change in the production function toward a new technology that complements skilled workers. See Acemoglu and Autor (2011) and Acemoglu and Restrepo (2018) for an overview of this literature.

day, firms that were exclusively exporters saw their expected revenues from foreign sales potentially cut by 15%, while those that were exclusively importers had a sudden expected 15% cost saving on their imported products. By lowering the price of importing inputs, the shock has generated an incentive for Swiss firms to offshore part of their production chain or to import cheaper capital from abroad. Both adjustment strategies could increase the demand for high skilled labor, as foreign inputs and capital are substitutes for workers involved in offshorable activities and workers who are more at risk of automation, respectively.

I use transaction-level custom data containing all the import and export movements at firm level to track the foreign trade of Swiss firms around the shock. I merge this data to firm-specific online job advertisements to record changes in the labor demand of different firms.[2] I classify firms based on a new measure of exposure to the shock, combining the offshorability and routine intensity of the pre-shock labor force. I start by estimating a series difference-in-differences models to calculate the impact of the shock on trade and on different indicators of the labor demand composition, for firms whose workers are exposed to substitutability versus those which labor force is not exposed. To get further insights on the effect of trade on skill requirements, I leverage exogenous changes in import, triggered by the appreciation shock for exposed firms. Specifically, I estimate a two stage least square model instrumenting import with an interaction term between the shock and the exposure measure.

I find a positive and significant correlation between trade, labor demand and some indicators of skill requirements in the period before the currency shock. Comparing pre and post shock levels, I show that a one-standard-deviation increase in the exposure to substitutability translates into an increase in monthly imports by 8.3%. It also increases the demand for high skilled workers: for each additional log monthly import, a firm reduces the routine intensity associated with its labor demand by 0.137 percentage points (2/3 of standard deviation) and the share of jobs requiring manufacturing skills by 0.107 percentage points (1/2 of standard deviation). The shock has no statistically significant effect of the shock on changes in export by exposure. To the best of my knowledge, this is the first

[2] Online job postings are shown to be useful for studying variations in employer skill demands within labor markets and occupations (Modestino et al., 2016; Deming and Kahn, 2017; Atalay et al., 2018; Azar et al., 2018 and Hershbein and Kahn, 2018).

paper that combines job posting data with trade custom data at firm level and provides evidence on the effect of currency appreciation on detailed skill requirements.

This paper contributes to several strands of the literature. Primarily, it relates to the literature on the effect of trade on labor market outcomes. This line of research documents long term changes in employment, occupational differences and wages induced by trade and import competition. Autor et al. (2013) and Autor et al. (2014) provide a detailed description of the evolution of the US labor market after China joined the World Trade Organization (WTO). The ease of access to foreign markets generated higher unemployment, lower labor force participation and a reduction in lifetime earnings for workers employed in import-competing manufacturing industries. Goos et al. (2014) reveal evidence of similar patterns in Europe, while Dauth et al. (2014) demonstrate that employment gains for exported oriented sectors outweigh the job losses from competition with foreign firms.

A channel through which trade affects skill requirements is innovation. Building on the seminal peper by Acemoglu (1998), Hanlon (2015) provides evidence that changes in the relative supply of inputs drives the direction of technological process. Bustos (2011) documents an increase in technology upgrading for firms facing tariff reductions in Argentina due to a free agreement with Brazil. Bloom et al. (2016) emphasize how exposure to import competition from China generates innovation in Europe and shifts employment towards more technologically advanced firms. Thoenig and Verdier (2003) examine skill-biased effects of trade through technological change. In their model, firms respond to foreign competition by shifting innovations toward skilled labor intensive technologies, contributing to the increase in the occupational wage inequality. Tanaka (2020) investigates the rapid opening of Myanmar to foreign trade after 2011 and finds that exporting has large positive impacts on sales, employment, working conditions, and wages. A second channel by which trade generates an impact on the labor market is offshoring. By analyzing Danish firms and workers, Hummels et al. (2014) estimate that offshoring increases wages for highly skilled workers and generates wage losses for routine-based jobs. In line with this, Hijzen et al. (2005) show that international outsourcing has had a strong negative impact on the demand for unskilled labor in the United Kingdom, while Becker et al. (2013) associate offshoring with a shift in the labor demand toward more non-routine and interactive tasks, and highly educated workers. This paper integrates these two lines of research by causally identifying skill-biased effects of changes in trade opportunities for firms exposed to automation or offshorability.

Currency fluctuations are often used to identify the relationship between trade and firm decision. Bastos et al. (2018) exploit exchange-rate movements in Portugal as a determinant for firm decision in investment location and find that exporting to richer countries leads firms to pay higher prices for inputs. Alvarez and Lopez (2015) investigate the relation between the real exchange rate and the acquisition of foreign technology in Chile. They document that a real depreciation increases foreign technology acquisition, but only among exporting firms. Chen (2017) uses country-level data for 49 countries and shows that an undervaluation of the real exchange rate decreases R&D expenditure. He primarily attributes this effect to the increasing costs of importing machinery and other inputs due to the currency depreciation. Kaiser and Siegenthaler (2016) use a panel of Swiss manufacturers covering the period 1998-2012 to show that an upward fluctuation of the local currency increases high-educated and reduces low-educated employment. While highlighting important employment effects of exchange rates on labor demand, all these papers rely on currency fluctuations rather than a cleaner discontinuity in prices. One exception is the paper by Verhoogen (2008), who analyzes the labor market effects of the 1994 peso crisis shock. He finds that initially more-productive plants increased the export share of sales, white-collar wages, blue-collar wages, and the relative wage of white-collar workers relative to initially less-productive plants. I complement this literature by analyzing a sharp variation in trade opportunities provided by the Swiss franc shock. Contrary to Verhoogen (2008), I exploit a currency appreciation rather than a depreciation, which occurred in a period of economic stability, and which, theoretically, is supposed to have an effect that is opposite to the one of the peso crisis in terms of incentives for firms. This paper also differs from this branch of literature also in terms of outcomes: the analysis of job postings, rather than employment, allows for a detailed description of the labor demand by firms.

This paper also relates to the literature on the evolution of skill requirements and its determinants. The acquisition of new technologies is shown to have substantial effects in shifting the labor demand. For this reason, this literature directly relates to the concept of skill biased technological change (SBTC)and to the *computerization* phenomenon. Krusell et al. (2000) show that the canonical SBTC framework can explain a large part of the skill premium. However, Card and DiNardo (2002) provide evidence that the SBTC fails in explaining the existing wage differentials between different groups of workers. Autor et al. (2003) argue that computer capital is a substitute for routine, algorithmic, low and middle skill tasks, while it is a complement for cognitive, problem solving, and communication tasks. Autor and Dorn (2013) demonstrate how the employment and wage polarization in the United States labor market partially stems from the adoption of information technology and the consequent falling cost of automating routine. Goos and Manning (2007) find similar results for Britain. I add to this literature by showing an additional channel through which the demand for skills evolves in a small open economy: the change in international market prices due to an unforeseen currency appreciation.

This paper contributes to the growing literature that exploits the information contained in the text of job advertisements to study labor market concentration (Azar et al. (2018)) and to better understand labor demand dynamics. Most of this research was made possible by the data on US vacancies made available for economic research by Burning Glass Technology. Online job postings are shown to be useful for studying variations in the employer skill demands across labor markets and occupations as they contain a detailed description of the requirements and are observed at high frequency and at a refined geographical level with respect to survey or administrative data. The seminal paper by Deming and Kahn (2017) shows the existence of substantial variation in skill requirements within occupations and that skill requirements positively correlate with wages. Hershbein and Kahn (2018) analyze the change in skill demand induced by the great recession, showing that US metropolitan statistical areas that suffered a higher unemployment rate during the crisis had a relatively greater increase in skill requirements. Modestino et al. (2016) document a negative relation between the employer skill requirements and the business cycle. I exploit, for the first time, a new database on job postings from Switzerland that is comparable to the Burning Glass Technology database in terms of contents. I follow the literature in the use of skill content extracted from job advertisements through text analysis, and complement it by showing how skill requirements in job ads are affected by a currency appreciation.

Finally, this paper adds to the literature exploiting the extraordinary variation in real prices provided by the Swiss exchange rate shock. Several papers study the exchange rate pass-through on prices (Auer et al., 2021; Auer et al., 2019; Kaufmann and Renkin, 2019; Bonadio et al., 2019). Efing et al. (2015) investigate the impact of the Swiss franc shock on investments by publicly listed Swiss firms. They find that firms with large currency risk exposure decreased their real investments by 8.1% half a year after the abolition of the exchange rate floor. Kaiser et al. (2018) employ a DID approach by comparing the evolution of the investment of firms with different net exposure before and in the two years following the Swiss franc shock. They find that firms with positive net exposure reduced gross fixed capital investment by roughly 15% in 2015 and by 12% in 2016 relative to negatively exposed firms. Exposed firms reduced investment in machinery and equipment, construction and R&D in 2015 and 2016. They also find evidence suggesting that the franc shock appears to have induced exposed firms to renew their machinery and equipment. The closest paper to this one is a policy report redacted by Kaufmann and Renkin (2017) for the Swiss State Secretariat for Economic Affairs. They employ a DID approach comparing Swiss manufacturing firms with a control group of similar Austrian firms before and after the Swiss franc shock. They find an average 4% decrease in employment for Swiss manufacturing firms in the two years after the appreciation. They also find a reduction in job vacancies and show how the decline in vacancy postings explains most of the variation in employment. However, they do not provide any evidence on potential skill-biased effects of the shock on labor demand. I integrate this literature by investigating the effect of the Swiss franc shock on international trade and skill requirements, using detailed information on the labor demand for skills and products that firms import or export, before and after the shock.

The remainder of this paper proceeds as follows. Section 2 provides the background information with a focus on the Swiss franc shock and its implications. Section 3 describes the data, while Section 4 investigates the correlation between trade and labor demand and their evolution. Section 5 provides details on the empirical strategy and presents evidence that the trade induced by the exchange rate shock has a skill-biased impact on the labor demand. Section 6 concludes.

2 BACKGROUND

2.1 THE SWISS MANUFACTURING SECTOR

Switzerland's manufacturing sector is a central pillar of the Swiss economy. According to the World Bank (2020), it generates about 18% of the Swiss GDP and it is the second biggest employer in the country. The Swiss manufacture production specializes primarily in high-tech and knowledge-based production. Major products include machinery and equipment, chemical-pharmaceutical products as well as scientific and precision instruments, such as luxury watches and hearing aids.[3] The largest industry is mechanical engineering, electrical engineering and metalworking (MEM), which makes up almost half of the manufacturing sector. With around 320,000 employees, it is the biggest industrial employer in Switzerland (SWISSMEM, 2019). This sector has increasingly become more dedicated to dynamic technology fields such as sensor technology, photonics, robotics, additive manufacturing, and industrial IT. This industry is highly export oriented, and the main client is by far the European Union, accounting for 60% of total exports, followed by the United States at 14%.

Swiss products and services have a good reputation worldwide. Customers associate Swiss made products with reliability, highest quality, longevity and technological superiority. The "Swiss Made" quality indicator in particular is beneficial manufacturing companies in the B2B sector. In order for a company's industrial product to earn the "Swiss Made" label, at least 60% of the product's manufacturing costs (including R&D, material and production costs including costs for quality assurance and certification) must be incurred in Switzerland. In addition, the main production stage must take place in Switzerland (Switzerland Global Enterprise, 2020).

Switzerland's workforce is highly skilled and the manufacturing sector has capitalized well on this. The large stock of high quality labor not only provides a steady stream of qualified workers but also a consistently high added-value to the economy through specialization. The main reason behind this extremely specialized skilled technical workforce is the Swiss vocational education system. Specifically, the vocational training system in Switzerland is oriented toward the labor market and based on a duality of theory and practice

[3] In comparison, the largest manufacturing industries in the US for instance include petroleum, steel, automobiles, aerospace as well as food processing, consumer goods and electronics.

(Switzerland Global Enterprise, 2020). Consequently, thousands of young, well-trained individuals enter the labor market every year, particularly in the manufacturing industry. While some workers are highly specialized and hard to replace, the liberal labor regulation with relatively weak protection with respect to other European countries allows firms to employ and dismiss staff at short notice without incurring incidental wage costs.

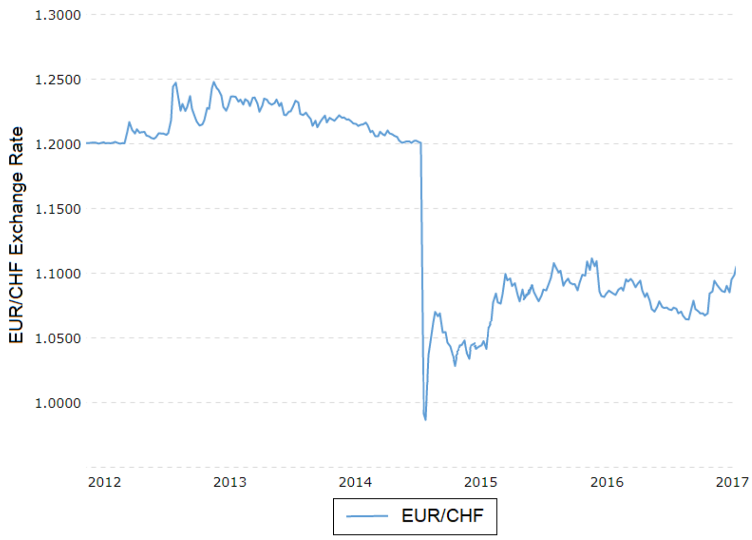
Historically, the Swiss manufacturing sector has been more resilient to foreign competition than other countries. High-margin industries such as pharmaceuticals and watchmaking have been able to focus on value creation and export growth in recent past years, and have increased productivity and employment rather than reducing the size of the workforce. The continuous innovation of Swiss manufacturing companies makes them less vulnerable to competition at the output level and prone to accomodate automation.

2.2 The Swiss Franc Shock

This paper estimates the impact of an unexpected currency appreciation on firm skill requirements. The appreciation is the result of a sudden monetary policy decision by the Swiss National Bank (SNB). After the global financial crisis, the Swiss franc (CHF) saw a strong appreciation with respect to the euro (EUR) and the US dollar. This process accelerated with the following euro crisis generating a drop in the CHF/EUR rate by more than 30% in 2 years. To curb this excessive appreciation, the SNB implemented a non-conventional monetary policy measure, announcing on September 6, 2011 a CHF/EUR exchange rate floor of 1.20. The SNB stated that it was ready to buy an unlimited amount of foreign currency to maintain the floor, if necessary. As a consequence, the CHF/EUR stabilized in the 1.20-1.24 window for the subsequent years, often binding at 1.20. On January 15, 2015, the SNB ended the exchange rate floor policy announcing that it would no longer artificially keep the Swiss franc low. After this announcement the Swiss franc appreciated against the Euro and other currencies. The CHF/EUR exchange rate instantaneously dropped to 0.98 and after a high volume of transactions it remained around 1.04 Swiss francs per Euro in the following months. Figure 1 plots the CHF/EUR exchange rate in the 3 years before and after the shock, showing that the ratio fluctuated between 1.05 and 1.10 even in subsequent years without ever going back to the previous shock levels.

The Swiss franc shock provides an ideal and unique setting to study trade and its effects

Figure 1: EUR/CHF Exchange rate around the shock



on the labor market for at least three reasons. First, the SNB decision to stop artificially maintaining a floor level was unanticipated. The KOF Consensus Forecast surveys a panel of 20 economists quarterly, asking them to forecast Swiss franc value for the following 12 months. One month before the shock, the average forecast measure predicted that the rate would stay at about 1.2 Swiss francs per Euro in the following year, with a narrowed confidence interval (Kaufmann and Renkin (2019)). Mirkov et al. (2016) investigated the possibility that markets would expect the end of the cap by the SNB. They analyzed financial derivatives on the exchange rate and transactions on the Forex liquidity market highlighting no significant shift in market expectations. In addition, figure A.1 in appendix shows that general interest toward the topic was also quite stable before the SNB announcement.

Second, this unexpected monetary policy change occurred in a period of relatively solid economic circumstances and after a three year period of stability. This permits a clear before-after comparison and allows to discern the effect of trade from other confounders.

Third, contrary to many currency crisis shocks, the result of the January 15, 2015 SNB decision was a sudden appreciation of the local currency, making imports cheaper and exports more expensive. This is crucial for the study of the labor market and the skill requirements, as it directly impacts the production function of firms creating incentives for offshoring and automation. The shock is particularly relevant since the Eurozone is the most important market for Swiss firms, accounting for more than 60% of the Swiss international manufacturing trade.

2.3 IMPLICATIONS

Motivated by the low cost of labor in foreign countries and the need to compete with emerging economies, offshoring has been one of the most common strategies of manufacturing companies based in developed countries in the last 30 years. Firms disaggregate their value chain, outsourcing some tasks to external providers located abroad. The external provider produces inputs that were previously produced in-house and sells them to the outsourcing company. The effect of this restructuring of the firm production function on its workforce is likely to be skill-biased. Offshoring in manufacturing usually concerns standardized products, requiring mainly non-cognitive and manual skills. Second, to offshore the firm needs to negotiate with foreign firms and to organize the internal structure, which requires managerial skills (Hijzen et al., 2005; Biscourp and Kramarz, 2007; Becker et al., 2013; Hummels et al., 2014). This implies that imported inputs substitute for unskilled labor while complementing the skilled workers, meaning that importing should upward bias the firm labor demand in terms of skills. An appreciation of the exchange rate lowers the relative price of imported goods making outsourcing more convenient. As a consequence, the relative demand for highly skilled workers should increase after a positive currency shock (Kaiser and Siegenthaler, 2016; Burstein et al., 2013).[4]

In addition, most of the the capital used by Swiss firms is imported from abroad. Therefore, by making foreign capital less expensive, the currency appreciation might affect skill requirements through a second driver. It could trigger technological change, which is shown to be complementary to highly skilled labor (Acemoglu, 1998; Krusell et al., 2000).

Building on Krusell et al. (2000) and Hummels et al. (2014) it is possible to construct a model accounting for both the capital–skill, and the foreign-inputs–skill complementary.[5] A CES production function that accommodates this features can have the following functional form $y = \Lambda_1 \{s\Lambda_2 [k\Lambda_3 (u, z)]\}$. Where y is output, k is capital, s and u are skilled and unskilled labor, respectively, z indicates imported inputs and Λ_1, Λ_2, and Λ_3 are CES

[4]As a small open economy, Switzerland is subject to international price spillovers which depend on the underlying shocks abroad (Baurle et al., 2017). However, the Swiss export market is inherently special, as exports are relatively inelastic to exchange rate and price fluctuations (Auer et al., 2021), while imports are not. Hanslin Grossmann et al. (2016) conclude that not only exports were less sensitive to exchange rate fluctuations, but that the underlying export sectors shifted towards a structure that is more independent of business cycles.

[5]Capital refers to foreign capital goods; it is possible to extend the model including both domestic and foreign capital without changing its implications.

aggregators.[6] An implication of the model would be that a reduction in import prices impacts the labor demand through both channels in the same direction: it generates a shift from workers performing tasks that can be automated or offshored and to highly skilled workers complementing the new technologies and trading activities.

3 Data

3.1 Data Sources

I rely on three sources of data. The first is the transaction-level records of Swiss imports and exports collected by the Swiss Customs Administration (Swiss-Impex). This data starts in 2014 and covers all goods that enter Switzerland or leave the country on a daily bases. For each good it reports the value-at-the-border in Swiss francs and the Harmonized-System 8-digit product classification. In addition, for each transaction the data records detailed information on the recipient and the sender, including the name and the exact address of the origin and destination and unique identifiers for importing and exporting firms (UID).[7]

The firm identifier allows me to merge the import-export information to the second source of data: the near-universe of online job postings in Switzerland scraped and assembled by a labor market analytic private firm. This data contains information such as name, industry and market of the firm or the recruitment agency that posted the job ad, the plant location, the posting and closing date, the position, the quota (full time/part time), the language of the advertisement, the job title and the full description of the job. The database covers the period from 2012 to 2021 for an average of almost 1 million job ads per year issued by 105,848 firms or public entities and 3,122 headhunters. The geographical representation closely follows the employment distribution of Switzerland with 19% of all postings associated with the Canton Zurich and 10% with the Canton Bern, followed by Argovia, St Gallen, Lucern and Vaud. Additional information on the requirements are

[6] This production function imposes two restrictions on substitution elasticities. First, it restricts the elasticity of substitution between capital and unskilled labor to be equal to that between capital and imported inputs. Second, the elasticity of substitution between skilled labor and capital is restricted to be the same as that between skilled labor and a CES composite input generated using unskilled labor and imported inputs.

[7] The firm identifier is not included for the years before 2016. I generate it through the firm name and a cross-walk name-UID constructed using the subsequent periods.

extracted from the title and the description by means of text analysis. This additional information includes: occupation (job), skills, education, experience and language. The skill content is the main variable of interest which allows for a detailed analysis of skill demand within each occupation: a margin that has been often ignored in the literature, but hass recently been shown to be relevant by Hershbein and Kahn (2018) and Deming and Kahn (2017). More than 10 thousand skills were classified. Each job ad requires, on average, 3.4 skills. In addition, a second skill classification is extracted: soft skills, accounting for 144 distinct categories and 4.5 entries per job ad, on average.

The last source of data is the Bureau van Dijk's ORBIS database, which contains publicly available information about firms, including balance sheets and income statements, as well as a detailed description of the activity of the firm.

3.2 Descriptive Statistics

Following the previous literature on trade and the labor market, I focus only on manufacturing firms. This is also a sector having the strongest ties with the rest of the world through trade and it employs a substantial part of the Swiss labor force. In order to focus on firms active in the labor market, I restrict the sample to firms posting at least 5 job ads in the period 2012-2014 and at least 10 job ads in the period 2012-2017. The result is a list of 1,752 firms of which 89% made at least one import transaction and 81% at least one export transaction in the period 2014-2015.

I use the Country of origin/destination to separate transactions with the Euro area from the rest. I merge the product classification with the Broad Economic Categories (BEC) to distinguish Consumption goods from Intermediate goods and Capital goods. I translate all the skills and merge them to the skill classification, which is produced by Burning Glass Technology and it is largely used in the literature. This skill-matching allows me to group skills into 512 clusters and into, more tractable, 28 skill families.[8] Using the job titles, and following the algorithm created by Mihaylov and Tijdens (2019), I generate five task measures related to each job ad: non-routine analytic, non-routine interactive, routine cognitive, routine manual and non-routine manual tasks. The five measures sum up to 1 for

[8]Figures D.1 and D.2 in the appendix show the presence of substantial variation in the distributions of skills by industry and occupation, respectively. This highlights how an analysis at the skill level can point out dynamics that can not be analyzed using traditional measures of occupations or industries.

each job and are then aggregated into a routine intensity index (RTI) ranging between -1 and 1: 1 indicates that the occupation contains only routine tasks, and -1 indicates that the occupation contains only non-routine tasks.[9] Still using the job titles, I also assign to each vacancy an offshorability measure based on the index constructed by Autor and Dorn (2013). This indicator assigns to each occupation a value based on the degree to which the job can be relocated abroad. In particular, it indicates *how much* a job requires interpersonal interaction or high proximity between the worker and the work location to be performed.[10]

I collapse all the information at firm-month level. If a firm does not appear in the custom data for a given month, I impute zero import and export. Similarly, if a firm does not show up in the job posting data, I infer that the firm did not post any job advertisement, while the skill requirements measures are registered as missing for that given month. The database contains, among others: information on total import and export by type of good and destination country; the number of new job advertisements by skill and the average RTI and minimum education requirement; time invariant characteristics of the firm such as the industry and the location and yearly information on the Capital, the operating revenue and the number of employees.

In Table 1, I report descriptive statistics for the main variables for the period 2014-2016. Panel A shows characteristics of the vacancies posted. The average monthly number of new job ads posted is 1.27 per firm, for a total of 79,860 postings. Only 8.7% of the job ads posted requires a bachelor degree.[11] The average routine index in the sample is -0.487, showing a tendency toward labor demand focused mainly on non-routine jobs. A standard deviation of 0.62 and the minimum and the maximum values at the boundaries show that there is a significant variation in this indicator that can be analyzed. The job offshorability measure ranges from -3.011 to 2.661 with an average of 0.391 and very large variance: the standard deviation is 1.025.

[9]This classification follows the idea of conceptualizing jobs as a series of occupational tasks which is labeled as the “task-based approach" (Autor et al., 2003; Autor, 2013; Autor and Dorn, 2013). Each occupation is divided into different tasks, for a total of 3,264 occupation-specific tasks, and each task is classified according to each of the five categories. These values are then averaged over all the tasks that are performed in each occupation. The five measures were shown to be positively correlated with the equivalent measures used in Acemoglu and Autor (2011) at the occupational level, with correlation coefficients ranging between 0.41 and 0.70. The RTI is just the difference between the routine and the non routine indexes.

[10]The indicator is based on two variables derived by Firpo et al. (2011) using the US O*NET database: *Face-to-face contact* and *on-site job*.

[11]For the remaining portion, it is not possible to state the exact required education.

Table 1: Summary statistics

Variable	**Mean** (1)	**Std. Dev.** (2)	**Min.** (3)	**Max.** (4)	**N** (5)
Panel A: Job Postings - by job ads					
Bachelor Degree or Higher	0.087	0.282	0	1	79860
RTI	-0.487	0.62	-1	1	72943
Job Offshorability	0.391	1.025	-3.011	2.661	72055
Panel B: Transactions - monthly					
Total					
Total Monthly Import	3.133	50.026	0	2183	63072
Total Monthly Export	5.569	77.523	0	3054	63072
By Type of Goods					
Monthly Import Intermediate	2.534	48.02	0	2183	63072
Monthly Import Consumption	0.129	1.42	0	192	63072
Monthly Import Capital	0.153	1.086	0	108	63072
Monthly Export Intermediate	3.531	63.39	0	2767	63072
Monthly Export Consumption	0.297	4.305	0	223	63072
Monthly Export Capital	0.581	3.188	0	153	63072
Euro Area					
Monthly Import Euro Area	1.586	28.246	0	1771	63072
Monthly Export Euro Area	2.507	36.38	0	1717	63072
By Currency					
Monthly Import CHF	0.492	17.783	0	1454	63072
Monthly Import EUR	1.417	17.6	0	883	63072
Monthly Import USD	1.082	29.353	0	2017	63072
Monthly Export CHF	1.773	29.716	0	2198	63072
Monthly Export EUR	1.989	30.287	0	1708	63072
Monthly Export USD	1.03	21.009	0	1224	63072
Panel C: Firm Information - yearly					
N. of Employees	209.964	3108.477	1	133413	5100
Capital (in million CHF) in	4.598	41.573	0.02	1228	5068
Operating revenue (in million CHF) in	157.65	2020.389	0.25	60983.953	2309
Listed	0.01	0.098	0	1	5256

Notes: This table shows the monthly summary statistics of some job ad variables in panel A, trade variables (in million CHF) on a monthly basis in Panel B and firm information on a yearly basis in Panel C for the period 2014-2016. The number of observations in panel B (63,072) is the product of 1,752 firms × 12 months × 3 years. The firm information (Panel C) is available only for a portion of the sample: number of employees and capital are present for about 97% of the firms, operating revenues for less than half of the sample. Number of employees and operating revenues are imputed for about 98% of the sample. Total Swiss Export 2014: 285,079 million CHF - Total Swiss Import 2014: 282,505 million CHF. Trade made by firms in the sample in 2014 accounts for 38.6% of total Swiss exports and 22.62% of total Swiss imports in 2014. Total Swiss employment in 2014: 4,897 million workers. In 2014, the firms in the sample employ 7.5% of the total Swiss employment.

Panel B reports the amount of monthly import and export transactions made by the firms in the sample. The total yearly export accounts for 38.6% of the total exports in 2014. Import reaches only 22.62% of the total import in the same year. This is not surprising since exports are more concentrated among bigger firms and imports also account for a vast portion of private consumption not related to firms. Slightly more than 50% of the trade in the sample is between Switzerland and the Euro Area - which is directly affected by the policy shock. Lastly, I divide import and export into four groups, according to the currency at which transactions were made[12]. For both import and export most trading is invoiced in euros. While one-third of exports concerns transactions in Swiss francs, less than 20% of imports are invoiced in Swiss francs. Conversely, the US dollar is more prominent for importing transactions.

Panel C shows the three yearly variables extracted from ORBIS that are observable for a discrete number of firms in the sample. These firms have an average operating revenue of 157 millions Swiss francs and account for 7.5% of the Swiss labor force.

4 Trade and Skill Requirements

In this section, I show how pre-shock values of trade and skill requirements are related and how they change after the shock. In section 5, I report results of a more complex analysis aimed at identifying how firms respond to the shock in terms of trade and how these adjustments impact their labor demand.

4.1 Cross-Sectional Correlation prior to 2015

I start by considering only the year 2014; a year of substantial stability in terms of the global and the Swiss economy, and with an (artificially) stable exchange rate between the Swiss franc and the Euro. I divide the firms into four groups, according to their level of trade. In particular, I consider two measures: total import per worker and total export per worker. Since these two measures are highly skewed, I sort firms over these measures and group them into four clusters.

[12] Bonadio et al. (2019) highlight important differences in the pass-through effect of the Swiss franc shock on prices dependent on whether the transaction was invoiced: for goods invoiced in euros, the pass-through is immediate and complete while for goods invoiced in Swiss francs it is slowed and partial.

Table 2 reports average skill requirements by import per worker in panel A, and export per worker in panel B. By construction each group contains an equal number of firms. The total labor demand is highly correlated with trade. Consistently with the theory that trading firms employ less workers in routine jobs, I find that the routine intensity indicator monotonically decreases as the import per worker increases. The gap between the first and the fourth quartiles is 0.12 points, which is equivalent to a reduction of about 19%. A similar pattern arises for exporting firms: the change between the two quartiles at the boundaries is even greater in this case, however, there is less variation in the middle of the distribution. This result can be due to the high correlation between the two trading measures as well as to other channels, other than offshoring, through which trade impacts on skill requirements.

Table 2: Summary statistics - Trade

						Weighted		
	N. Firms	**N. ads**	**RTI**	**Manuf.**	**I.T.**	**RTI**	**Manuf.**	**I.T.**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Import per worker								
First quartile	423	.837	-.306	.152	.378	-.374	.124	.397
Second quartile	423	.825	-.309	.127	.405	-.377	.109	.386
Third quartile	423	1.593	-.354	.093	.421	-.476	.086	.487
Fourth quartile	424	2.406	-.429	.097	.466	-.501	.083	.487
B. Export per worker								
First quartile	423	.836	-.283	.125	.363	-.342	.107	.388
Second quartile	423	.997	-.329	.109	.393	-.372	.088	.392
Third quartile	423	1.342	-.334	.112	.42	-.468	.096	.443
Fourth quartile	424	2.485	-.443	.109	.481	-.524	.089	.518

Notes: This table reports the average number of job postings per month, the average routine Intensity Indicator and the share of ads requesting Manufacturing and I.T. skills for four groups of firms in 2014. Firms are grouped based on total yearly import per worker in Panel A, and export per worker in Panel B. Averages in columns (6-8) are weighted by the number of ads posted.

To further investigate the relation between trade and selected skill requirements, columns (4) and (5) of the table look at two families of skills: manufacturing skills and information technology (IT) skills, respectively. The choice of these two families of skills is driven by the nature of the labor demand I analyze. The sample is composed by manufacturing firms, which traditionally employ workers with manufacturing skills. If outsourcing or automation take place, the firm might rather employ individuals with skills that are not closely related to the main firm activity. IT skills here are intended to be understood in a broad sense, this class includes all the job advertisements that mention a specific software or a programming language, ranging from *Data management* to standard software use skills like *microsoft office* skills, and to more complex programming language skills, for example, *C* and *Java*.[13] A clear pattern arises: firms in the fourth import quartiles require 36% less manufacturing skills and 23% more IT skills with respect to firms in the first quarter. While for IT skills the gap is slightly greater in the export case, for manufacturing it is about half. This difference might be explained by the nature of these requirements and the mechanisms behind the two forces. Both international buying and selling require some kind of infrastructure and distance communication which can be performed by workers with IT skills. On the other hand, offshoring and the input of production factors from abroad substitutes mainly for workers with manufacturing skills. Columns (6), (7) and (8) show that the patterns highlighted above also remain stable when using weighted measures of skill requirements as outcomes. Table E.1 in the appendix shows linear correlations between trade and skill indicators, confirming these patterns.

4.2 Evolution of Trade and Skill Requirements

Panel A of Figure 2 reports the total quarterly exports and imports for Swiss firms in the period 2014-2016. It shows an initial stable evolution of exports and a slight decrease in imports in 2014 and in the first two quarters of 2015. Starting from the last quarter of 2015 there is an increasing and quite parallel trend in both measures.

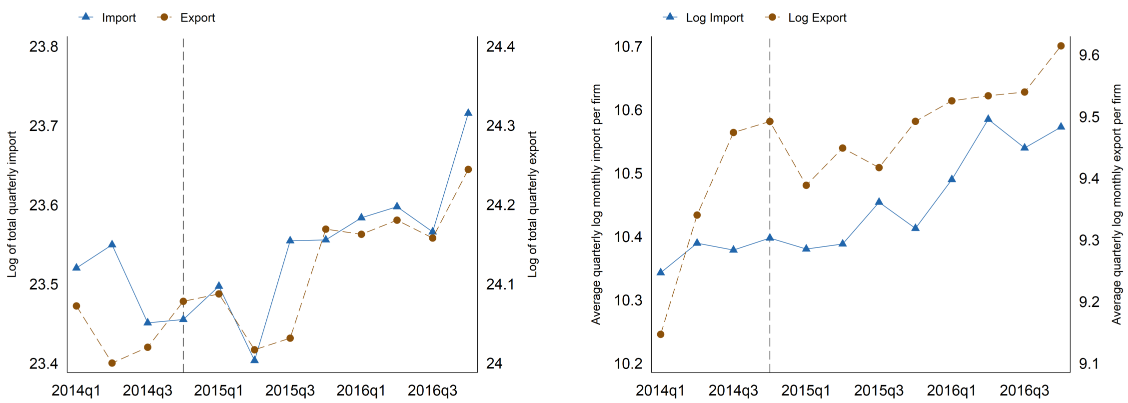
There is high volatility in the data, and the distribution of imports and exports is strongly skewed toward the right.[14] For this reason, I also consider the log monthly imports and exports and I plot their quarterly averages in panel B of figure 2. This measure is less sensitive

[13]Tables B.4 and B.5 in the appendix provide a description of the skill clusters associated with these skill families. I also regress imports and exports on all the skill families in the sample, highlighting positive correlation between imports and IT skills and a negative one between imports and manufacturing is negative.

[14]Figure C.1 in the appendix shows the distribution of monthly imports and exports highlighting the skewness of the distribution and the concentration of most of the exports to fewer firms, rather than imports, which is less concentrated.

Figure 2: Evolution of Trade

(a) Log of Total Imports and Exports (b) Average Log Imports and Log Exports



Notes: This figure shows the amount of imports and exports for Swiss firms from 2014 to 2016. Panel A reports the logarithm of the total amount of imports and exports generated in each quarter by all the firms. Panel B reports the average of the monthly log imports and exports generated by each firm.

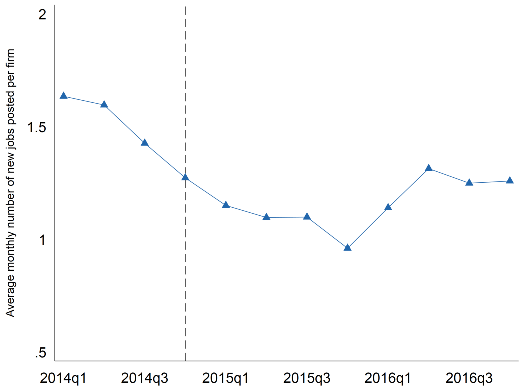
to outliers and better describes the behavior of firms in the middle of the distribution. In contrast to the past, imports and exports evolve quite differently. It is indeed possible to underline a stable trend in imports in 2014 and most of 2015, followed by a rise in the right part of the graph. The opposite is true for exports: the amount of exported goods from Switzerland constantly increased in 2014. This trend ended after the shock and total exports remained relatively constant in 2015 and 2016. The trend inversion for both variables is very likely to be driven by the exchange rate shock, which generated a change in prices making imports less costly while exports less convenient.

In Figure 3, I report the evolution of labor demand (panel A) and several measures of skill requirements. The number of new jobs posted online by the firm in the sample, constantly decreases in 2014. This unusual declining pattern is consistent with the global employment in the Swiss context.[15] The labor demand remains then quite stable in 2015 and slightly increases in 2016. The number of total skills identified in the text of job advertisements constantly increases (panel B), from approximately 3.1 skills required per job in the first quarter of 2014, to 3.6 in the last quarter of 2016. Panel C and D show the evolution of the routine intensity index (RTI) and the income associated with each job posted. To avoid mixing composition effects with change in salary, I consider the income of each occupation as fixed at its level in 2014. Therefore, any change has to be addressed only to a variation in the composition of labor demand in terms of jobs. The RTI does not vary

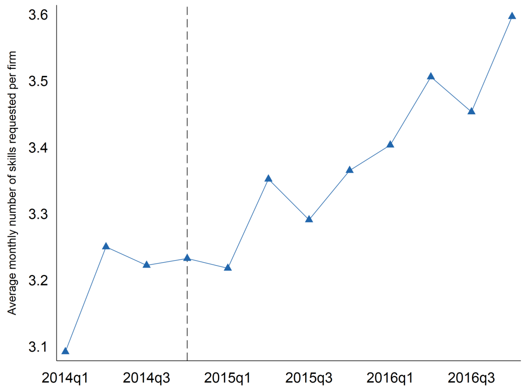
[15] See www.bfs.admin.ch for a description of Swiss employment in the last decade.

Figure 3: Evolution of Labor Demand in time

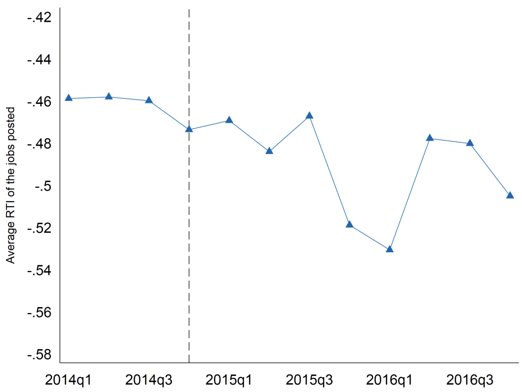
(a) Number of new job ads



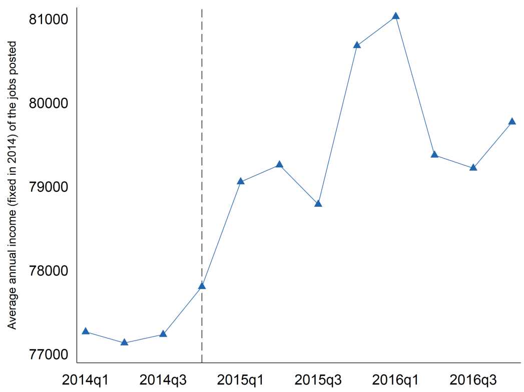
(b) Number of skills required



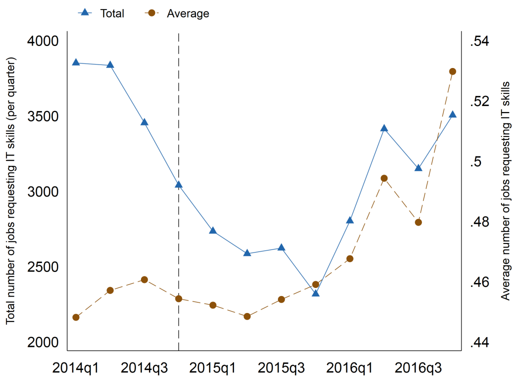
(c) Average RTI



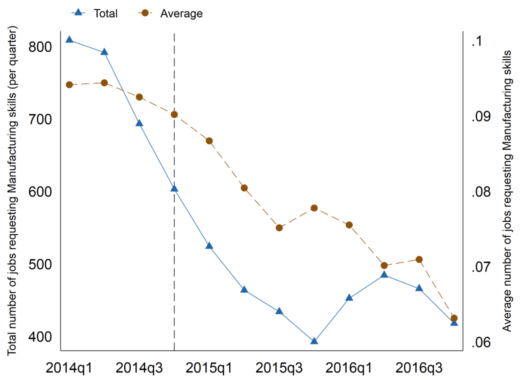
(d) Average income of the jobs posted



(e) Jobs requiring IT skills



(f) Jobs requiring Manufacturing skills



Notes: This figure shows the average monthly new job postings (panel A) the average number of skills requested (panel B), the average RTI (panel C) and the average income of the posted jobs (panel C) from 2014 to 2016, by quarter. Income is calculated at the occupational level in 2014. Panel E and F plots the number, and the average, of job advertisements requiring IT skills and manufacturing skills for the same period, by quarter.

much. It is quite stable around -0.46, and slightly decreases at the end of 2015 and the beginning of 2016, as well as in the last quarter of 2016. The income measure shows a constant increasing pattern starting in the first quarter of 2015 and ending in the first quarter of 2016. The range is about 3,000 Swiss francs per year.

The last two panels of figure 3 plot the total and the average number of job advertisements requiring IT and manufacturing skills. As a consequence of the reduction in the number of job postings in 2014, both measures show a declining pattern for the first six quarters. However, when moving to the average values two quite mirroring trends arise. IT skills are constant in the first half of the period and almost monotonically increase starting in the third quarter of 2015. Conversely, manufacturing skills show a mild decreasing trend in 2014 and decline more rapidly in 2015 and 2016. These changes in skill requirements, taken together with the increasing imports reported in figure 2 signal a potential transformation of the production functions of firms after the exchange rate shock, with a substitution between imported inputs and manufacturing skills. I investigate this causal link further in the next section.

4.3 Post shock Changes in Trade and Skill Requirements.

Earlier in this section, I show (i) the existence of a strong correlation between trade and different measures of skill requirements and (ii) an increment of the monthly imports, the demand of jobs with higher payment and the requirements for IT skills, as well as a decline in the postings targeting manufacturing skills after the shock. In order to establish a link between changes in trade after the shock and changes in skill requirements, I first group firms based on the change in log imports and log exports per worker between 2014 and 2015. I then show how labor demand in 2015 is distributed among these groups of firms. Results are reported in table 3.

Firms in the second and third quartiles posted a greater number of job advertisements in 2015. The greater the increase in imports after the exchange rate shock, the lower the average routine intensity indicator of the jobs that are posted. This is valid for the first three quartiles, but not for the last quartile. Changes in imports do not seem to have an impact on labor demand instead. Manufacturing skills are strongly negative correlated with the change in imports, while IT skills positively correlate with this change. The first-fourth

Table 3: Changes in Trade and Skill Requirements

	N. Firms	N. ads	RTI	Manuf.	I.T.	Weighted RTI	Weighted Manuf.	Weighted I.T.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Δ Import per worker								
First quartile	391	.646	-.348	.128	.411	-.404	.109	.423
Second quartile	391	1.076	-.382	.099	.423	-.474	.089	.491
Third quartile	391	1.734	-.41	.082	.456	-.534	.068	.488
Fourth quartile	392	.852	-.373	.081	.459	-.435	.077	.469
B. Δ Export per worker								
First quartile	354	.877	-.385	.087	.464	-.482	.079	.507
Second quartile	354	1.288	-.388	.105	.463	-.492	.089	.514
Third quartile	354	1.603	-.401	.103	.454	-.484	.076	.451
Fourth quartile	354	.798	-.387	.085	.412	-.377	.077	.428

Notes: This table reports the average number of job postings per month, the average routine Intensity Indicator and the share of ads requesting Manufacturing and I.T. skills for four groups of firms in 2015. Firms are grouped based on the difference between the log total yearly imports per worker in 2015 and the log total yearly imports per worker in 2015 in Panel A, and on the difference between the log total yearly exports per worker in 2015 and the log total yearly exports per worker in 2015 in Panel B. Averages in columns (6-8) are weighted by the number of ads posted.

quartile change for manufacturing skills is sizeable: a 53% reduction. The IT skills change is also important, but less significant, as it accounts for a 12% increase. Additionally, the change in exports does not seem to be strongly correlated with these two measures of skill requirements. This signals that imports, and therefore its substitutability with low skilled workers, is the channel through which the exchange rate shock affected the composition of the labor demand.

5 Empirical Analysis

Results in the previous section show that firms which increased their import shares changed their demand for skills in a way consistent with the theory on the substitutability between low skills and imported goods. To further establish a link between exchange-rate-driven changes in imports and changes in skill requirements, in this section I classify firms based on their exposure to the substitutability of their labor force and then estimate a series of OLS and 2SLS models to see how firms with different levels of exposure react to the shock.

5.1 Exposure Measure

The price effect generated by the exchange rate shock potentially affects every Swiss firm or individual. However, not all firms could react to it and not all by the same magnitude. The reaction depends on which portion of the production chain a firm can offshore and which share of workers it can substitute with imported inputs. To differentiate among different types of firms, I construct a measure of *exposure to substitutability* by firm. This new measure combines the offshorability index and the routine intensity indicator of pre-shock firm labor demand, and aims at indicating how much the labor force of a firm can be substituted either by the relocation of some activities abroad, or by the import of capital from abroad.

The Swiss manufacturing activity is very peculiar (section 2.1), as it is highly concentrated on high standard products, located at the top of the quality ladder (Grossman and Helpman, 1989, 1991a,b). In some sectors, Swiss producers are quasi-oligopolist in the world market and use their privileged position to set a high quality-adjusted market price for their products. In most cases, the *Swiss Made* label associated with their products is essential to guarantee high mark-ups when placing the goods on the market. Offshoring can be less convenient in Switzerland in comparison with other countries. For example, jobs like *handicraft workers in textile, leather and related materials*, *metal moulders and core-makers* and *weighers* reside in the top decile of the offshorability index, but it is very unlikely that firms employing these workers relinquish their privileged position in the market by offshoring their activities. On the other hand, instead of offshoring, firms can replace part of their labor force through automation, mantaining the production in Switzerland, while benefiting from the cheaper price of imported capital from abroad generated by the exchange rate shock.

To capture both channels through which the currency shock might impact the labor demand in the peculiar Swiss setting, I augment the offshorability index with the RTI. The new *substitutability* measure basically consists in the average between the offshorability index and the routine intensity indicator.[16] By including these two indexes, this new substitutability measure is intended to indicate the potential degree to which a job can be substituted either by a machine or by foreign workers.

I start by assigning an offshorability index value Off_{jit} to each vacancy j posted by firm i at time t through the job title.[17] I then create rescaled measures ranging between 0 and 1 of the offshorability ($StOff_{jit}$) and the routine intensity index ($StRTI_{jit}$) of the vacancy j, and average them with equal weights to construct the *substitutability* index (sub_{jit}), as shown in the equation below.[18]

$$sub_{jit} = \left(StOff_{jit} \ + \ StRTI_{jit}\right)/2 \tag{1}$$

I then use the job advertisements posted in the 2 years before the analyzed period, 2012 and 2013, to construct a measure of exposure to substitutability for each firm (sub_i). This is simply the average of the substitutability of all the job advertisements posted by firm i in those two years.

$$sub_i = \sum_j \frac{sub_{jit}}{N_{it}} \qquad \forall t \in [2012, 2013] \tag{2}$$

Table 4 reports descriptive statistics in 2014 for the exposure measure, the two variables used to construct it, and the main variables used in the analysis. The average level of exposure is 0.44 with a standard deviation of 0.12. Panel (B) and (C) of the same table reports descriptive statistics for exposed firms, that is, firms with an exposure measure greater than the median, and the remaining unexposed firms. By construction, the substitutability measure as well as the RTI and the offshorability index are substantially lower for unexposed firms. Additionally, the other skill requirements indicators and trade variables present some pre-shock differences consistent with the predictions: exposed firms request more manufacturing and less IT skills, and present lower values of trade.

Figure 4 presents the distribution of the exposure measure across firms by sub-sector.

[16]The relation between routine and offshorability index is not straightforward: in a survey, Blinder and Krueger (2013) find that the two measures are non correlated, while Autor and Dorn (2013) find a correlation index between routine and offshorability across US commuting zones of 0.66. In this database the correlation between the two indicators at the occupational level is also positive (ρ=0.19).

[17]The index was constructed following the SOC occupation nomenclature. In order to assign a value to each job in the database I transformed and adapted it to the ISCO-08 occupation classification using the crosswalk document provided by the US Bureau of Labor Statistics.

[18]Figure C.3 in the appendix presents the distribution of the three variables.

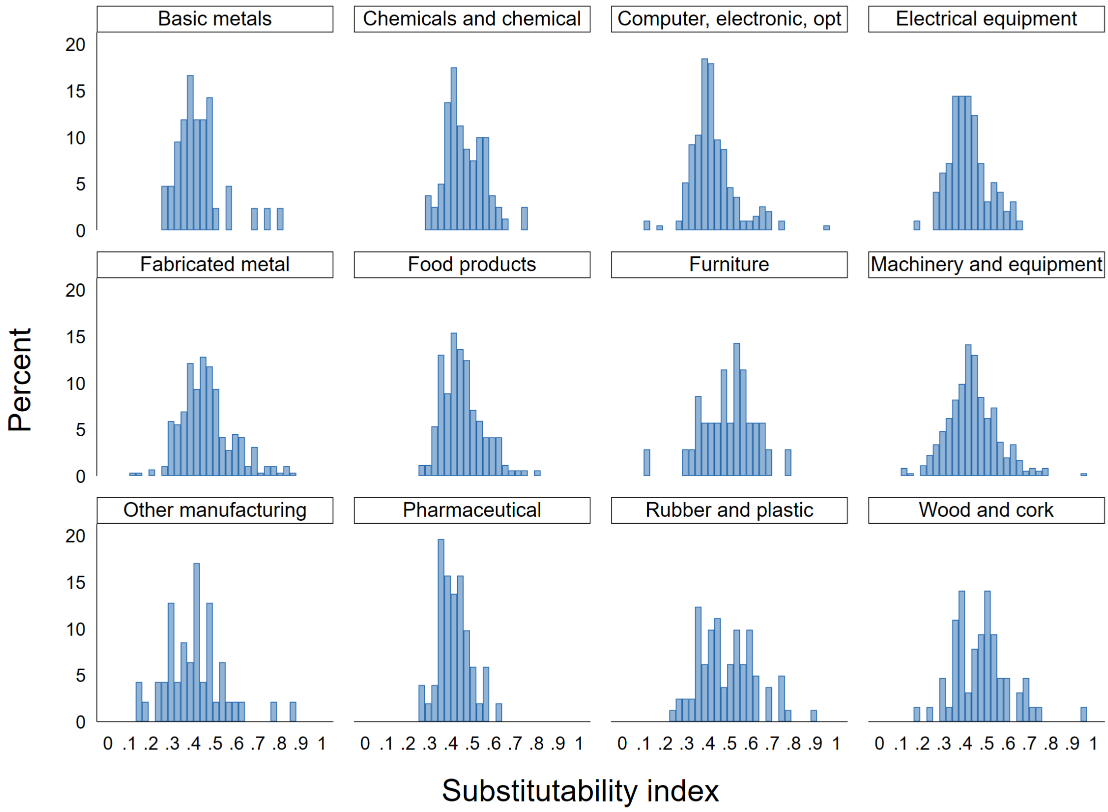
Table 4: Summary statistics - Variables in the main analysis

Variable	Mean (1)	Std. Dev. (2)	Min. (3)	Max. (4)	N (5)
Panel A: *All Firms*					
Exposure to Substitutability	0.443	0.116	0.114	0.961	1653
RTI Index	-0.309	0.46	-1	1	1653
Offshorability Index	0.324	0.654	-2.629	2.661	1655
Manufacturing Skills	0.125	0.228	0	1	1627
IT Skills	0.394	0.33	0	1	1627
Log Import	10.92	4.086	0	21.001	1752
Log Export	10.252	5.274	0	21.564	1752
Panel B: *Firms with exposure lower than the median*					
Exposure to Substitutability	0.356	0.058	0.114	0.428	827
RTI Index	-0.43	0.418	-1	1	776
Offshorability Index	0.243	0.635	-2.629	1.963	778
Manufacturing Skills	0.117	0.223	0	1	761
IT Skills	0.416	0.331	0	1	761
Log Import	11.249	4.188	0	21.001	827
Log Export	10.759	5.315	0	21.564	827
Panel C: *Firms with exposure greater than the median*					
Exposure to Substitutability	0.53	0.092	0.429	0.961	826
RTI Index	-0.197	0.467	-1	1	780
Offshorability Index	0.407	0.652	-1.934	2.661	781
Manufacturing Skills	0.129	0.228	0	1	771
IT Skills	0.382	0.327	0	1	771
Log Import	10.643	4.035	0	20.038	826
Log Export	9.870	5.24	0	19.864	826

Notes: This table reports summary statistics for vacancies posted in 2014. Each observation is a firm. Log Import and Log Export refer to the logarithm of the monthly average over each year.

The substantial variation within each industry displayed in the figure highlights the presence of firm-specific behaviors that can be detected and investigated only with a firm-level analysis.

Figure 4: Distribution of the exposure by sub sector



Notes: This figure shows the the distribution of the exposure index by sub sector for the period 2014-2015. Each observation is a firm-year cell. Only sectors with more than 100 observations.

5.2 Measuring Effects on Skill Requirements

I begin by using a simple difference in differences framework to measure how firms with different levels of exposure to substitutability change their labor demand after the shock. I estimate the following model.

$$Y_{it} = \alpha_1 + \gamma_{1,i} + \lambda_{1,t} + \delta_1 X_{it} + \beta_1 sub_i \times D_{t=post} + \varepsilon_{it} \quad (3)$$

Where Y_{it} is a measure of skill requirement, $\gamma_{1,i}$ and $\lambda_{1,t}$ are firm and time fixed effects, respectively, X_{it} is a vector of firm time variant characteristics, $D_{t=post}$ is an indicator taking value 1 for the post ban period and sub_i is the exposure to substitutability described above. The coefficient of interest is β_1, which is intended to estimate the effect of the shock on skill requirements for a unitary change in the exposure measure.

I collapse data at firm-year cells and fit the model in equation 3 for three outcomes. Table 5 presents the results. Columns (1) and (2) report the results on the routine intensity indicator (RTI), which ranges between -1 and 1. The exposure measure strongly correlates with the RTI in the pre-shock period: the coefficient of 1.059 indicates that for a unitary increase of the exposure measure the RTI increases by 1.059. Considering that the exposure measure is bounded between 0 and 1 and it is constructed, for its 50%, using a scaled RTI measure, this coefficient shows a substantial consistency between job ads posted in 2012-2013 and those posted in 2014. The interaction coefficient is negative, signaling a decrease in the RTI of jobs posted after the shock for firms with a high level of exposure. The appreciation lowers the role of exposure, by 0.175 and once firm effects are included, by 0.195. Appreciation weakens the link between exposure and RTI: a unitary increase in the exposure lowers the routine intensity of the labor demand by 14.7%.[19]

The lower the effect of the shock on the demand for manufacturing skills (column 4), the greater the exposure to substitutability. In particular, an increase of 1 in the exposure measure translates into a decrease in the share of the job postings requesting manufacturing skills by 0.086, which equals to a 74% increase. Conversely, I do not report any difference in the share of job ads requesting IT skills by exposure, both before and after shock (column 6). However, the sign of the interaction coefficient is positive signaling a positive correlation between the exposure and the change in IT skills after the shock.[20]

To provide further evidence that the effect is the result of the appreciation and is not due to any trend, I perform a placebo exercise. I compute the exposure measures using only information in 2012, and re-estimate the model in equation 3 in the period 2013-2014, modeling a placebo shock in 2014.[21] Results in table 6 show no changes in skill requirements after the shock for exposed firms. The interaction coefficients for RTI and manufacturing skills are not significant and in terms of magnitude are four times smaller

[19] This result is computed taking into account the distribution of the main variables of interest reported in the appendix table 4

[20] Table F.2 in appendix shows that these results are robust to clustering standard errors at firm level.

[21] Because of the data availability, this placebo exercise differs from the main analysis in terms of sample size. Indeed, the exposure measure is computed using only job advertisements posted in 2012, rather than 2012-2013, and the (placebo) treatment sample is 2014, rather than 2015-2015. To eliminate the concern that the differences between the placebo analysis and the main analysis can be due to the dimensionality of the two subsamples, in table F.1 in appendix I replicate the placebo analysis shifting all by one year, to include 2015 as treatment and I show that results are consistent with the ones presented in table B.4

Table 5: Skill Requirements - Results

	OLS Estimation					
Dependent Variable:	*RTI*		*Manuf. Skills*		*IT Skills*	
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.035	0.067	0.015	0.032	-0.019	-0.011
	(0.058)	(0.041)	(0.029)	(0.022)	(0.044)	(0.033)
Exposure (sub)	1.059***		0.073		-0.052	
	(0.101)		(0.051)		(0.077)	
Exposure × Post	-0.175	-0.196**	-0.056	-0.086*	0.090	0.069
	(0.127)	(0.089)	(0.064)	(0.048)	(0.097)	(0.073)
Controls	✓	✓	✓	✓	✓	✓
Firm FEs		✓		✓		✓
N	4232	4232	4121	4121	4121	4121

Notes: This table shows estimated coefficients of equation 3. Dependent variables are: the RTi index in columns (1) and (2), the share of Manufacturing Skills in columns (3) and (4), and the share of IT skills in columns (5) and (6). All variables are year averages. Capital and Number of Employees are included as controls. *Post* is a dummy taking value 1 in years 2015 and 2016. Robust standard errors in parentheses. Table F.2 in the appendix presents estimates with standard errors clustered at the firm level. $^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$.

than those identified in table 5; the placebo treatment effect on IT skills is also not significant and its sign is opposite to that found in the table above.

5.3 Measuring Effects on Trade

Next I turn to difference-in-differences estimates on trade. I regress the model in equation 3 on the log of the average monthly imports, the log of monthly exports and the difference between the two, which can be interpreted as the log of the import-export ratio. As before, I consider firm-year cells and use the 2014 data as the “pre" period and 2015-2016 as the “post" period. Table 7 summarizes the coefficients.

Consistent with the correlation patterns reported in table 2, the exposure measure is negatively correlated with both imports (column 1) and exports (column 2) before the shock. Looking at the treatment effects, the estimates in column (2) show that the shock increases monthly imports by 0.716 log points for a unitary increase in the exposure mea-

Table 6: Skill Requirements - Placebo

	OLS Estimation					
Dependent Variable:	*RTI*		*Manuf. Skills*		*IT Skills*	
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.051	0.048	0.030	0.013	0.025	0.014
	(0.061)	(0.053)	(0.035)	(0.024)	(0.052)	(0.039)
Exposure (sub)	0.878***		0.104*		-0.079	
	(0.095)		(0.056)		(0.082)	
Exposure × Post	-0.054	-0.045	-0.056	-0.022	-0.044	-0.027
	(0.132)	(0.116)	(0.077)	(0.053)	(0.113)	(0.085)
Controls	✓	✓	✓	✓	✓	✓
Firm FEs		✓		✓		✓
N	2201	2201	2147	2147	2147	2147

Notes: This table shows estimated coefficients for equation 3. Dependent variables are: the RTI index in columns (1) and (2), the share of Manufacturing Skills in columns (3) and (4), and the share of IT skills in columns (5) and (6). All variables are year averages. Capital and Number of Employees are included as controls. Period: 2013-2014. $Post$ is a dummy taking value 1 in year 2014. Exposure is calculated using job ads posted in 2012. Robust standard errors in parentheses. $^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$.

sure.[22] This result is in line with the prediction that firms with workers that can be more easily substituted by imported inputs or can be substituted by machines react strongly than others to the change in trade prices by importing more goods. This suggests that, potentially, an increase in imports is the channel through which these firms change the composition of their workforce. A further indicator in support of this thesis is provided by the fact that, conversely to imports, I do not record any difference between exposed and less exposed firms in terms of exports after the shock (column 4). Therefore, any change in terms of exports between firms can not be attributed to different compositions of their labor force.

5.4 Trade Driven skill-biased Effects of the Shock

To further investigate the link between changes in trade and in labor demand after the shock, and to combine the two results above, I estimate a two stage least square model on

[22]Table F.3 in the appendix shows that these results are robust to clustering standard errors at the firm level.

Table 7: Trade - Results

	OLS Estimation					
Dependent Variable:	*Log Import*		*Log Export*		*L Imp - L Exp*	
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.033	-0.207**	0.117	0.042	-0.084	-0.249
	(0.456)	(0.099)	(0.625)	(0.145)	(0.389)	(0.154)
Exposure (sub)	-1.875**		-2.775**		0.900	
	(0.794)		(1.088)		(0.677)	
Exposure × Post	0.711	0.716***	0.511	0.127	0.200	0.589*
	(0.995)	(0.217)	(1.364)	(0.317)	(0.848)	(0.335)
Controls	✓	✓	✓	✓	✓	✓
Firm FEs		✓		✓		✓
N	4232	4232	4232	4232	4232	4232

Notes: This table shows estimated coefficients for equation 3 on log imports in columns (1) and (2). In columns (3) and (4) the dependent variable is log exports and in columns (5) and (6), it is the Import-Export ratio in logs. Dependent variables are log of monthly averages, observed yearly. Capital and Number of Employees are included as controls. $Post$ is a dummy taking value 1 in years 2015 and 2016. Robust standard errors in parentheses. Table F.3 in the appendix presents estimates with standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

the effects of imports on skill requirements and I use the interaction between the exposure and the shock as an instrument for imports. In practice, the first stage is an estimation of the model in equation 3 on imports, as in the section above. The equations 4 and 5 below, represent the first and second stage models, respectively.

$$import_{it} = \alpha_2 + \gamma_{2,i} + \lambda_{2,t} + \delta_2 X_{it} + \beta_2 sub_i \times D_{t=post} + \varepsilon_{it} \tag{4}$$

$$Y_{it} = \alpha_3 + \gamma_{3,i} + \lambda_{3,t} + \delta_3 X_{it} + \beta_3 \widehat{import}_{it} + \varepsilon_{it} \tag{5}$$

This model is based on the assumption that imports are the channel through which different values of exposure translate into changes in skill requirements. While the assumption is ex-ante not easy to digest, the difference in the interaction coefficients between imports and exports highlighted in table 7 makes it more plausible.

Table 8 presents the estimated second stage coefficients together with the estimates of

Table 8: Trade and Skill Requirements - Results

OLS and 2SLS Estimation						
Dependent Variable:	*RTI*		*Manuf. Skills*		*IT Skills*	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)	2SLS (6)
Post	-0.021**	0.010	-0.005	0.006	0.018***	0.015
	(0.008)	(0.018)	(0.004)	(0.009)	(0.007)	(0.011)
Log Import	0.009	-0.274*	-0.003	-0.107*	0.030***	0.062
	(0.009)	(0.155)	(0.003)	(0.065)	(0.006)	(0.081)
Controls	✓	✓	✓	✓	✓	✓
Firm FEs	✓	✓	✓	✓	✓	✓
N	4232	4232	4156	4156	4156	4156
KP F Stat		10.085		10.742		10.742

Notes: This table shows estimated coefficients for equation **??**. Dependent variables are: the RTI index in columns (1) and (2), the share of Manufacturing Skills in columns (3) and (4), and the share of IT skills in columns (5) and (6). All variables are year averages. Capital and Number of Employees are included as controls. Lof Import in columns (2), (4) and (6) is instrumented with Exposure × Post. *Post* is a dummy taking value 1 in years 2015 and 2016.
Robust standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

simple models of skill requirements and imports.[23] As shown in columns (1) and (3), once firm fixed effects are taken into account, the strong correlation between imports and the routine intensity index or manufacturing skills highlighted in section 4.1 vanishes. On the other hand, the share of jobs requesting IT skills significantly increases with imports. Turning to the two stage least squares results, column (1) indicates that, for each additional log-unit in monthly imports after the shock, firms posted jobs with a 20.6% less routine index. Column (2) shows that the demand for manufacturing skills decreases substantially and statistically significantly in response to an appreciation driven surge in imports. Workers with these skills are probably those that suffered the most from the appreciation, as an increase in imports by one log point decreases the share of job postings requesting manufacturing skills by more than 90%.

[23] The first stage coefficients are reported in the first two columns of table 7.

6 CONCLUSION

In this paper, I study the effect of trade on skill requirements for manufacturing firms. I exploit an unexpected appreciation of the Swiss franc. On January 15, 2015 the Swiss National Bank abandoned a floor to the exchange rate with respect to the euro generating a sudden and stable appreciation of the local currency by more than 15%. The exchange rate remained quite stable in the following period: the change from January to June was 14.7%. This unforeseen appreciation immediately reduced the profits of exporting firms while simultaneously creating new opportunities and incentives for importing firms.

Using transaction-level import and export data and data on online job advertisements for 1,752 Swiss manufacturing firms, I document three facts. First, I document that imports positively correlate with postings in non-routine jobs and with IT skills, while negatively affect the demand for the manufacturing skills, traditionally linked to the main activity of the firms in the sample. Second, I show that firms that were positively exposed to substitutability reacted to the shock by importing more and by upskilling their labor demand. Specifically, a one standard deviation increase in the exposure to substitutability generates a post-shock increase in monthly imports by 8.3% and in the routine intensity indicator by 1.7%. Third, I quantify the effects of exposure-induced-imports to labor demand: I find that for each additional log monthly import, a firm reduces the routine intensity associated to its labor demand by 0.274 (2/3 of standard deviation) and the share of jobs requiring manufacturing skills by 0.107 (1/2 of standard deviation).

The first implication of this study is that trade triggers skill-biased labor demand, since offshorable and automatable skills are substitutes for imported inputs and capital. The second implication is that exchange rate policy is labor market policy: preventing the local currency from appreciation versus those of the trading partners slows down the upskilling. To my knowledge, this is the first paper analyzing a sudden and extraordinary change in real prices to provide evidence of short and medium term effects of imports on detailed skill requirements at the firm level.

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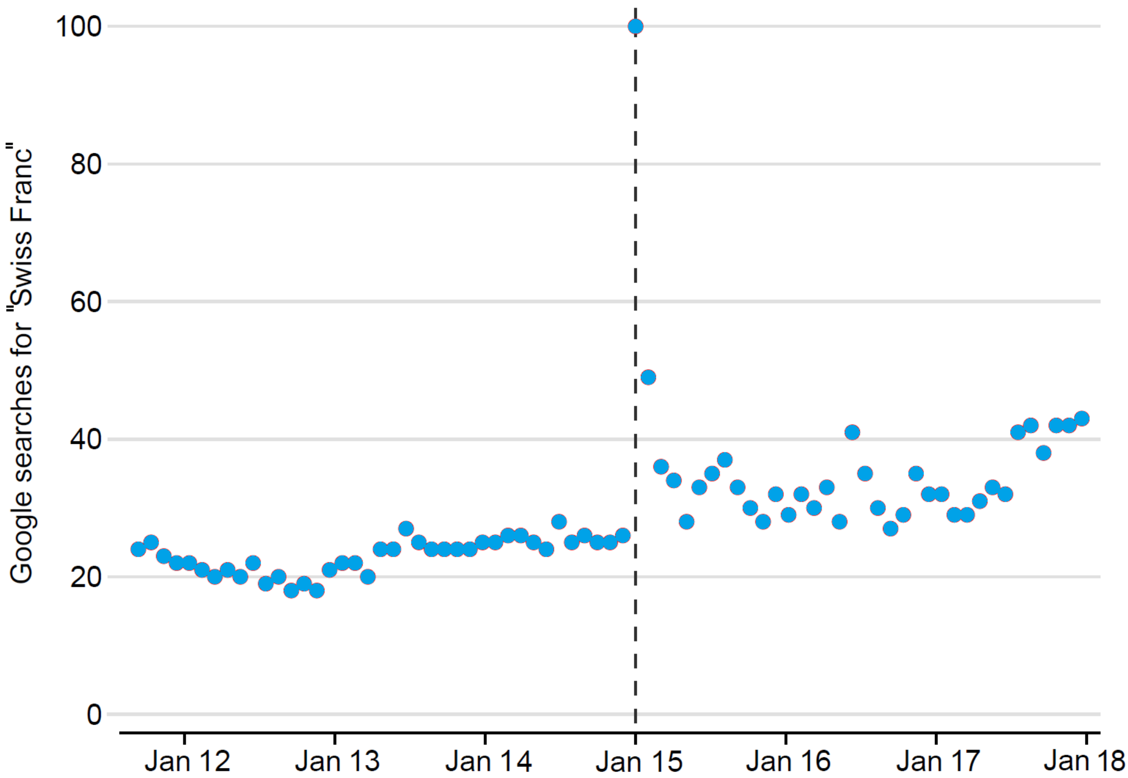
APPENDIX

A UNANTICIPATED SHOCK - GOOGLE TRENDS

Figure A.1: Google Trend Search for "Swiss Franc"



Notes: This figure shows the number of times that the term "*Swiss Franc*" was searched on Google, in percentage with respect to the number of times it was searched in January 2015.

B Additional Descriptive Statistics

Table B.1: List of Industries

Industry (NACE 2dg)	**N. of firms** (1)	**Share** (2)	**N. of Postings** (3)	**Share** (4)
Manufacture of machinery and equipment n.e.c.	375	.214	12781	.16
Manufacture of fabricated metal products, except machinery and equipment	303	.173	6907	.086
Manufacture of computer, electronic and optical products	208	.119	13373	.167
Manufacture of food products	180	.103	11321	.142
Manufacture of electrical equipment	103	.059	4023	.05
Manufacture of chemicals and chemical products	85	.049	3935	.049
Manufacture of rubber and plastic products	83	.047	2414	.03
Manufacture of wood and of products of wood and cork, except furniture	69	.039	1079	.014
Manufacture of basic pharmaceutical products and pharmaceutical preparations	54	.031	11892	.149
Other manufacturing	51	.029	1612	.02
Manufacture of basic metals	43	.025	1683	.021
Manufacture of furniture	36	.021	851	.011
Repair and installation of machinery and equipment	31	.018	876	.011
Manufacture of textiles	25	.014	981	.012
Manufacture of motor vehicles, trailers etc.. i	23	.013	1015	.013
Manufacture of paper and paper products	21	.012	719	.009
Manufacture of other non metallic mineral products	19	.011	873	.011
Manufacture of beverages	16	.009	832	.01
Manufacture of other transport equipment	13	.007	1923	.024
Printing and reproduction of recorded media	4	.002	120	.002
Manufacture of wearing apparel	4	.002	210	.003
Manufacture of tobacco products	3	.002	294	.004
Manufacture of leather and related products	2	.001	41	.001
Manufacture of coke and refined petroleum products	1	.001	105	.001
Total	1752		79860	

Notes: This table reports the average number of firms and postings by Sector. Period 2014-2016.

Table B.2: List of Occupations

Industry (ISCO 2dg)	**N. of Postings** (1)	**Share** (2)	**RTI** (3)	**Offshorability** (4)
Administrative and Commercial Managers	11130	.139	-.9582016	.3443703
Science and Engineering Professionals	7780	.097	-.9525113	.5246673
Business and Administration Professionals	6678	.084	-.9164736	1.1048
Science and Engineering Associate Professionals	6480	.081	-.3026362	.2347695
Metal, Machinery and Related Trades Workers	4409	.055	-.1608545	-.7707986
Business and Administration Associate Professionals	4316	.054	-.4285929	.7969047
Numerical and Material Recording Clerks	3692	.046	.6166951	1.173425
Information and Communications Technology Professionals	3545	.044	-.8101774	1.501084
Missing	3495	.044		
Sales Workers	3414	.043	-.3356114	-.2576303
Electrical and Electronics Trades Workers	2988	.037	-.656814	-1.98177
Production and Specialized Services Managers	2966	.037	-.9292242	.0308005
Other Clerical Support Workers	2602	.033	.5131762	1.535775
Stationary Plant and Machine Operators	1990	.025	.7820621	1.045133
Chief Executives, Senior Officials and Legislators	1723	.022	-.9573376	.5057079
Food Processing, Woodworking, Garment and Related Trades Workers	1216	.015	.2575031	.004385
Assemblers	1197	.015	.9985917	.4333546
Legal, Social and Cultural Professionals	1093	.014	-.6072029	1.126926
General and Keyboard Clerks	1052	.013	.7981312	.9541268
Information and Communications Technicians	1052	.013	-.1757562	.5445752
Customer Services Clerks	1034	.013	-.1149181	1.102903
Health Associate Professionals	910	.011	.1469327	-.4876955
Hospitality, Retail and Other Services Managers	755	.009	-.4204742	-.0660189
Labourers in Mining, Construction, Manufacturing and Transport	729	.009	.1979881	.279027
Teaching Professionals	685	.009	-.9832062	-.3442284
Personal Services Workers	593	.007	-.5209406	.3340856
Building and Related Trades Workers (excluding Electricians)	516	.006	-.8654285	-.5524015
Health Professionals	428	.005	-.8838043	-1.59927
Drivers and Mobile Plant Operators	426	.005	.0308621	-.5969043
Handicraft and Printing workers	325	.004	-.006214	-.3120773
Cleaners and Helpers	219	.003	-.9972603	.9090365
Refuse Workers and Other Elementary Workers	136	.002	-.7892157	.2633111
Legal, Social, Cultural and Related Associate Professionals	133	.002	-.4523416	.7680697
Protective Services Workers	102	.001	-1	-.8487132
Food Preparation Assistants	20	0	-.9777778	.9009433
Market-oriented Skilled Agricultural Workers	13	0	-.5780219	-.1445741
Personal Care Workers	12	0	-.7916667	-.7419518
Agricultural, Forestry and Fishery Labourers	4	0	-.5384616	.751695
Market-oriented Skilled Forestry, Fishery and Hunting Workers	2	0	-.5641026	-.3713484
Total	79860			

Notes: This table reports the average number of postings by Occupation, together with the RTI and the offshorability index attributed to the job. Period 2014-2016.

Table B.3: Summary statistics - Skill Families

Variable	**Mean** (1)	**Std. Dev.** (2)	**Min.** (3)	**Max.** (4)	**N** (5)
Higher Education	0.087	0.282	0	1	79860
RTI	-0.487	0.62	-1	1	72943
Job Offshorability	0.391	1.025	-3.011	2.661	72055
Administration	0.025	0.155	0	1	79860
Analysis	0.037	0.188	0	1	79860
Business	0.42	0.494	0	1	79860
Design	0.086	0.281	0	1	79860
Economics and Social	0.015	0.121	0	1	79860
Education and Training	0.031	0.172	0	1	79860
Energy and Utilities	0.021	0.143	0	1	79860
Engineering	0.092	0.289	0	1	79860
Finance	0.173	0.378	0	1	79860
Health Care	0.054	0.226	0	1	79860
Human Resources	0.072	0.259	0	1	79860
Industry Knowledge	0.512	0.5	0	1	79860
Information Technology	0.467	0.499	0	1	79860
Manufacturing	0.082	0.274	0	1	79860
Marketing and PR	0.062	0.241	0	1	79860
Media and Writing	0.028	0.164	0	1	79860
Personal Care, Services	0.035	0.185	0	1	79860
Sales	0.13	0.336	0	1	79860
Science and Research	0.09	0.286	0	1	79860
Logistics	0.059	0.235	0	1	79860

Notes: This table reports summary statistics for vacancies posted in the period 2014-2016. Each observation is a job advertisement.

Table B.4: Manufactruring Skills

Skill Cluster	Share (percent) (1)	Cumulative (percent) (2)
Manufacturing Skills		
Metal Fabrication	47.61	47.61
Product Development	20.77	68.38
Manufacturing Processes	11.89	80.27
Materials Science	6.15	86.42
Materials Process	6.07	92.49
Welding	4.06	96.55
Computer-Aided Manufacturing	1.16	97.71
Machinery	0.98	98.69
Machine Tools	0.41	99.11
Manufacturing Design	0.37	99.47

Notes: This table shows the top 10 skill clusters in the skill family "Manufacturing Skills". For each cluster the share of skills with that cluster over all skills in the family is reported. Sample: 2014-2016.

Table B.5: IT Skills

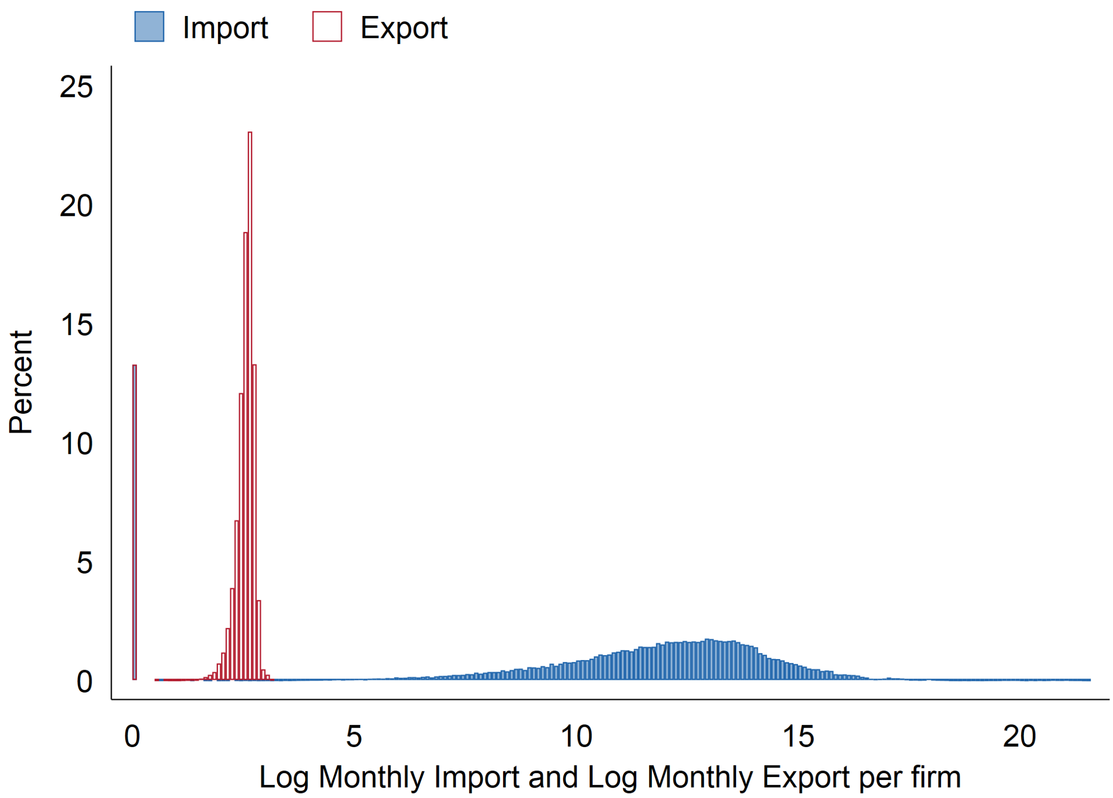
Skill Cluster	Share (percent) (1)	Cumulative (percent) (2)
IT Skills		
Microsoft Office and Productivity Tools	13.09	13.09
Other Programming Languages	10.57	23.66
Enterprise Resource Planning (ERP)	10.54	34.21
Software Development Tools	8.39	42.6
Technical Support	7.3	49.89
Scripting Languages	6.81	56.7
IT Management	6.71	63.41
Advanced Microsoft Excel	5	68.41
Internet Protocols	3.7	72.11
Computer Hardware	3.09	75.2
Operating Systems	2.13	77.33
Database Management Systems	1.62	78.95
Application Development	1.56	80.51
Microsoft Development Tools	1.45	81.95
Data Management	1.31	83.26
Microsoft Windows	1.17	84.42
Internet Services	1.08	85.51
Network Configuration	0.95	86.46
Database Administration	0.9	87.36
Internet Security	0.84	88.2

Notes: This table shows the top 20 skill clusters in the skill family "Information Technology Skills". For each cluster the share of skills with that cluster over all skills in the family is reported. Sample: 2014-2016.

C Distributions

C.1 Trade

Figure C.1: Distribution of Imports and Exports

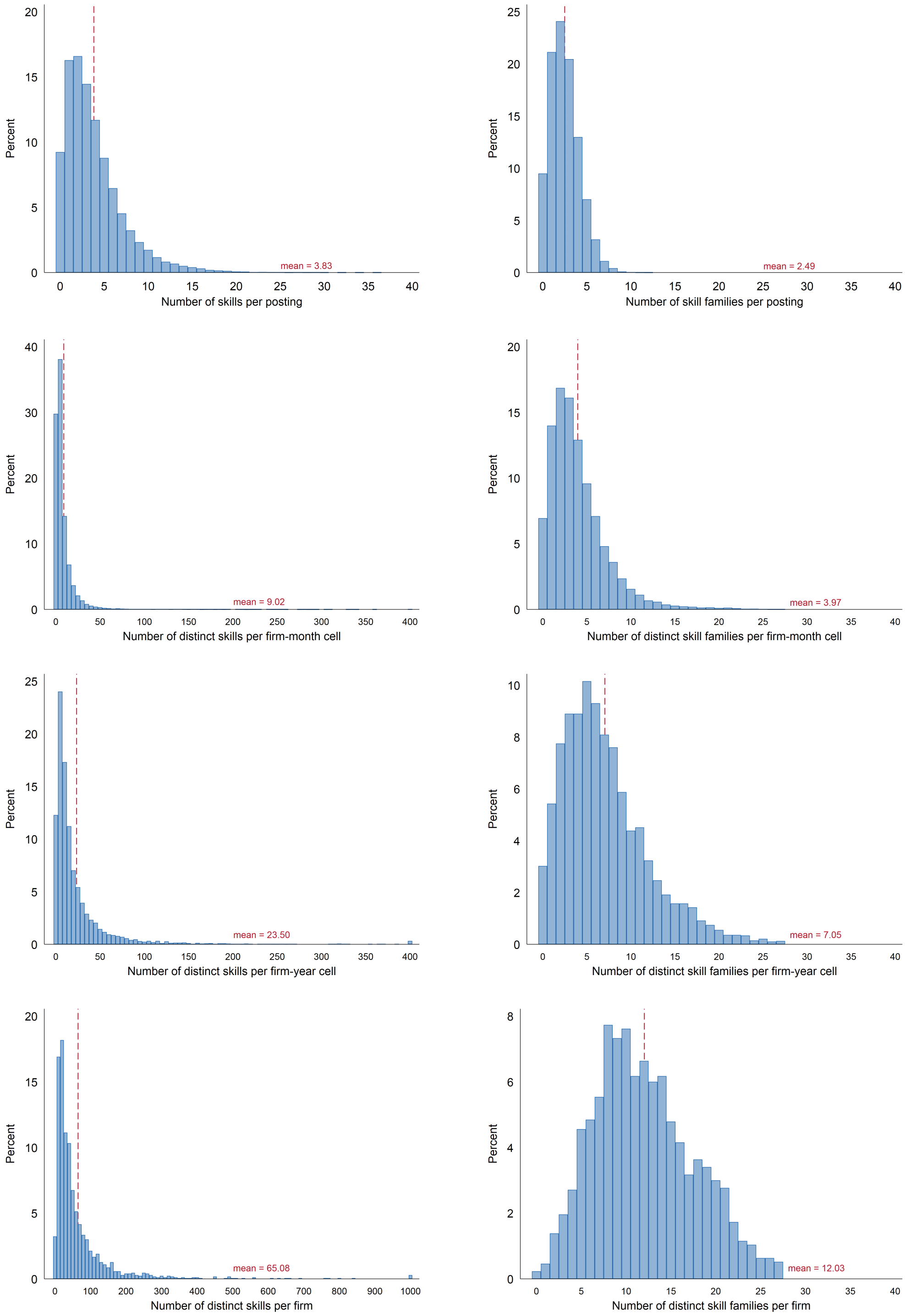


Notes: This figure shows the the distribution of log imports and log exports for the period 2014-2015. Each observation is a firm-month cell.

C.2 Skills and Skill Families

Figure C.2: Distribution of Skills

(a) Skills | (b) Skill Families

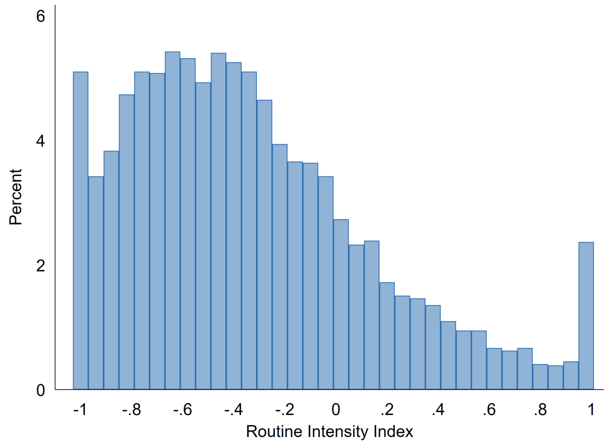


Notes: This figure shows the distribution of skills and skill families by job, firm-month cell, firm-year cell, and firm for the period 2014-2016

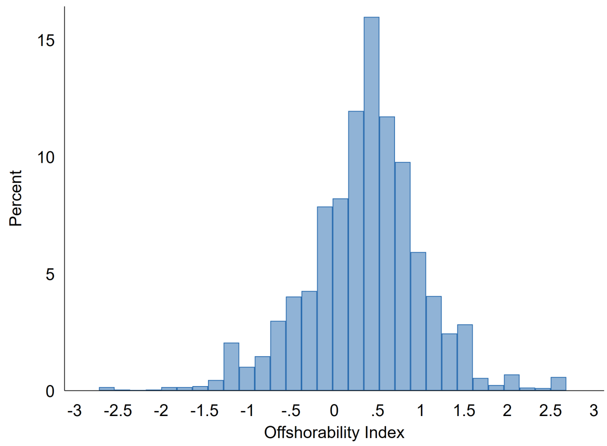
C.3 RTI, OFFSHORABILITY AND SUBSTITUTABILITY

Figure C.3: Distributions

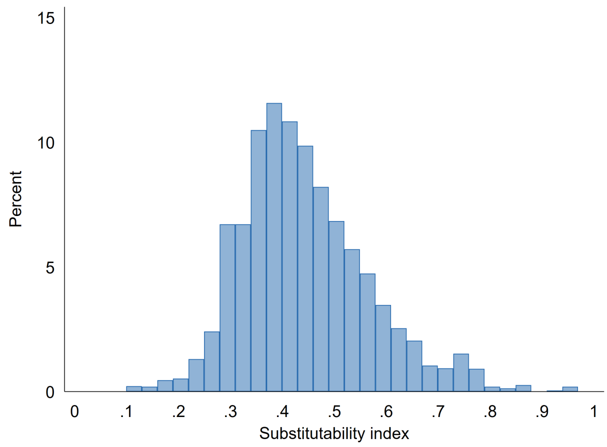
(a) Routine Intensity Index



(b) Offshorability Index



(c) Substitutability Index



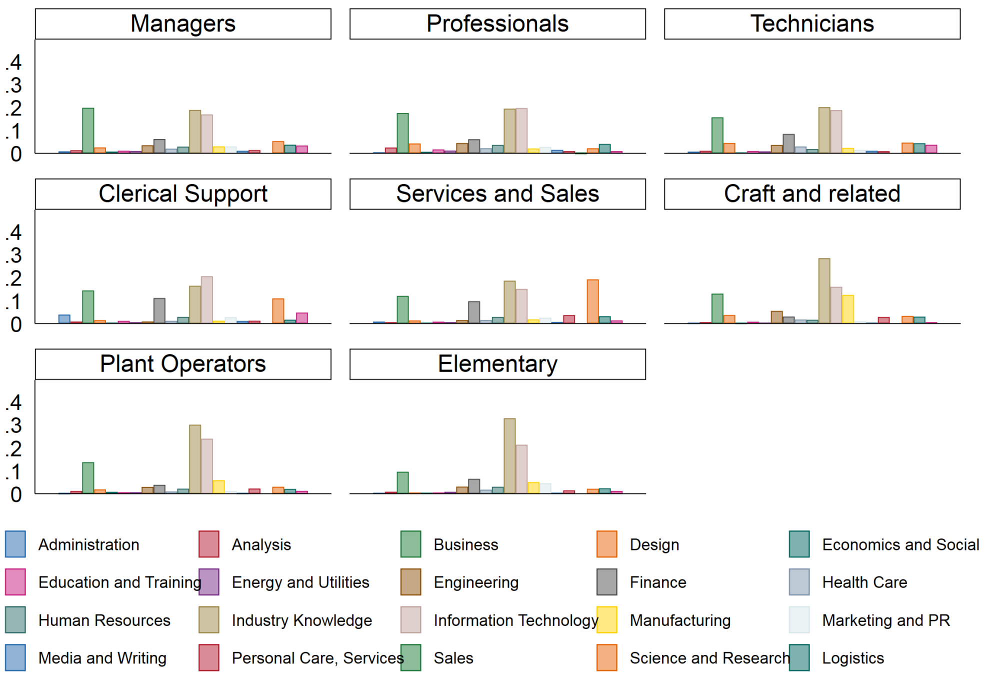
Notes: This figure shows the distribution of the routine intensity indicator (RTI), the offshorability index and the substitutability index for the period 2014-2015. Each observation is a firm-year cell.

D Skills, Occupations and Industries

Figure D.1: Skills and Occupations

(a) Share of Postings by Occupation within Skill Requirements

(b) Share of Postings by Skill Requirement within Occupations



Notes: This figure shows the heterogeneity between skills and occupations. Panel A shows the share of postings by occupation within skill requirements. Panel B shows the share of Job Postings by skill requirement within each occupation. Each bar indicates the portion of job postings in an occupation and with a given skill requirement over the total number of job postings with the same skill requirement in Panel A, and over the total number of job postings in that occupation in Panel B.

Figure D.2: Skills and Industries

(a) Share of Postings by Sectors within Skill Requirements

(b) Share of Postings by Skill Requirement within Sectors

Notes: This figure shows the heterogeneity between skills and sub manufacturing sectors. Panel A shows the share of postings by sector within skill requirements. Panel B shows the share of job postings by skill requirement within each sector. Each bar indicates the portion of job postings in an occupation and with a given skill requirement over the total number of job postings with the same skill requirement in Panel A, and over the total number of Job Postings in that sector in Panel B.

E PRE-SHOCK: CORRELATIONS AND DISTRIBUTIONS

E.1 LINEAR CORRELATIONS

Table E.1: Correlation Coefficients

Variable	**N ads** (1)	**High Educ** (2)	**RTI** (3)	**Offshorability** (4)	**N Empl** (5)	**Capital**	**Op Rev**	**Import**	**Export**
Panel A: *Job Postings*									
Number of ads	1.000								
Bachelor Degree or Higher	0.152	1.000							
RTI	-0.120	-0.210	1.000						
Job Offshorability	0.026	0.115	0.131	1.000					
Panel B: *Firm*									
Number of Employees	0.604	0.096	-0.043	0.008	1.000				
Capital	0.388	0.100	-0.055	0.017	0.679	1.000			
Operating Revenue	0.532	0.116	-0.053	0.010	0.993	0.671	1.000		
Panel C: *Trade*									
Total Import	0.496	0.085	-0.046	0.000	0.707	0.446	0.737	1.000	
Total Export	0.711	0.119	-0.057	0.006	0.888	0.530	0.806	0.888	1.000

Notes: This table reports correlation coefficients between the main variables in the analysis for the year 2014. Each observation corresponds to a firm.

E.2 TRADE BY SECTOR

Table E.2: Trade by Sector

Sector (NACE 2dg)	Import (in Mln CHF) (1)	Export (in Mln CHF) (2)
Manufacture of basic pharmaceutical products and pharmaceutical preparations	453.82	1054.23
Manufacture of basic metals	484.95	391.86
Manufacture of other transport equipment	56.62	129.12
Manufacture of coke and refined petroleum products	49.63	102.72
Manufacture of chemicals and chemical products	24.78	43.42
Manufacture of computer, electronic and optical products	18.38	42.05
Manufacture of paper and paper products	20.44	29.43
Manufacture of machinery and equipment n.e.c.	9.96	26.88
Manufacture of motor vehicles, trailers, etc...	17.32	25.89
Manufacture of other non metallic mineral products	18.28	24.81
Manufacture of electrical equipment	11.90	21.92
Manufacture of textiles	11.34	21.03
Other manufacturing	5.98	20.94
Manufacture of food products	15.51	19.65
Manufacture of wearing apparel	12.34	13.15
Manufacture of leather and related products	5.42	11.18
Manufacture of rubber and plastic products	8.01	10.70
Manufacture of fabricated metal products, except machinery and equipment	4.52	10.44
Manufacture of wood and of products of wood and cork, except furniture	4.97	5.72
Printing and reproduction of recorded media	10.53	5.18
Manufacture of furniture	4.12	4.41
Manufacture of beverages	18.11	2.71
Repair and installation of machinery and equipment	1.84	2.31
Manufacture of tobacco products	9.47	1.27

Notes: This table reports the firm average yearly imports (in million CHF) and exports (in million CHF) per sector in 2014.

E.3 TRADE AND SKILLS

Table E.3: Trade and Skill Requirements - Cross Section Correlations in 2014

	OLS Estimation							
Dependent Variable:	*Log Import*				*Log Export*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
N ads	0.014***			0.011***	0.017***			0.013***
	(0.003)			(0.003)	(0.004)			(0.003)
RTI		-1.205***		-0.655**		-2.015***		-1.175***
		(0.281)		(0.286)		(0.376)		(0.387)
Administration			-0.748	-0.059			0.016	1.177
			(1.106)	(1.051)			(1.368)	(1.371)
Analysis			1.105	0.509			1.204	0.316
			(0.792)	(0.766)			(1.315)	(1.269)
Business			1.733***	1.421***			2.179***	1.816***
			(0.408)	(0.408)			(0.551)	(0.553)
Design			-1.610**	-1.620**			-0.347	-0.403
			(0.666)	(0.660)			(0.851)	(0.846)
Economics and Social			3.170	2.127			5.684**	4.497
			(2.022)	(1.996)			(2.845)	(2.755)
Education and Training			0.558	0.425			-1.657	-1.352
			(1.145)	(1.149)			(1.754)	(1.628)
Energy and Utilities			-0.010	-0.798			0.967	-0.252
			(2.240)	(2.156)			(2.809)	(2.663)
Engineering			0.210	0.070			1.201	1.026
			(0.676)	(0.689)			(0.905)	(0.917)
Finance			1.632***	1.687***			2.958***	3.181***
			(0.494)	(0.502)			(0.646)	(0.644)
Health Care			-0.650	-0.694			-0.867	-0.937
			(0.784)	(0.784)			(1.005)	(0.993)
Human Resources			0.093	-0.172			0.258	-0.128
			(0.925)	(0.910)			(1.146)	(1.127)
Industry Knowledge			1.084***	0.909**			1.854***	1.670***
			(0.375)	(0.372)			(0.489)	(0.487)
Information Technology			1.085***	0.988***			2.144***	1.993***
			(0.368)	(0.365)			(0.495)	(0.490)
Manufacturing			-1.043**	-0.937*			-0.720	-0.510
			(0.510)	(0.519)			(0.709)	(0.722)
Marketing and PR			-1.063	-1.150			-1.878	-2.264*
			(0.950)	(0.855)			(1.329)	(1.323)
Media and Writing			-0.441	-0.577			-0.564	-0.753
			(1.266)	(1.251)			(1.685)	(1.675)
Personal Care, Services			-4.326***	-4.479***			-8.715***	-8.536***
			(1.622)	(1.671)			(2.016)	(2.067)
Sales			0.013	0.008			-1.085	-0.933
			(0.495)	(0.493)			(0.666)	(0.663)
Science and Research			1.421	1.139			3.168**	2.723**
			(0.909)	(0.916)			(1.333)	(1.342)
Logistics			2.222**	1.961**			1.749	1.501
			(0.922)	(0.902)			(1.399)	(1.331)
Constant	13.064***	12.983***	11.911***	11.789***	12.213***	11.936***	10.031***	9.722***
	(0.123)	(0.142)	(0.292)	(0.293)	(0.159)	(0.190)	(0.362)	(0.370)
Observations	1670	1653	1670	1653	1670	1653	1670	1653

Notes: This table shows the regression coefficients of a cross-sectional linear model for 2014 projecting trade over several measures of skill requirements. Each observation refers to a firm in the sample. Robust standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

F Robustness

F.1 Main results - restricted sample

Table F.1: Skill Requirements - 2014-2015

	OLS Estimation					
Dependent Variable:	*RTI*		*Manuf. Skills*		*IT Skills*	
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.030	0.072**	0.029	0.060**	-0.008	-0.022
	(0.067)	(0.032)	(0.034)	(0.025)	(0.051)	(0.038)
Exposure (sub)	1.059***		0.073		-0.052	
	(0.101)		(0.051)		(0.076)	
Exposure × Post	-0.130	-0.172**	-0.098	-0.150***	0.054	0.083
	(0.146)	(0.071)	(0.074)	(0.055)	(0.112)	(0.082)
Controls	✓	✓	✓	✓	✓	✓
Firm FEs		✓		✓		✓
N	2201	2201	2147	2147	2147	2147

Notes: This table shows estimated coefficients for equation 3. Dependent variables are: the RTI index in columns (1) and (2), the share of Manufacturing Skills in columns (3) and (4), and the share of IT skills in columns (5) and (6). All variables are year averages. Capital and Number of Employees are included as controls. Period: 2014-2015. *Post* is a dummy taking value 1 in year 2015. Exposure is calculated using job ads posted in 2013.
Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

F.2 MAIN RESULTS - CLUSTERING

Table F.2: Skill Requirements - Clustering

	OLS Estimation					
Dependent Variable:	*RTI*		*Manuf. Skills*		*IT Skills*	
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.035	0.067	0.015	0.032	-0.019	-0.011
	(0.051)	(0.050)	(0.026)	(0.025)	(0.035)	(0.034)
Exposure (sub)	1.059***		0.073		-0.052	
	(0.109)		(0.055)		(0.081)	
Exposure × Post	-0.175	-0.196*	-0.056	-0.086*	0.090	0.069
	(0.115)	(0.114)	(0.050)	(0.049)	(0.077)	(0.075)
Firm FEs		✓		✓		✓
Cluster Firm ID	✓	✓	✓	✓	✓	✓
N	4232	4232	4121	4121	4121	4121

Notes: This table shows estimated coefficients for equation 3. Dependent variables are: the RTi index in columns (1) and (2), the share of Manufacturing Skills in columns (3) and (4), and the share of IT skills in columns (5) and (6). All variables are year averages. Capital and Number of Employees are included as controls. *Post* is a dummy taking value 1 in years 2015 and 2016. Standard Errors Clustered at firm level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table F.3: Trade - Clustering

	OLS Estimation					
Dependent Variable:	*Log Import*		*Log Export*		*L Imp - L Exp*	
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.033	-0.207	0.117	0.042	-0.084	-0.249
	(0.225)	(0.133)	(0.264)	(0.158)	(0.199)	(0.168)
Exposure (sub)	-1.875**		-2.775**		0.900	
	(0.848)		(1.133)		(0.729)	
Exposure × Post	0.711	0.716**	0.511	0.127	0.200	0.589
	(0.514)	(0.306)	(0.585)	(0.346)	(0.443)	(0.383)
Firm FEs		✓		✓		✓
Cluster Firm ID	✓	✓	✓	✓	✓	✓
N	4232	4232	4232	4232	4232	4232

Notes: This table shows estimated coefficients for equation 3 on log imports in columns (1) and (2). In columns (3) and (4) the dependent variable is log exports and in columns (5) and (6), it is the Import-Export ratio in logs. Dependent variables are log of monthly averages, observed yearly. Capital and Number of Employees are included as controls. *Post* is a dummy taking value 1 in years 2015 and 2016.
Standard Errors Clustered at firm level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.