When trade shocks collide with labor mobility: A perfect storm for labor market outcomes?

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Abstract

This paper investigates whether trade shocks interact with labor mobility in affecting workers' outcomes. As a natural experiment, I exploit the sharp Swiss franc appreciation following the unexpected removal of the exchange rate floor against the euro in January 2015, which raised EU cross-border workers' incentives to seek employment in Switzerland. Leveraging variation in sectoral trade exposure and geographic proximity to national borders, I find that the adverse unemployment and earnings effects are concentrated in border regions, where the share of immigrant cross-border workers in trade-exposed industries increased by more than 4 percentage points in areas closest to the frontier.

Keywords: exchange rate shock, trade, labor mobility, unemployment, wages

JEL codes: F14, F16, J31, J61

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1 Introduction

Despite recent setbacks to globalization driven by renewed protectionist sentiment and escalating geopolitical tensions, the past decades have seen increasing economic interdependence across countries, with trade and labor mobility among its most prominent channels. While close interconnections foster income growth (Frankel and Romer, 2017), recent crises have highlighted the increased vulnerability arising from exposure to severe macroeconomic shocks.

A growing literature has examined the labor market effects of trade disruptions (e.g., Autor et al., 2013, 2014; Utar, 2018; Kim and Vogel, 2021) and immigration inflows (e.g., Borjas, 2003; Peri and Sparber, 2009; Ottaviano and Peri, 2012; Foged and Peri, 2016; Beerli et al., 2021). Several studies also show how immigration can foster trade (Ariu, 2022; Bonadio, 2023). Yet, despite existing evidence on the role of occupation-specific tradability in shaping the labor market effects of immigration shocks (Burstein et al., 2020) and on the heterogeneous responses of native and immigrant workers to trade shocks (Autor et al., 2025), less is known about how adverse trade shocks affect substitution between resident and immigrant workers.

This paper investigates whether trade shocks impact the substitutability between resident and immigrant workers when the shock simultaneously shifts reservation wages and outside options of immigrants. Exchange rate shocks provide an ideal setting to answer this research question, as they affect both trade flows and workers' incentives to migrate (Keita, 2016). Leveraging the unexpected and persistent sharp appreciation of the Swiss franc that followed an exchange rate shock in January 2015, I estimate the impact of trade disruptions on resident workers' labor market outcomes and assess the extent to which this effect is driven by a simultaneous change in the share of immigrant workers.

On January 15, 2015, the Swiss National Bank unexpectedly lifted the exchange rate floor of 1.20 Swiss francs per euro introduced in September 2011 to counter the excessive appreciation of the Swiss franc during the euro crisis. As a result, after a period of stability in macroeconomic outcomes, the Swiss franc experienced a steep and immediate appreciation. Due to the absence of anticipation effects (Jermann, 2017; Mirkov et al., 2019; Bonadio et al., 2020; Auer et al., 2021) and economic agents' perceptions of the currency appreciation as permanent (Kaufmann and Renkin, 2017), this exchange rate shock represents an ideal natural experiment.

Moreover, the Swiss labor market serves as a clean *laboratory* to study the interaction between trade shocks and labor mobility, due to its large share of immigrant workers residing in neighboring countries and commuting daily across the border. These cross-border workers active in Swiss regions close to the frontier take advantage of the sizable wage differential with respect to their home countries and are therefore sensitive to exchange rates (Bello, 2020). In particular, currency appreciations imply an increase in the purchasing power of their earnings and, thus, a reduction in their reservation wages (Dustmann et al., 2024) in Swiss francs. Moreover, these workers' migration decisions are not constrained by large moving costs that may prevent full responsiveness to increased wage differentials (Borjas, 2001; Autor et al., 2013; Amior and Manning, 2018; Bartik and Rinz, 2018).

The 2015 Swiss currency appreciation is thereby a *multidimensional* shock that affected not only imports and exports of different commodities, but also migration incentives, cross-border consumption, and financial markets. While this combination of effects may, in principle, hinder the clean identification of each single mechanism, such complexity provides a unique context to investigate how large shocks disrupt the economy through the interaction of different channels. In particular, this paper sheds light on an adjustment margin to trade shocks operating through changes in workforce composition between resident and immigrant workers, which has received limited attention in the existing literature.

To focus on the effects of the exchange rate shock operating through the trade channel, this analysis relies on a pre-shock industry-level indicator that captures exposure to import competition, export intensity, and imported input dependence. The difference-in-differences estimates show that the rise in unemployment and the decline in earnings among Swiss-resident workers after the shock were driven by border labor market areas, where highly exposed industries exhibited a far larger increase in the share of cross-border workers. The adverse labor market effects of the shock were mainly concentrated among (likely young) foreign residents with short-term permits, likely more substitutable by incoming cross-border workers.

These empirical findings can be rationalized within a two-channel framework. On the one hand, the negative effects on employment and wages are consistent with demand-side pressure from reduced exports and stronger import competition. On the other hand, the reduction in cross-border immigrant workers' reservation wages may have eased firms' adjustment to the shock, while being associated with worse labor market outcomes for resident workers. This paper thus complements existing evidence on the effects of output-market import competition and cheaper imported inputs on workers' outcomes (Arni et al., 2024) by investigating substitution between immigrant and resident labor as a further margin of adjustment to the shock.

This paper contributes to the extensive literature on the labor market effects of trade shocks and the unequal distribution of their adjustment costs among groups of workers (Autor et al., 2013, 2014; Dauth et al., 2014; Balsvik et al., 2015; Acemoglu et al., 2016; Autor et al., 2016; Fan, 2019; Greenland et al., 2019). More specifically, it adds to the growing literature analyzing the variety of factors (e.g., market power, technological development, openness to trade, regulation) that explain the overall labor market effects of exchange rate variations (Campa and Goldberg, 2001; Klein et al., 2003; Berman et al., 2012; Alexandre et al., 2017). I contribute to this body of research by documenting how exposure to immigration inflows is another crucial factor that determines the impact of a trade shock on workers' outcomes. While existing evidence on immigrants' responsiveness to trade shocks is often confounded by high relocation costs (e.g., Autor et al., 2013; Borjas, 2001), the focus on cross-border workers active in the Swiss labor market provides a clean setting in which the effects of trade shocks can be studied in the absence of substantial mobility frictions.

Moreover, this paper complements the empirical findings of an extensive body of research that examines the relationship between labor demand and exchange rate fluctuations, documenting how firms substitute low-skilled labor with cheaper imported intermediate inputs while expanding the demand for high-skilled workers (Ekholm et al., 2012; Kaiser and Siegenthaler, 2016; Colella, 2022). In particular, I extend this stream of literature by exploring in more depth the role played by a further channel, namely, the substitution between resident and immigrant labor as an additional margin of adjustment in sectors highly affected by the shock.

Relatedly, this paper contributes to existing studies examining exchange rate variations as a key driver of migration decisions (Keita, 2016), especially among workers who are sensitive to the purchasing power of remittances (Nekoei, 2013; Dustmann et al., 2024), migrants willing to return in their home country (Yang, 2006; Dustmann and Görlach, 2016), and cross-border commuters (Bello, 2020). Focusing on cross-border workers, I analyze whether trade shocks affect their employment and identify which groups of resident citizens become more exposed to competition.

This paper therefore adds to the large literature on the impact of immigration on workers' labor market outcomes. While several studies document that high-skilled foreign workers foster productivity and wages due to their complementarity with physical capital (Lewis, 2011; Ottaviano et al., 2018; Beerli et al., 2021; Cristelli and Lissoni, 2024), resident workers may be displaced by immigrant employees with similar characteristics and qualifications (Aepli and Kuhn, 2021; Gatti et al., 2022; Gentili and Mazzonna, 2024).

Finally, this paper complements the existing evidence on price effects and firms' responses that follow large exchange rate shocks. After a currency appreciation, while domestic consumers benefit from lower retail prices of imported goods and from increased convenience of cross-border shopping (e.g., Bonadio et al., 2020;

Auer et al., 2021, 2024; Burstein et al., 2024), firms tend to experience a decline in export growth (e.g., Auer et al., 2019) and to upgrade product quality as a response (Freitag and Lein, 2023). This paper sheds light on a further mechanism, suggesting that Swiss firms located close to the border may have limited competitiveness losses by reducing their production costs through the employment of cross-border workers willing to accept lower salaries.

From a policy perspective, this paper informs the design of effective measures aimed at mitigating the adverse labor market impact of large macroeconomic shocks. Identifying the different interacting channels through which these shocks propagate allows policymakers to better offset welfare losses and rising inequalities by efficiently targeting those individuals who bear the worst economic and social costs. Moreover, cross-border labor mobility is gaining increasing relevance worldwide, but especially in the European context, where nearly two million workers are involved (European Commission, 2024). The effects documented in this paper also help explain the evolution of political outcomes observed in response to large globalization shocks in recent years. For instance, the adverse labor market effects in Swiss border regions after 2015 have likely contributed to the substantial rise in electoral support for anti-immigration parties in those municipalities in several referenda (Colantone and Stanig, 2018; Autor et al., 2020; Alrababah et al., 2024).

The remainder of this paper is organized as follows. Section 2 reports background information on the 2015 exchange rate shock and the role of cross-border workers in the Swiss labor market. Section 3 describes the data and provides descriptive evidence on the evolution of both trade flows and the share of cross-border workers in the labor force. Section 4 outlines the empirical models. Section 5 discusses the main results and the underlying mechanisms. Section 6 concludes.

2 Background

2.1 The 2015 exchange rate shock

This paper leverages the sharp and persistent appreciation of the Swiss franc against the euro that followed the Swiss National Bank's unexpected decision to abandon the minimum exchange rate of 1.20 Swiss francs per euro on January 15, 2015. This exchange rate floor was introduced after the outbreak of the euro area sovereign debt crisis, on September 6^{th}, 2011, to limit the appreciation of the Swiss franc generated by an increasing foreign demand for this currency as a safe haven. This measure aimed at preventing both a loss of export competitiveness and a rising level of import competition that could negatively affect production and employment. As a result, until the beginning of 2015 Switzerland was characterized by a period of substantial stability in terms of macroeconomic outcomes such as GDP growth, unemployment, interest and exchange rates.

Although the exchange rate floor was an exceptional and temporary measure to face a transitory period of uncertainty, the decision of the Swiss National Bank in January 2015 – partly driven by the forthcoming expansionary monetary policy of quantitative easing in the euro area – was largely unanticipated by the forecasts of economic agents, who perceived the subsequent currency appreciation as permanent (Kaufmann and Renkin, 2017). Several studies document that the evolution of forward rates (i.e., interest rates for economic transactions taking place in the near future) and option prices (i.e., prices to acquire the right to buy or sell specific securities) remained flat until the announcement of the monetary policy change on January 15, 2015 (Jermann, 2017; Mirkov et al., 2019; Bonadio et al., 2020; Auer et al., 2021). Thus, economic agents' forecasts incorporated the declarations released in late 2014 by the Chairman of the Governing Board of the Swiss National Bank, who guaranteed the enforcement of the exchange rate floor (Jordan, 2014). Indeed, surveys conducted among economists by *Bloomberg* immediately before the shock actually reveal that the event was unexpected (Bosley, 2015).

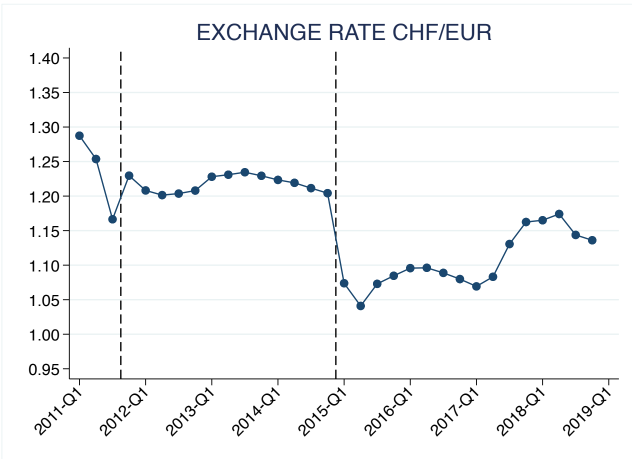


Figure 1: Evolution of the CHF/EUR exchange rate (2011–2019)

Notes: This figure shows the evolution over time (2011-2019) of the average exchange rate between the Swiss franc and the Euro. The first vertical dashed line, before the last quarter of year 2011, identifies the beginning of the period characterized by the enforcement of the minimum exchange rate of 1.20 Swiss francs per euro introduced on September 6^{th}, 2011. The second vertical dashed line, before the first quarter of year 2015, identifies the beginning of the sharp appreciation of the Swiss franc after the removal of the exchange rate floor on January 15, 2015.

As reported in Figure 1, the immediate appreciation of the Swiss franc by more than 20% was rather persistent over time. Until 2017, the value of the Swiss franc against the euro remained substantially higher compared to the pre-shock period, on average by 16%. This implied a loss of competitiveness for Swiss exports, which became more expensive, and an increased import competition due to the availability of cheaper imported goods.

This exchange rate shock was extremely salient for the Swiss economy, since European countries are the main trade partners for Switzerland, accounting for approximately 70% of its imports and 50% of its exports (OECD, 2025b). These figures acquire even more relevance considering that the overall value of Swiss trade flows exceeds 120% of the country's GDP, a share that doubles the OECD ($\approx 56\%$) and world ($\approx 58\%$) averages (World Bank, 2025). Such strong trade relationships are also the result of the high economic integration between Swiss border regions and their respective neighboring euro countries, which is facilitated by the common linguistic background (Egger and Lassmann, 2015).

2.2 Cross-border workers in Switzerland

In the Swiss labor market, immigrant workers represent more than 30% of the labor force (Swiss Federal Statistical Office, 2025b). In border regions, a large fraction of these employees are cross-border workers, who continue to reside in their neighboring home countries, usually commuting on a daily basis. Cross-border workers account for more than 6% of the total workforce of the country and in border regions their proportion is far more substantial, reaching 29% in the canton of Ticino and 24% in the canton of Geneva (Swiss Federal Statistical Office, 2025a).

The labor supply of these workers increased remarkably after the 2002 *Agreement on the Free Movement of Persons* between Switzerland and the European Union, which granted EU workers unrestricted access to the Swiss labor market, removing all previous restrictions on labor mobility. After this agreement, the number of permits issued to EU cross-border workers in Switzerland has not been subject to quotas or ceilings. To obtain a permit, applicants need only a valid employment contract with a Swiss firm and must return to their residence abroad at least once a week. Since no further regulatory changes occurred during the period of analysis considered in this study (i.e., between 2011 and 2018),[1] any observed changes in the composition of cross-border and resident workers can be attributed to labor market dynamics rather than to institutional reforms.

As they reside in neighboring Eurozone countries (roughly 55% of them live in France, 23% in Italy, 18% in Germany, and 3% in Austria), cross-border workers take

[1]Note that relevant recent policy changes (e.g., the new fiscal rules on the taxation of Italian cross-border workers in 2023) fall outside the time window considered in this paper.

advantage of the large wage differential between Switzerland and these states, where living costs are significantly lower. These workers are therefore highly sensitive to exchange rate variations that alter their purchasing power. The full responsiveness of their labor supply to exchange rate movements is facilitated by both the *Agreement on the Free Movement of Persons* and the absence of relevant moving costs. Indeed, they need neither to relocate nor to face linguistic and skill barriers.

Approximately two-thirds of cross-border workers are active in service sectors, while only one-third of them work in manufacturing industries, often in high-skilled occupations. However, the share of cross-border workers in the total workforce is larger in the secondary sector, due to the extremely high concentration of resident employees in service occupations (Swiss Federal Statistical Office, 2025a).

3 Data and descriptive evidence

3.1 Data sources

This paper leverages data on resident workers' labor market outcomes provided by the *Swiss Labor Force Survey* and information on the value of Swiss imports and exports released by the *Federal Office for Customs and Border Security* and the *Trade in Value Added Database* (OECD, 2025b). Additional region- and sector-level data on employment and cross-border workers, plus further control variables, have been obtained from the *Swiss Federal Statistical Office*.

To ensure geographic representativeness, data are aggregated at the level of local labor market areas. These areas, called *spatial mobility regions*, are 106 subdivisions of the Swiss territory based on the concentration of economic activities and, in turn, commuting flows around a main location (Swiss Federal Statistical Office, 2025c). The time horizon under analysis includes all years between 2012 and 2018, covering the period of economic stability preceding the 2015 exchange rate shock (see Section 2) and the subsequent years marked by the persistent appreciation of the Swiss franc against the euro.

The *Swiss Labor Force Survey*

The main investigation of the labor market effects of the shock is based on the *Swiss Labor Force Survey* (SLFS), which covers a representative sample of the working-age resident population (i.e., excluding cross-border workers) in Switzerland (Swiss Federal Statistical Office, 2025f) over the years 2012–2018, with each individual observed in two adjacent years.

This dataset contains information on both sociodemographic characteristics (e.g., sex, age, education, nationality, marital status, number of children, residence) and employment status of the individual (e.g., employee, unemployed, retired).

The SLFS reports active individuals' occupation according to the *International Standard Classification of Occupations* (ISCO-08), whether they hold a permanent contract, and their employment rate. The data also include the size and the 2-digit industry code (NOGA-08, based on the *Swiss General Classification of Economic Activities*) of the employing firm. In case of unemployment, subjects registered with regional employment centers are distinguished from those who are not and are therefore not eligible for unemployment benefits. Additionally, the industry code of the last employing firm is provided.

The SLFS is then matched with the *Social Protection and Labor Market* (SESAM) individual-level data, which report workers' gross and net annual nominal earnings (Swiss Federal Statistical Office, 2025e). These earnings are expressed in real terms at 2014 prices, using the consumer price index.

Appendix Table B.1 presents the summary statistics for the main variables of interest from the *Swiss Labor Force Survey*, differentiating the pre-shock period (2012–2014) from the after-shock period (2015–2018).

Import-export data

The evolution over time of Swiss imports and exports is investigated using detailed data provided by the *Federal Office for Customs and Border Security* (FOCBS). This dataset contains monthly information on quantities and monetary values (in Swiss francs) of Swiss trade flows at postal-code level, by type of commodity (Harmonized System 6-digit classification) and by destination or origin country. I aggregate the data annually at the level of local labor market areas[2], focusing on transactions with non-zero quantities that are worth at least 1,000 Swiss francs (Ariu, 2022).

Each HS 6-digit code is matched to both EUC (*End Use Categories*) and ISIC (*International Standard Industrial Classification*) codes (OECD, 2017). The EUC classification distinguishes between intermediate goods, final consumption goods, and capital goods. The ISIC 2-digit code identifies the sector that produces each commodity and fully corresponds to the Swiss General Classification of Economic Activities (NOGA, 2008 Nomenclature). It is worth underlining that these data cover only manufacturing sectors whose goods pass through customs offices.[3]

[2]Note that the information at postal code level may not be reliable in case of large depots located in small towns.

[3]The primary sector (i.e., agriculture, forestry, fishing, mining, and quarrying) is excluded.

Appendix Table B.2 reports some descriptive statistics from the raw data on trade flows between Switzerland and euro countries, showing the average annual monetary value (in millions of Swiss francs, unadjusted for price and exchange rate changes) and the average annual number of traded commodities (according to the HS-6 digit classification). The table reports separate statistics for exports and imports, not only differentiating between intermediate, final, and capital goods, but also between the pre-shock (2012–2014) and the after-shock (2015–2018) period.

I exploit the *Input-Output Tables* (OECD, 2025a) to collect information on the sector-specific level of *vertical specialization* in Switzerland, namely, on the share of the value of exported goods represented by imported inputs. This indicator measures the extent to which losses in export competitiveness after a currency appreciation can be counterbalanced by the availability of cheaper imported inputs. Further information on the sector-specific (2-digit industry code) value of Swiss imports and exports has been obtained from the *Trade in Value Added Database* (OECD, 2025b). Additional sector-specific data include statistics on gross production, value added, total wage bills, and price deflators (Swiss Federal Statistical Office, 2025d).

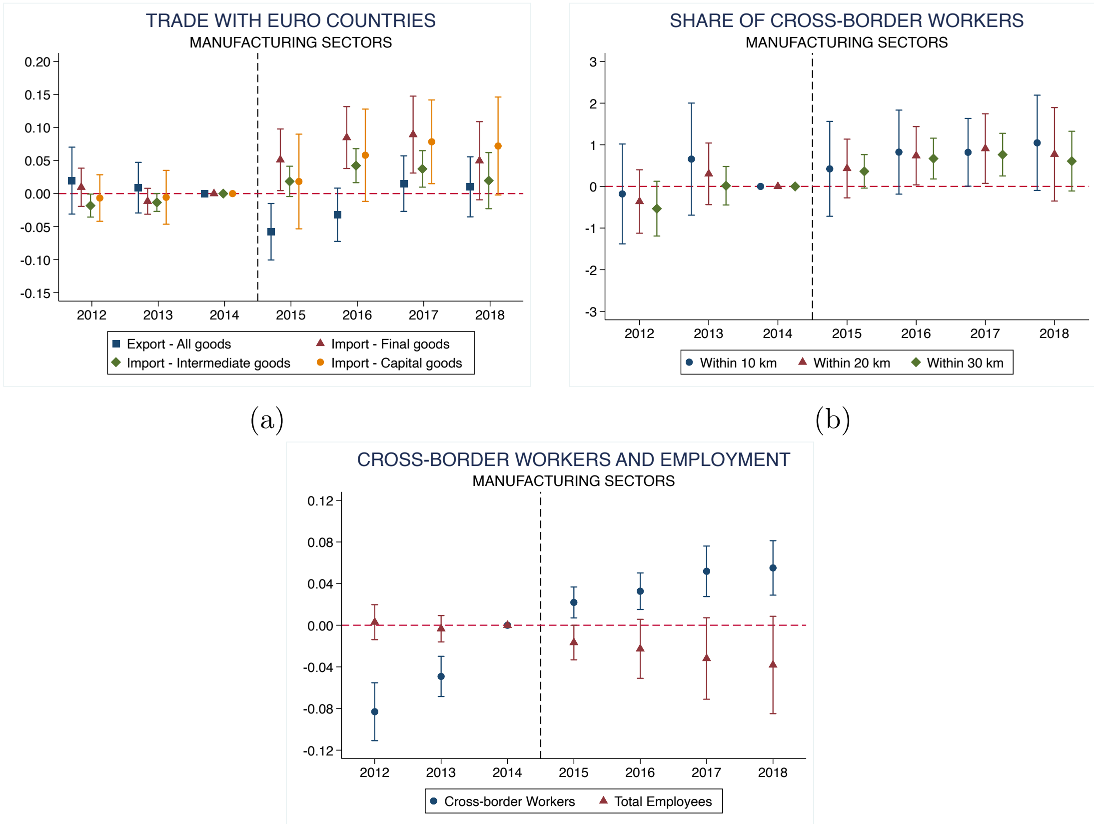
Cross-border workers

The main datasets are complemented by municipal-level statistics released by the *Swiss Federal Statistical Office* on the number of firms, employees, and cross-border workers by 2-digit NOGA-08 economic sector, as well as on the resident population. Even in this case, data are aggregated at the level of local labor market areas, which are also differentiated depending on their distance from the nearest border-crossing office (see Appendix Figure A.1). Appendix Table B.3 reports the average number of cross-border workers, and their share in the workforce, for the pre-shock (2012–2014) and the post-shock period (2015–2018), defining border regions based on different thresholds (i.e., within 10, 20, or 30 km of the frontier). Additional canton-level data on the number of residence permits by type and on working permits for cross-border workers were obtained from the *Swiss State Secretariat for Migration.*

3.2 Descriptive evidence

Figure 2 descriptively examines the relationship between the 2015 exchange rate shock, the evolution of Swiss trade flows with euro countries, and the employment of cross-border workers in Swiss manufacturing firms.

Panel 2a plots the year coefficients from a regression model of the (log) value of Swiss exports and imports across industry and labor market area cells, controlling



(a) (b)

(c)

Figure 2: Trade flows, cross-border workers and total employment in Switzerland - Year fixed effects (2012–2018)

Notes: This figure reports the estimated year fixed effects (with 95% confidence intervals) for the period 2012–2018 from regressions at the labor-market-area × industry level (within the manufacturing sector) for Swiss trade flows, the share of cross-border workers, and total employment. In panel 2a, the dependent variable is the logarithm of the annual monetary value of exports and imports involving euro area countries, distinguishing the latter between final goods, intermediate goods, and capital goods. Monetary values are deflated using the *producer price index* and the *import price index* in case of exports and imports, respectively. In panel 2b, the dependent variable is the share of cross-border workers employed in each manufacturing industry and labor market area, considering different distance thresholds from the national border. In panel 2c, the dependent variable is either the number of cross-border workers or the total number of employees. In both cases, the variables are transformed using the *arcsinh* function. In all panels, every specification includes industry and labor market area fixed effects. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. Robust standard errors are clustered at the sector level. In panel 2b, estimates are weighted by the size of region-level employment. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.

for industry and labor market area fixed effects. To isolate the effect of quantity changes from price fluctuations, the monetary values of exports and imports are adjusted using, respectively, the *producer price index* and the *import price index* as price deflators.[4] This figure shows a large (5 percentage points) immediate reduc-

[4]Note that the actual increase in imported quantities from euro trade partners after 2015 might be even larger, as the *import price index* also reflects less affected currencies.

tion in exports (blue squares) in 2015. At the same time, the amount of imported final consumption goods (red triangles) and capital goods (orange circles) increases sharply (up to 9 and 8 percentage points in 2017, respectively). There is also a rise (reaching 4 percentage points in 2016) in the quantity of imported intermediate inputs (green diamonds).[5] Appendix Figure A.4 reports evidence of a similar increase in imports across areas at different distances to the border, while the drop in exports turns out to be less significant in areas closer to the border.

Panel 2b displays the year coefficients from an analogous specification for the share of cross-border workers in total employment, distinguishing between three distance thresholds from the national border (within 10 km, 20 km, and 30 km). While the pre-shock coefficients are not different from zero, a sizable increase in the share of cross-border workers emerges after 2015. The difference-in-differences estimates in Figure 5 will show that this upward shift is mostly driven by industries more exposed to the adverse effects of the trade shock.

Panel 2c also reports the estimated year coefficients when the dependent variable is either the number of cross-border workers (red triangles) or the total number of employees (blue circles). While the upward trend in the number of employed cross-border workers continues after 2015, total employment declines substantially.

Figure 2 suggests that despite reduced exports, stronger import competition, and increased potential substitutability between imported inputs and labor, employment opportunities for cross-border workers did not shrink, but instead expanded relative to those of resident workers. Indeed, following the shock, firms close to the border may have employed cross-border workers with lower reservation wages (in Swiss francs) to offset, at least partially, the competitiveness losses induced by the adverse trade shock (Dustmann et al., 2024).

4 Empirical strategy

Measuring trade exposure

To measure the overall degree of trade exposure of each manufacturing sector, the empirical analysis is based on the following index:

$$\tau_s = \frac{e_{s,2012-14} \cdot (1 - n_s) + i_{s,2012-14}}{v_{s,2012-14}}$$

[5] Appendix Figure A.2 suggests that these effects are driven by changes in traded quantities, as the average number of commodities (at HS-6 digit code level) did not change. Appendix Figure A.3 shows the limited impact of the shock on trade flows with non-euro partners, presenting a stable pattern for exports and an already growing pre-trend for imports, likely driven by the free trade agreement with China in 2013.

where $e_{s,2012-14}$ is the average value of exports of sector s towards euro countries over the period 2012–2014, n_s is the sector-specific share of exports represented by imported inputs (OECD, 2025a); $i_{s,2012-14}$ is the average value of imports from euro countries of final goods produced by sector s in years 2012–2014; and $v_{s,2012-14}$ is the average value of total gross production of sector s in Switzerland over the same time window. The index is normalized between 0 and 1.

The rationale behind τ_s is as follows. First, an industry s is more vulnerable if it was heavily reliant on foreign demand before the shock. This exposure is mitigated when exports incorporate a large share of imported inputs, whose cost is reduced by the currency appreciation. Second, when import penetration is already high for a given final good, Swiss producers are particularly exposed to intensified competition, because foreign suppliers with existing contracts, networks, and bargaining power can readily increase their deliveries after the currency appreciation.

Based on the value of τ_s, the most exposed sectors include the production of textiles, vehicles, machinery and electrical equipment, plastic and metal products, as well as chemicals (Appendix Table B.4, Index 1). When considering different versions of τ_s (see Section 5), the index remains stable and the relative ranking of sectoral exposure is unchanged (see also Appendix Table B.5).

Finally, regarding the geographic distribution of trade exposure in the country, also within border and non-border regions, when aggregating the industry-level index τ_s to the labor market area level (weighting by industry employment), Appendix Figure A.6 shows evidence of a high degree of spatial dispersion, with substantial heterogeneity across areas.

The DiD event-study model

To evaluate the impact of the 2015 shock, I estimate the following diff-in-diff model, distinguishing between border and non-border labor market areas,[6] defining the former as those whose centroid lies within 30 km of the nearest border-crossing office and further splitting them using finer (i.e., 10 km and 20 km) distance-to-border thresholds:

$$y_{is\ell t} = \beta_0 + \sum_{k=2012}^{2018} \beta_k \, \tau_s \cdot \mathbb{1}[t = k] + \psi^T X_{is\ell t} + \lambda_s + \chi_\ell \times \mu_t + \epsilon_{is\ell t} \tag{1}$$

where $y_{is\ell t}$ is the log of net annual earnings (at 2014 prices) or the unemployment status of worker i in manufacturing sector s, labor market area ℓ, and year t. This

[6] Recall that Appendix Figure A.6 shows that trade exposure in manufacturing sectors varies across Swiss labor market areas, also within border and non-border regions.

model is also estimated for the share of cross-border workers employed in industry s and labor market area ℓ in year t.[7]

In Equation (1), exposure to the exchange rate shock through the trade channel is measured by τ_s, rescaled by its 10-90 percentile range to ease the interpretation of coefficients. This rescaled exposure index τ_s is interacted with an indicator variable $\mathbb{1}[t = k]$ for each year t. The omitted reference year is 2014, the year before the shock. Hence, the coefficients β_k (k = 2012, 2013, 2015, ..., 2018) capture the dynamic impact of the shock on resident workers' outcomes.

The vector of individual-level controls $X_{is\ell t}$ includes sex, a quadratic term for age, tertiary education, and residence permit status (Swiss citizen, long-term foreign resident or short-term foreign resident). When earnings are the outcome, $X_{is\ell t}$ also includes contract type (permanent vs. temporary), employment rate (part-time vs. full-time), and firm size (50+ employees).

The model further includes sector fixed effects that control for time-invariant differences across industries (λ_s), as well as labor market area $\times$ year fixed effects ($\chi_\ell \times \mu_t$) that account for time-varying differences across regions (e.g., heterogeneous local economic conditions, exposure to immigrant inflows...). The error term $\epsilon_{is\ell t}$ captures unobservable time-varying shocks. Robust standard errors are two-way clustered at sector and year level.

While the fixed effects included in the model specification absorb confounding factors that remain constant within industries or vary across labor market areas over time, they cannot capture industry-specific shocks that evolve over time and are potentially correlated with the pre-shock measure of trade exposure τ_s. In this sense, the estimated diff-in-diff coefficients β_k may capture additional mechanisms systematically related to trade exposure, such as changes in uncertainty or financing conditions in more globally oriented industries. Although the existence of such correlated channels cannot be fully ruled out in this setting, the dynamic event-study specification allows an assessment of whether industries with higher values of τ_s exhibited differential trajectories prior to the 2015 shock. The absence of pre-trends can therefore mitigate concerns that the results are driven by other developments correlated with trade exposure rather than by the trade shock itself.[8]

I also employ a *static* version of the diff-in-diff model, where the treatment measure τ_s is interacted with one single post-shock indicator and with a categorical variable accounting for different levels of proximity to the border.[9]

[7] In this case, individual-level controls $X_{is\ell t}$ are not included.

[8] Note that the absence of pre-trends in both border and non-border regions mitigates concerns that potential structural differences between the two areas might confound the estimated effects.

[9] In this case, labor market area and year fixed effects are entered separately, without interaction.

5 Results

Figure 3 presents the estimates from model (1), showing the overall impact of the trade shock on resident workers' unemployment and real net annual earnings (at 2014 prices) in manufacturing industries, also distinguishing between border and non-border labor market areas using different distance thresholds.

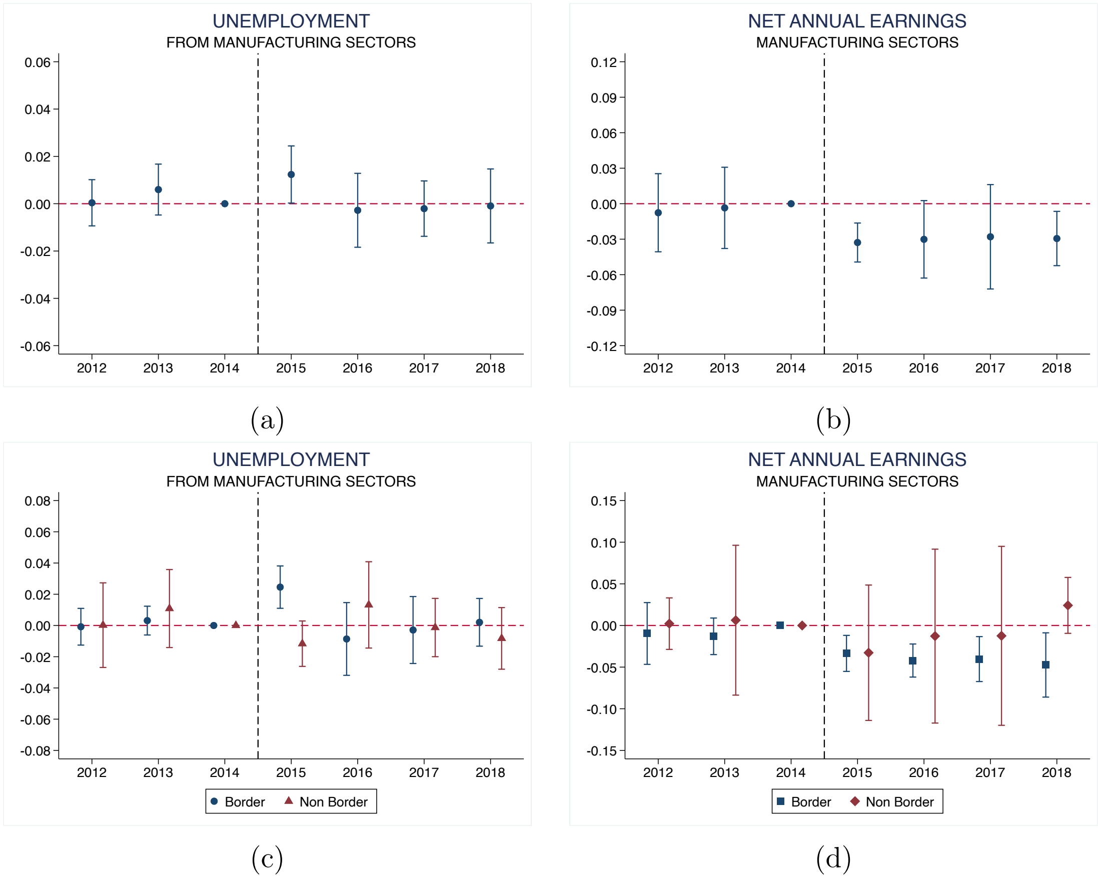


Figure 3: Resident workers' labor market outcomes by distance from the border - Manufacturing sectors – Dynamic DiD model (2012–2018)

Notes: This figure shows the estimates from the dynamic difference-in-differences model (1) for resident workers' labor market outcomes in private manufacturing sectors. Panels (a) and (b) show the effects of the shock on, respectively, the probability of unemployment and (log) net annual earnings at 2014 prices. Panels (c) and (d) further distinguish between border and non-border regions, considering a threshold of 30 km of distance between the centroid of each labor market area and the nearest border crossing office. Each graph shows the estimates of the coefficients β_k (k = 2012, 2013, 2015, ..., 2018), with confidence intervals at the 5% significance level. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. All models include sector and labor market area × year fixed effects, as well as a vector of individual-level controls. This vector includes sex, a quadratic polynomial for age, tertiary education, type of residence permit, as well as – only for earnings – contract type (permanent vs. temporary), employment rate (part-time vs. full-time), and firm size (50+ employees). Robust standard errors are two-way clustered at sector and year level. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.

Panels 3a and 3b document that after the shock resident workers employed in manufacturing sectors with higher trade exposure experienced an immediate increase in unemployment probability and a decline in earnings relative to their counterparts in less affected industries. According to these estimates, moving from the 10^{th} to the 90^{th} percentile of the trade exposure index τ_s[10] is associated with a 2.3 percentage point rise in unemployment and a 4 percentage point decline in earnings in 2015. The evolution over time of these effects closely mirrors the evolution of the Swiss franc appreciation against the euro (Figure 1). However, panels 3c and 3d indicate that the adverse effects of trade exposure after the shock are not evenly distributed across Swiss regions and are instead largely driven by border labor market areas.

Figure 4 corroborates these empirical findings, showing that the effects of the shock exhibit a clear gradient with distance from the border and depend strongly on resident workers' attachment to the labor market. To this aim, after distinguishing between workers holding different residence permits, Figure 4 presents the estimates from a *static* version of model (1), where the diff-in-diff coefficients are further interacted with a categorical measure of proximity to the border (i.e., within 10 km, between 10 and 30 km, or above 30 km).[11] More specifically, the analysis distinguishes between Swiss citizens and long-term foreign residents (i.e., employed in the country for at least five years) *versus* foreign residents holding short-term permits (i.e., employed in the country for less than five years).

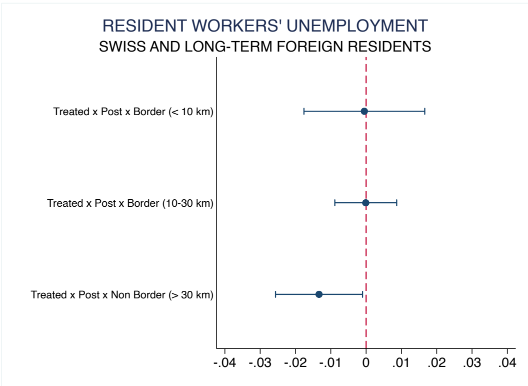
Panels 4a and 4b show that the sharp and immediate rise in unemployment observed in Switzerland after the shock (Figure 3a) is entirely concentrated in border labor market areas and is fully borne by foreign residents holding short-term permits, hence with a relatively low degree of attachment to the Swiss labor market.[12] At the same time, panels 4c and 4d show that, while the sizable negative impact on earnings is again attributable to regions close to the border, it is borne by all resident workers, though the loss is larger in magnitude for short-term foreign residents.

The substantial rise in unemployment among non-Swiss workers with short-term residence permits, who are in a more precarious position in the Swiss labor market, is consistent with the evidence reported in Appendix Figure A.7, which shows that the effect is largely driven by (likely young) individuals who are *not* registered with employment centers and thus are not eligible for unemployment benefits.

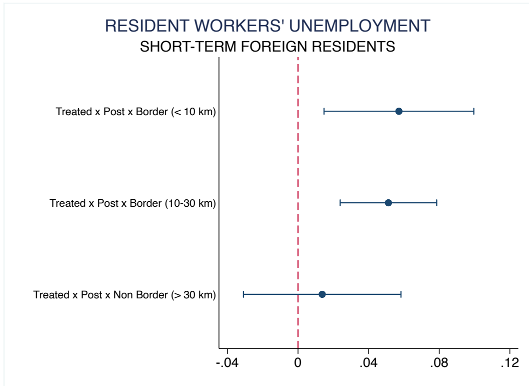
[10]Note that this difference corresponds to approximately a 30 percentage point change in the original (non-rescaled) trade exposure index.

[11]Note that the coefficients reported in Figure 4 are category-specific treatment effects; that is, for labor market areas within 10 km or between 10 and 30 km of the border, they equal the sum of the baseline estimate for non-border regions and the corresponding interaction term.

[12]In fact, in non-border labor market areas, Swiss natives and foreign workers with long-term residence permits even experienced a reduction in unemployment risk.



(a)



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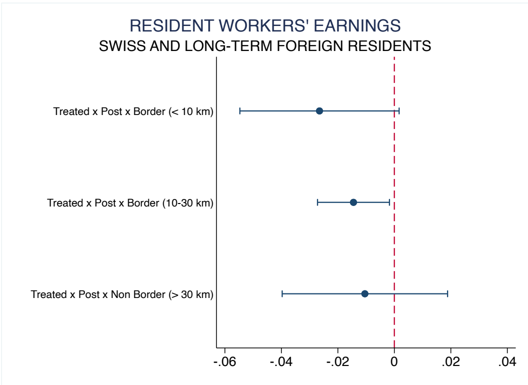
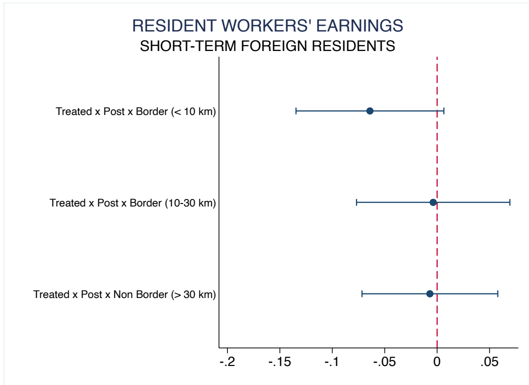


(c)



(d)

Figure 4: Resident workers' labor market outcomes by residence permit - Manufacturing sectors – Triple difference model (2012–2018)

Notes: This figure shows the estimates from a *static* specification of model (1) for resident workers' labor market outcomes in private manufacturing sectors, in which the diff-in-diff coefficients are interacted with a categorical measure of proximity to the border (i.e., within 10 km, between 10 and 30 km, above 30 km). Panels (a) and (b) show the effects of the shock on resident workers' probability of unemployment, distinguishing between Swiss citizens and long-term foreign residents (i.e., those employed in the country for at least five years) on the one hand, and foreign residents holding short-term permits (i.e., employed in the country for less than five years) on the other. Analogously, panels (c) and (d) show the effects of the shock on resident workers' (log) net annual earnings at 2014 prices, again distinguishing them based on their residence permit in Switzerland. The different thresholds of proximity to the national border are computed based on the distance between the centroid of each labor market area and the nearest border crossing office. The coefficients reported for each group of regions are category-specific treatment effects, i.e., for labor market areas within 10 km or between 10 and 30 km, they are the sum of the baseline diff-in-diff estimate for non-border regions and the corresponding interaction term. All models include sector, labor market area, and year fixed effects, as well as a vector of individual-level controls. This vector includes sex, a quadratic polynomial for age, tertiary education, type of residence permit, as well as – only for earnings – contract type (permanent vs. temporary), employment rate (part-time vs. full-time), and firm size (50+ employees). Robust standard errors are two-way clustered at sector and year level.

To complement and explain the larger negative effects of the trade shock observed in border regions in Figure 3, Figure 5 presents the diff-in-diff coefficients obtained from model (1) when the outcome variable is the share of immigrant cross-border workers in each manufacturing sector s and labor market area ℓ. Figure 5 documents that, in border regions, the 2015 shock was followed by a sizable increase in the share of immigrant cross-border workers (over the total number of employees) in industries with higher trade exposure, relative to less exposed ones. This increase exceeds 4 percentage points in regions within 10 km of the frontier, with a clear gradient showing that the closer a region is to the border, the larger the effect in highly exposed sectors.

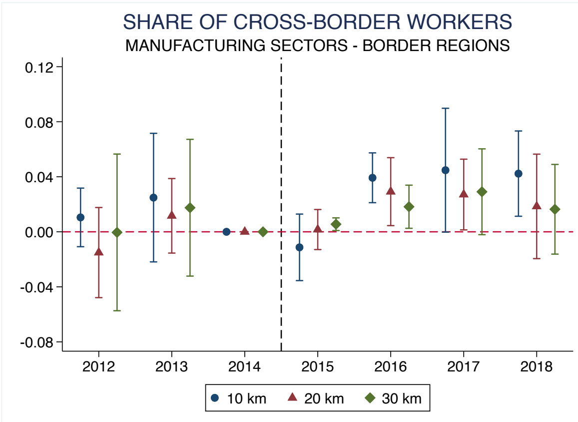


Figure 5: Share of immigrant cross-border workers by distance from the border - Manufacturing sectors – Dynamic DiD model (2012–2018)

Notes: This figure shows the estimates from the dynamic difference-in-differences model (1) (excluding the vector of individual-level control variables) for the share of immigrant cross-border workers in private manufacturing sectors, considering different thresholds for the distance between the centroid of each labor market area and the nearest border crossing office. The graph shows the estimates of the coefficients β_k (k = 2012, 2013, 2015, ..., 2018), with confidence intervals at the 5% significance level. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. All models include sector and labor market area $\times$ year fixed effects. Robust standard errors are two-way clustered at sector and year level. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.

Figure 6 sheds light on the dynamics underlying the positive effect of the shock on the share of cross-border workers employed in trade-exposed sectors. Focusing on Swiss labor market areas within 30 kilometers of the border, this figure reports the diff-in-diff coefficients when the dependent variable is the number of cross-border workers and of total employees in each industry s and labor market area ℓ.[13] These estimates show that, starting in 2015, there was a sizable decrease in the number of employees in highly exposed manufacturing sectors in response to the shock. At

[13]Note that the *arcsinh* transformation is used to account for the presence of potential zeros in specific sectors in some labor market areas. The coefficients reported in Figure 6 have been obtained after cleaning a mild linear pre-trend in the *opposite* direction (thereby not threatening the actual estimated effects) by using a two-step procedure: *i*) using only pre-shock years, regress the outcome variable on a linear trend interacted with the continuous treatment τ_s (including sector and labor market area $\times$ year fixed effects); *ii*) remove this fitted differential pre-trend from the outcome variable and estimate the model again for the whole period. Appendix Figure A.8 shows the estimates obtained before applying any pre-trend correction.

the same time, the number of cross-border workers rose even more sharply in highly treated sectors relative to less-exposed sectors. Appendix Figure A.9 confirms that these results hold, although with a smaller magnitude, when considering a distance threshold of 20 km from the border.

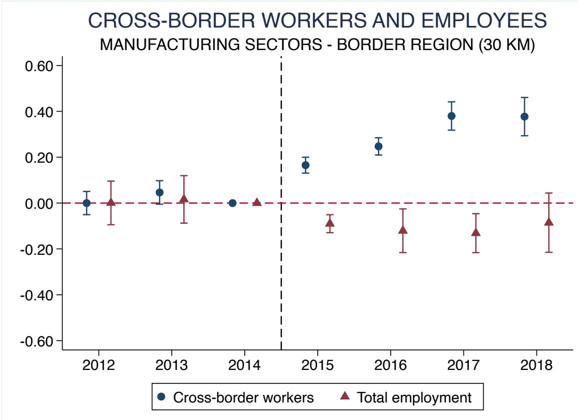


Figure 6: Number of cross-border workers and employees - Manufacturing sectors – Dynamic DiD model (2012–2018)

Notes: This figure shows the estimates from the dynamic difference-in-differences model (1) (excluding the vector of individual-level control variables) for the number of immigrant cross-border workers and of total employees in private manufacturing sectors, considering a threshold distance from the border of 30 km. The graph shows the estimates of the coefficients β_k (k = 2012, 2013, 2015, ..., 2018), with confidence intervals at the 5% significance level. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. All models include sector and labor market area $\times$ year fixed effects. Robust standard errors are two-way clustered at sector and year level. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.

Taken together, these results suggest that the immediate rise in job losses among resident workers in 2015 was associated with both a sizable and persistent decline in total employment and a subsequent increase in cross-border hiring in the following years, consistent with cross-border workers replacing resident workers displaced at the outbreak of the shock. Thus, the negative effects on resident workers' outcomes after 2015, which are stronger near the border, may reflect greater competition from cross-border workers with lower reservation wages.

Robustness checks and extensions

As a first robustness check, in Appendix Table B.4 I compute alternative versions of τ_s using the average values of exports, imports, and production over the years 2013–2014 rather than 2012–2014 (Index 2), or using directly the values of years 2012 (Index 3) and 2014 (Index 4). In all cases, the index remains substantially unchanged. Other versions of τ_s have been obtained using as denominator the average value added (Index 5) or the average total wage bill (Index 6) of each sector rather than its gross production. Finally, Index 7 includes all trade flows rather than only those with euro countries. In all these cases, the relative degree of exposure of the different manufacturing sectors is unaffected, as all these versions of the index exhibit an extremely high degree of correlation (Appendix Table B.5). For instance, Appendix Figure A.10 reports the estimated coefficients when the treatment variable τ_s is the index constructed using as average value added instead of gross production (i.e., Index 5 in Appendix Table B.4). All coefficients are consistent with those reported in Figure 3.

As a further check, I use an indicator of trade exposure τ_s computed over a time window that is excluded when estimating the model, to rule out any concern that results are mechanically driven by correlations between outcome variables and treatment measures. Thus, I estimate model (1) over the years 2013–2018 using as treatment variable the index based on the values of exports, imports, and production in 2012 (Index 3 in Appendix Table B.4). Even in this case, the coefficients displayed in Appendix Figure A.11 are not different from those presented in Figure 3.

Finally, to measure whether the adverse effects of the shock should be mostly attributed to losses of export competitiveness or stronger import competition, in Appendix Table B.6 the sector-level exposure index τ_s is separated into these two components.[14] These estimates suggest that the impact of the 2015 shock on resident workers' outcomes is almost exclusively driven by increased import competition. This is consistent with the fact that Swiss exports mainly consist of technologically advanced goods with low price elasticities (Thorbecke and Kato, 2018), as well as with the evidence provided by Freitag and Lein (2023), who document quality upgrading induced by the 2015 shock itself.

6 Conclusions

This paper studies the labor market effects of a large exchange-rate–induced trade shock and investigates whether, in the presence of high labor mobility, its overall impact on resident workers' outcomes is mediated by changes in the composition of the labor force between resident and immigrant workers whose reservation wages are affected by the shock. To shed light on the role of this adjustment margin, I

[14]Each exposure measure is rescaled by its 10^{th}–90^{th} percentile range, as in the main analysis. Since the export- and import-based measures – $\frac{e_{s,2012-14}(1-n_s)}{v_{s,2012-14}}$ and $\frac{i_{s,2012-14}}{v_{s,2012-14}}$, respectively – have different distributions from the overall index τ_s, the coefficients reported in Appendix Table B.6 are not directly comparable in magnitude to those obtained using τ_s in the main specification (see Figure 3).

leverage as a natural experiment the sharp and persistent Swiss franc appreciation that followed the Swiss National Bank's unexpected decision to lift the exchange rate floor with the euro on January 15, 2015. This shock implied large exogenous variation in both the volume of trade flows and the reservation wages of EU cross-border workers in Switzerland.

Results show that the decline in earnings and the rise in unemployment among resident workers in more trade-exposed manufacturing industries are concentrated in labor market areas close to the Swiss national border. In particular, job losses are borne by foreign individuals holding short-term residence permits, whereas sizable wage losses affect all workers. Consistent with an adjustment mechanism operating through changes in the workforce composition under high mobility, these negative labor market effects are associated with a large and persistent increase in the share and number of cross-border workers employed in highly trade-exposed industries.

However, a *caveat* is necessary to interpret these findings, since the empirical design cannot fully disentangle adjustments in firms' labor demand from shock-induced changes in cross-border workers' labor supply. Hence, the estimated effects may capture both firms' substitution toward cross-border labor and a simultaneous increase in cross-border workers' inflows driven by the currency appreciation.

The results of this paper have two main implications. First, when labor mobility is high, estimating the labor market effects of a trade shock requires accounting for simultaneous changes in workforce composition between residents and immigrants. Second, effective policies to mitigate the adverse consequences of trade shocks should target workers who are more exposed to the risk of substitution with newcomers. In particular, the concentration of negative effects among more precarious (likely younger) individuals with weaker ties to the labor market underscores the need for measures that prevent long-term penalties stemming from reduced labor force participation, delayed career progression, and persistent earnings losses.

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Appendix A Additional Figures

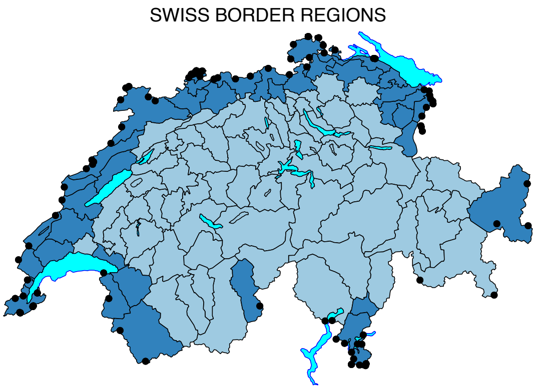
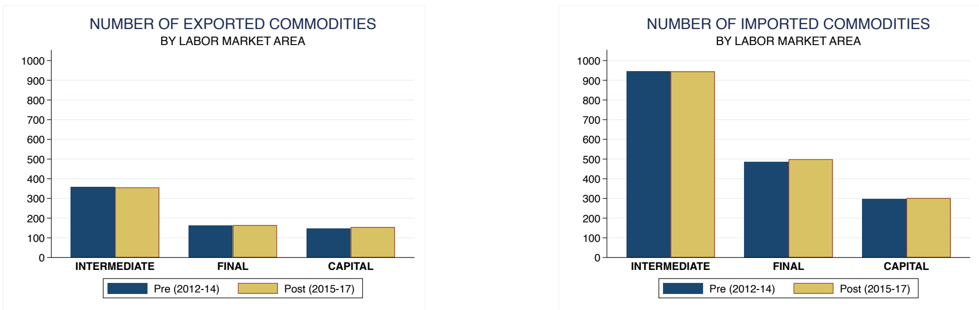


Figure A.1: Swiss Border Regions

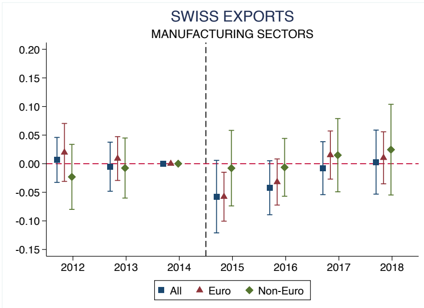
Notes: This map shows border and non-border Swiss labor market areas, using a threshold of 20 kilometers for the maximum distance between the centroid of each region and the nearest border-crossing office. Border-crossing offices (open all year, 24 hours per day) are represented by black dots on the border.

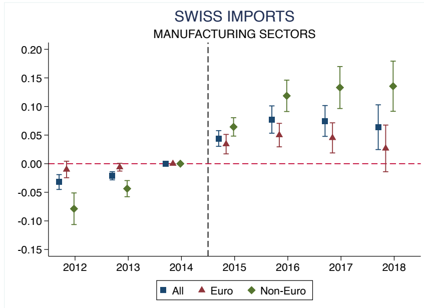


(a) (b)

Figure A.2: Average number of different traded commodities (2012–2017)

Notes: This figure compares the average annual number of commodities (at HS6-digit code) that each Swiss labor market area exported to (panel a) or imported from (panel b) euro countries before (2012–14) and after (2015–18) the shock, distinguishing between intermediate inputs, final consumption goods, and capital goods.

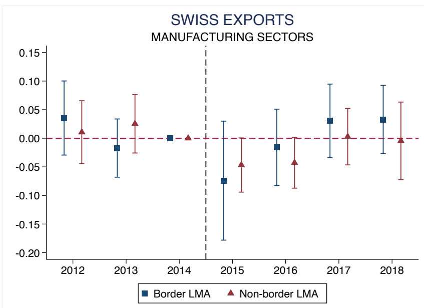


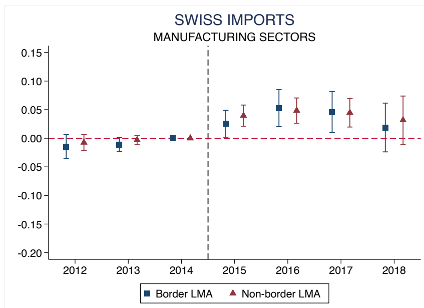


(a) (b)

Figure A.3: Swiss trade flows with euro *vs.* non-euro partners (2012–2018)

Notes: This figure plots the time coefficients for each year between 2012 and 2018 from a regression model for the logarithm of the annual monetary value of goods produced in a given manufacturing sector and exported or imported by each Swiss labor market area, with confidence intervals at the 5% significance level. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. The model is estimated separately for exports (panel a) and imports (panel b). In each panel, coefficients are reported both when the model is estimated considering all trade flows (blue squares) and when the analysis is restricted separately to trade flows with euro (red triangles) and non-euro (green diamonds) countries. All specifications include sector and region fixed effects. Robust standard errors are clustered at the sector level and estimates are weighted for the region-level population size. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.





(a) (b)

Figure A.4: Swiss trade flows with euro countries - Border vs. non-border labor market areas (2012–2018)

Notes: This figure plots the time coefficients for each year between 2012 and 2018 from a regression model for the logarithm of the annual monetary value of goods produced in a given manufacturing sector and exported or imported by each Swiss labor market area, with confidence intervals at the 5% significance level. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. The model is estimated separately for exports (panel a) and imports (panel b). In each panel, coefficients are reported separately for border (blue squares) and non-border (red triangles) labor market areas. Border labor market areas are here defined as those whose centroid lies within 20 km from the closest border-crossing office. All specifications include sector and region fixed effects. Robust standard errors are clustered at the sector level and estimates are weighted for the region-level population size. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the exchange rate shock.

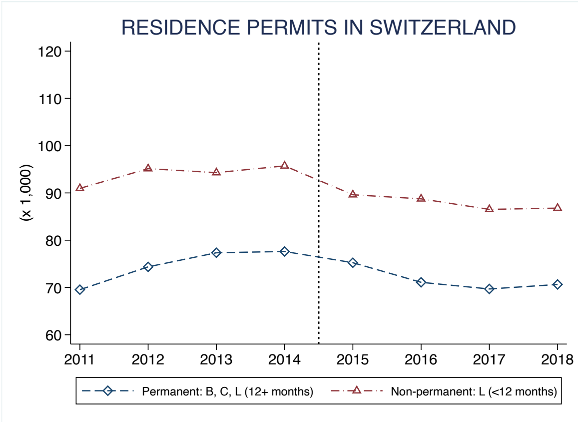


Figure A.5: Number of residence permits in Switzerland (2012–2018)

Notes: This figure shows the evolution over time of the number of new residence permits for foreign citizens released in Switzerland between 2011 and 2018, based on the information provided by the *Swiss State Secretariat for Migration*. Permanent permits (i.e., B and C) are valid for more than one year, while non-permanent permits (i.e., L) have a maximum duration of 12 months. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.

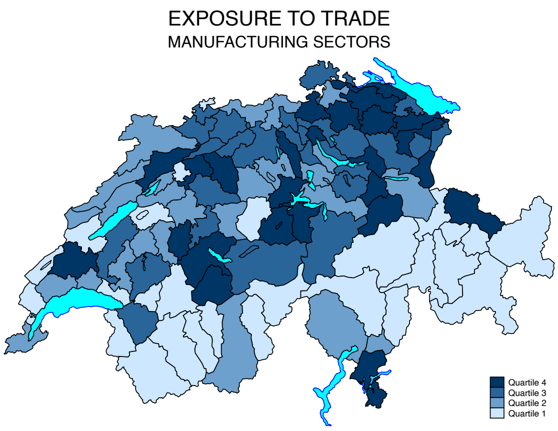
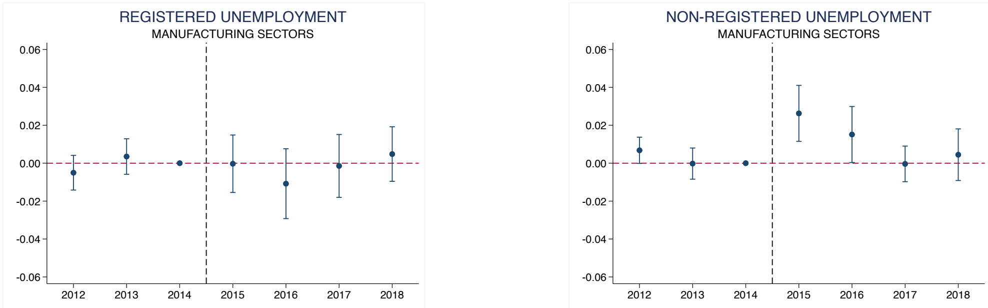


Figure A.6: Geographic distribution of trade exposure

Notes: This map shows the geographic distribution of trade exposure across Swiss local labor market areas in pre-shock years. Focusing on manufacturing sectors, for each labor market area the displayed value is computed as the employment-weighted average of the industry-level index τ_s, where weights correspond to employment in industry s within the area. Labor market areas are classified into four quartiles, with darker shades indicating higher values of trade exposure.



(a) (b)

Figure A.7: Resident workers' unemployment - Manufacturing sectors – Dynamic DiD model (2012–2018)

Notes: This figure shows the estimates from the dynamic difference-in-differences model (1) for the resident workers' unemployment in private manufacturing sectors. Panels (a) and (b) focus on registered and non-registered unemployment, respectively. Each graph shows the estimates of the coefficients β_k (k = 2012, 2013, 2015, ..., 2018), with confidence intervals at the 5% significance level. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. All models include sector and labor market area × year fixed effects, plus a vector of controls for sex, tertiary education, type of residence permit, and a quadratic polynomial for age. Robust standard errors are two-way clustered at sector and year level. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.

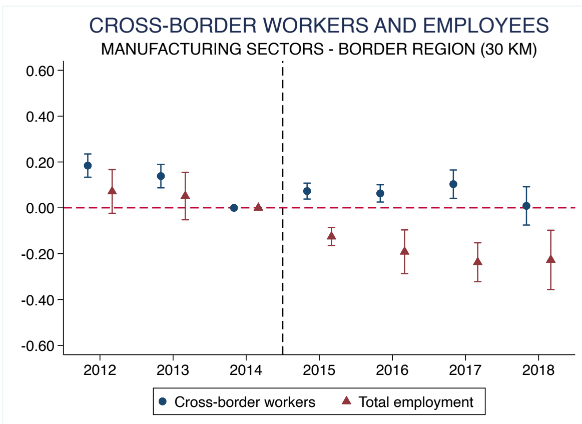


Figure A.8: Number of cross-border workers and employees - Manufacturing sectors – Dynamic DiD model (2012–2018)

Notes: This figure shows the estimates from the dynamic difference-in-differences model (1) (excluding the vector of individual-level control variables) for the number of immigrant cross-border workers and of total employees in private manufacturing sectors, considering a threshold distance from the border of 30 km. The graph shows the estimates of the coefficients β_k (k = 2012, 2013, 2015, ..., 2018), with confidence intervals at the 5% significance level. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. All models include sector and labor market area × year fixed effects. Robust standard errors are two-way clustered at sector and year level. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.

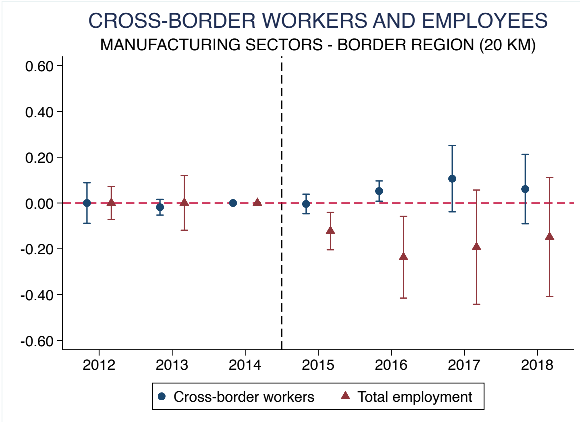
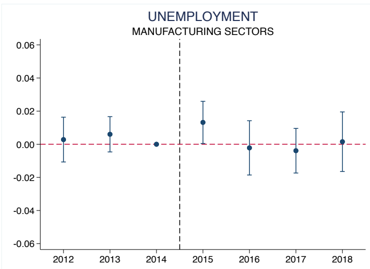
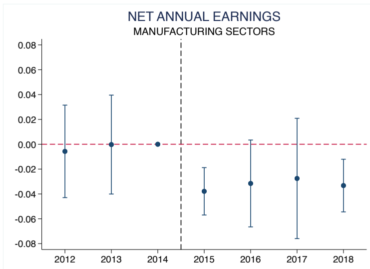


Figure A.9: Number of cross-border workers and employees - Manufacturing sectors – Dynamic DiD model (2012–2018)

Notes: This figure shows the estimates from the dynamic difference-in-differences model (1) (excluding the vector of individual-level control variables) for the number of immigrant cross-border workers and of total employees in private manufacturing sectors, considering a threshold distance from the border of 20 km. The graph shows the estimates of the coefficients β_k (k = 2012, 2013, 2015, ..., 2018), with confidence intervals at the 5% significance level. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. All models include sector and labor market area × year fixed effects. Robust standard errors are two-way clustered at sector and year level. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.



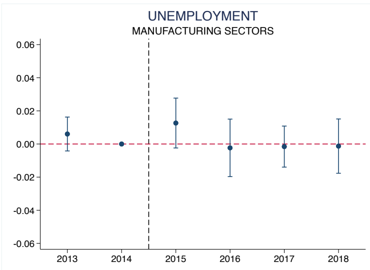
(a)



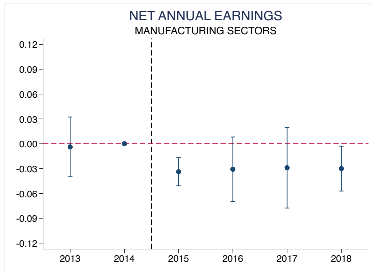
(b)

Figure A.10: Resident workers' labor market outcomes - Manufacturing sectors – Dynamic DiD model - Alternative exposure index (2012–2018)

Notes: This figure shows the estimates from the dynamic difference-in-differences model (1) for resident workers' labor market outcomes in private manufacturing sectors, using an alternative definition of exposure τ_s (Index 5 in Appendix Table B.4). Panel (a) shows the effect of the shock on resident employees' probability of unemployment and panel (b) shows the effect on the logarithm of resident employees' real net annual earnings at 2014 prices. Each graph shows the estimates of the coefficients β_k (k = 2012, 2013, 2015, ..., 2018), with confidence intervals at the 5% significance level. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. All models include sector and labor market area × year fixed effects, as well as a vector of individual-level controls. This vector includes sex, a quadratic polynomial for age, tertiary education, type of residence permit, as well as – only for earnings – contract type (permanent vs. temporary), employment rate (part-time vs. full-time), and firm size (50+ employees). Robust standard errors are two-way clustered at sector and year level. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.



(a)



(b)

Figure A.11: Resident workers' labor market outcomes - Manufacturing sectors – Dynamic DiD model - Out-of-sample index (2013–2018)

Notes: This figure shows the estimates from the dynamic difference-in-differences model (1) for resident workers' labor market outcomes in private manufacturing sectors, when τ_s is constructed using the values for year 2012 only (Index 3 in Appendix Table B.4). Panel (a) shows the effect of the shock on resident employees' probability of unemployment and panel (b) shows the effect on the logarithm of resident employees' real net annual earnings at 2014 prices. Each graph shows the estimates of the coefficients β_k (k = 2013, 2015, ..., 2018), with confidence intervals at the 5% significance level. The last year before the occurrence of the exchange rate shock (i.e., 2014) is the omitted year. All models include sector and labor market area × year fixed effects, as well as a vector of individual-level controls. This vector includes sex, a quadratic polynomial for age, tertiary education, type of residence permit, as well as – only for earnings – contract type (permanent vs. temporary), employment rate (part-time vs. full-time), and firm size (50+ employees). Robust standard errors are two-way clustered at sector and year level. The vertical dashed line (between 2014 and 2015) indicates the beginning of the period following the shock.

Appendix B Additional Tables

Table B.1: Summary statistics - Swiss Labor Force Survey (2012-2018)

	(1) Overall	(2) 2012–2014	(3) 2015–2018
Share of Females	49.86%	49.92%	49.80%
	(0.5000)	(0.5000)	(0.5000)
Average Age	41.22	41.10	41.34
	(13.00)	(12.99)	(13.00)
Share *Swiss* Residents	59.61%	61.57%	57.72%
	(0.4907)	(0.4864)	(0.4940)
Share Foreign *Long-term* Residents (C-permit)	25.12%	24.03%	26.16%
	(0.4337)	(0.44273)	(0.4395)
Share Foreign *Short-term* Residents (B-permit)	13.59%	12.87%	14.28%
	(0.3427)	(0.3349)	(0.3499)
Share Married	50.88%	51.50%	50.28%
	(0.4999)	(0.4998)	(0.5000)
Share Tertiary Education	32.45%	29.76%	35.04%
	(0.4682)	(0.4572)	(0.4771)
Share Manufacturing Sector	10.83%	11.06%	10.62%
	(0.3109)	(0.3137)	(0.3081)
Share of Unemployed	7.24%	7.08%	7.40%
	(0.2591)	(0.2564)	(0.2617)
Share of Non-Registered Unemployed	2.05%	1.99%	2.11%
	(0.1418)	(0.1397)	(0.1437)
Average Weekly Hours Worked	35.30	35.38	35.22
	(12.15)	(12.29)	(12.03)
Share Part-Time Workers	37.44%	36.57%	38.26%
	(0.4840)	(0.4816)	(0.4860)
Share High-Skilled Occupations	51.31%	49.53%	53.01%
	(0.4998)	(0.5000)	(0.4991)
Average Net Annual Earnings	61'935.57	60'906.95	62'891.36
	(36'668.92)	(36'648.76)	(36'661.91)
N	382'379	196'826	185'553

Notes: This table shows descriptive statistics for the variables of interest included in the *Swiss Labor Force Survey*, showing average values over the full time window 2012–2018 (Column 1), over the pre-shock period 2012–2014 (Column 2) and over the after-shock period 2015–2018 (Column 3). Standard deviations in parentheses. All statistics are computed using sample weights provided by the *Swiss Labor Force Survey.*

Table B.2: Swiss trade flows with euro countries (2012-2018)

	(1) Overall	(2) 2012–2014	(3) 2015–2018
Panel A: Exports			
Intermediate Goods			
Average Total Value (mln. CHF)	50’058.34	50’224.52	49’892.17
Average Number of Commodities (HS-6 digit)	2’705	2’732	2’677
Final Goods			
Average Total Value (mln. CHF)	19’464.85	18’950.06	19’979.64
Average Number of Commodities (HS-6 digit)	1’026	1’029	1’022
Capital Goods			
Average Total Value (mln. CHF)	11’911.94	11’792.18	12’031.69
Average Number of Commodities (HS-6 digit)	628	630	626
Panel B: Imports			
Intermediate Goods			
Average Total Value (mln. CHF)	52’169.03	54’143.97	50’194.1
Average Number of Commodities (HS-6 digit)	2’928	2’946	2’911
Final Goods			
Average Total Value (mln. CHF)	24’097.48	24’021.81	24’173.16
Average Number of Commodities (HS-6 digit)	1’164	1’165	1’162
Capital Goods			
Average Total Value (mln. CHF)	14’050.41	14’356.18	13’744.64
Average Number of Commodities (HS-6 digit)	638	637	638

Notes: This table shows the descriptive statistics for trade flows between Switzerland and euro countries, separating exports (Panel A) and imports (Panel B), but also distinguishing between intermediate, final, and capital goods. The table reports the average annual monetary value (in millions of Swiss francs) and the average annual number of traded commodities (according to the HS-6 digit classification), based on the data released by the *Federal Office for Customs and Border Security.* Average annual values are computed over the full time window 2012–2018 (Column 1), over the pre-shock period 2012–2014 (Column 2), and over the after-shock period 2015–2018 (Column 3).

Table B.3: Cross-border workers in Switzerland (2012-2018)

	(1) Overall	(2) 2012–2014	(3) 2015–2018
All Switzerland	6.14% (289'490)	5.91% (273'506)	6.37% (305'474)
Border Region - 10 km	20.61% (215'000)	19.98% (204'896)	21.23% (225'104)
Border Region - 20 km	14.31% (254'114)	13.85% (241'501)	14.78% (266'726)
Border Region - 30 km	8.82% (280'368)	8.52% (265'527)	9.12% (295'208)

Notes: This table reports the average annual share of cross-border workers in the total workforce (and the average annual absolute number of cross-border workers) in Switzerland over the full time window 2012–2018 (Column 1), over the pre-shock period 2012–2014 (Column 2) and over the after-shock period 2015–2018 (Column 3), using the data released by the *Swiss Federal Statistical Office*. The table reports statistics for the whole country and for the border region. As for the border region, results are reported considering three different thresholds, namely, including labor market areas whose centroid has a maximum distance from the nearest border-crossing office of at most 10, 20, and 30 kilometers.

Table B.4: Sector-level exposure index (τ_s) - Manufacturing sectors

NOGA-08 Code	Sector	Index 1	Index 2	Index 3	Index 4	Index 5	Index 6	Index 7
10-12	Food products, beverages and tobacco	0.1539	0.1583	0.1449	0.1458	0.4570	0.9628	0.2895
13-15	Textiles, textile products, leather and footwear	0.6776	0.6629	0.7074	0.6280	1.7479	2.9320	1.6280
16	Wood and products of wood and cork	0.0753	0.0750	0.0760	0.0679	0.1943	0.2737	0.1159
17-18	Paper products and printing	0.1605	0.1624	0.1568	0.1456	0.3683	0.5645	0.2720
19	Coke and refined petroleum products	0.1787	0.1715	0.1931	0.1541	0.6805	2.1150	0.2299
20-21	Chemicals and pharmaceutical products	0.1830	0.1827	0.1836	0.1777	0.5251	2.2900	0.5299
22	Rubber and plastics products	0.3251	0.3282	0.3187	0.3103	0.8363	1.1905	0.5567
23	Other non-metallic mineral products	0.0915	0.0930	0.0882	0.0862	0.2147	0.4086	0.1992
24	Basic metals	0.1733	0.1749	0.1700	0.1671	0.5147	0.9272	0.4334
25	Fabricated metal products	0.1438	0.1473	0.1367	0.1308	0.2953	0.4561	0.2884
26	Computer, electronic and optical equipment	0.1807	0.1794	0.1837	0.1540	0.4627	1.2029	0.5825
27	Electrical equipment	0.2730	0.2714	0.2760	0.2460	1.0033	1.9076	0.5549
28	Machinery and equipment	0.3830	0.3757	0.3983	0.3708	0.9701	1.6783	0.8025
29	Motor vehicles, trailers and semi-trailers	1.7832	1.7345	1.8777	1.7551	4.3707	10.6261	2.6251
30	Other transport equipment	0.4861	0.4925	0.4732	0.4519	1.2551	2.4825	1.0718
31-33	Repair and installation of machinery and equipment	0.1713	0.1698	0.1746	0.1643	0.4113	0.7068	0.4247

Notes: This table presents the value of the index τ_s for each manufacturing sector. Index 1 corresponds to the baseline definition (Section 4): $\tau_s = \frac{e_{s,2012-14} \cdot (1-n_s) + i_{s,2012-14}}{v_{s,2012-14}}$, where $e_{s,2012-14}$ is the average value of exports of sector s towards euro countries over the period 2012–2014, n_s is the sector-specific share of exports value represented by imported intermediate inputs, $i_{s,2012-14}$ is the average value of imports of final goods produced by sector s in euro countries over the period 2012–2014, and $v_{s,2012-14}$ is the average total value of gross production of sector s over years 2012–2014. Index 2 is based on the average values of exports, imports, and production over years 2013–2014 rather than 2012–2014. Index 3 is based on the values of exports, imports, and production of year 2012. Index 4 is based on the values of exports, imports, and production of year 2014. Index 5 and index 6 are alternative versions of index 1 that use as denominator, respectively, the average value added and the average wage bill of the sector instead of its average gross value of production. Finally, index 7 considers all exports and imports of Switzerland, not only trade flows with euro countries.

Table B.5: Correlation across different versions of the sector-level exposure index

Exposure Index	Index 1	Index 2	Index 3	Index 4	Index 5	Index 6	Index 7
Index 1	1.00						
Index 2	1.00	1.00					
Index 3	1.00	1.00	1.00				
Index 4	1.00	1.00	1.00	1.00			
Index 5	1.00	0.99	1.00	0.99	1.00		
Index 6	0.97	0.97	0.97	0.97	0.98	1.00	
Index 7	0.96	0.97	0.96	0.96	0.96	0.92	1.00

Notes: This table reports the degree of correlation across the alternative versions of the exposure index τ_s for each manufacturing sector. Index 1 corresponds to the baseline definition (Section 4): $\tau_s = \frac{e_{s,2012-14} \cdot (1-n_s) + i_{s,2012-14}}{v_{s,2012-14}}$, where $e_{s,2012-14}$ is the average value of exports of sector s towards euro countries over the period 2012–2014, n_s is the sector-specific share of exports value represented by imported intermediate inputs, $i_{s,2012-14}$ is the average value of imports of final goods produced by sector s in euro countries over the period 2012–2014, and $v_{s,2012-14}$ is the average total value of gross production of sector s over years 2012–2014. Index 2 is based on the average values of exports, imports, and production over years 2013–2014 rather than 2012–2014. Index 3 is based on the values of exports, imports, and production of year 2012. Index 4 is based on the values of exports, imports, and production of year 2014. Index 5 and index 6 are alternative versions of index 1 that use as denominator, respectively, the average value added and the average wage bill of the sector instead of its average gross value of production. Finally, index 7 considers all exports and imports of Switzerland, not only trade flows with euro countries.

Table B.6: Resident workers' labor market outcomes - Manufacturing sectors (2012-2018)

	(1) Baseline	(2) Only Imports	(3) Only Exports
Panel A: Unemployment			
$\tau_s \times$ post	-0.00034	-0.00050	0.00034
	(0.00475)	(0.00482)	(0.00452)
N	35936	35936	35936
Panel B: Earnings			
$\tau_s \times$ post	-0.026***	-0.028***	-0.007
	(0.006)	(0.004)	(0.015)
N	29420	29420	29420

Notes: This table shows the estimates of a *static* version of model (1) for resident workers' labor market outcomes in private manufacturing sectors. Panel A refers to the impact of the shock on the probability of unemployment, while panel B refers to the impact on the logarithm of real net annual earnings at 2014 prices. Column (1) reports the estimates of the baseline diff-in-diff model, while Columns (2) and (3) report the estimates when the continuous treatment variable is an alternative version of exposure index τ_s that excludes, respectively, exports or imports. Note that columns are not directly comparable, as the use of alternative measures of trade exposure results in slightly different orderings of affected sectors. All models include sector and labor market area $\times$ year fixed effects, as well as a vector of individual-level controls. This vector includes sex, a quadratic polynomial for age, tertiary education, type of residence permit, as well as – only for earnings – contract type (permanent vs. temporary), employment rate (part-time vs. full-time), and firm size (50+ employees). Robust standard errors are two-way clustered at sector and year level. Significance levels: *** $p < 0.01$; ** $0.01 \leq p < 0.05$; * $0.05 \leq p < 0.10$.