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Exchange rate fluctuations and border crossings : evidence from the Swiss-Italian border

Exchange rate fluctuations and border crossings: evidence from the Swiss-Italian border *

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Abstract

This paper provides an empirical analysis of the effects of nominal exchange rate fluctuations on cross-border mobility and on retailer firms' sales. Exchange rate shocks may affect the labour supply decisions of cross-border workers and the propensity for consumers to shop across the border. By using hourly data on traffic flows in Ticino, the southernmost canton of Switzerland, and data on Italian supermarkets, I analyse the effects of the Swiss franc appreciation on cross-border travel by both Italian workers and Swiss consumers and on Italian retailers' sales. I find that a 10% appreciation of the Swiss franc increases the number of cars along the border by 1.5-3% more than in the rest of the canton. This effect is found only during specific time intervals, which differ according to the direction of the flow (the early morning from Italy to Switzerland, the afternoon from Switzerland to Italy and late morning for both directions). Moreover, I show that a stronger Swiss Franc positively affects supermarkets' sales in Italian provinces bordering Switzerland. Finally, I provide additional evidence for the labour supply hypothesis by using data on search volumes provided by Google Trends and official statistics on cross-border commuters in Switzerland.

Keywords: geographic labor mobility, labor supply, traffic flows
JEL classification codes: J61, J22,R41

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1 Introduction

This paper studies how exchange rate movements affect cross-border travel by both workers and consumers and the effects of the latter on retail firms' sales. While considerable attention has been paid to different kinds of long-term migration, much less research has focused on short-term travel. Given the magnitude of cross-border travel, this is a little surprising. Eurostat reports that in 2015, almost 2 million residents of Schengen countries crossed the border to go to work, and cross-border shopping in North-America as well as within the EU is becoming increasingly widespread.

According to the literature on migration, the bulk of the migration stream is explained by the income advantages and better job profiles in the region of destination (Todaro (1969), Harris and Todaro (1970), Dustmann (2003)) as well as by high unemployment rates and recession in the region of origin Bauer and Zimmermann (1999)). Compared to international long-term migration, the labor supply decisions of commuters are supposed to be even more sensitive to wage and income differentials because the cost associated with the decision of commuting is much lower. Despite a rich literature on the determinants of international migration, the role of key macroeconomic variables, such as the exchange rate, is not well documented. As far as know there are a few papers showing the influence of exchange rate fluctuations on the labour supply decisions of immigrants (Nekoei (2013), Hanson, Robertson, and Spilimbergo (2002)) and none looking at commuting.

Moreover, nominal exchange rate fluctuations are known to be related to persistent price differences for similar goods across countries (Engel and Rogers (2001) and Engel and Rogers (1994)) [1], which affect the number of cross-border shoppers (Chandra, Head, and Tappata (2014)) and in turn retail firms' sales at the border (Baggs, Fung, and Lapham (2015) and Baggs, Beaulieu, Fung, and Lapham (2016)).[2]

The literature analysing the response of cross-border travel to the exchange rate movements is almost entirely limited to the North American context, and how nominal exchange rate movements affect retailers' pricing decisions and sales is still an open question. Moreover, exchange rate effects on cross-border commuting have never been formally documented in the economic literature. The novelty of this paper is to analyse the cross-border shopping on a European

[1] Engel and Rogers (1994) used CPI data for U.S. and Canadian cities and analyse the price variation for homogenous goods within and across countries. They found that the variation is much higher for two cities located in different countries than for two equidistant cities in the same country. Sticky nominal prices appear to be one explanation. As the nominal exchange rate is highly variable, prices are sticky in terms of the currency of the country in which the good is sold.

[2] There have been also empirical studies on fiscally-induced cross-border shopping for specific products (Asplund, Friberg, and Wilander (2007), Lovenheim (2008), (Banfi, Farsi, Filippini, and Jakob (2008) and Garrett and Marsh (2002)).

border and, in addition, to provide initial evidence of the responsiveness of cross-border workers to the exchange rate. To this end, I look at Switzerland, which represents the ideal setting for analysing the response of border crossings to exchange rate fluctuations. Switzerland is a small country with relatively easy-to-cross frontiers, given the Schengen agreement, and strong integration with neighbouring countries in terms of language and culture. In addition, since most of the other European countries have adopted the euro, and therefore do not see any kind of relative currency change, Switzerland is one of the few European countries in which a cross-border analysis of this sort is possible.

Over the 2008-2011 period, the Swiss franc soared by almost 20% in value against the euro and the rise was stopped by the introduction of a minimum exchange rate of SFr 1.20 per euro by the Swiss National Bank (SNB) in November 2011. Then, in January 2015, the franc appreciated more sharply when the Swiss National Bank decided to abandon the minimum exchange rate. If the benefit derived from the higher purchasing power of the Swiss franc in the euro area had outweighed the cost of commuting, the revaluation might have increased the labour supply from euro area workers. Moreover, the appreciation of the Swiss franc might have made cross-border shopping much more attractive.

To study the effects of the appreciation on Swiss-Italian border crossings I use data on traffic flows in Ticino over the 2005-2015 period. I exploit the fact that only municipalities close to the border are affected by cross-border shopping and cross-border labour supply. Hence, I identify two groups of traffic counting stations - traffic counting stations located within 10 km of the border represent my *Treatment group*, while traffic counting stations located further away from the border are used as a *Control group*. By comparing the changes in traffic flows between the two groups, I am able to identify the effects of the exchange rate on cross-border travel. The findings show that a 10% appreciation of the Swiss franc is associated with an additional increase of 1.5-3% in the traffic flows at the border (corresponding to 5-16 cars per hour and per traffic counting station) compared to that in the rest of the region. In addition, interestingly, I observe that the vehicle flows crossing the Swiss-Italian border are affected by the exchange rate only during specific hours, which differ according to the direction of the flow. The flows toward Ticino are affected only during the morning (early morning and late morning) while the flows from Ticino to Italy are affected during the late morning and the afternoon. These differences across hours and directions point to the role of cross-border shopping and commuting in explaining this effect.[3]

Furthermore, since the increase in cross-border travel by consumers acts as a demand shock for retailers, I also use data from the Lombardy Chambers of Commerce to study the effects

[3]In a companion paper, Bello (2017), using the same identification strategy, I also analyse the effects of exchange rate fluctuations on traffic accidents and air pollution.

on retailer firms' sales in Lombardy.[4] I find that Italian supermarkets in provinces bordering on Switzerland perform better when the Swiss Franc is stronger. The effect is heterogeneous across product categories: a higher increase in revenues, unit values, and number of units sold is found for more expensive products.

Finally, in order to provide supporting evidence for the results for the cross-border labour supply hypothesis, I draw upon two additional datasets: search volumes of keywords in Google provided by Google Trends and official statistics on commuters in Ticino. The results suggest that there is a positive relationship between the value of the Swiss franc against the euro and both the intensity of searches from Lombardy for a job in Ticino and the number of cross-border workers in Swiss municipalities within a road distance of up to 10 km from the Swiss-Italian border. This finding is consistent with the idea that the increase found in traffic flows - in the early morning and in the afternoon - is due to a higher number of Italian workers, who decide to commute to Switzerland on a daily basis, responding to the economic incentives generated by the Swiss franc appreciation.

The paper is structured as follows. Section 2 discusses the background. Sections 3 and 4 respectively describe the data and the identification strategy, and the results on traffic flows. Section 5 explores the effects on retail firms' sales in Lombardy. Finally, Section 6 provides supporting evidence and Section 7 concludes.

2 Background and motivation

This work combines two strands of literature: one on cross-border shopping and the other regarding immigrant labour supply.

2.1 Cross-border shopping

Most of the literature on cross-border travel has focused on fiscally induced cross-border shopping. There are studies for several geographical areas and for various goods (alcoholic drinks, cigarettes, gasoline and gambling). Asplund, Friberg, and Wilander (2007) estimate the response in terms of monthly sales of alcohol in Sweden to changes in price differentials between Denmark and Germany, taking into account the sensitivity of the distance from the border. They found that a 10% reduction in the foreign price is associated with a fall in per-capita sales of 4 % at the border; moving 200 (400) km inland reduces the elasticity to 0.2 (0.1) respectively. Similar empirical evidence for alcoholic drinks has been provided by Beard, Gant,

[4]Lombardy is one of the twenty administrative regions of Italy; it is in the northwest of the country and borders on Switzerland.

and Saba (1997) and by Fleenor (1999) using data for the United States. Lovenheim (2008) instead studies cigarette consumption by using data from the Current Population Survey. He estimates that between 13 and 25 percent of consumers purchase cigarettes in a lower-price state and that cigarette demand becomes more elastic with respect to the home state price the farther one lives from a lower-price border. Regarding gasoline, Banfi et al. (2008) show that a decrease of 10% in the Swiss gasoline price leads to a reduction in demand in the border areas (Italy, France and Germany) of nearly 17%. Doyle and Samphantharak (2008) and Manuszak and Moul (2009) conduct the same exercise for the United States, while Leal, López-Laborda, and Rodrigo (2009) do so for Spanish regions. Finally, evidence of a state revenue loss due to neighbouring state lotteries is found in Garrett and Marsh (2002).

Studies of cross-border shopping motivated by exchange rate movements are instead still very few and focus mainly on the Canada-US border. The first evidence is provided by Chandra, Head, and Tappata (2014), who uses micro-data on vehicle counts for provinces along the Canada-US border and shows that a 10% appreciation of the home currency increases the propensity to cross the border by 8% to 26%. The elasticity is higher when the home currency is strong and decreases with the distance from the border. Moreover, Campbell and Lapham (2001) show that this increase acts as a demand shock for retailers near the Canada-US border; in fact, the number of stores along the border is affected by the exchange rate movements. Finally, the intensive and extensive margins of the response of Canadian retail firms to an appreciation of the Canadian dollar is studied in greater depth in Baggs, Fung, and Lapham (2015) and Baggs, Beaulieu, Fung, and Lapham (2016). They show that profits, sales, and employment of retailers are negatively affected by the value of the domestic currency. With the effect on profits the strongest, their results suggest that firms respond to such a shock by reducing their markups, rather than through the extensive margins.

2.2 The determinants of immigrants labour supply

The literature on the labour supply of foreign workers highlights many factors influencing migration decisions. The probability of migration seems to be positively related to different kinds of (expected) wage and income differential (Todaro (1969), Harris and Todaro (1970), Dustmann (2003)). However, in order to register positive migration flows, any wage gap must be smaller than the cost of migration, including non-financial costs, like psychological costs (e.g. separation from home culture) or the risk of migration (costs associated with finding work and / or accommodation) (Carrington, Detragiache, and Vishwanath (1996)). High levels of unemployment at home relative to in the host country (Bauer and Zimmermann (1999)) and access to social security benefits (Heitmueller (2005), De Giorgi and Pellizzari (2009), Fiva (2009)) are two further major factors driving migration.

The exchange rate affecting the purchasing power of wages in home countries is another important determinant of migration flows. Nevertheless, there exist only two studies analysing explicitly the response of immigrants' labour supply to the price of their home country's currency and both studies are based on the North American setting. Nekoei (2013), using data on Mexican immigrants to the United States, shows that a dollar appreciation leads immigrants to cut their annual hours worked. Focusing instead on illegal immigration, Hanson, Robertson, and Spilimbergo (2002) show that a negative correlation between the value of the Mexican Peso against the US dollar and border apprehension exists. To my knowledge, no studies exist analysing the effects of exchange rate fluctuations on cross-border workers.

2.3 The labour market in Ticino

The extent to which the exchange rate can affect the labour supply decisions of Italian workers depends on the level of integration between the two labor markets, namely, the Swiss and the Italian. The two labour markets have become highly integrated since the implementation of the bilateral agreements between Switzerland and the EU. In particular, the Agreement on the free movement of persons, signed in 1999, made Swiss and Euro Area citizens free to choose their place of work and place of domicile inside the boundaries of the contracting parties. The agreement has been gradually implemented. Three distinct phases can be identified: partial liberalization (1999-2004), full liberalization for cross-border workers in border regions (2004-2007) and full liberalization for cross-border workers and EU immigrants anywhere in Switzerland (post-2007) (Beerli and Peri (2015)).[5] Since the signing of the agreement, the number of immigrants, and in particular, of cross-border workers, has increased in both countries. Cross-border commuting remains strictly polarized, though compared to 50,000 trans-border commuters from the Italian provinces to Canton Ticino, there are only 1,000 Swiss citizens commuting from Ticino to Italy. In Ticino, in fact, the cross-border labour force represents 43 per cent of total employment. Most of these workers are employed in sectors characterized by low value-added activities (Baruffini (2011)). It is only recently that a shift in the composition of the Italian workforce has been taking place, with a considerable improvement not only in the level of qualifications but also in the share of people employed in services. It is worth noting that the two regions are very different in terms of population size: while 10 million people live in Lombardy, Canton Ticino has only 340,000 inhabitants.

[5]The border region for the canton of Ticino was defined by all municipalities located south of the municipalities of Claro/Preonzo. All the traffic counting stations included in the Treatment Group in this analysis are located in this area.

3 The identification and the data

3.1 Data

This paper uses two main datasets: data on road traffic flows and data on supermarket sales in Lombardy.

For the first dataset, the main source is the Sezione Mobilità del Canton Ticino, which provides data on traffic flows in Ticino using information obtained from 60 automatic traffic-counting stations. These traffic-counting stations, located along the Canton's main roads, record all traffic movements by direction and time (hours) every day. I collected data from all these stations for the years from 2005 to 2015. The data consist of vehicle counts crossing a specific station at a certain time and on a certain day of the year, for each direction of travel. The latter, issued by the Lombardy Chambers of Commerce [6], contains province-level data on supermarket sales in Lombardy in the 2006-2015 period. The data provide quarterly information on sales (units) and revenues for five product categories: groceries (food), beverages, fresh foods, frozen foods, health and beauty, and home products. Moreover, I compute unit values (prices) for each product category, defined as revenue divided by number of units sold. [7]

Moreover, to provide additional evidence I also rely on two additional datasets. The first consists of searching volume data coming from Google Trends and the latter, the Cross-Border Commuters Statistics, contains quarterly information on the number of foreign cross-border commuters working in Switzerland and their main characteristics. Finally, I obtained daily data on EUR/SFr exchange rate from the Swiss National Bank.

3.2 Identification

My identification strategy relies on the geographical variation in the location of traffic counting stations. To analyse the impact of the Swiss franc's appreciation on cross-border mobility I identify traffic counting stations in municipalities located within a road distance up to 10 km from the border as my *Treatment Group* and compare them to the rest of the stations, which represent my *Control Group*. Figure 1 shows the location of the traffic counting stations. To make sure that long-distance goods transport traffic flows were not included in the analysis, I decided to disregard all traffic-counting stations located on highways. Stations not active over the entire period of analysis are similarly excluded. Thus, I obtain an unbalanced panel of 25 traffic counting stations, with 11 in the *Treatment Group* and 14 in the *Control Group*.

[6] Source: IRI - Information Resources

[7] The province of Sondrio is not included because of the low number of observations available there. The province of Milan includes the province of Monza-Brianza.

The assumption is that only the traffic flows along the border are affected by cross-border travel, while changes in trade traffic flows that the appreciation phases might have generated pertain to both groups of traffic-counting stations. Thus, by comparing the *Treatment Group* to the *Control Group*, I am able to disentangle the effect of the monetary shock on mobility due to the increase in cross-border shopping or cross-border labour supply from other kinds of impact of the exchange rate on traffic. In addition, by looking at the time of day and at the direction of the traffic flows, I can distinguish flows related to cross-border shopping from those related to cross-border labour supply.

As in Kaiser and Siegenthaler (2016), I claim that the exchange rate fluctuations of the Swiss franc act as exogenous shocks for the Swiss economy because of the special status of this currency. The Swiss franc is regarded as a safe haven asset: when financial markets are in turmoil, investors from different parts of the word flock to the franc, and its value surges dramatically.

4 Traffic Flows

4.1 Descriptive statistics

Figure 2 presents the evolution of the EUR/SFr exchange rate from 2000 through to 2015. During the financial turmoil of 2008, the Swiss franc gained appreciably since investors started depositing their money in francs. In the middle of the Euro-zone crisis, in 2011, the value of the Swiss franc soared, to the extent that the Swiss National Bank (SNB) decided to provide support for the Euro by printing new francs and using them to buy euros. On 6 September 2011, the SNB introduced a minimum EUR/SFr exchange rate of SFr 1.20. The hope was that this would help bring down the value of the Swiss franc and help the country maintain its price competitiveness in the export market. Then in January 2015, the SNB announced that it would no longer hold the Swiss franc at a fixed exchange rate with the euro, and so removed the cap. The value of 1 euro fell to just Sfr 0.85. This happened ahead of the European Central Bank (ECB)'s move, among other things, to buy up huge amounts of state bonds. In so doing, the SNB managed to protect the Swiss economy from further volatility and upward pressure on the Swiss Franc.

Before turning to a direct estimation of the effects, it is interesting to look at the raw traffic data to appreciate the relevant differences in the traffic flow patterns across the two groups of stations and to establish that exchange rate fluctuations matter for traffic flows. Figures 3 and 4 display the hourly distribution of the number of vehicles in the *Treatment Group* and the *Control Group*. Figure 3 (a) and (b) shows the two distributions during working days

(Monday-Friday), while Figures 4 (a) e (b) analyses the traffic flows during non-working days (Saturday-Sunday). Two driving directions are analysed, North to South and South to North.[8] The traffic flows in treated municipalities on working days are clearly affected by cross-border workers who commute on a daily basis, entering Switzerland in the morning and going back to Italy in the afternoon. Differences between the two groups of traffic counting stations are found also for non-working days: while the two distributions coincide for the Control Group, they still appear staggered for the Treatment Group. Evidence of similar patterns is provided in Table 1, which indicates the average number of vehicles per hour in five time intervals for each group (5-9am, 10am-1pm, 2pm-8pm, 9pm-11pm, 12 am-4am). Finally, Figures 5 and 6 present the correlation between the average number of vehicles per hour and the exchange rate fluctuations by showing the time patterns in trips for the two directions. A clear surge in the number of vehicles after the currency began to appreciate in 2008 emerges for the *Treatment Group* in both graphs, while the flows seem to remain constant over time for the *Control Group*.

4.2 Empirical Strategy

To analyse the effects of the exchange rate on cross-border mobility, the empirical strategy entails comparing the elasticity of cross-border crossings with regard to the exchange rate across the two groups of stations: the *Treatment Group* and the *Control Group*. I estimate the following regression:

$$\ln n_{ihdmy} = f_i + \eta_1 \ln e_{dmy} + \eta_2 \ln e_{dmy} * Treat_i + \eta_3 X_{my} + \epsilon_{ihdmy}; \quad (1)$$

where n_{ihdmy} denotes the number of cars crossing the traffic counting station i at time h, day d, month m and year y. Variable e_{dmy} represents the log of the EUR/SFr exchange rate, whereas $Treat_i$ is a dummy for traffic counting stations located within 10 km from the border. $e_{dmy} * Treat_i$ is the interaction term between the dummy and the exchange rate, and it measures the effect of my interest, and f_i are traffic counting station fixed effects accounting for differences across stations. X_{my} is a vector of control variables including the log of the Swiss GDP, the log of the Italian GDP, and the log of the unemployment rate in Lombardy.[9] A dummy for the period after the full labour market liberalization and monthly fixed effects to control for strong seasonality in trips are also included.

I estimate this equation separately for working days and non-working days, for each travel direction and for five time intervals (5-9 am, 10 am-1 pm, 2 pm-8 pm, 9 pm-11 pm, 12 am-4 am).

[8] I use the abbreviation CH->IT to indicate North to South flows and IT->CH for South to North.
[9] Swiss GDP, Italian GDP and unemployment rates are quarterly data.

4.3 Results on Traffic Flows

Estimates on traffic flows are presented in Table 2. Traffic flows from Italy to Switzerland are analysed in Panel 1, and those from Switzerland to Italy in Panel 2. For any temporal interval there are two columns, respectively for working days and non-working days. The results in columns 1-2 show that the elasticity of traffic flows from Italy to Switzerland, during the first temporal interval (5 am-9 am), with respect to the EUR/SFr exchange rate, is lower at the border compared to that in the rest of Ticino. A 10% appreciation of the Swiss Franc seems to increase the number of cars crossing the Italian border in the early morning by 2.8-3% more than in the rest of the canton. The estimated effect corresponds to 15 additional cars per hour adn per traffic counting station. The interpretation of these results is that Italian workers respond strongly to the exchange rate variations by increasing their propensity to work in Switzerland when the Swiss currency is stronger. In line with this hypothesis, I find that the interaction term is negative and statistically significant also in Panel 2 column 5, which refers to the traffic flows from Switzerland to Italy during 2-8 pm, when, presumably, cross border workers are going back to Italy. The interaction terms in columns 1-2 Panel 2 and 5-6 of Panel 1 are never statistically significant suggesting that, instead, the labor force commuting from Switzerland to Italy is not affected by the monetary shocks. Columns 3-4 of Panel 1 and Panel 2 refer to the second temporal interval (10 am-1 pm). The interaction terms are still negative and statistically significant in both panels. The estimated elasticity for this time interval is 0.18%. A cross-border shopping hypothesis can explain these results. The stronger the Swiss Franc is, the higher the number of trips by Swiss consumers to the less expensive Italian shops (a 10% appreciation is associated with an increase of 7 cars per hour and per traffic counting station crossing the border in the late morning). In the appendix, Table A.1 presents the results for night traffic flows.

5 The response of Italian Supermarkets to the Swiss franc appreciation

The increase in cross-border travel found during the late morning in both directions is consistent with the hypothesis that the expensive franc drove more Swiss consumers to cross the border to shop in cheaper Italy. The exchange rate shocks might have then positively affected the Italian retailers' performance by acting as a demand side shock.[10]

Hence, in this section, I investigate the effects of nominal exchange rate fluctuations on retail-

[10]Fist of all, the exchange rate shocks act as supply side shocks to retail firms by changing the price of imported goods.

ers' sales in Lombardy. As in the previous section, I exploit a geographic variation, this time, across provinces in Lombardy.[11] I distinguish two groups of provinces; the provinces bordering Switzerland (Varese and Como) represent the Treatment Group, while the remainder are in the Control Group. By comparing the two groups, I am able to distinguish the supply-side effect of the exchange rate on retail firms (which is assumed to be constant across provinces) and the demand-side effect related to the increase in cross-border travel (which affects only those along the border). I analyse the effects on average sales revenue, unit value and number of units sold for each product category.

Table 3 reports descriptive statistics for these variables by province.

To analyse how the exchange rate affects supermarket sales in Lombardy, I estimate a model similar to equation (1):

$$\ln v_{ity} = f_i + \eta_1 \ln e_{ty} + \eta_2 \ln e_{ty} * TreatProv_i + \eta_3 X_{ty} + \epsilon_{ity}; \tag{2}$$

where v_{ity} denotes the variable of interest (log of the average sales revenue, log of the average number of units sold and average unit value) in the Lombardy province i in the trimester t and year y for any product categories. The variable e_{ty} represents the log of the EUR/SFr exchange rate, whereas $TreatProv_i$ is a dummy for the provinces of Varese and of Como. $e_{ty} * Treat_i$ is the interaction term between the dummy and the exchange rate and measures the effect of my interest. f_i are province fixed effects and X_{ty} is a vector of control variables: the log of the Swiss GDP, the log of the Italian GDP and the log of the unemployment rate in Lombardy. Monthly fixed effects are also included. I estimate this equation separately for any product categories.

Table 4-5 show the results. Whereas Table 4 analyses the effects on the total revenue, Table 5 studies the effects across product categories. The results show that the average unit value in treated provinces increases by 0.54% more than in other areas of Lombardy when the EUR/SFr exchange rate drops by 10%. The effect seems to be heterogeneous across products. The coefficient of the interaction is statistically significant in column 6 Panel 2 and in columns 1,4, and 5 Panel 3. This indicates that a 10% appreciation of the Swiss Franc increases the unit values of beverages by 2,7%, the revenues of home care products by 1,9%, and the revenue and the number of units of home care products sold by about 2%. The exchange rate does not seem to affect differently the two groups in terms of groceries, fresh food and frozen food sales.

Similar evidence on unit values is found in Figure 7, where I plot the average unit value

[11] The Italian region comprises 12 administrative divisions called provinces: Bergamo, Brescia, Como, Cremona, Lecco, Lodi, Mantova, Milano (regional capital), Monza and Brianza, Pavia, Sondrio and Varese. Canton Ticino's borders are adjacent to two of them (Varese and Como).

against the nominal exchange rate across the two groups of provinces and by product category. The figure clearly shows the high correlation between the nominal exchange rate and the performance of Italian supermarkets along the Swiss border. In particular, it seems that there is a parallel trend between the two groups until 2012, then, when the first Swiss franc appreciation phase begins, the provinces along the border start increasing the unit values of their products (especially of beverages, home care and personal care products) and finally the patterns of the two groups diverge in correspondence with the sharper appreciation in 2015.

6 Robustness checks

6.1 The cross-border labor-supply hypothesis: official statistics on commuters

In the previous section, I show that the traffic flows from Italy to Switzerland are affected by the exchange rate during the early morning, while traffic flows from Switzerland to Italy are affected in the afternoon. These differences across hours and directions point to the role of cross-border labour supply in explaining these effects. An appreciation of the Swiss franc against the euro by increasing the value of Swiss wages in terms of the euro induces more Italian workers to cross the border to work in Switzerland. In order to provide additional supporting evidence for the findings, I use official statistics on commuters in Ticino to show that the number of cross-border workers in municipalities close to the border is strongly affected by the value of the Swiss franc. I estimate the following equation:

$$\ln s_{ity} = f_i + \eta_1 \ln e_{ty} + trend + trend2 + \eta_3 X_{ty} + \epsilon_{ity}; \tag{3}$$

where s_{ity} denotes the log of the number of cross-border workers in each municipality i in the trimester t and year y . The variable e_{ty} represents the log of the EUR/SFr exchange rate, and f_i are municipal fixed effects. X_{ty} is a vector of control variables including the log of the Swiss GDP, the log of the Italian GDP, and the log of the unemployment rate in Lombardy. A dummy for the period after 2007, quarter fixed effects, and a linear and quadratic year time trend are also included.

I use driving distance to calculate the distance between each municipality and the closest border post and I estimate this equation for a subsample of communities within a driving distance up to 5, 10, 15 or 20 km from the border. Table 6 presents the results of the estimation for each distance to border post cut-offs. In line with the previous analysis, the nominal exchange rate seems to affect the number of cross-border workers in municipalities within a road distance up to 10 km from the border. The value of the effect is between 0.2-0.4%. This means that the supply of cross-border workers increases by 2.3 - 3% in response

to a 10 % appreciation of the Swiss franc. The labour supply elasticity is larger for women than for men.

6.2 The cross-border labour-supply hypothesis: additional supporting evidence provided by Google Trends

Does the increase in cross-border workers reflect changes in the labour supply rather than in the labour demand? To answer this question, I look for evidence in Google Trends' search volume data. I test whether people in Lombardy increase their job hunting in Ticino when the Swiss Franc appreciated compared to the previous period, in other words, in response to the economic incentives created by the fluctuations in the exchange rate.

Google has begun to provide access to aggregate information on the volume of queries for different search terms and on how these volumes change over time, via the publicly available service Google Trends. This facility shows how often a particular search-term is entered relative to the total search-volume for a given region and time.

The aim of this section, therefore, is to demonstrate that a link exists between the volume of job-related searches for a position in Ticino from Lombardy and the EUR/SFr exchange rate. I analyse the trends of two different queries: "Offerte lavoro in Ticino" (Job Vacancies in Ticino) and "Offerte lavoro in Lombardy" (Job Vacancies in Lombardy"). I focus exclusively on data from Lombardy. The hypothesis is that while people resident in Lombardy intensify their search for a job in Ticino under the influence of monetary shocks, the exchange rate does not affect the intensity with which people look for a job in their own region. The comparison between the two trends allows me to disentangle the effects of the exchange rate from other factors that could affect the labour supply of Italian workers.

The hypothesis is tested using the following model:

$$s_{imy} = Ticino_i + \eta_1 \ln e_{my} + \eta_2 \ln e_{my} * Ticino_i + \eta_3 X_{my} + \epsilon_{imy}; \tag{4}$$

where s_{imy} denotes the volume of searches carried out on Google in Lombardy for query i in month m and the year y relative to the total number of searches carried out during the period (2004-2015).[12] The variable e_{my} represents the log of the EUR/SFr exchange rate, whereas $Ticino_i$ is a dummy equal to 1 for Ticino-related searches and 0 otherwise. $e_{my} * Ticino_i$ is the interaction term between the dummy and the exchange rate, whereas X_{my} is a vector of control variables, which includes the log of the Swiss GDP, the log of the Italian GDP, and the

[12] A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. Likewise, a score of 0 means the term is less than 1% as popular as the peak.

log of the unemployment rate in Lombardy. Monthly fixed effects, and a linear and quadratic year time trend are also included.

Table 7 reports the results. The coefficient of the interaction term in column 1 is negative and statistically significant. This suggests that the Swiss franc appreciation leads to a greater increase in the volume of searches made in Lombardy for a job in Ticino than that for a job in the same Lombardy. The evidence presented bears out the hypothesis that Italian workers increase their labour supply in Ticino in response to a stronger Swiss franc. The result confirms the role of cross-border commuters in explaining the surge in traffic flows at the border during the appreciation phases.

7 Concluding remarks

Understanding how the exchange rate influences traffic flows is important for exchange rate policies as well as for taxation, migration, and labour policies. Even more so in a context of restrictive migration policies and terrorism-related concerns that have thrust international border crossings under the spotlight.

This work adds new findings on the relationship between exchange rate fluctuations and cross-border mobility to the existing literature. While most of the related literature has focused on the determinants of long-term migration, in this work, I have focused on short-term travel. The contribution is twofold. To begin with, it is the first study to scrutinize the effects of exchange rate fluctuations on cross-border shopping and, in turn, on retailer's sales in an European context. Second, it provides the first evidence of cross-border commuters' sensitivity to exchange rate movements, which have not previously been formally documented in the economic literature.

This work's key finding is that Italy-Ticino border crossings are heavily influenced by exchange rate fluctuations. The empirical evidence provided suggests that in response to an appreciation of the Swiss franc, more Italian workers decide to commute across the border to work in Switzerland, mainly motivated by the higher purchasing power of Swiss wages. Furthermore, non-workday traffic flows in the late morning respond to exchange rate changes in line with a consumption-motive related hypothesis.

The labour-supply channel is confirmed by using search volume data from Google Trends and official statistics on cross-border commuters in Switzerland. The empirical evidence, in fact, suggests that when the Swiss franc is stronger, more people resident in Lombardy looked for a job in Ticino, and the number of cross-border workers increased in municipalities within a road distance of up to 10 km from the border.

Moreover, I have studied the effects of exchange rate fluctuations on retail firms' sales in Lombardy. I show that Italian supermarkets in the vicinity of the Swiss border perform better compared to other supermarkets during the phases of Swiss franc appreciation by increasing their revenues derived from specific products.

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Tables and Figures

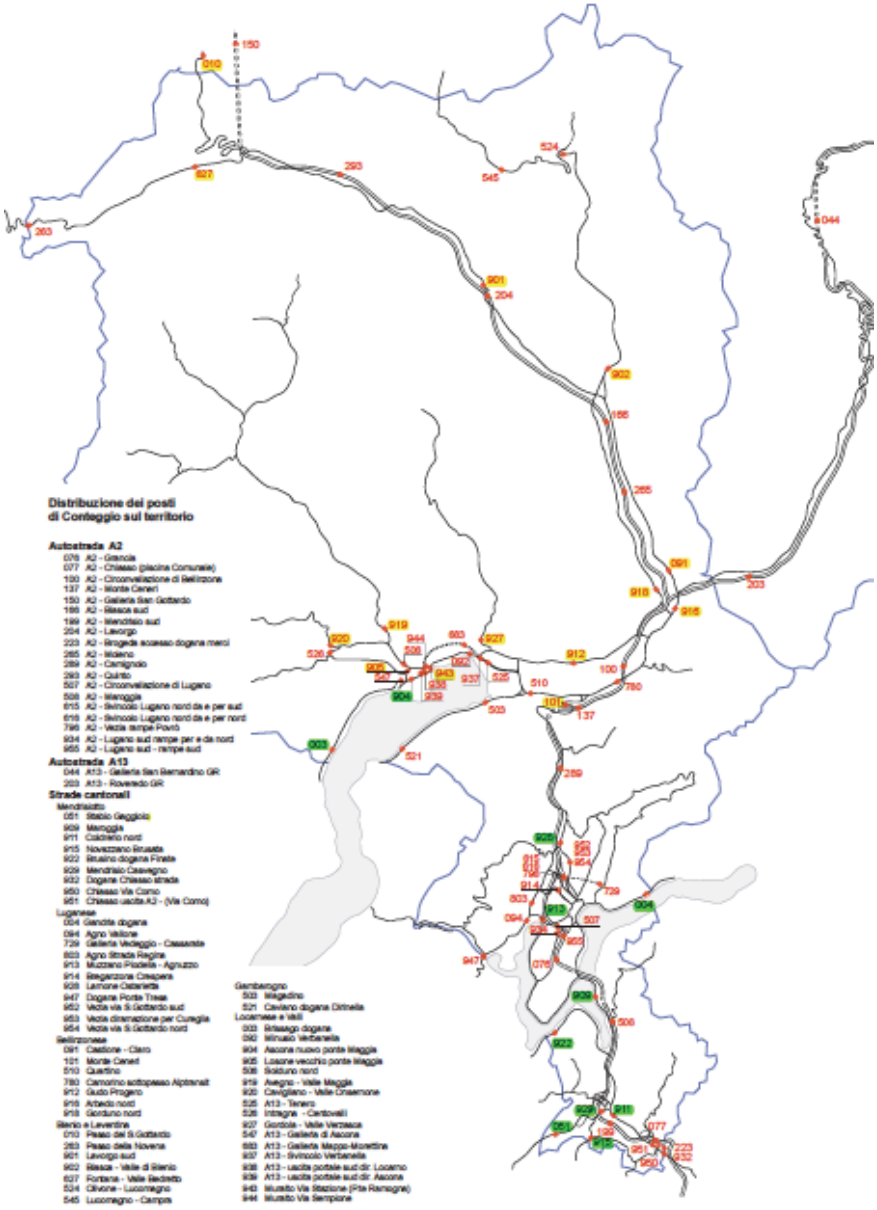
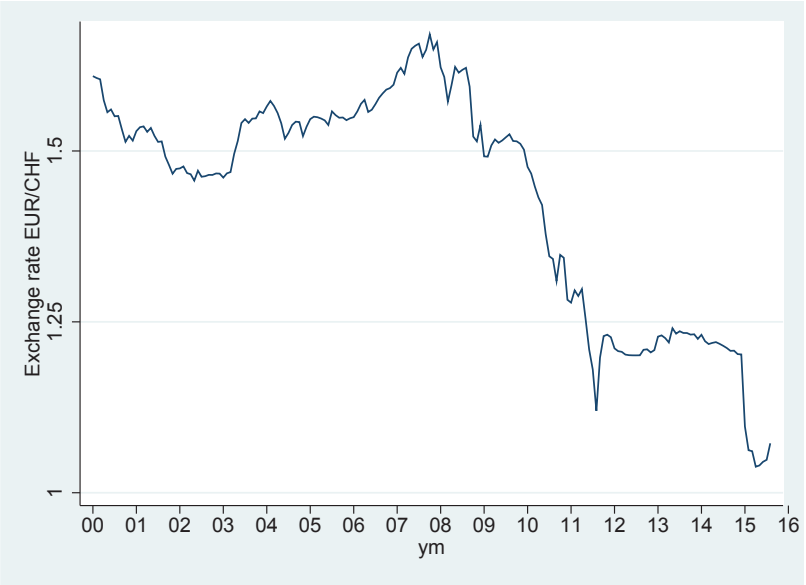


Figure 1: Distribution of traffic counting stations in Ticino

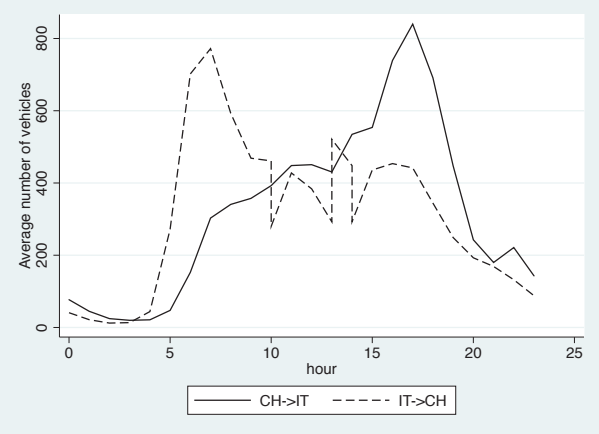
Note. The map shows where the traffic counting stations are located. The *Treatment Group* consists of the traffic counting stations located within 10 km of the border (in yellow on the map), and the *Control Group* includes the rest of the traffic counting stations (in blue on the map). Traffic counting stations on highways and those that were not active over the entire period of analysis are not included in the analysis.

Figure 2: The EUR/Sfr Exchange rate, 2000-2016

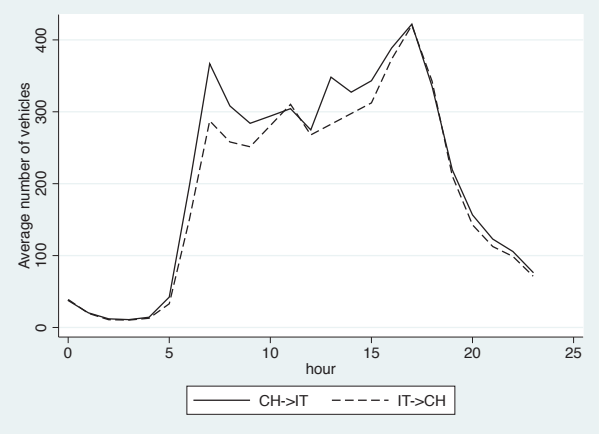


Note. Monthly average EUR/SFr exchange rates over the 2000-2016 period. On 6 September 2011, the Swiss National Bank introduced the minimum exchange rate of CHF 1.20 per euro. On January 2015, the cap was removed.

Figure 3: Distribution of traffic flows by time and direction, Monday - Friday

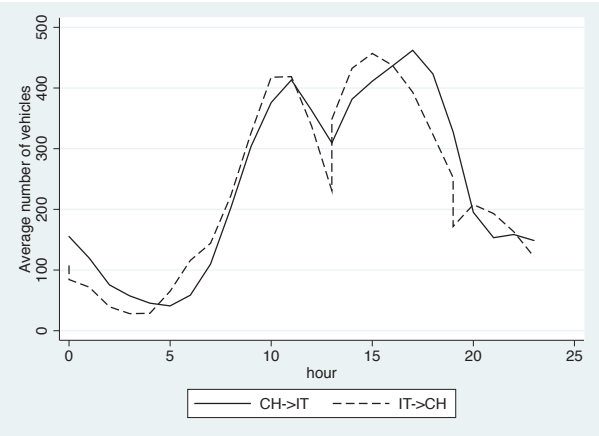


(a) *Treatment Group*

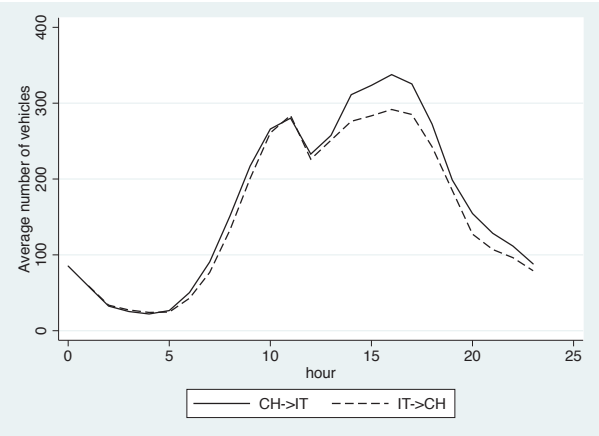


(b) *Control Group*

Figure 4: Distribution of traffic flows by time and direction, Saturday - Sunday



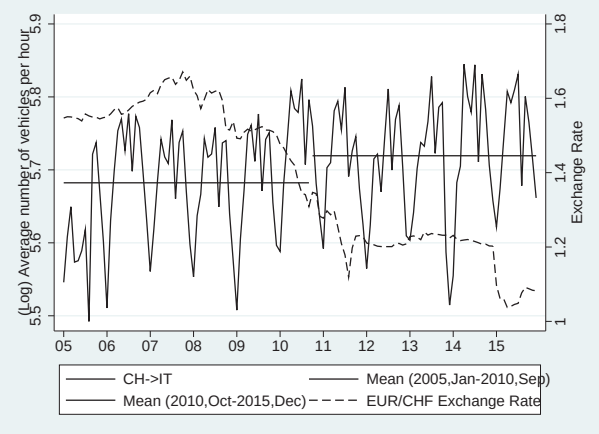
(a) *Treatment Group*



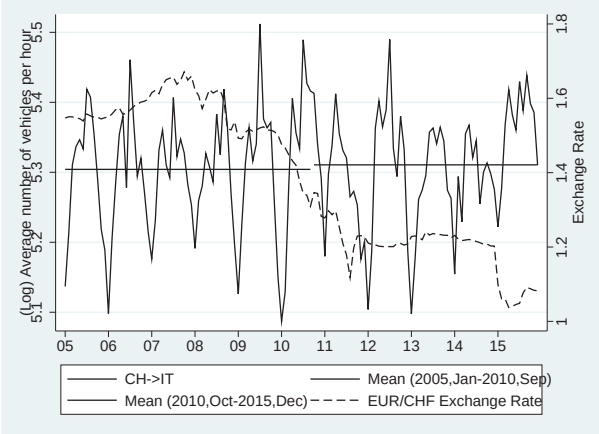
(b) *Control Group*

Note. Years 2005-2015. Log of the average number of cars per hour crossing a Treated or Control station throughout the day. The symbol CH->IT indicates North to South flows and IT->CH South to North flows. The *Treatment Group* consists of the traffic counting stations located within a road distance of up to 10 km from the border, and the *Control Group* includes the rest of the traffic counting stations.

Figure 5: Annual and monthly variation in crossings. Direction: IT

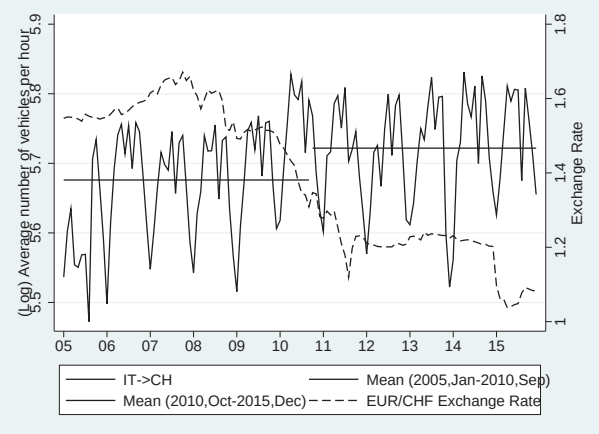


(a) *Treatment Group*

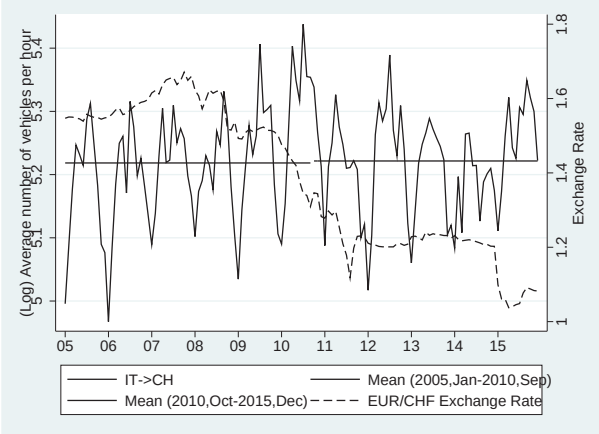


(b) *Control Group*

Figure 6: Annual and monthly variation in crossings. Direction: CH



(a) *Treatment Group*



(b) *Control Group*

Note. Years 2005-2015. Log of the average number of cars per hour crossing a Treated or Control station. The symbol CH->IT indicates North to South flows and IT->CH South to North flows. The *Treatment Group* consists of the traffic counting stations located within a road distance of up to 10 km from the border, and the *Control Group* includes the rest of the traffic counting stations. The two straight lines represent the average number of crossings over the two periods (Jan, 2005-Sept, 2010) and (Oct, 2011-Dec,2015) respectively.

Table 1: Descriptive Statistics on the average number of cars per hour

Panel 1: Monday-Friday						
Cantonal roads, CH → IT						
	24h	5-9am	10am- 1pm	2pm-8pm	9pm-11pm	12am-4am
Control	214.35	241.04	305.34	313.42	101.89	19.32
sd	257.18	254.35	262.88	290.91	112.85	31.39
N	8.2e+05	1.8e+05	1.4e+05	2.5e+05	1.0e+05	1.6e+05
Treatment	322.97	240.31	430.56	578.37	181.39	37.68
sd	327.76	248.93	288.81	353.93	118.18	39.22
N	6.9e+05	1.4e+05	1.2e+05	2.0e+05	86955.00	1.4e+05
Cantonal roads, IT → CH						
	24h	5-9am	10am- 1pm	2pm-8pm	9pm-11pm	0am-4am
Control	197.09	197.44	287.64	299.43	94.42	18.85
sd	229.91	221.02	232.73	259.04	88.01	25.15
N	8.1e+05	1.7e+05	1.4e+05	2.4e+05	1.0e+05	1.5e+05
Treatment	323.04	561.48	448.40	366.51	129.67	26.65
sd	328.12	351.34	308.56	300.66	104.63	29.86
N	6.9e+05	1.4e+05	1.2e+05	2.0e+05	86947.00	1.4e+05
Panel 2: Saturday-Sunday						
Cantonal roads, CH → IT						
	24h	5-9am	10am- 1pm	2pm-8pm	9pm-11pm	12am-4am
Control	171.12	108.04	259.14	274.91	109.52	45.34
sd	202.83	137.73	221.35	240.19	121.95	66.12
N	3.3e+05	70022.00	56761.00	99156.00	41811.00	65959.00
Treatment	239.39	143.03	365.46	376.77	153.51	91.02
sd	226.31	163.10	249.16	242.01	102.76	76.80
N	2.8e+05	58085.00	46498.00	81369.00	34865.00	56939.00
Cantonal roads, IT → CH						
	24h	5-9am	10am- 1pm	2pm-8pm	9pm-11pm	0am-4am
Control	155.04	96.28	250.47	239.81	94.24	46.37
sd	174.24	118.97	199.25	199.53	90.15	54.48
N	3.3e+05	69166.00	56000.00	97815.00	41358.00	64942.00
Treatment	236.93	174.60	380.60	357.66	159.34	55.62
sd	233.52	170.07	252.50	255.31	123.29	59.41
N	2.8e+05	58116.00	46498.00	81369.00	34864.00	56124.00

Note. Years 2005-2015. I use the symbol CH->IT to indicate North to South flows and IT->CH for the ones from South to North. The *Treatment Group* consists of the traffic counting stations located within a road distance up to 10 km from the border, the *Control Group* includes the rest of the traffic counting stations. Source: Sezione Mobilità del Canton Ticino.

Table 2: Log Crossings

	Mon-Frid 5am-9am	Sat-Sun 5am-9am	Mon-Frid 10am-1pm	Sat-Sun 10am-1pm	Mon-Frid 2pm-8pm	Sat-Sun 2pm-8pm
Panel 1: IT → CH, Day						
	(1)	(2)	(3)	(4)	(5)	(6)
ln e	-0.150	0.090	-0.010	0.079	-0.091	0.002
	(0.123)	(0.111)	(0.066)	(0.070)	(0.055)	(0.051)
Treat*ln e	-0.297*	-0.284**	-0.179**	-0.127	0.014	0.086
	(0.146)	(0.128)	(0.086)	(0.087)	(0.073)	(0.070)
Observations	317,435	127,282	255,305	102,498	446,597	179,184
R-squared	0.667	0.515	0.905	0.845	0.836	0.797
Panel 2: CH→IT, Day						
	(1)	(2)	(3)	(4)	(5)	(6)
ln e	-0.105	-0.045	-0.035	0.077	-0.057	0.061
	(0.093)	(0.096)	(0.053)	(0.066)	(0.047)	(0.043)
Treat*ln e	-0.169	-0.018	-0.186**	-0.177**	-0.148*	0.001
	(0.141)	(0.118)	(0.075)	(0.082)	(0.082)	(0.064)
Observations	320,050	128,107	257,161	103,259	449,600	180,525
R-squared	0.615	0.506	0.911	0.841	0.802	0.802
Controls FE	YES	YES	YES	YES	YES	YES
Monthly FE	YES	YES	YES	YES	YES	YES
Station FE	YES	YES	YES	YES	YES	YES

Note. Years 2005-2015. The dependent variable is the log of the number of cars crossing a specific station per hour. I use the symbol CH->IT to indicate North to South flows and IT->CH for the ones from South to North. Treatment is a dummy for the traffic counting stations located within a road distance of up to 10 km from the border. Controls include the log of the Swiss GDP, the log of the Italian GDP and the log of the unemployment rate in Lombardy. Monthly and traffic counting station fixed effects are also included. Robust standard errors in parentheses are clustered at the traffic counting station level. The following symbols indicate different significance levels: *** p<0.01, ** p<0.05, * p<0.1. Source: Sezione Mobilità del Canton Ticino.

Table 3: Descriptive statistics on supermarket sales in Lombardy

Province	Units	Revenue	Unit Value
BG	12939.18 .35	22369.83	1.73
sd	799.23	1945.57	0.07
BS	15804.76	26770.01	1.69
sd	790.88	2156.56	0.08
CO	7426.83	13543.05	1.82
sd	312.55	1134.17	0.09
CR	4733.70	7842.38	1.65
sd	271.66	690.65	0.07
LC	4433.91	7966.80	1.79
sd	251.50	760.59	0.09
LO	3260.45	5534.50	1.70
sd	124.79	319.47	0.07
MI	63988.15 5	1.1e+05	1.74
sd	4779.58	12790.20	0.09
MN	4594.52	7275.28	1.59
sd	348.62	480.53	0.06
PV	7559.27	12859.95	1.70
sd	319.86	967.94	0.08
VA	14691.57	25212.12	1.71
sd	683.77	2234.04	0.09
N	400	400	400

Note: Years 2006-2015. Average revenues, sales, and number of units sold in each Lombardy province. The province of Sondrio is not included because of the low number of observations. The province of Milan includes also the province of Monza-Brianza. The variables in columns 1, 2 and 3 are in 10'000. Source: Lombardy Chambers of Commerce.

Table 4: Supermarket sales in Lombardy

	(1) Revenue Tot	(2) Units Tot	(3) Unit Value Tot
ln e	-0.059	-0.049	-0.010
	(0.071)	(0.068)	(0.013)
TreatProv * ln e	-0.141	-0.087	-0.054**
	(0.099)	(0.090)	(0.024)
Observations	2,400	2,400	2,400
R-squared	0.990	0.993	0.962
Monthly FE	YES	YES	YES
Province FE	YES	YES	YES
Product FE	YES	YES	YES

Note. Years 2006-2015. The dependent variable is the log of average revenues, sales and the average unit values in a specific Lombardy province. TreatProv is a dummy for provinces along the Swiss-Italian Border (Como and Varese). I control for the log of the Swiss GDP, the log of the Italian GDP and the log of the unemployment rate in Lombardy. Quarter and province fixed effects are also included. Robust standard errors clustered at the province level are in parentheses. The following symbols indicate different significant levels: *** p<0.01, ** p<0.05, * p<0.1. Source: Lombardy Chambers of Commerce.

Table 5: Supermarket sales in Lombardy

	Panel 1					
	Groceries			Fresh Food		
	(1)	(2)	(3)	(4)	(5)	(6)
	Revenue	Units	Unit Value	Revenue	Units	Unit Value
lne	-0.149*	0.029	-0.305***	-0.259***	-0.149*	-0.200***
	(0.078)	(0.075)	(0.023)	(0.066)	(0.072)	(0.022)
TreatProv*ln e	-0.115	-0.078	-0.073	-0.109	-0.103	-0.021
	(0.104)	(0.098)	(0.040)	(0.099)	(0.091)	(0.047)
R-squared	0.996	0.997	0.938	0.997	0.997	0.919
	Panel 2					
	Frozen Food			Beverages		
	(1)	(2)	(3)	(4)	(5)	(6)
	Revenue	Units	Unit Value	Revenue	Units	Unit Value
ln e	-0.141	-0.166**	0.069	-0.176**	-0.241***	0.080**
	(0.079)	(0.071)	(0.045)	(0.069)	(0.073)	(0.034)
TreatProv*ln e	-0.112	-0.091	-0.055	-0.097	0.081	-0.276***
	(0.114)	(0.095)	(0.130)	(0.091)	(0.096)	(0.051)
R-squared	0.996	0.997	0.656	0.996	0.995	0.959
	Panel 3					
	Health & Beauty Care Pr.			Home Care Pr.		
	(1)	(2)	(3)	(4)	(5)	(6)
	Revenue	Units	Unit Value	Revenue	Units	Unit Value
ln e	0.169**	0.083	0.258***	0.203**	0.151*	0.117*
	(0.070)	(0.069)	(0.061)	(0.079)	(0.070)	(0.052)
Treat*ln e	-0.196*	-0.149	-0.140	-0.220*	-0.185*	-0.085
	(0.104)	(0.092)	(0.131)	(0.115)	(0.100)	(0.075)
R-squared	0.996	0.996	0.643	0.994	0.996	0.476
Observations	400	400	400	400	400	400
Monthly FE	YES	YES	YES	YES	YES	YES
Province FE	YES	YES	YES	YES	YES	YES

Note. Years 2006-2015. The dependent variable is the log of average revenues, sales and the average unit values in a specific Lombardy province. TreatProv is a dummy for provinces along the Swiss-Italian Border (Como and Varese). I control for the log of the Swiss GDP, the log of the Italian GDP and the log of the unemployment rate in Lombardy. A dummy for the period after 2007, quarter and province fixed effects are also included. Robust standard errors clustered at the province level are in parentheses. The following symbols indicate different significance levels: *** p<0.01, ** p<0.05, * p<0.1. Source: Lombardy Chambers of Commerce.

Table 6: Cross-Border Commuters Statistics: Distance Cut-Offs

Panel 1:All					
	5km	10km	15km	20km	TI
ln e	-0.234*	-0.229**	-0.155	-0.122	-0.192
	(0.122)	(0.101)	(0.115)	(0.108)	(0.150)
Observations	836	2,112	2,904	3,388	5,720
R-squared	0.597	0.510	0.408	0.396	0.303
Panel 2: Men					
	5km	10km	15km	20km	TI
ln e	-0.296**	-0.245*	-0.154	-0.145	-0.244
	(0.130)	(0.124)	(0.114)	(0.108)	(0.149)
Observations	836	2,112	2,904	3,388	5,720
R-squared	0.627	0.425	0.338	0.330	0.303
Panel 3: Women					
	5km	10km	15km	20km	TI
ln e	-0.267	-0.304**	-0.204	-0.067	0.103
	(0.180)	(0.148)	(0.173)	(0.165)	(0.150)
R-squared	0.367	0.385	0.342	0.324	0.275
Observations	836	2,112	2,904	3,388	5,720
Controls	YES	YES	YES	YES	YES
Municipality FE	YES	YES	YES	YES	YES
Semester FE	YES	YES	YES	YES	YES

Note. Years 2005-2015. The dependent variable is the log of the number of cross-border workers. Controls include the log of the Swiss GDP, the log of the Italian GDP, and the log of the unemployment rate in Lombardy. Linear and quadratic year time trends, a dummy for the period after 2007, and quarter and province fixed effects are also included. Robust standard errors in parentheses clustered at the municipal level. The following symbols indicate different significance levels: *** p<0.01, ** p<0.05, * p<0.1. Source: Swiss Federal Statistical Office.

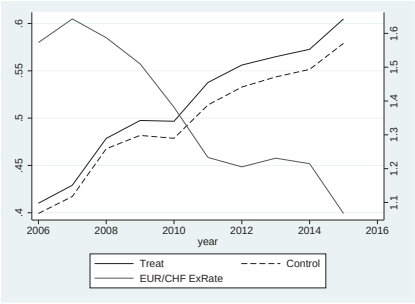
Table 7: Search volume from Google Trends

	Job Vacancies Ticino/ Lombardy Data: Lombardy
	(1)
ln e	-18.987
	(15.913)
Ticino * ln e	-38.530***
	(12.095)
Observations	264
R-squared	0.459
Monthly FE	YES

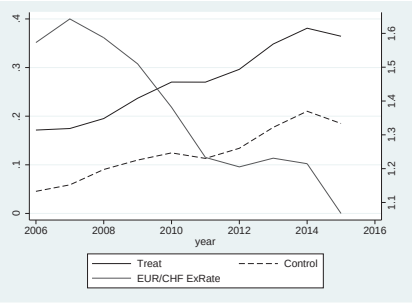
Note. Years 2005-2015. The dependent variable is the search volume of the query "Offerte Lavoro Lombardia" or " Offerte lavoro in Ticino" relative to the total search volume in the temporal interval (2005-2015). Ticino is a dummy equal to 1 for Ticino-related searches. I control for the log of the Swiss GDP, the log of the Italian GDP, and the log of the unemployment rate in Lombardy. Linear and quadratic year time trends, and monthly fixed effects are also included. Robust standard errors are in parentheses. The following symbols indicate different significance levels: *** p<0.01, ** p<0.05, * p<0.1. Source: Google Trends.

Appendix

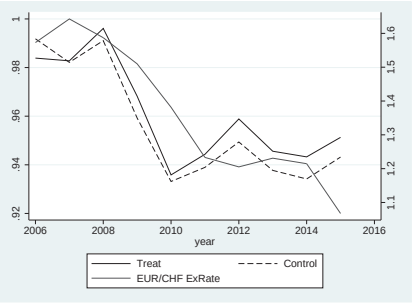
Figure 7: Avarage Unit Values by product category across the Treatment and Control Groups



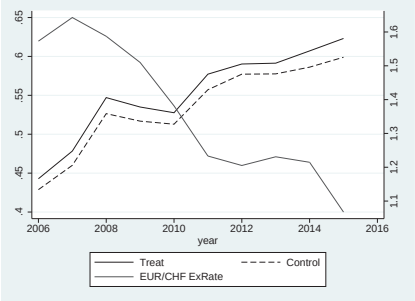
(a) *Groceries*



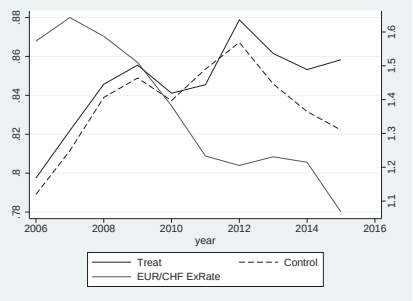
(b) *Beverages*



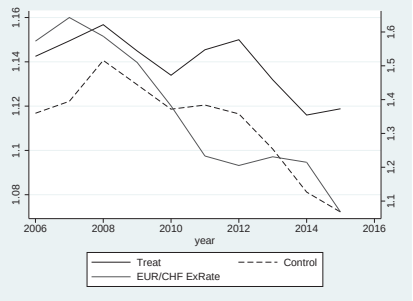
(c) *Frozen Food*



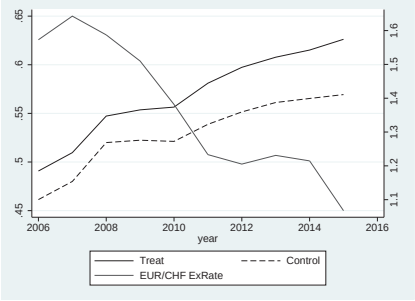
(d) *Fresh Food*



(e) *Home Care Prod.*



(f) *Health and Beauty Care Prod.*



(g) *Tot*

Note. Years 2006 - 2015. The Treatment Group consists of the Lombardy provinces of Varese and Como, while the rest of the provinces represent the Control Group. Source: Lombardy Chambers of Commerce.

Table A.1: Log Crossings, Night

	Mon-Frid 8pm-11pm	Sat-Sun 8pm-11pm	Mon-Frid 0am-4am	Sat-Sun 12am-4am
Panel 1: IT → CH, Night				
	(1)	(2)	(3)	(4)
ln e	-0.198**	-0.198**	0.018	0.044
	(0.077)	(0.074)	(0.108)	(0.101)
Treat*ln e	0.176	0.273**	-0.113	0.140
	(0.129)	(0.130)	(0.182)	(0.202)
Observations	189,623	76,222	290,545	121,066
R-squared	0.850	0.854	0.533	0.708
Panel 2: CH→IT, Night				
	(1)	(2)	(3)	(4)
ln e	-0.076	-0.086	-0.118*	-0.100
	(0.063)	(0.076)	(0.068)	(0.098)
Treat*ln e	0.021	0.187	0.451**	0.505
	(0.102)	(0.124)	(0.195)	(0.318)
Observations	190,740	76,676	295,593	122,898
R-squared	0.862	0.880	0.669	0.765
Controls FE	YES	YES	YES	YES
Monthly FE	YES	YES	YES	YES
Station FE	YES	YES	YES	YES

Note. Years 2005-2015. The dependent variable is the log of the number of cars crossing a specific station per hour. I use the symbol CH->IT to indicate North to South flows, and IT->CH for the South to North flows. Treatment is a dummy for the traffic counting stations located within a road distance of up to 10 km from the border. Controls include the log of the Swiss GDP, the log of the Italian GDP, and the log of the unemployment rate in Lombardy. A dummy for the period after 2007, and quarter and province fixed effects are also included. Robust standard errors in parentheses are clustered at the traffic counting station level. The following symbols indicate different significance levels: *** p<0.01, ** p<0.05, * p<0.1. Source: Sezione Mobilità del Canton Ticino.

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