# Does the implementation of the Schengen agreement boost cross-border commuting? Evidence from Switzerland*

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**Abstract**

In this paper we study the effects of Switzerland implementing the Schengen agreement on cross-border commuting from regions of neighbouring countries. As vehicles are allowed to cross borders without stopping and residents in border areas are granted freedom to cross borders away from fixed checkpoints, commuting costs are severely reduced. Using data from the European Labour Force Survey, we estimate that the individual probability to cross-border commute to Switzerland in response to this policy has increased by a factor in the range between 3 and 6 percentage points, according to different model specifications. Our result is particularly important due the meaningful policy implications, in a time in which the Schengen agreement is under scrutiny and at risk of termination.

Keywords: Schengen agreement, labour mobility, commuting costs, policy change.

JEL Classification: D04, J61, R10, R23.

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# 1 Introduction

The freedom of movement of goods and persons between European countries had been a priority since the Treaty of Rome in 1957, but it was not until countries could be assured of their security that open borders were made feasible. By proposing the gradual abolition of border checks at the signatories' common borders and the harmonisation of visa policies, the Schengen agreement is one of the most important measures adopted to promote internal mobility. The Schengen area operates very much like a single state for international travel purposes with external border controls for travellers entering and exiting the area and common visas, but with no internal border controls. The implementation of the Schengen agreement is particularly relevant for cross-border commuters. By allowing vehicles to cross borders without stopping and residents in border areas freedom to cross borders away from fixed checkpoints, the treaty made the cross-country inter-regional travels to work journey shorter and easier. According to a recent study (Centre for Future Studies, 2006), "Taking advantage of the removal of mobility and labour market barriers between European countries, EU citizens are increasingly living in one EU country, working in another, shuttling back and forth between the two". The European Commission quantifies the border control costs for commuters, as well as other travellers, to be between 1.3 billions euro and 5.2 billions euro in terms of time lost (European Commission, 2016). In addition, increased commuting time would reduce cross-border job opportunities: for France, for instance, it could mean the loss of 5,000 to 10,000 cross-border workers, which could account for an economic loss of 150-300 euro millions annually.

Despite the benefits of Schengen being evident, the Schengen area is currently facing major challenges. The combination of an increasing number of refugees, growing migratory pressure, security concerns and a rather week economic recovery has put the Schengen area under stress, and called into question its functioning. In particular, the significant increase in immigration flows in several countries of the European Union (EU) has created a lot of tension and pushed a number of Member States to re-introduce temporary internal border controls at certain crossings. Even on a temporary basis, these border controls are already disrupting

the flow of goods and services within the Single Market, with economic costs for business and citizens (Ademmer et al., 2015). Parallel to a clear, temporary, limited suspension of the Schengen agreement, some parties have also discussed the possibility to permanently re-introduce border controls within the EU, and therefore in practice to terminate the Schengen agreement (Bertelsmann Foundation, 2016).

A number of studies (EPRS, 2016; France Strategie, 2013, 2016) have attempted to quantify the potential cost of the re-establishment of border controls within the Schengen area. They identify three major implications. First, border controls itself within the Schengen area have direct and immediate costs (number of border guards, border stations and infrastructures, etc.). Second, by introducing significant obstacles to intra-European trade and by issuing barriers to free movement of people, goods and services, which is the pillar on which the EU is built, they undermine the general progress of the past 20 years. Third, they weaken the police and judicial cooperation on terrorism and organised crime. All this could result in an estimated loss of more than 100 billions euro for the EU economy. It is believed that after the impact on cross-border transport of goods, the second most important impact would be on commuting workers (France Strategie, 2016). There are currently 1.7 millions workers in the EU who cross a border every day to go to work and who would see their quality of life significantly affected. More generally, such a decision would lead to greater disparities in regional job markets and certainly more uneven economic development (Bertelsmann Foundation, 2016).

Our objective in this paper is to quantify the effect of Switzerland joining the Schengen area in December 2008 on cross-border commuting. We choose Switzerland for several reasons. First, Switzerland is one of the countries which implemented the Schengen agreement after the freedom of movement was already granted to all EU-15 and EFTA citizens. Therefore, this setup allows us to isolate and identify the specific effect of the implementation of Schengen in promoting labour mobility. Second, Switzerland is a country located in the centre of Europe, which shares borders with many European countries. The trend of individuals who commute towards Switzerland has been consistently increasing in the last ten

years (Figure 1), making Switzerland one of the most chosen destinations for many of the commuters from the EU (European Commission, 2011). We include in our study workers commuting from Germany, Italy and France, who together represent more than 97% of the total commuting population to Switzerland (Figure 1).
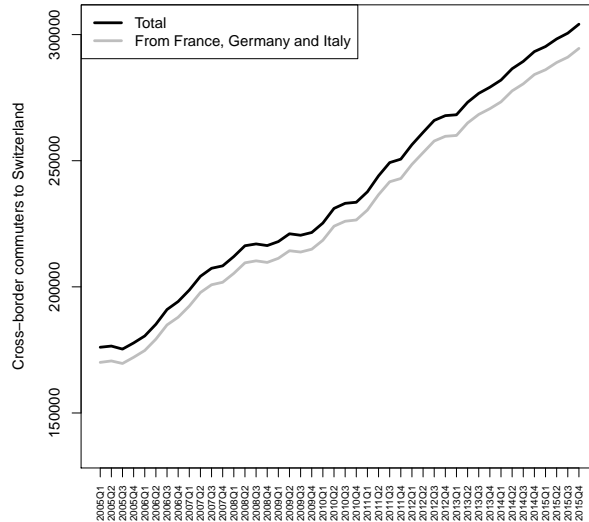


**Figure 1.** Total cross-border commuters to Switzerland. Source: Swiss Federal Statistical Office.

We quantify the effects of the abolition of Switzerland's regional borders on commuting by means of a Difference-in-Differences model. We envision commuters to react positively to lower barriers to cross-border traveling and therefore we expect to observe an increase in the cross-border commuting flows. After controlling for several individual and job characteristics and a number of regional features, in line with our expectations we find that the entrance of Switzerland in the Schengen area had a positive and significant effect on the individual probability to commute for work across borders. In particular, we find that the probability of cross-border commuting is approximately 3% higher after the implementation of Schengen. This result is shown to be consistent to several alternative specifications and to a number of additional robustness tests. We also show that the effect is even stronger when we restrict our analysis to cross-border workers who commute towards a region which is geographically contiguous to the region of residence: for this category of workers the increased probability of cross-border commuting is up by 6%.

The rest of the paper is organized as follows. In the next section, we review the related literature, while in Section 3 we describe in detail the institutional background. Section 4 presents the data, while Section 5 discusses the identification and the empirical strategies. We show the main results in Section 6. Section 7 concludes the paper.

## 2 Literature Review

Even though the role of borders in affecting the decision to work in a neighbouring country is policy relevant, the literature on the topic is scarce. Few papers analyse the role of borders, defined broadly as a geographical, institutional and cultural barrier, in impeding labour market integration. In a recent study, Bloomfield et al. (2015) examine whether international regulatory harmonization increases cross-border labour migration. To investigate this issue, they analyse EU initiatives that harmonized accounting and auditing standards. They find that due to this harmonization plan, international labour migration in the accounting profession has increased significantly compared to other professions. Niebuhr and Stiller (2004) provide evidence of a measurable spatial segmentation of labour markets between EU-15 countries along national borders. They show that on average, border regions in the EU are characterised by a lower degree of labour market integration with neighbouring regions than non-border areas due to significant border impediments that hamper equilibrating forces between labour markets on both sides of national frontiers. Bartz and Fuchs-Schündeln (2012) study the causes of the low labour market integration in Europe by testing whether the abolition of the border controls through the Schengen agreement and the introduction of the Euro currency have led to an improvement in cross-border integration. Their empirical investigation shows that neither of the two events had an effect in improving labour market integration, while language barriers seem to be the main impediment. The paper by Persyn and Torfs (2015) quantifies the effect of regional borders on commuting in Belgium. After controlling for differences in local economic conditions and multilateral resistance, the authors conclude that regional borders are a strong barrier to commuters and impose strong spatial imperfection in the labour market.

This paper also fits into the literature that with a Difference-in-Differences estimation strategy evaluates the effects of newly implemented policy interventions on cross-border commuting. In a recent paper, Dustmann et al. (2016) analyse the short-run impact of the opening of Germany's border to Czech cross-border workers in 1991. They find that the large inflow of these workers in municipalities close to the border had a negative effect on the employment of natives and a moderate, negative effect on wages. By far, the paper that resembles the most our work is the one by Beerli and Peri (2016)[1] who investigate the labour market effects of implementing the free movement of labour in Switzerland, by looking specifically at the category of cross-border commuters. They use the same methodological approach (a Difference in Differences strategy) to test for the effect of the gradual implementation of the policy which granted freedom of movement to cross-border commuters on labour supply in bordering regions. They analyse three phases of the implementation: a pre-phase before 1999, a first phase between 1999 and 2004 and a second phase between 2004 and 2010. They find no significant effect of the treatment in the first two periods (pre-phase and phase one) but a strong positive effect on labour supply in phase two.[2] However, by considering in phase two a period of time between 2004 and 2010 they capture not only the implementation of the freedom of movement to cross-border commuters in border regions (in 2004) and of the full liberalization for all EU-15 and EFTA workers in the whole country (in 2007), but also the implementation of the Schengen agreement (in December 2008). Therefore, they are not able to disentangle the specific effect of each of these three policies on the increased flow of cross-border commuters to Switzerland. Using a different experimental design and alternative data sources, our paper complements their work by identifying the specific effect of the implementation of the Schengen agreement on the probability to cross-border commute. We find that by opening the Swiss borders through the abolishment of border checks, the implementation of the Schengen agreement strongly boosted cross-border commuting to

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[1]Complementary to this study, the work by Bigotta et al. (2012) explores the short-term employment effects of the policy which implemented the free movement of labour for cross-border commuters in Switzerland. They find contrasting negative short-run effects on total employment and positive effects on average wages of native workers.

[2]They also find that the presence of cross-border workers in Switzerland increased employment with no significant effect on their skill composition. This inflow had a positive effect on the wages of highly educated Swiss workers and no significant effect on the wages of other workers.

Switzerland.

# 3   The Schengen agreement

The Schengen agreement is a treaty which is at the basis of the creation of the Schengen Area, where internal border checks have been to a great extent abolished. It was signed on 14 June 1985 by five of the ten member states of the the European Economic Community.[3] It proposed measures intended to gradually abolish border checks at the signatories' common borders, including reduced speed vehicle checks which allowed vehicles to cross borders without stopping, allowing residents in border areas freedom to cross borders away from fixed checkpoints, and the harmonisation of visa policies. In 1990, the agreement was supplemented by the Schengen Convention which proposed the complete abolition of systematic internal border controls and a common visa policy. Originally, the Schengen treaties and the rules adopted under them operated independently from the European Union. However, in 1999 the incorporation of the Schengen acquis into the main body of European Union law was agreed along with opt-outs for Ireland and the United Kingdom, which were to remain outside of the Schengen area. Several non-EU countries, such as Switzerland, are included in the area. In 2005, by means of a national referendum Swiss citizens were asked to express their opinion about Switzerland signing the agreement. Swiss voters agreed, by a 55% majority, to join the Schengen area. It was on 27 November 2008, that the interior and justice ministers of the EU in Brussels announced Switzerland's accession to the Schengen passport-free zone from 12 December 2008. Since then the land border checkpoints have remained in place only for goods movements, but systematic checks on individuals at the frontier have been abolished. On 12 December 2008, with the entry into force of the Schengen agreement, also the Swiss Border Guard, which is the Switzerland armed and uniformed corps, underwent a significant change: not only it has increasingly been taking part in Schengen substitute measures and in assignments at the EU external borders (FRONTEX), but most of the guards have been redeployed to replace international police officers at Swiss airports to carry out controls on

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[3]Belgium, France, Luxembourg, the Netherlands, and West Germany first signed the agreement.

passengers crossing external Schengen borders (AdminCH).

# 4 Data and descriptive statistics

In order to perform our analysis, we use data from the European Labour Force Survey (ELFS). The ELFS is conducted in the 28 Member States of the European Union plus Iceland, Norway and Switzerland since 1983 and in each year it is representative of the specific country population. The surveys are conducted by the national statistical institutes and are centrally processed by Eurostat, which releases harmonised data at European level. The survey provides demographic and socio-economic information at individual level, with specific focus on employment and job characteristics. Most importantly for the present study, by offering information on the place of residence (current and one year before) and the workplace, it is possible to reconstruct measures of mobility. In this paper commuting is defined based on place of residence at the time of the interview and working place at the time of the interview being located in two different NUTS2 regions.[4] We have information at NUTS2 level for Italy and France, which corresponds to the first-level administrative division of the country (regions), while for Germany and Austria only information at NUTS1 level (macro-regions) is available. To avoid confounding effects, due to the fact that there is only one Austrian region which shares the border with Switzerland for a very limited number of kilometres, and at the same time it shares the border with Italy and Germany, we exclude from our analysis commuters from Austria. Nevertheless, according to the Swiss Federal Statistical Office, in 2014 among the 290,000 Europeans who commuted across the border to work in Switzerland, more than 97% travelled from Germany, France and Italy.

We complement this dataset with Eurostat, Cambridge Econometrics, Bank of International Settlements (BIS) and OECD data. Specifically, we use OECD data on unemployment and youth unemployment to construct measures of unemployment variations at regional level

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[4]The NUTS (Nomenclature of Units for Territorial Statistics) is a geo-code standard for referencing the subdivisions of countries for statistical purposes. The standard is developed and regulated by the European Union, and thus only covers the member states of the EU plus Norway and Switzerland in detail. For each country, a hierarchy of three NUTS levels is established by Eurostat; the subdivisions in some levels do not necessarily correspond to administrative divisions within the country.

for the years 2005-2015 for specific sub-categories of individuals. We compute per each region the percentage point changes in unemployment as the difference between the unemployment rate at time $t$ and at time $t-1$. Moreover, we use Cambridge Econometrics data on the share of employment by sector at regional level to capture the way the structure of regional economies has changed over time during different phases of the business cycle. In addition, we also take into consideration the quality of the infrastructures by including a measure of road length between two regions (in kilometers), as provided by Eurostat. Using the same source, we also gather information on the real exchange rate between all the countries considered and Switzerland to capture the effect of the exchange rate volatility. We also use national data on house prices from the Bank of International Settlements (BIS) to take into account differences in real estate prices across different countries. To facilitate the interpretation of the coefficients, all these macroeconomic variables are constructed per each region as the ratio between the average value among regions within the origin country and the average value among all potential destination regions abroad.[5] Finally, to account for the language barrier, which in the literature has been mentioned as a rather important deterrent to mobility in Europe, we also control for language differences. Specifically, in order to understand whether language borders between two languages which share the same roots are more permeable than borders between distinct languages, we take into consideration a measure of closeness of languages, using data from the lexicostatical analysis of Dyen et al. (1992). They compute the percentage of words that are cognate[6] between two languages, "the lexicostatistical percentage", and use it as a measure of the closeness of the two languages.

We focus on the period 2005-2015, during which the survey data collection has not changed neither over time nor across countries. Hence, we are able to avoid any issue of data comparability. Among all individuals living in Germany, France or Italy, we keep observations

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[5]Given that the probability of commuting is expected to decrease with the geographical distance between the region of origin and the region of potential destination, the average values are constructed as weighted averages with weights proportional to the inverse of the (squared) great circle distance between regional centroids. When we limit our sample to commuters for which the region of residency and the region of work are geographically contiguous, the averages are calculated using equal weights for all regions and excluding the regions which are not geographically contiguous.

[6]The translations of a word in two languages are "cognate" if within both languages they have an unbroken history of descent from a common ancestral form. If there are more than two translations for a word (as there often are), the highest degree of cognation judged between any of the translations is used.

of individuals who live in regions, which share the border either with Switzerland or with a country belonging to the Schengen area.[7] The literature on commuting shows evidence of self-selection of workers that are willing to commute, especially long-distance.[8] Hence, to keep our sample of observations as homogeneous as possible, we focus our study on cross-regional commuters, i.e., workers who commute for work from the region of residency to a different region, located either in the same country or in a bordering country. However, we will also replicate the same analysis for the whole sample of workers, which includes all working individuals, both commuters and non-commuters (Section 6.4.2). Our sample includes 125,506 individuals who commute for working reasons across regions which are located either in the same country or in a neighbouring country.



(a) Total and to Switzerland.

(b) By sector.
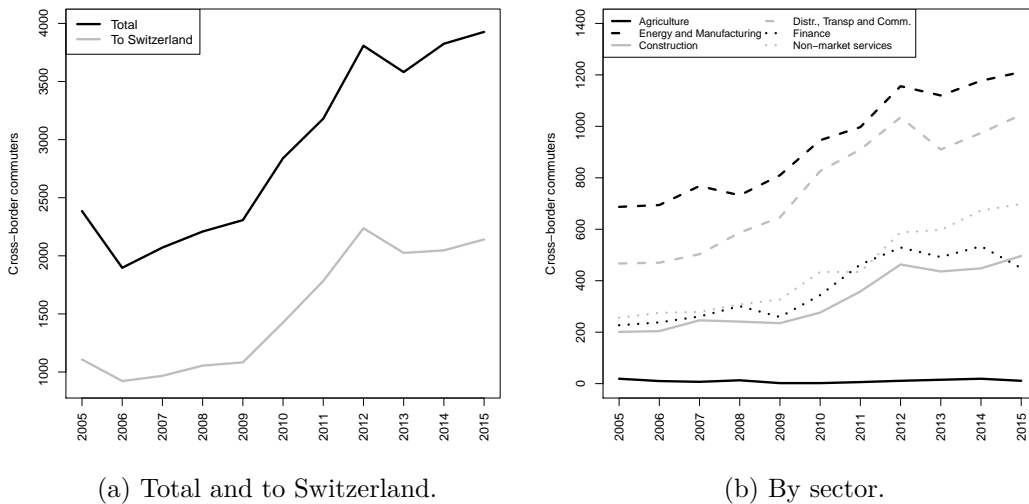
**Figure 2.** Cross-border commuters. Source: ELFS.

Overall, we observe an increasing trend of individuals who commute cross-border. Specifically, the total number of cross-border commuters went up from approximately 2,000 indi-

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[7]The list of regions includes: for Italy, ITC1, ITC2, ITC3, ITC4, ITH1, ITH3; for France, FR21, FR22, FR30, FR41, FR42, FR43, FR61, FR62, FR71, FR81, FR82 and for Germany, DE1, DE9, DEA, DEB, DEC, DEF.

[8]A large number of country studies finds that commuters within a country are more highly skilled than non-commuters (Eliasson et al., 2003; Parenti and Tealdi, 2017; Rouwendal, 1999; van Ommeren et al., 1999). Overall, commuters are more often male, with the largest gender differences existing for internal commuters (Huber, 2011). Gottholmseder and Theurl (2007) finds that individuals with children who live with other cross-border commuters are less likely to become cross-border commuters themselves, while the probability to become a cross-border worker for women is much lower compared to men. Specifically for the case of Switzerland, the majority of commuters is employed on a permanent job in the manufacturing industry, even though the share of workers in the tertiary sector is currently growing (European Commission, 2009b).

**Table 1.** Descriptive statistics

| | Treated | | Control | | All | |
|---|---|---|---|---|---|---|
| | mean | s.d. | mean | s.d. | mean | s.d. |
| Female | 0.347 | 0.476 | 0.358 | 0.479 | 0.354 | 0.478 |
| Single | 0.369 | 0.483 | 0.376 | 0.485 | 0.374 | 0.484 |
| Head of hh | 0.564 | 0.496 | 0.589 | 0.492 | 0.579 | 0.494 |
| Hh size | 3.001 | 1.251 | 2.923 | 1.293 | 2.953 | 1.278 |
| Age 16-24 | 0.076 | 0.265 | 0.084 | 0.278 | 0.081 | 0.273 |
| Age 25-34 | 0.233 | 0.423 | 0.213 | 0.410 | 0.221 | 0.415 |
| Age 35-49 | 0.439 | 0.496 | 0.438 | 0.496 | 0.438 | 0.496 |
| Age 50-64 | 0.252 | 0.434 | 0.265 | 0.441 | 0.260 | 0.439 |
| Primary Ed. | 0.223 | 0.416 | 0.178 | 0.382 | 0.195 | 0.396 |
| Secondary Ed. | 0.468 | 0.499 | 0.492 | 0.500 | 0.483 | 0.500 |
| Tertiary Ed. | 0.309 | 0.462 | 0.329 | 0.470 | 0.322 | 0.467 |
| Full-time | 0.863 | 0.343 | 0.856 | 0.351 | 0.859 | 0.348 |
| Tenure | 114.239 | 115.191 | 125.462 | 121.574 | 121.159 | 119.292 |
| Permanent job | 0.868 | 0.339 | 0.866 | 0.340 | 0.867 | 0.340 |
| High-skilled white-collar | 0.479 | 0.500 | 0.487 | 0.500 | 0.484 | 0.500 |
| Low-skilled white-collar | 0.199 | 0.399 | 0.223 | 0.416 | 0.214 | 0.410 |
| High-skilled blue-collar | 0.153 | 0.360 | 0.125 | 0.330 | 0.136 | 0.342 |
| Low-skilled blue-collar | 0.169 | 0.375 | 0.165 | 0.371 | 0.166 | 0.372 |
| Firm size 1-10 | 0.169 | 0.375 | 0.154 | 0.361 | 0.160 | 0.366 |
| Firm size 11-19 | 0.177 | 0.382 | 0.154 | 0.361 | 0.163 | 0.369 |
| Firm size 20-49 | 0.144 | 0.351 | 0.139 | 0.346 | 0.141 | 0.348 |
| Firm size > 50 | 0.510 | 0.500 | 0.554 | 0.497 | 0.537 | 0.499 |
| Agriculture | 0.008 | 0.089 | 0.009 | 0.094 | 0.009 | 0.092 |
| MEM | 0.317 | 0.465 | 0.233 | 0.423 | 0.265 | 0.441 |
| Construction | 0.089 | 0.284 | 0.076 | 0.265 | 0.081 | 0.272 |
| DTC | 0.275 | 0.447 | 0.310 | 0.462 | 0.297 | 0.457 |
| Finance | 0.128 | 0.334 | 0.158 | 0.365 | 0.147 | 0.354 |
| NMS | 0.183 | 0.387 | 0.214 | 0.410 | 0.202 | 0.402 |
| Unemployment Diff | 0.412 | 5.261 | 0.523 | 3.318 | 0.401 | 3.811 |
| Youth Unemployment Diff | 0.079 | 4.941 | −0.241 | 19.249 | 0.301 | 3.623 |
| Road network (km) | 1.278 | 0.296 | 1.477 | 0.353 | 1.400 | 0.346 |
| Reg. Empl. Agriculture | 1.319 | 0.270 | 1.557 | 0.350 | 1.466 | 0.342 |
| Reg. Empl. MEM | 1.653 | 1.137 | 1.729 | 1.058 | 1.700 | 1.090 |
| Reg. Empl. Construction | 1.423 | 0.422 | 1.667 | 0.522 | 1.573 | 0.500 |
| Reg. Empl. Finance | 1.621 | 0.562 | 1.821 | 0.849 | 1.744 | 0.758 |
| Reg. Empl. NMS | 1.323 | 0.284 | 1.786 | 0.540 | 1.609 | 0.512 |
| House Price | 0.608 | 1.162 | 1.169 | 1.195 | 0.954 | 1.213 |
| Language closeness | 96.471 | 15.837 | 97.952 | 11.278 | 97.384 | 13.233 |
| Exchange Rate | 0.878 | 3.786 | 0.119 | 3.903 | 0.410 | 3.876 |
| Observations | 46,763 | | 78,743 | | 125,506 | |

viduals before 2009 to almost 4,000 individuals in the years after 2010 (Figure 2a). When we confine our analysis looking at workers who commute towards Switzerland we observe a rather similar trend. These numbers are in line with the statistics provided by the Swiss Federal Statistics Office, which show that since 2009 the number of people crossing the border for work has risen remarkably leading up to the end of 2014 by 29.6%. They are concentrated in the energy and manufacturing as well as in the distribution, transportation and communication sectors (Figure 2b).

We take advantage of the rich set of variables provided by the labour force survey at individual, household and job levels. Among individual characteristics, we control for age, sex, education, marital status, role within the household and household size. In addition, we control for several job characteristics such as the full-time work schedule, job permanency, tenure, sector of employment, firm size and type of occupation (high-skilled and low-skilled white and blue collars).

In our sample (Table 1), approximately 65% of workers are men and married and more

than 55% of individuals are head of household, in a family of three components. More than 40% of individuals belong to the 35 to 49 age group and have a secondary level of education. Almost 90% of individuals work full-time and have a permanent contract, and almost 50% are hired as high-skilled white-collars in a large firm with more than 50 employees either in the energy and manufacturing sector or in the distribution, transportation and communication (DTC) sector. The average tenure is of 114 months which corresponds approximately to 9 years.

# 5 Identification and empirical strategy

We perform our analysis using a Difference-in-Differences estimation technique. We therefore first define the treated and control groups in the context of our study, then we check the validity of our approach and finally we present in details our estimation strategy.
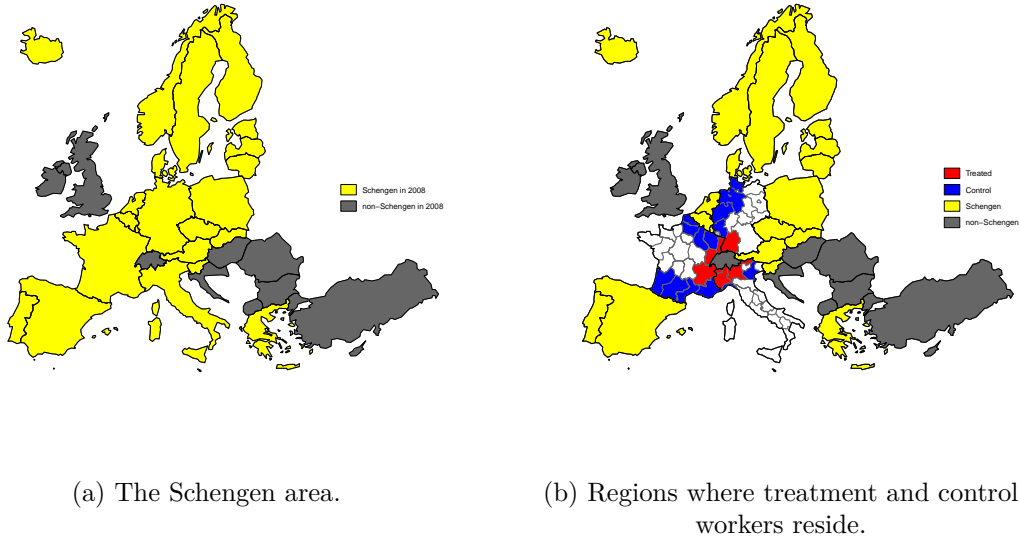
## 5.1 Treated and control groups

To perform our analysis, we identify a treated group, which has been directly affected by Switzerland joining the Schengen area and a control group, for which the implementation of the Schengen agreement in Switzerland has been irrelevant. In Figure 3a, the countries which belonged to the Schengen area in 2008 are reported. According to our strategy, the treated group includes workers who live in regions of Italy, France and Germany, which share the border with Switzerland and who commute for work to a neighbouring region, as shown in Figure 3b.[9] The control group is made by commuters who live in regions, which share the border with a Schengen country, but not with Switzerland and commute across neighbouring regions.[10] Examples of workers in the treated group are commuters who live in regions such are Lombardy in Italy and Alsace in France, which share the border with

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[9]The treated group includes the following regions: FR42, FR43, FR71, ITC1, ITC2, ITC4, ITH1, DE1.

[10]The control group includes the following regions: FR21, FR22, FR30, FR41, FR61, FR62, FR81, FR82, ITC3, ITH3, DE9, DEA, DEB, DEC, DEF. We exclude the Italian region Friuli Venezia Giulia, as it shares the border with Slovenia, which joined the Schengen area in December 2007 and the German regions DE2, DE3, DE4, DE8, DED which share the border with the Eastern European countries which joined the Schengen area after 2008.

Switzerland. Examples of workers in the control group are commuters who live in regions such as Liguria in Italy and Champagne-Ardenne in France, who share the border with a country belonging to the Schengen area (France and Belgium, respectively), but not with Switzerland. Switzerland entering the Schengen area should therefore have an impact on the first group, while leaving the second group unaffected.



(a) The Schengen area.

(b) Regions where treatment and control
workers reside.

**Figure 3.** Countries in the Western part of the Schengen area and regions where treated and control workers reside.

## 5.2 Validity of our approach

The key assumption for any Difference-in-Differences strategy is that the outcome in treated and control groups would follow the same time trend in the absence of the treatment. This means that the average change in the control group represents the counter-factual change in the treated group if there were no treatment. Although there is no formal procedure to test the validity of this assumption, we provide some encouraging evidence in support of it. We report in Figure 4 both the absolute number of cross-border commuters in treated and control regions and the percentage of cross-border commuters on the total number of commuters in treated and control regions. Remarkably, we observe that in the years before the entrance of Switzerland in Schengen (December 2008), even though the absolute number

and the percentage of cross-border commuters were higher in treated regions, the trend was similar across the two groups, reassuring us on the validity of the Difference-in-Differences identifying assumption.



(a) Absolute numbers.

(b) Percentage.
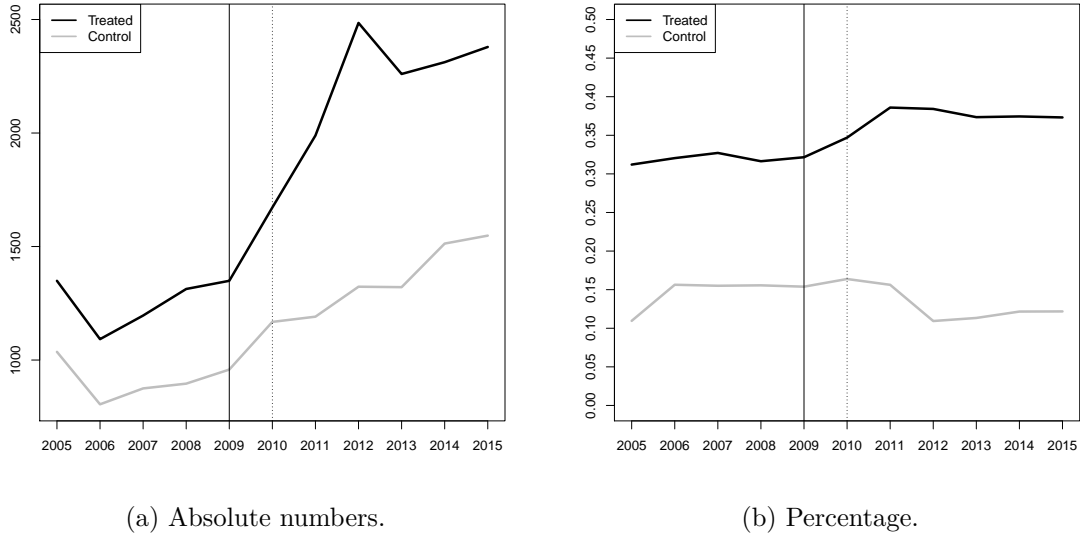
**Figure 4.** Cross-border commuters in treated and control regions.

A potential factor which may have boosted the flow of cross-border commuters to Switzerland is the great recession which began with the subprime mortgage market crisis in the USA in 2007 and was followed by a global economic downturn, which had its greatest repercussions on the European economies in 2009 (European Commission, 2009a). As the change in economic conditions may have affected individual mobility decisions, we provide supportive empirical evidence in Section 6.3 to rule out the hypothesis that the crisis played a major role in determining the observed increase in cross-border commuting to Switzerland.

## 5.3 Empirical specification

Our objective in this paper is to estimate the effect of Switzerland entering the Schengen area on the individual probability to commute cross-border at regional level. As described in Section 3, the official date of entry of Switzerland in the Schengen area is December 2008, hence we consider 2009 as the year of the treatment. The enlargement of the Schengen area to Switzerland represents an exogenous event which we exploit within a Difference-

in-Differences framework. The key aspect of this setting is that by identifying the treated group as those commuters who reside in regions sharing the border with Switzerland, the control group, which includes those commuters who reside in regions sharing the border with a Schengen country, but not Switzerland, is never observed to be exposed to the treatment. As a consequence, the possibility that a misclassification affects our sample split is ruled out.

We pool together data before and after the entrance of Switzerland in the Schengen area[11] and we estimate the following equation:

$$P(\text{CB-Comm} = 1|X)_{i,r,t} = E(\alpha + \beta\text{Treat}_{i,r} + \gamma\text{Treated}_t + \delta\text{Treat}_{i,r}\text{xTreated}_t + \lambda X_{i,r,t} + \epsilon_{i,r,t})$$

where $i$ identifies the individual, $r$ the region of residence and $t$ the time. We estimate the equation above using as outcome the probability to cross-border commute, which takes value one if the individual commutes across regions towards a foreign country (cross-border) and value zero if the individual commutes across regions within national borders. *Treat* is a dummy variable equal to zero for the years before Switzerland joined the Schengen area (2005-2008) and equal to one for the years after (2009-2015). *Treated* is the dummy variable which identifies the treated group, and takes value one for those individuals who reside in a treated region, i.e., a region sharing the border with Switzerland, and value zero for those individuals living in a control region, i.e., a region sharing the border with a country in the Schengen area. The matrix $X_{i,r,t}$ includes a set of individual and job characteristics which may affect the individual probability to cross-border commute. It also includes regional fixed effects and regional time-varying characteristics to capture region-specific economic trend which may affect the dependent variable. $\epsilon_{i,r,t}$ is the individual iid error term.[12]

We run this equation by using ordinary least squares, so the estimated coefficients are readily interpretable as marginal effects. The coefficient $\beta$ measures the difference in the probability of cross-border commuting after Switzerland joined the Schengen area for both

[11]For reasons of confidentiality the identification code of the individual/household is not released. Hence, it is not possible to follow the individuals over time and only 11 cross-sections of data from 2005 to 2015 are considered.

[12]In an additional specification we also include time fixed effects to account for any joint time trend in the data, however results are unchanged.

groups. The coefficient $\gamma$ measures the difference in the probability of cross-border commuting between treated and control groups. The parameter of interest is $\delta$ that captures the differential effect of the entrance of Switzerland in the Schengen area on the individual probability to commute cross-border between treated and control groups. A positive $\delta$ reflects a higher probability of cross-border commuting from Italy, France and Germany to work in Switzerland due to its entrance in the Schengen area, after having controlled for individual and job characteristics (i.e., individual-specific propensity to cross-border commute) as well as regional differential in macro-economic variables. Conversely, a value of $\delta$ equal to zero indicates that the entrance of Switzerland into the Schengen area did not have any significant effect on the probability to commute cross-border.

Since we include in our model individual variables as well as variables aggregated at regional level, both constant and time-varying, the failure to account for the presence of common group errors can lead to estimated standard errors that are seriously downward biased (Moulton, 1990). We therefore compute region-year clustered standard errors.

# 6   Results

Results of our estimations are reported in Table 2. In the first column, we report the baseline specification, where we control for country fixed effects. We find no significant effect associated with our variable of interest. In the second column, we replace country fixed effects with regional fixed effects and we observe that our coefficient of interest is positive and significant. Specifically, in line with the evidence of Figure 4, we find that the probability to commute cross-border to Switzerland is approximately 3.5% higher for individuals who reside in regions which share the border with Switzerland, after the country joined the Schengen area. It is interesting to notice that by introducing regional fixed effects we are able to explain a much bigger share of the variation of our dependent variable, as shown by the much higher R-squared (16.8% compared to 36%).

In order to control for time-variant region-specific characteristics, we include in columns 3 and 4 of Table 2 unemployment differentials (either total or youth) as well as an index of the

quality of the road infrastructure. The coefficient of interest is still positive and significant across all specifications, and maintains the same magnitude. Moreover, we observe that while the total unemployment differential is not significantly different from zero, the youth unemployment differential, when interacted with the 16-24 age group dummy, as expected, has a positive and significant effect on the probability to cross-border commute. That is, the higher the average rate of youth unemployment in the regions within the same country relative to the regions in a foreign country, the higher the likelihood for young individuals to commute across the border. Hence, younger individuals seem to be the category of workers who is more responsive to unemployment differentials across regions. However, a more thorough analysis of these variables is carried out in Section 6.3. The variable which captures the quality of the infrastructure is instead not significantly different from zero.

In column 5 of Table 2, we control for regional employment shares by sector and we interact these variables with the corresponding individual sector dummy variables. By including these controls, we aim at capturing the changes in the share of regional employment across sectors due to the business cycle. Specifically, we want to capture the asymmetric impact of the great recession on European regions across economic sectors. As expected, we find that the regional employment shares in agriculture, construction, manufacturing, mining and energy and finance have a negative sign, even though not always significant, that is, whenever the share of employment in those specific sectors is higher in national regions compared to foreign regions, cross-border commuting to foreign regions is lower. Nevertheless, the coefficient of interest is still positive, significantly different from zero and keeps the same magnitude. In column 6 of Table 2, we control for house prices at national level. We expect a negative sign as an increase in housing price in e.g. France relative to Switzerland may lead French residents to migrate to Switzerland, instead of commuting. The coefficient turns out to be negative and significant, while the effect of Schengen is still positive and significant and keeps the same magnitude. Finally, in our last specification, we also control for the language barrier by including a measure of the closeness of language across regions. The variable turns out to be negative and significant, while slightly reducing the magnitude

**Table 2.** Large sample 2009

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Year 2009 | 0.014 | 0.011** | 0.011** | 0.011** | 0.011** | 0.016*** | 0.022*** |
| | (0.057) | (0.005) | (0.005) | (0.005) | (0.005) | (0.006) | (0.005) |
| Treated | 0.270*** | 0.367*** | 0.367*** | 0.367*** | 0.372*** | 0.367*** | 0.275*** |
| | (0.058) | (0.028) | (0.030) | (0.029) | (0.027) | (0.028) | (0.028) |
| Treated 2009 | 0.010 | 0.035** | 0.035** | 0.034** | 0.033** | 0.034** | 0.029* |
| | (0.066) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) |
| Female | 0.025*** | 0.026*** | 0.026*** | 0.026*** | 0.025*** | 0.026*** | 0.024*** |
| | (0.005) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| Single | −0.022*** | −0.007 | −0.007 | −0.007 | −0.007 | −0.007 | −0.006 |
| | (0.006) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.004) |
| HH size | −0.005** | −0.004** | −0.004** | −0.004** | −0.004** | −0.004** | −0.003* |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| Age 16-24 | −0.019* | −0.018** | −0.018** | −0.019** | −0.018** | −0.018** | −0.011 |
| | (0.010) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.008) |
| Age 25-34 | 0.027*** | 0.027*** | 0.027*** | 0.027*** | 0.027*** | 0.027*** | 0.029*** |
| | (0.008) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| Age 35-49 | 0.024*** | 0.023*** | 0.023*** | 0.023*** | 0.023*** | 0.023*** | 0.023*** |
| | (0.006) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| Tertiary | 0.009 | −0.017** | −0.017** | −0.017** | −0.016** | −0.017** | −0.011* |
| | (0.009) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) |
| Full-time | −0.037*** | −0.020*** | −0.020*** | −0.020*** | −0.021*** | −0.020*** | −0.023*** |
| | (0.008) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) |
| Tenure | −0.0002*** | −0.0002*** | −0.0002*** | −0.0002*** | −0.0002*** | −0.0002*** | −0.0002*** |
| | (0.00003) | (0.00003) | (0.00003) | (0.00003) | (0.00003) | (0.00003) | (0.00003) |
| Permanent | 0.088*** | 0.075*** | 0.075*** | 0.075*** | 0.076*** | 0.075*** | 0.078*** |
| | (0.010) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) |
| HW skilled | −0.109*** | −0.064*** | −0.064*** | −0.064*** | −0.063*** | −0.064*** | −0.055*** |
| | (0.014) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.008) |
| LW skilled | −0.043*** | −0.021*** | −0.021*** | −0.022*** | −0.020*** | −0.022*** | −0.015** |
| | (0.009) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) |
| HB skilled | 0.048*** | 0.053*** | 0.053*** | 0.053*** | 0.058*** | 0.053*** | 0.056*** |
| | (0.010) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) |
| Agriculture | −0.213*** | −0.142*** | −0.142*** | −0.142*** | −0.091 | −0.142*** | −0.139*** |
| | (0.024) | (0.019) | (0.019) | (0.019) | (0.100) | (0.019) | (0.019) |
| MEM | −0.027* | −0.039*** | −0.039*** | −0.039*** | 0.018 | −0.039*** | −0.053*** |
| | (0.014) | (0.013) | (0.013) | (0.013) | (0.031) | (0.013) | (0.012) |
| DTC | −0.086*** | −0.070*** | −0.070*** | −0.070*** | −0.103*** | −0.070*** | −0.071*** |
| | (0.011) | (0.009) | (0.009) | (0.009) | (0.031) | (0.009) | (0.009) |
| Finance | −0.078*** | −0.067*** | −0.067*** | −0.067*** | −0.077** | −0.067*** | −0.068*** |
| | (0.013) | (0.011) | (0.011) | (0.011) | (0.037) | (0.012) | (0.011) |
| NMS | −0.093*** | −0.061*** | −0.061*** | −0.061*** | −0.109*** | −0.061*** | −0.066*** |
| | (0.013) | (0.010) | (0.010) | (0.010) | (0.033) | (0.010) | (0.010) |
| Unem rate | | | −0.0001 | | | | |
| | | | (0.0001) | | | | |
| Youth unem rate | | | | 0.001** | | | |
| | | | | (0.0004) | | | |
| Road network | | | 0.001 | 0.008 | | | |
| | | | (0.109) | (0.109) | | | |
| Empl agriculture | | | | | −0.056 | | |
| | | | | | (0.066) | | |
| Empl MEM | | | | | −0.052*** | | |
| | | | | | (0.006) | | |
| Empl Construction | | | | | −0.022 | | |
| | | | | | (0.017) | | |
| Empl MEM | | | | | −0.014* | | |
| | | | | | (0.007) | | |
| Empl NMS | | | | | 0.008 | | |
| | | | | | (0.009) | | |
| House prices | | | | | | −0.004* | |
| | | | | | | (0.003) | |
| Language | | | | | | | −0.006*** |
| | | | | | | | (0.0005) |
| Country fixed effect | YES | NO | NO | NO | NO | NO | NO |
| Regional fixed effect | NO | YES | YES | YES | YES | YES | YES |
| Sector dummies/Firm size | YES | YES | YES | YES | YES | YES | YES |
| Observations | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 |
| R² | 0.168 | 0.360 | 0.360 | 0.360 | 0.364 | 0.360 | 0.391 |

*Note:* Region-year clustered standard errors. Significance levels: *p<0.1; **p<0.05; ***p<0.01.

of the coefficient of interest to 2.9%. The negative sign of the language variable is driven by the fact that inter-regional commuting within the same country is always associated with the highest value of the closeness of language (100), while cross-border commuting is on average associated with a lower value. The robustness of our estimations across all specifications reassures us about the goodness of the model specification and the validity of our results.

In terms of individual characteristics, surprisingly we find that female workers are more likely to commute across border rather than internally, as well as head of households. Being married or single does not affect the decision to commute cross-border, even though the household size has a negative impact. This result is in line with the findings of Gottholmseder and Theurl (2007), who claim that the presence of children increases the opportunity costs of being away from home since individuals prefer to spend more time together with the family. We also find that young workers in the cohorts 25-34 and 35-49 are more likely to commute to a Schengen country compared to older workers. Gottholmseder and Theurl (2007) show that the age distribution for cross-border workers has a significant peak at about 40 years. They explain this evidence as individuals first finish education in their country of residence and become cross-border commuters afterwards. When they get older, they stop commuting cross-border due to the increased necessity to utilize health care services and the preference to consume them in the home country. Interestingly, tertiary educated workers commute less across borders compared to primary and secondary educated individuals, in line with the descriptive statistics of cross-border commuters to Switzerland as provided by Beerli and Peri (2016).

In terms of job characteristics, full-time workers commute less cross-border than part-time workers. We explain this result as part-time workers are more likely to be female and young, all characteristics associated with higher probability to commute cross-border. We also find that the longer the tenure within the job, the lower the probability to commute cross-border. In fact, workers with longer job tenure are less mobile as they are less likely to change jobs due to the accumulated sector-specific and firm-specific human capital. The reduced job mobility is also explained by their proximity to retirement, which makes a job

change rather costly van Ham et al. (2001). Surprisingly, permanent employees commute more across the border than temporary employees. In terms of occupation, blue collars are the ones who are more likely to commute to a foreign country, particularly if high-skilled, in line with the descriptive statistics of Beerli and Peri (2016). Moreover, employees of small firms (between 11 and 19 employees) or very large firms (more than 50 employees) commute more cross-border compared to employees of medium-size firms (20-50 employees) or very small firms (below 11 employees). This can be explained by the fact that larger firms are able to recruit from a larger territory and may afford to subsidize more commuting compared to smaller firms (Paci et al., 2007).

## 6.1 Effect in 2009 or 2010?

In order to understand whether there is a chance that the increase in the cross-border commuting flow was delayed compared to the entrance of Switzerland in the Schengen area as it may take some time to find a new job in a different country, we estimate the same regression by considering the year 2010 as the year of the treatment. Results are reported in Table 3. We observe that in all specifications (except the one with country fixed effects instead of regional fixed effects) the coefficient of interest is positive and significant, and the magnitude is larger (approximately 4.2% compared to 3.4% when 2009 was picked as the treatment year).

**Table 3.** Large sample 2010

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Year 2010 | 0.025 | 0.011** | 0.011** | 0.011** | 0.011** | 0.011** | 0.022*** |
| | (0.052) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.004) |
| Treated | 0.250*** | 0.364*** | 0.364*** | 0.364*** | 0.369*** | 0.364*** | 0.270*** |
| | (0.052) | (0.026) | (0.029) | (0.028) | (0.026) | (0.026) | (0.027) |
| Treated 2010 | 0.017 | 0.044*** | 0.044*** | 0.043*** | 0.042*** | 0.044*** | 0.039*** |
| | (0.062) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) |
| Country fixed effect | YES | NO | NO | NO | NO | NO | NO |
| Regional fixed effect | NO | YES | YES | YES | YES | YES | YES |
| Sector dummies | YES | YES | YES | YES | YES | YES | YES |
| Individual and job characteristics | YES | YES | YES | YES | YES | YES | YES |
| Regional characteristics | YES | YES | YES | YES | YES | YES | YES |
| Observations | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 |
| $R^2$ | 0.167 | 0.361 | 0.361 | 0.361 | 0.364 | 0.361 | 0.392 |

*Note:* Region-year clustered standard errors. Significance levels: *$p<0.1$; **$p<0.05$; ***$p<0.01$.

## 6.2 Freedom of movement or removal of border checks?

Our main result about the positive and significant impact of the implementation of the Schengen agreement on cross-border commuting to Switzerland is in line with the findings of Beerli and Peri (2016). They indeed show that after 2004, year in which the freedom of movement for cross-border commuters to Swiss border regions was implemented, and specifically in the period 2004-2010, cross-border commuting has significantly increased. However, as they are pulling together many years of observations, they are not able to disentangle the effect of the 2004 reform, from the effect of the 2007 reform, which extended the freedom of movement to all EU-15 and EFTA workers and to all Swiss regions, from the effect of the Schengen implementation. With data availability from 2005,[13] we can test whether the 2007 reform had an impact on cross-border commuting to Switzerland. Hence, we re-estimate Equation 1 using 2007 as the treatment year. This test has a double purpose: first, it is going to reveal whether the extension of the freedom of work to the whole country and to all EU citizens had an impact on the decision of workers to commute cross-border. In addition, it serves also as a placebo test, to rule out the presence of heterogeneous trends between treatment and control regions before the date of the implementation of the Schengen agreement. Results are shown in Table 4. Across all our specifications, we observe no significant effect of our coefficient of interest on cross-border commuting.

As the implementation of the 2007 reform may have been internalized by workers with some delay, we also run the regression using a false implementation date in 2008, which is one year after the implementation of the freedom of movement and one year earlier than the implementation of the Schengen agreement. Table 5 shows that across all specifications the variable of interest is never significantly different from zero.

These results rule out the presence of different trends between treatment and control regions, confirming our hypothesis of the implementation of Schengen being an independent random event. In addition, when we combine these findings with the findings of Beerli and Peri (2016), we have a clear picture of the policies which were effective in increasing the flow

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[13]ELFS data before 2005 are available, but since the rotation scheme used to collect the data has changed between 2004 and 2005 for a large number of countries, data are not fully comparable across time.

**Table 4.** Large sample placebo 2007

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Year 2007 | 0.010 | 0.010 | 0.009 | 0.009 | 0.011 | 0.011* | 0.022*** |
| | (0.076) | (0.007) | (0.007) | (0.008) | (0.007) | (0.007) | (0.006) |
| Treated | 0.274*** | 0.369*** | 0.376*** | 0.375*** | 0.374*** | 0.368*** | 0.281*** |
| | (0.081) | (0.033) | (0.034) | (0.034) | (0.032) | (0.033) | (0.033) |
| Treated 2007 | 0.005 | 0.025 | 0.026 | 0.025 | 0.024 | 0.026 | 0.017 |
| | (0.087) | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.024) |
| Country fixed effect | YES | NO | NO | NO | NO | NO | NO |
| Regional fixed effect | NO | YES | YES | YES | YES | YES | YES |
| Sector dummies | YES | YES | YES | YES | YES | YES | YES |
| Individual and job characteristics | YES | YES | YES | YES | YES | YES | YES |
| Regional characteristics | YES | YES | YES | YES | YES | YES | YES |
| Observations | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 |
| $R^2$ | 0.168 | 0.360 | 0.360 | 0.360 | 0.363 | 0.360 | 0.390 |

*Note:* Region-year clustered standard errors. Significance levels: *$p<0.1$; **$p<0.05$; ***$p<0.01$.

**Table 5.** Large sample placebo 2008

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Year 2008 | 0.023 | 0.011** | 0.011* | 0.011* | 0.012** | 0.014** | 0.022*** |
| | (0.062) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.005) |
| Treated | 0.255*** | 0.370*** | 0.374*** | 0.374*** | 0.375*** | 0.369*** | 0.279*** |
| | (0.066) | (0.029) | (0.031) | (0.030) | (0.028) | (0.029) | (0.029) |
| Treated 2008 | 0.006 | 0.027 | 0.028 | 0.027 | 0.026 | 0.028 | 0.021 |
| | (0.073) | (0.018) | (0.019) | (0.019) | (0.018) | (0.018) | (0.019) |
| Country fixed effect | YES | NO | NO | NO | NO | NO | NO |
| Regional fixed effect | NO | YES | YES | YES | YES | YES | YES |
| Sector dummies | YES | YES | YES | YES | YES | YES | YES |
| Individual and job characteristics | YES | YES | YES | YES | YES | YES | YES |
| Regional characteristics | YES | YES | YES | YES | YES | YES | YES |
| Observations | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 | 125,506 |
| $R^2$ | 0.166 | 0.360 | 0.360 | 0.360 | 0.364 | 0.360 | 0.391 |

*Note:* Region-year clustered standard errors. Significance levels: *$p<0.1$; **$p<0.05$; ***$p<0.01$.

of commuters across the border. Both the reform implemented in 2004, which introduced full freedom of work for cross-border commuters in border regions, and the border openings due to the Schengen implementation increased the flow of cross-border commuters to Switzerland, by creating incentives and reducing the costs of commuting. However, as the great majority of cross-border commuters work in border regions, the extension of the freedom of movement to non-border regions and to all EU citizens in 2007 did not have a significant impact.

We interpret this result in support of our hypothesis that the free movement of labour and the opening of the borders are two complementary policies, that are effective particularly when they are used simultaneously. In fact, the opening of the borders promoted by the Schengen agreement represents the concrete implementation of the freedom of movements which are at the basis of the Single Market.

## 6.3 Schengen or the economic crisis?

The economic and financial crisis which asymmetrically hit European countries would have had a major impact on cross-border commuting if we would observe a different trend in unemployment in treated and control regions before or at the same time as the implementation of Schengen. We focus on unemployment since previous studies (Reinhart and Rogoff, 2009; Scott et al., 2008) have shown that financial crises have a much stronger impact on unemployment than other economic recessions. Moreover, as the sensitivity to business cycle is found to be twice as high for young workers below the age of 24 than for older workers (Brian and Patrick, 2010), Jimeno and Rodríguez-Palenzuela (2003), we document also the trend of youth unemployment. Young workers are in fact the ones who are affected the most by the crisis and its impact on youth unemployment usually persists for a longer time, even after recovery (Parodi et al., 2012).



(a) Changes in total unemployment        (b) Changes in youth unemployment
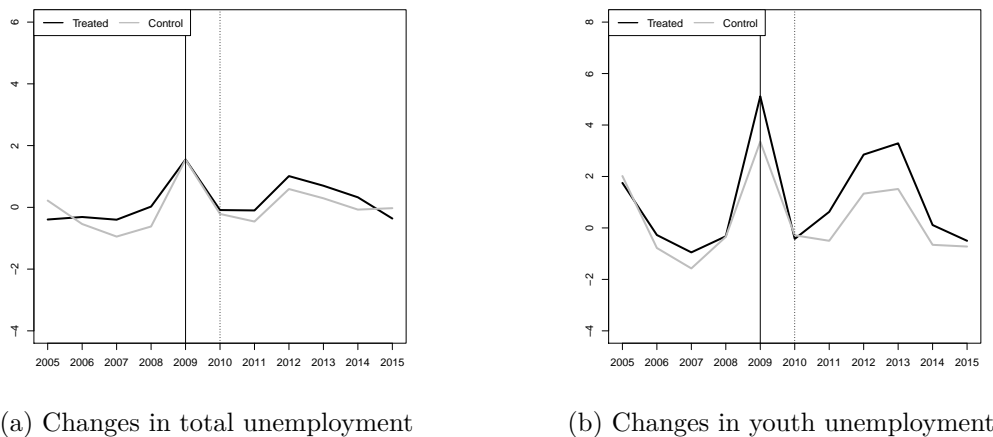
**Figure 5.** Unemployment trends in treated and control regions.

We compute the percentage point changes in the total unemployment rate and the youth unemployment rate in treated and control regions, as it is the annual change in these two indicators which might have had a stronger impact on the individual commuting decision.[14] Results are reported in Figures 5a and 5b. We notice that during the entire period of observation, both indicators show similar values and trends in treated and control regions, ruling out the hypothesis of a major impact of the crisis. The evidence provided above is

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[14]Nevertheless, we report also in Section 6.4.6 the analysis where we control for unemployment rates instead of differences.

in line with the findings of the European Commission (2009a), which shows that the 2009 economic downturn did not systematically hit poorer or richer countries, but had a strong asymmetric impact across European regions (Dijkstra et al., 2015), Groot et al. (2011) and Davies (2011). In particular, Davies (2011) shows that the features of the most resilient[15] regions in Italy and France are rather different. While in Germany and Italy the least resilient regions were the ones with higher GDP per capita and lower unemployment rates, in France regions with lower GDP and not high unemployment were the least resilient. Moreover, regions with high employment shares in construction had poor resilience in France, but the strongest resilience in Germany and Italy. Since in our sample both treated and control groups include a mix of German, Italian and French regions, the absence of a systematic trend in unemployment is not surprising.[16]

In addition, there is plenty of evidence in the literature (Groot et al., 2011; Verick, 2009), which documents that the great recession affected specific sectors, such as construction, manufacturing, real estate and financial services, while other sectors such as non-market services, agriculture and mining have instead experienced little or no contraction at all. Therefore, we look at a measure of regional employment across sectors during the years 2008-2011 in Europe. The large variations of employment across sectors and regions confirm the asymmetric character of the crisis. However, when we look at trends of employment across sectors by country (Figure 6), we notice that the Spanish economy is the one which has been affected the most, while other countries of interest for the present studies, such as Switzerland, France, Italy and Germany do not show significant drops in employment in the year of the crisis. In Section 6.4.4 a robustness exercise is performed excluding Spain from the sample, however the results are unchanged. Moreover, when we plot the employment by sector in treated and control regions (Figure 7), we observe similar trends across the two
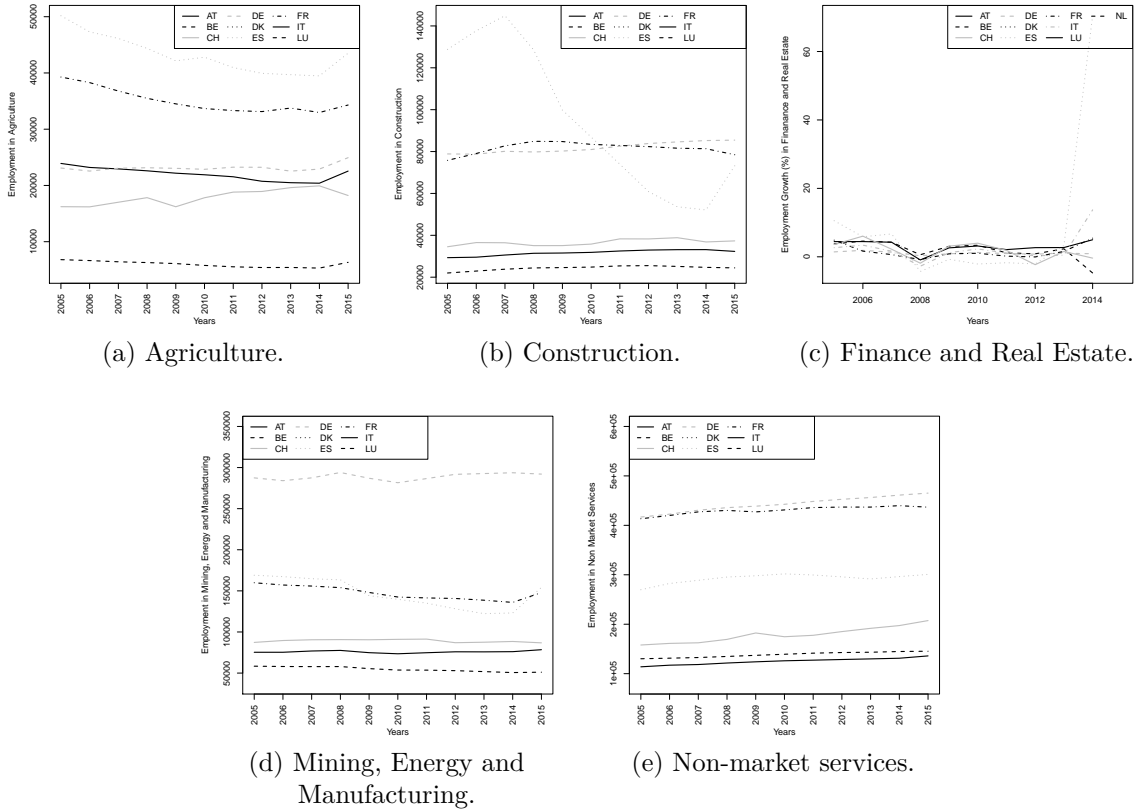
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[15]Resilience is defined both as the capacity of a regional economy to withstand change or to retain its core functions despite external upheaval and as the ability of a region to remain on or return to a long run developmental path in the face of an external shock.

[16]In the specific case of the Swiss-Italian border regions, Baruffini (2011) shows that the trend in unemployment in Ticino (CH07) has been not so different from the trends in unemployment in Northern Italian regions until the third quarter of 2008; moreover, after the first quarter of 2009, the unemployment rates in the Italian regions of Piedmont (ITH1) and Lombardy (ITH4) show a decline, while the unemployment rate in Ticino (CH07) has remained stable.

groups, ruling out the hypothesis that the asymmetric nature of the crisis had a major impact on our results.



(a) Agriculture.    (b) Construction.    (c) Finance and Real Estate.

(d) Mining, Energy and Manufacturing.    (e) Non-market services.

**Figure 6.** Employment by country and sector.

We have already provided some evidence in favour of our argument that the positive effect we estimate on cross-border commuting is mainly due to the implementation of the Schengen agreement in Switzerland in December 2008 and not to the economic crisis which hit Europe in the period 2009-2010. To shed additional light on this issue and to disentangle the effect of the crisis from the effect of the abolition of border controls, we split our sample according to sectors which have been either severely affected or not affected by the crisis (Groot et al., 2011; Verick, 2009). The difference in the magnitude of the coefficients of interest estimated using the two sub-samples should quantify the effect of the crisis. The results of our regressions on the subsamples of sectors not affected by the crisis (agriculture and non market services) and strongly hit by the crisis (manufacturing, construction and finance) are reported in Tables 6 and 7, respectively.

(a) Agriculture.

(b) Construction.

(c) Finance and Real Estate.

(d) Mining, Energy and Manufacturing.

(e) Non-market services.
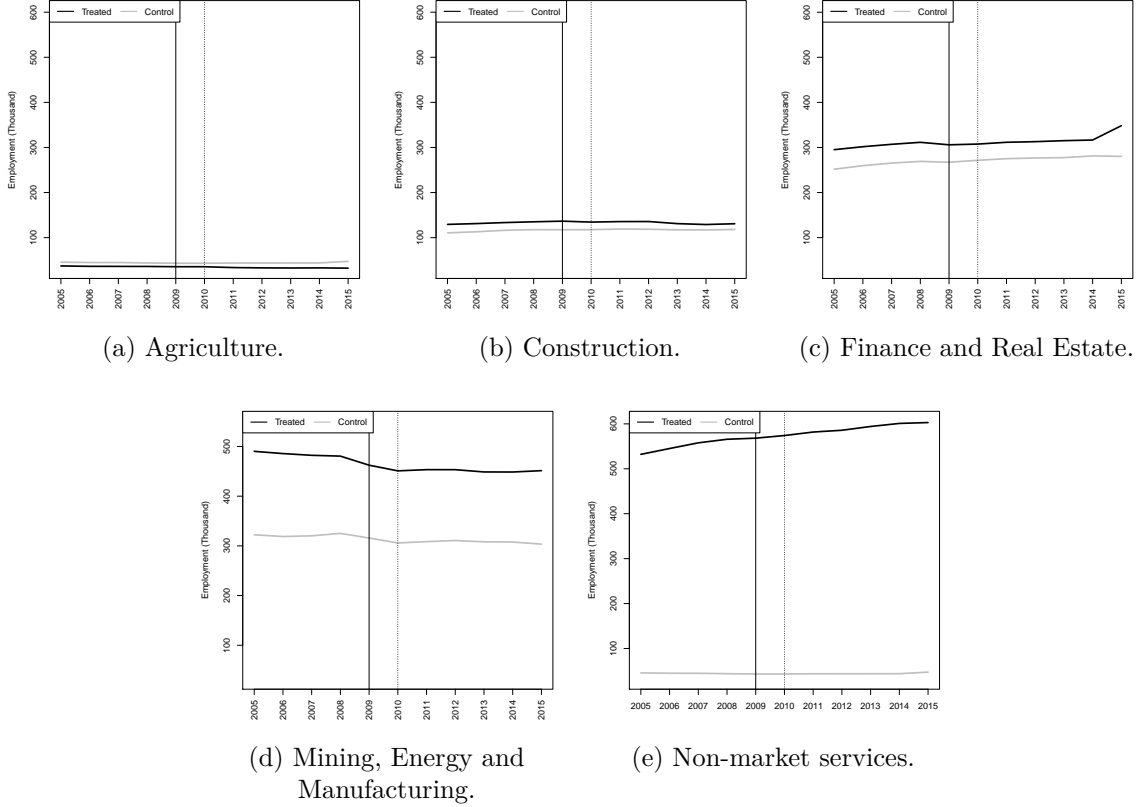
**Figure 7.** Employment by sector in treated and control regions.

We observe that across all specifications and across the two sub-samples, the coefficient of interest is always positive and significant. When we compare the magnitude of the coefficients across the two sub-samples, the numbers are only slightly higher in the subsample of sectors hit by the crisis. Specifically, on average, the effect on cross-border commuting estimated using the subsample of sectors hit by the crisis is 5%, while for the subsample of sectors not affected by the crisis is approximately 4.5%. Hence, we claim that the abolition of the border checks by itself had the effect of significantly increasing cross-border commuting to Switzerland. The role of the economic crisis has been only marginal, as the increase in the share of cross-border commuters ascribable to the crisis barely amounts to half percentage point. Nevertheless, it is natural to think that the absence of border checks represented an important incentive for individuals to turn into cross-border commuters as a consequence of the crisis and they would have not necessarily chosen to do so if the controls at the frontier were still in place.

**Table 6.** Restricted sample with only workers in agriculture and non-market services sectors

|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Year 2009 | 0.007*** | 0.001*** | 0.0001 | −0.0001 | −0.011*** | 0.001** | 0.010*** |
|  | (0.00004) | (0.0002) | (0.0002) | (0.0003) | (0.003) | (0.0005) | (0.0004) |
| Treated | 0.249*** | 0.405*** | 0.417*** | 0.418*** | 0.496*** | 0.405*** | 0.189*** |
|  | (0.002) | (0.037) | (0.041) | (0.042) | (0.051) | (0.037) | (0.024) |
| Treated 2009 | 0.027*** | 0.045*** | 0.047*** | 0.045*** | 0.049*** | 0.044*** | 0.042*** |
|  | (0.002) | (0.005) | (0.004) | (0.005) | (0.003) | (0.004) | (0.004) |
| Country fixed effect | YES | NO | NO | NO | NO | NO | NO |
| Regional fixed effect | NO | YES | YES | YES | YES | YES | YES |
| Sector dummies | YES | YES | YES | YES | YES | YES | YES |
| Individual and job characteristics | YES | YES | YES | YES | YES | YES | YES |
| Regional characteristics | YES | YES | YES | YES | YES | YES | YES |
| Observations | 26,584 | 26,584 | 26,584 | 26,584 | 26,584 | 26,584 | 26,584 |
| $R^2$ | 0.172 | 0.289 | 0.290 | 0.289 | 0.291 | 0.289 | 0.345 |

*Note:* Region-year clustered standard errors. Significance levels: $^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

**Table 7.** Restricted sample with only workers in manufacturing, construction and finance sectors

|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Year 2009 | 0.003* | 0.004*** | 0.003*** | 0.004*** | 0.005*** | 0.005*** | 0.018*** |
|  | (0.001) | (0.001) | (0.001) | (0.001) | (0.0004) | (0.001) | (0.001) |
| Treated | 0.253*** | 0.358*** | 0.373*** | 0.373*** | 0.385*** | 0.358*** | 0.299*** |
|  | (0.0002) | (0.030) | (0.032) | (0.032) | (0.034) | (0.030) | (0.026) |
| Treated 2009 | 0.029*** | 0.052*** | 0.051*** | 0.050*** | 0.049*** | 0.052*** | 0.045*** |
|  | (0.0002) | (0.001) | (0.002) | (0.002) | (0.002) | (0.002) | (0.003) |
| Country fixed effect | YES | NO | NO | NO | NO | NO | NO |
| Regional fixed effect | NO | YES | YES | YES | YES | YES | YES |
| Sector dummies | YES | YES | YES | YES | YES | YES | YES |
| Individual and job characteristics | YES | YES | YES | YES | YES | YES | YES |
| Regional characteristics | YES | YES | YES | YES | YES | YES | YES |
| Observations | 61,747 | 61,747 | 61,747 | 61,747 | 61,747 | 61,747 | 61,747 |
| $R^2$ | 0.181 | 0.390 | 0.390 | 0.390 | 0.394 | 0.390 | 0.413 |

*Note:* Region-year clustered standard errors. Significance levels: $^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

This evidence reassures us about the crisis not being a major factor behind the increased flow of cross-border commuters to Switzerland and provides support to our belief that the effect that we are estimating is ascribable to the implementation of the Schengen agreement.

## 6.4 Robustness checks

In order to test for the robustness of our results, we carry out several additional tests. First, we utilize a stricter definition of cross-border commuting, and keep only the observations of those individuals who commute for work in a foreign bordering region (and not in any region of a bordering foreign country). Second, we estimate our model by including in our sample all workers and not only inter-regional commuters. Third, we look at the number of individuals who commute and migrate from/to Switzerland to rule out the hypothesis that the effect

we find is due to migrants. Fourth, we exclude Spain from the sample as it is the country that has been hit most severely by the crisis. Finally, we explore additional specifications in which we include the exchange rate between Switzerland and all other countries considered and the unemployment rates (both total and young) in levels rather than in differentials. All these additional tests lead to similar results: the implementation of Schengen significantly increased cross-border commuting to Switzerland.

### 6.4.1   Commuting to a bordering region

As there is evidence that the majority of cross-border commuting is towards contiguous regions (Beerli and Peri, 2016), we consider a stricter definition of cross-border commuting. We exclude from our sample all those individuals who commute cross-border towards a region which does not share the border with the region of residence.

**Table 8.** Small sample 2009

|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Year 2009 | 0.008 | 0.005 | 0.004 | 0.005 | 0.004 | 0.007 | 0.019*** |
|  | (0.084) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.005) |
| Treated | 0.037 | −0.029* | −0.028 | −0.028 | −0.034* | −0.030* | −0.031 |
|  | (0.078) | (0.017) | (0.021) | (0.021) | (0.018) | (0.017) | (0.019) |
| Treated 2009 | 0.032 | 0.061*** | 0.061*** | 0.061*** | 0.061*** | 0.061*** | 0.060** |
|  | (0.092) | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.024) |
| Country fixed effect | YES | NO | NO | NO | NO | NO | NO |
| Regional fixed effect | NO | YES | YES | YES | YES | YES | YES |
| Sector dummies | YES | YES | YES | YES | YES | YES | YES |
| Individual and job characteristics | YES | YES | YES | YES | YES | YES | YES |
| Regional characteristics | YES | YES | YES | YES | YES | YES | YES |
| Observations | 80,775 | 80,775 | 80,775 | 80,775 | 80,775 | 80,775 | 80,775 |
| $R^2$ | 0.179 | 0.586 | 0.587 | 0.586 | 0.587 | 0.587 | 0.616 |

*Note:* Region-year clustered standard errors. Significance levels: *p<0.1; **p<0.05; ***p<0.01.

Our sample is down to 80,775 individuals and results are reported in Table 8. We find that across all specifications our coefficient of interest is positive and significant. Moreover, the magnitude of the coefficient is stable and significantly higher compared to the coefficient estimated for the larger sample, which includes also commuters towards non-contiguous regions. Specifically, we find that the probability to commute cross-border to Switzerland is approximately 6% higher for individuals who reside in regions which share the border with Switzerland, after the country joined the Schengen area.

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### 6.4.2 Large sample with all workers

In the main regression we have considered only the sample of inter-regional commuters, as we believe that this specific type of workers may have a different propensity to travel for work compared to those workers who reside and work in the same region (Section 4). However, as an additional robustness test, we replicate our estimation using the whole sample of workers, commuters and non-commuters, having the number of observations increasing to more than 2.3 millions. This exercise allows to capture the effect of the removal of border checks also on those workers who were not commuting before the implementation of Schengen and decided to do so as a response to lower commuting costs. Results are reported in Table 9. We find that the coefficient of interest is still positive and strongly significant across all specifications, even though considerably smaller in magnitude.

**Table 9.** Enlarged sample with all workers (commuters and non-commuters)

|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Year 2009 | 0.001 | −0.0003 | −0.0004 | −0.0004 | −0.0003 | −0.0003 | 0.002*** |
|  | (0.004) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.0005) |
| Treated | 0.014*** | 0.005*** | 0.005*** | 0.005*** | 0.002 | 0.005*** | 0.002 |
|  | (0.004) | (0.001) | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) |
| **Treated 2009** | 0.003 | 0.004*** | 0.004*** | 0.004*** | 0.004*** | 0.004*** | 0.003** |
|  | (0.005) | (0.001) | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) |
| Country fixed effect | YES | NO | NO | NO | NO | NO | NO |
| Regional fixed effect | NO | YES | YES | YES | YES | YES | YES |
| Sector dummies | YES | YES | YES | YES | YES | YES | YES |
| Individual and job characteristics | YES | YES | YES | YES | YES | YES | YES |
| Regional characteristics | YES | YES | YES | YES | YES | YES | YES |
| Observations | 2,310,992 | 2,310,992 | 2,310,992 | 2,310,992 | 2,310,992 | 2,310,992 | 2,310,992 |
| Adjusted $R^2$ | 0.018 | 0.047 | 0.047 | 0.047 | 0.049 | 0.047 | 0.196 |

*Note:* Region-year clustered standard errors. Significance levels: *p<0.1; **p<0.05; ***p<0.01.

### 6.4.3 Commuting and migration from/to Switzerland

The Schengen agreement made commuting into Switzerland as well as out of Switzerland easier and hence more attractive. This is a valuable feature of the treatment because we would expect commuting flows to increase in both directions. Figure 8 shows the number of cross-border commuters from Switzerland to bordering countries. Clearly, even in this direction the number has increased significantly after the implementation of Schengen in 2008, conferming our hypothesis of the importance of the treatment for both the directions
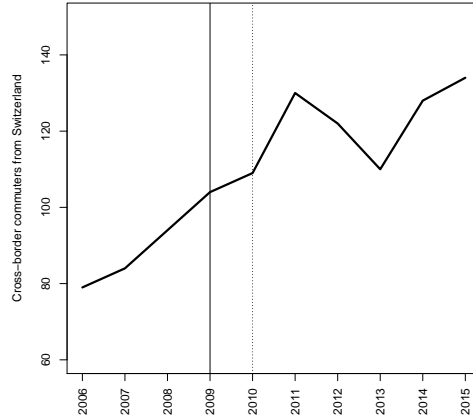
**Figure 8.** Cross-border commuters from Switzerland to bordering countries.

of commuting.

A potential concern could relate to the hypothesis that the increase in cross-border commuting to Switzerland could be at least partly ascribable to individuals who moved away from Switzerland to commute across borders later on. For instance inviduals could have moved from Switzerland to France, Germany and Italy and currently commute to Switzerland as a result of the cheaper and more convenient commuting journey ascribable to Schengen.

**Table 10.** Migrants from Switzerland (residing in Switzerland one year before)

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | | | | | | | | | | | |
| DE | | | | 1 | | 1 | | 7 | 8 | 5 | 9 |
| FR | | 1 | 4 | 2 | 5 | 8 | 11 | 5 | 4 | 1 | 4 |
| IT | 2 | 2 | 1 | 1 | 1 | 3 | | | 1 | | |
| | | | | | | | | | | | |
| Cross-border commuters to Switzerland | | | | | | | | | | | |
| DE | | | | 1 | | 1 | | 7 | 7 | 5 | 9 |
| FR | | 1 | 4 | 1 | 5 | 8 | 11 | 5 | 4 | 1 | 4 |
| IT | 2 | 2 | 1 | 1 | 1 | 3 | | | 1 | | |

In order to rule out this hypothesis, we look at the number of individuals who migrated from Switzerland the year before and currently live in France, Germany and Italy: among those, we identify the ones who are currently commuting to Switzerland (Table 10). As the numbers are very small across the entire period considered, the hypothesis of cross-border commuting after migrating is therefore excluded. Finally, we also looked at the number of individuals who moved in the other direction, that is they moved from Italy, France and Germany to Switzerland: again, among those we identify the ones who cross-border commute

**Table 11.** Migrants to Switzerland (NOT residing in Switzerland one year before)

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| **Total** | | | | | | |
| FR | 2 | 3 | 3 | 1 | 3 | 5 |
| DE | 17 | 23 | 21 | 15 | 17 | 17 |
| IT | 2 | 4 | 3 | 2 | 6 | 9 |
| | | | | | | |
| **Cross-border commuters to Germany/Italy/France** | | | | | | |
| FR | 0 | 1 | 0 | 0 | 0 | 2 |
| DE | 5 | 6 | 3 | 3 | 2 | 1 |
| IT | 1 | 2 | 1 | 0 | 1 | 4 |

to a bordering country (Table 11). Again, the numbers are very small across the entire period considered, ruling out the migration/commuting hypothesis.

### 6.4.4 Exclusion of Spain

As an additional robustness check we exclude Spain as a destination county for commuters, as Spain has been hit relatively more severely by the crisis, as shown in Figure 6. The results of this exercise are reported in Table 12. The coefficient of interest is still positive and significant and the magnitude consistent with the main estimation.

**Table 12.** Restricted sample without commuters to Spain.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Year 2009 | 0.013 | 0.010* | 0.011** | 0.011** | 0.010** | 0.016*** | 0.021*** |
| | (0.057) | (0.005) | (0.005) | (0.005) | (0.005) | (0.003) | (0.004) |
| Treated | 0.271*** | 0.366*** | 0.353*** | 0.353*** | 0.372*** | 0.367*** | 0.276*** |
| | (0.058) | (0.028) | (0.029) | (0.029) | (0.027) | (0.013) | (0.028) |
| Treated 2009 | 0.011 | 0.036** | 0.037** | 0.036** | 0.034** | 0.034*** | 0.031** |
| | (0.066) | (0.015) | (0.015) | (0.015) | (0.015) | (0.005) | (0.015) |
| Country fixed effect | YES | NO | NO | NO | NO | NO | NO |
| Regional fixed effect | NO | YES | YES | YES | YES | YES | YES |
| Sector dummies | YES | YES | YES | YES | YES | YES | YES |
| Individual and job characteristics | YES | YES | YES | YES | YES | YES | YES |
| Regional characteristics | YES | YES | YES | YES | YES | YES | YES |
| Observations | 125,379 | 125,379 | 125,379 | 125,379 | 125,379 | 125,506 | 125,379 |
| $R^2$ | 0.169 | 0.364 | 0.364 | 0.364 | 0.367 | 0.360 | 0.393 |

Note: $p^* < 0.1$; $p^{**} < 0.05$; $p^{***} < 0.01$.

### 6.4.5 Exchange rate

An additional robustness check we perform is to include among the regressors the exchange rate. In fact, the value of the Swiss Franc increased significantly from 2007 to 2011 and this could have made commuting into Switzerland more attractive after 2008.

**Table 13.** Exchange rate 2009

| | |
|---|---|
| Year 2009 | 0.012** |
| | (0.005) |
| Treated | 0.367*** |
| | (0.028) |
| Treated 2009 | 0.035** |
| | (0.015) |
| Exchange Rate | −0.0005 |
| | (0.001) |
| Country fixed effect | NO |
| Regional fixed effect | YES |
| Sector dummies | YES |
| Individual and job characteristics | YES |
| Observations | 125,506 |
| $R^2$ | 0.360 |

Note:*p<0.1; **p<0.05; ***p<0.01.

As shown in Table 13, the exchange rate variable is not significantly different from zero. Nevertheless, the coefficient of interest is robust and keeps the same sign and magnitude.

### 6.4.6 Unemployment and youth unemployment rates

Finally, we replaced the regional unemployment and youth unemployment variables computed as the differentials with respect to the previous year with the rates. The result is reported in Table 14. While the unemployment rate is not significantly different from zero, as in our main specification, the youth unemployment rate looses its significance when used in rates rather than in differentials. Nevertheless, the coefficient of interest keeps its sign and magnitude.

**Table 14.** Unemployment and youth unemployment rates.

| | (1) | (2) |
|---|---|---|
| Year 2009 | 0.010* | 0.011** |
| | (0.005) | (0.005) |
| Treated | 0.375*** | 0.367*** |
| | (0.030) | (0.030) |
| Treated 2009 | 0.031* | 0.035** |
| | (0.016) | (0.015) |
| Unem rate | 0.016 | |
| | (0.012) | |
| Youth unem rate | | −0.005 |
| | | (0.016) |
| Road network | −0.083 | 0.003 |
| | (0.129) | (0.110) |
| Country fixed effect | NO | NO |
| Regional fixed effect | YES | YES |
| Sector dummies | YES | YES |
| Individual and job characteristics | YES | YES |
| Observations | 125,506 | 125,506 |
| $R^2$ | 0.360 | 0.360 |

Note: *p<0.1; **p<0.05; ***p<0.01.

# 7 Conclusions and policy implications

In this paper we study the effects of Switzerland implementing the Schengen agreement in December 2008 on cross-border commuting. By allowing residents in border areas freedom to cross borders away from fixed checkpoints, we expect the flow of cross-border commuters to be larger between countries belonging to the Schengen area. We use data from the European Labour Force Survey (ELFS) to estimate a Difference-in-Differences model in which the probability to cross-border commute is regressed on a number of individual, job and regional variables. We find that the decision of Switzerland to join the Schengen area had a positive and significant effect on cross-border commuting. Indeed, after the Schengen implementation, the individual probability to commute cross-border has increased by more than 3% for individuals who live in regions, which share the border with Switzerland. Several robustness checks confirm our findings. Interestingly, when we restrict our sample to those workers who commute for work in a region which is contiguous to the region of residency, we find that the effect is larger and approximately equal to 6%.

Since the great recession hit asymmetrically European regions and affected specific sectors more than others, we provide evidence that unemployment rates and employment rates in specific sectors did not change differently in control and treated groups. Moreover, we disentangle the effect of the crisis from the effect of the abolition of border checks, by splitting the sample in two sub-samples according to sectors which have been hit strongly or lightly by the crisis. We confirm our finding that the implementation of the Schengen agreement (purified by the effect of the crisis) had the effect of significantly increasing cross-border commuting to Switzerland. In sectors strongly affected by the crisis, the effect is as expected even higher. Nevertheless, we claim that the decision of workers to move their workplace to Switzerland as a consequence of the economic downturn was also due to the easiness of commuting cross-border without the need to stop at the frontier for border checks.

This result is very important for several reasons. First, it represents a meaningful contribution, as the effect of the implementation of Schengen has been so far neglected in the literature. Second, it provides evidence that border controls represent a serious obstacle

to cross-border commuting. Third, when combined with the recent findings of Beerli and Peri (2016), it sheds some light on the cross-border commuting phenomenon for the case of Switzerland. Specifically, it provides evidence that both the implementation of the free movement of labour for cross-border workers in border regions, implemented in Switzerland in 2004, and the opening of the borders through the implementation of Schengen were effective policies to increase cross-border commuting. Hence, it confirms the idea that the free movement of labour and the border openings are two fundamental arrangements, which are particularly effective when implemented together.

Our findings are relevant for the noteworthy policy implications. The literature in fact has shown that labour mobility is an important equilibrating mechanism, and has the potential of reducing disparities in regional labour market outcomes, such as employment and unemployment (Blanchard and Katz, 1992; Decressin and Fatas, 1995). Inter-regional labour mobility can lead to an efficient spatial allocation of labour and therefore to welfare gains, particularly in areas with marked differences in regional labour market performance, as it is the case of Europe. Moreover, commuting appears to be more responsive than migration to cross-regional differences in labour market indicators (Erbenova, 1995). Thus, commuting appears to have a higher potential as a means of facilitating transitions out of joblessness. Policy actions which aim at encouraging commuting have therefore the potential to effectively address the issue of regional disparities, especially in European countries, where such disparities are rather large. This is particularly important in light of the fact that the empirical evidence shows a close to zero effect of labour mobility on the wages of native workers (Peri, 2014). Specifically for the case of Switzerland, Beerli and Peri (2016) show that the increase in cross-border commuters had a significant positive impact on wages of highly educated natives, and a positive effect on employment and hours worked by less educated natives. Hence, contrary to popular believes, measures to increase commuting could potentially improve job opportunities for commuters, while increasing the wage level of natives.

As part our research agenda we plan to extend this study to other countries to learn more about the response of labour mobility to European policies.

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