Does the Implementation of the Schengen Agreement Boost Cross-Border Commuting? Evidence from Switzerland

Angela Parenti
Cristina Tealdi

I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

Does the Implementation of the Schengen Agreement Boost Cross-Border Commuting? Evidence from Switzerland

Angela Parenti
University of Pisa

Cristina Tealdi
Heriot-Watt University and IZA

ABSTRACT

Does the Implementation of the Schengen Agreement Boost Cross-Border Commuting? Evidence from Switzerland*

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 among inter-regional commuters 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.

Corresponding author:
Cristina Tealdi
Heriot-Watt University
Edinburgh EH14 4AS
Scotland
E-mail: c.tealdi@hw.ac.uk

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 the 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". 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 quan-

tify 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. For the case of Switzerland, it could cost up to 1.5 billion Swiss Francs per year. Moreover, the loss of access to Schengen security data could severely compromise the efficiency of border checks (Confederazione Svizzera, 2018). More generally, such a decision would lead to greater disparities in regional job markets and certainly more uneven economic development (Bertelsmann Foundation, 2016).

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. 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. For the case of Switzerland, whose borders are crossed every day by more than 1.7 million individuals and 1.2 million vehicles, it could imply a decline in the rate of cross-border commuters between 27% and 62% as it has been estimated that cross-border commuters are expected to tolerate at most an additional waiting time of 45 minutes (Confederazione Svizzera, 2018).

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 rea-

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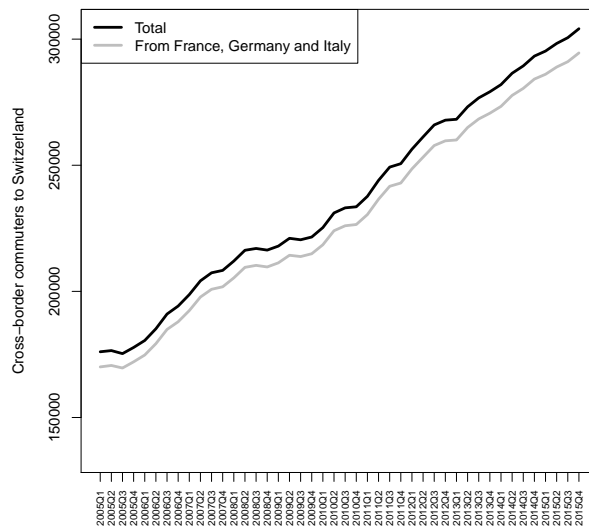
Figure 1. Total cross-border commuters to Switzerland. Source: Swiss Federal Statistical Office.

We quantify the effects of the abolition of Switzerland's regional borders on commuting by means of a Difference-in-Differences model. We define as treated all 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. The control group is made of commuters who live in regions, which share the border with a Schengen country, but not with Switzerland and commute across neighbouring regions. 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 among inter-regional commuters the probability of crossing the border for work is approximately 3 percentage points 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 percentage points.

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 discusses the identification and the empirical strategies, while Section 5 presents the data. We show the main results in Section 6, while in Section 7 we provide robustness checks. Section 8 shows evidence of labour market effects, while Section 9 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 et al. (2018)[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 and labour demand 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

---

[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.

periods (pre-phase and phase one) but a strong positive effect on labour supply and labour demand in phase two. Specifically, they show that the increased presence of cross-border workers in Switzerland had a positive effect on the wages of highly educated Swiss workers and no significant effect on the wages of other workers. Moreover, they find a concurrent increase in labor demand in skill-intensive firms: they find evidence of increased size, productivity, innovation and performance in incumbent firms, while also new firms appeared in the market, and new opportunities were created for native workers to move to managerial jobs. 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 Switzerland among inter-regional commuters.

3 Institutional background

In this section we aim to provide a full picture of the immigration reforms implemented in Switzerland in the past twenty years, which significantly affected the category of workers we are interested in: cross-border workers. Even though it won't be the focus of this paper, we first describe the way the freedom of movement was introduced and the way cross-border workers benefited. Second, we illustrate the enforcement of the Schengen agreement and its impact on the workers commuting behaviour.

3.1 The free movement of labour in Switzerland

In 1999 the EU and Switzerland signed the Agreement on the Free Movement of Persons (AFMP). The AFMP had the objective of lifting the restrictions on EU citizens wishing to live or work in Switzerland. The right of free movement was complemented by the mutual recognition of professional qualifications, by the right to buy property, and by the coordination of social insurance systems. The liberalization was officially approved by a national referendum in 2000 and came into force for citizens of the "old" EU member states (EU-15) as well as for citizens of EFTA member states in 2002. This agreement represented an important step towards the free movement of workers in Switzerland, which came officially into place for the EU-15 citizens in 2007. The AFMP gradually removed all prior legal restrictions on hiring and employing of resident immigrants and cross-border commuters. However, the transition process towards full mobility differed for the two categories of workers (Ruffner and Siegenthaler, 2017). Before 1999, Swiss firms were only allowed to hire cross-border commuters if the "priority requirement" was satisfied, that is if no equally qualified resident worker could be found for a given job. In addition, cross-border commuters could only work in the border regions of Switzerland. The other type of immigrant workers were subject instead to annual national quotas set by the federal government on top of satisfying the "priority requirement". Between 1999 and 2004, gradually cross-border commuters were allowed to commute to work weekly (instead of daily), their permits were no longer bound to a particular job and were valid for 5 years (instead of 1 year) and applicants for a new cross-border commuters permit were no longer required to have resided in the adjacent border region of the neighbouring country for the previous six months. In 2004, the second phase of the reform was implemented and the labour markets of border regions municipalities became fully open to cross-border commuters, even though they were not allowed to work in non border regions. Finally, on June 1, 2007, all regions adopted full liberalization for cross-border commuters as well as for resident immigrants from the EU and citizens of EFTA member states.

3.2 The Schengen agreement

In 2005, by means of a national referendum Swiss citizens were asked to express their opinion about Switzerland signing the Schengen agreement. Swiss voters agreed, by a 55% majority, to join the Schengen area. 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.[2] 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 EU. However, in 1999 the incorporation of the Schengen acquis into the main body of EU 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.

As a consequence of the 2005 referendum result, on 27 November 2008, 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 increasingly took part in Schengen substitute measures and in assignments at the EU external borders (FRONTEX), but most of the guards were redeployed to replace international police officers at Swiss airports to carry out controls on passengers crossing external Schengen borders (AdminCH).

---

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

3.3 Recent Developments

Following the terrorist attacks in Paris (November 2015) and Brussels (March 2016), several EU Member States re-established border controls due to the geopolitical situation at international level. Although these decisions were temporary and legally envisioned by the Schengen agreement, their extent disrupted the free movement within the Schengen area, specifically in border regions. Although several Member States had used those safeguarding mechanisms in the past, the geographical and temporal scale of these restrictions of the free movement of labour led some analysts to talk about the "dismantling" of the Schengen area (Evrard et al., 2018).

In addition, in February 2014 in Switzerland the popular initiative "Against mass immigration" was launched by the national conservative Swiss People's Party with the goal of re-introducing immigration quotas (Abu-Hayyeh et al., 2014). The referendum was accepted by a majority of the electorate. Being all Swiss-EU bilateral treaties on single market participation all co-dependent, the termination of one implies the end point of all. On December 2016, Switzerland and the EU concluded an agreement that a new Swiss law (in response to the referendum) may require Swiss employers to give priority to Swiss-based job seekers (Swiss nationals and foreigners registered in Swiss job agencies) but does not limit the free movement of EU workers to Switzerland. *De facto*, this new law penalizes cross-border commuters, as Swiss residents, both Swiss and EU, have priority in getting jobs with respect with non-Swiss residents.

4 Identification and empirical strategy

The objective of our study is to investigate the impact of the implementation of the Schengen agreement on cross-border commuting. 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.

4.1 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.
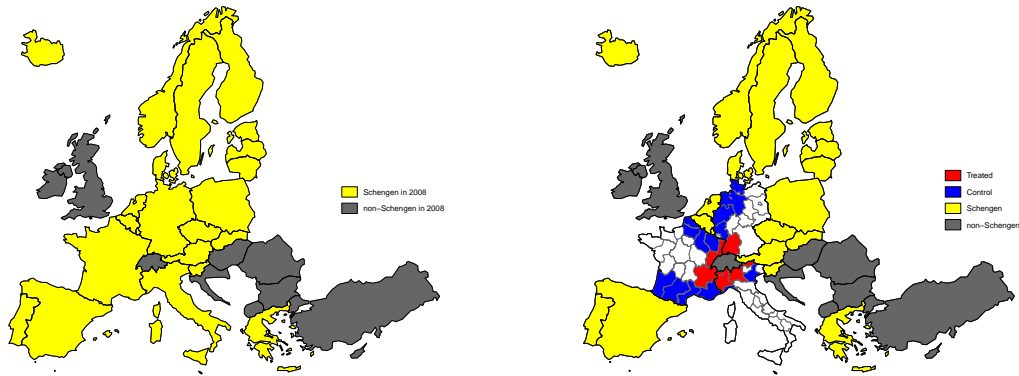
(a) The Schengen area.

(b) Regions where treatment and control workers reside.

Figure 2. Countries in the Western part of the Schengen area and regions where treated and control workers reside.

In Figure 2a, 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.[3] 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 (Figure 2b).[4] 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 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

---

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

[4]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.
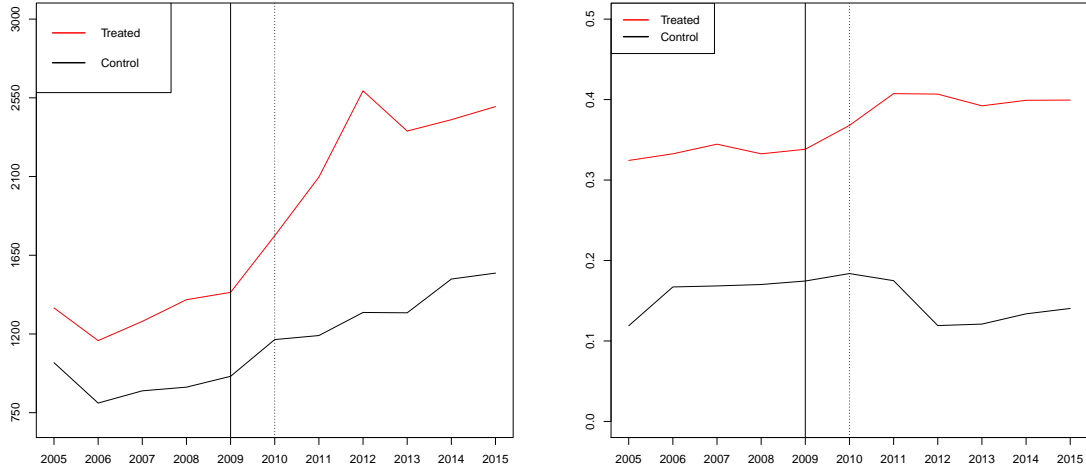
(a) Absolute numbers. (b) Percentage of inter-regional commuters.

Figure 3. Cross-border commuters in treated and control regions.

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.

4.2 Validity of our approach

The two key assumptions for any Difference-in-Differences strategy is that (i) the outcome in treated and control groups would follow the same time trend in the absence of the treatment (parallel trend assumption) and (ii) the composition of treated and control groups is stable for repeated cross-sectional design (Abadie, 2005; Bertrand et al., 2004).

The first assumption implies 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 3 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

12

regions, the trend was similar across the two groups, reassuring us on the validity of the Difference-in-Differences identifying assumption.

Table 1. Characteristics of inter-regional commuters in treated and control groups before and after treatment.

	Control				Treated			
	Pre-2008		Post-2008		Pre-2008		Post-2008	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Demographic characteristics								
Female	0.34	0.47	0.34	0.47	0.33	0.47	0.34	0.47
Single	0.37	0.48	0.37	0.48	0.37	0.48	0.37	0.48
Age 16-24	0.10	0.29	0.08	0.27	0.08	0.27	0.08	0.27
Age 25-34	0.23	0.42	0.20	0.40	0.26	0.44	0.22	0.41
Age 35-49	0.44	0.50	0.44	0.50	0.44	0.50	0.44	0.50
Age 50-64	0.23	0.42	0.28	0.45	0.22	0.41	0.27	0.44
Primary	0.21	0.41	0.15	0.36	0.26	0.44	0.20	0.40
Secondary	0.48	0.50	0.50	0.50	0.47	0.50	0.47	0.50
Tertiary	0.30	0.46	0.35	0.48	0.27	0.45	0.33	0.47
Work characteristics								
Cross-border	0.15	0.36	0.14	0.35	0.33	0.47	0.39	0.49
Full-time	0.88	0.32	0.86	0.35	0.89	0.32	0.86	0.35
Permanent	0.81	0.39	0.82	0.38	0.77	0.42	0.80	0.40
HS WC	0.47	0.50	0.50	0.50	0.47	0.50	0.51	0.50
LS WC	0.20	0.40	0.22	0.42	0.19	0.39	0.19	0.39
HS BC	0.14	0.35	0.12	0.32	0.16	0.37	0.15	0.36
Unempl 1y	0.03	0.18	0.03	0.18	0.04	0.18	0.04	0.19
Empl 1y	0.92	0.27	0.92	0.27	0.92	0.27	0.92	0.27
Agriculture	0.01	0.12	0.01	0.10	0.01	0.12	0.01	0.09
MEM	0.24	0.43	0.22	0.41	0.30	0.46	0.30	0.46
Construction	0.07	0.26	0.07	0.26	0.08	0.27	0.09	0.28
DTC	0.28	0.45	0.31	0.46	0.27	0.45	0.28	0.45
Finance	0.17	0.38	0.16	0.37	0.15	0.36	0.14	0.34
NMS	0.23	0.42	0.22	0.42	0.18	0.39	0.19	0.39
Firm size 1-10	0.15	0.35	0.15	0.36	0.17	0.38	0.17	0.37
Firm size 11-19	0.14	0.35	0.14	0.34	0.15	0.36	0.16	0.37
Firm size 20-49	0.14	0.35	0.13	0.34	0.14	0.35	0.13	0.34
Firm size 50+	0.54	0.50	0.56	0.50	0.46	0.50	0.49	0.50
Observations	23991		63017		14861		37035	

Note: The characteristics of inter-regional workers in treated and control regions before and after 2008 are reported. Occupations are categorised into the high-skilled white-collar (HS WC), low-skilled white-collar (LS WC) and high-skilled blue-collar (HS BC). Sectors are categorised into Agriculture, Mining, Energy and Manufacturing (MEM), Distribution, Transportation and Communication (DTC), Finance and Non-Market Services (NMS). Source: ELFS data.

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.

The second assumption implies that the Difference-in-difference approach cannot be used

if the composition of treated and control groups pre/post treatment are not stable. Hence, in order to provide evidence in support of this assumption, we report in Table 1 the demographic and work characteristics of inter-regional commuters in treated and control groups before and after the implementation of Schengen. The stability in the features characterizing the two groups before and after the treatment supports the validity of our approach.

4.3   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 3.2, 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[5] and we estimate the following equation:

$$
\begin{aligned}
P(\text{CB-Comm} = 1 | X)_{i,r,t} \;=\; & E(\alpha + \beta \text{Post-2008}_t + \gamma \text{Treated}_r + \delta \text{Treated}_r \text{Post-2008}_t + \\
& + \; \lambda X_{i,r,t} + \rho_r + \mu_t + \epsilon_{i,r,t})
\end{aligned}
\tag{1}
$$

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. *Post-2008* is

---

[5]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.

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, but not Switzerland. The matrix $X_{i,r,t}$ includes a set of individual pre-treatment characteristics which may affect the individual probability to cross-border commute. It also includes regional time-varying characteristics to capture region-specific economic trend which may affect the dependent variable. Finally, μ_t captures year fixed effects, ρ_r includes regional fixed effects and $\epsilon_{i,r,t}$ is the individual iid error term.

We run this equation by using ordinary least squares, so the estimated coefficients are readily interpretable as marginal effects. The coefficient β measures the difference in the probability of cross-border commuting after Switzerland joined the Schengen area for both groups. The coefficient γ measures the difference in the probability of cross-border commuting between treated and control groups. The parameter of interest is δ 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 δ 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 characteristics (i.e., individual-specific propensity to cross-border commute) as well as regional differential in macro-economic variables. Conversely, a value of δ 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-sector clustered standard errors.

As mentioned before, the crucial identifying assumption of our empirical approach is that

we would have observed the same average change in outcomes in treated and control regions in the absence of the reform. Although in Section 4.2 we have provided some evidence in support of the common-trend assumption, we will also assess its plausibility more formally. To this end, we generalize Equation 1 to an event study Difference-in-Difference model by interacting the treatment with a dummy for each year in the period 2005-2015. The model takes the following form:

$$
\begin{aligned}
P(\text{CB-Comm} = 1|X)_{i,r,t} \;=\; & E(\alpha + \gamma \text{Treated}_r + \delta_t \text{Treated}_r \text{Year}_t + \\
& + \; \lambda X_{i,r,t} + \rho_r + \mu_t + \epsilon_{i,r,t})
\end{aligned}
\tag{2}
$$

The estimates of the coefficients δ_t for each year between 2005 and 2015 are the parameters of interest. All effects are estimated relative to 2009. The impact of the policy is expected to be equal to zero before 2009, the year of the treatment. After 2009, the parameters reveal the effect of Switzerland joining the Schengen Area on the probability to commute across the border.

Finally, in order to explore differences in the treatment across specific categories of workers, we estimate a triple Difference-in-Difference model, where we take into account individual features according to the following model:

$$
\begin{aligned}
P(\text{CB-Comm} = 1|X)_{i,r,t} \;=\; & E(\alpha + \beta \text{Post-2008}_t + \gamma \text{Treated}_r + \sigma \text{Category}_j + \\
& + \; \kappa \text{Treated}_r \text{Post-2008}_t + \eta \text{Category}_j \text{Post-2008}_t + \\
& + \; \phi \text{Category}_j \text{Treated}_r + \delta_j \text{Treated}_r \text{Post-2008}_t \text{Category}_j + \\
& + \; \lambda X_{i,r,t} + \rho_r + \mu_t + \epsilon_{i,r,t})
\end{aligned}
\tag{3}
$$

We are interested in the parameters δ_j which provides information on the causal effect of the implementation of Schengen on the probability of cross-border commuting among specific groups of individuals, according to gender, education, age, and employment status

and professional status one year before.

5 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 EU 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.[6] 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 kilometers, while sharing also the border with Germany and Italy for a number of kilometers, we exclude from our analysis commuters from Austria.[7] 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% traveled 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

---

[6]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 EU, 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.

[7]We also exclude from our sample commuters residing in Switzerland and commuting to Italy, France, and Germany as the information on the region of work is missing in the Swiss labour force survey until 2009.

and youth unemployment to construct measures of unemployment variations at regional level 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. To take into account differences in real estate prices across different countries we also use national data on house prices from the Bank of International Settlements (BIS) .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.[8] From Eurostat 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 on the decision to cross-border commute. The exchange rate variable is constructed as the ratio between the exchange rate between the region of residence and the region of work and the price level of the region of residence. This allows us to have a measure of the "real" exchange rate that takes into account where cross-border commuters work and reside. 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[9] between two languages, "the lexicostatistical percentage", and

---

[8]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.

[9]The translations of a word in two languages are "cognate" if within both languages they have an unbroken

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. Moreover, this is the period in which the Schengen agreement was fully implemented in the countries which are included in our analysis, as described in Section 3. Among all individuals living in Germany, France or Italy, we keep observations of individuals who live in regions, which share the border either with Switzerland or with a country belonging to the Schengen area.[10] Moreover, we focus our study on inter-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. The literature on commuting shows evidence of self-selection of workers that are willing to commute, especially long-distance.[11] While a number of these features are observable and can be controlled for, some are endogenous and cannot be included in our regression and some are unobservable, thus affecting the validity of our estimates (Imbens and Wooldridge, 2009).[12]

Hence, to keep our sample as homogeneous as possible, we focus on inter-regional commuters who share similar features, including a higher propensity to commute. Our sample includes 138,904 individuals who commute for working reasons across regions which are located either in the same country or in a neighbouring country.

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-

---

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.

[10]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.

[11]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, 2019; 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).

[12]In fact, when considering the whole sample of workers, which includes all working individuals, and the sample of the entire labour force, both employed and unemployed individuals, both the parallel trend assumption and the assumption on the stability of the composition between treated and control groups are not satisfied.

(a) To Switzerland and to Other Countries.

(b) By sector.
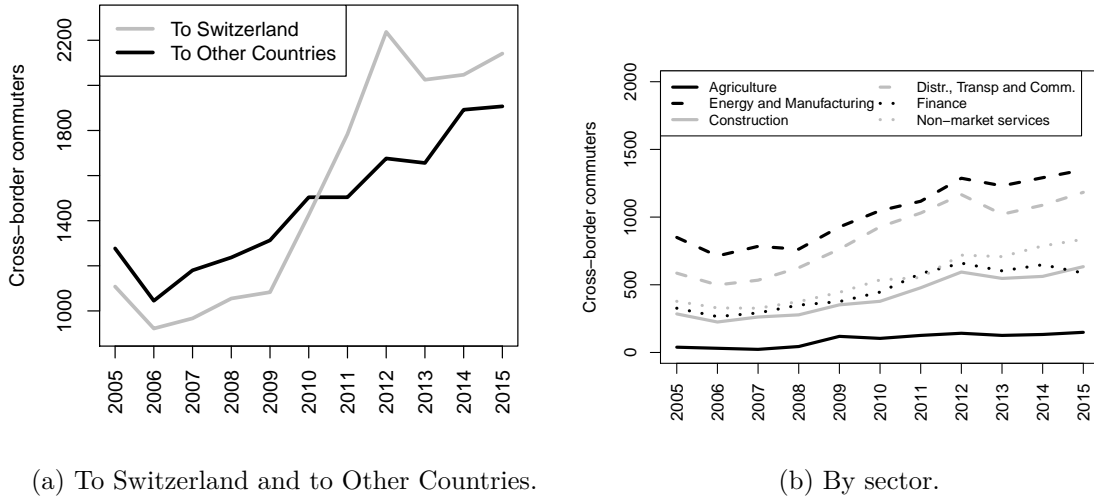
Figure 4. Number of cross-border commuters. Source: ELFS.

viduals before 2009 to almost 4,000 individuals in the years after 2010 (Figure 4a). When we confine our analysis looking at workers who commute towards Switzerland we observe a spike starting from 2009. 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 4b).

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, and marital status. We also control for the labour status one year before, i.e., if the workers were employed or unemployed.

Among cross-border commuters in both treated and control regions (Table 2), we observe that approximately 65% of workers are men and married. Almost 50% 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 more than 85% have a permanent contract; almost 30% are hired as high-skilled white-collars and almost 60% work in a large firm with more than 50 employees either in the energy and manufacturing sector (MEM) or in the distribution, transportation and communication (DTC) sector. More than 90% were employed one year before. These

20

Table 2. Characteristics of cross-border commuters in treated and control groups before and after treatment.

	Control				Treated			
	Pre-2008		Post-2008		Pre-2008		Post-2008	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Demographic characteristics								
Female	0.34	0.47	0.34	0.47	0.34	0.48	0.36	0.48
Single	0.38	0.49	0.38	0.48	0.33	0.47	0.35	0.48
Age 16-24	0.08	0.27	0.07	0.25	0.07	0.25	0.06	0.24
Age 25-34	0.26	0.44	0.25	0.43	0.23	0.42	0.23	0.42
Age 35-49	0.49	0.50	0.47	0.50	0.48	0.50	0.46	0.50
Age 50-64	0.17	0.38	0.21	0.41	0.22	0.42	0.25	0.43
Primary	0.28	0.45	0.20	0.40	0.29	0.45	0.19	0.39
Secondary	0.49	0.50	0.52	0.50	0.49	0.50	0.49	0.50
Tertiary	0.23	0.42	0.28	0.45	0.22	0.41	0.32	0.47
Work characteristics								
Full-time	0.89	0.32	0.85	0.36	0.87	0.34	0.83	0.37
Permanent	0.86	0.35	0.85	0.36	0.87	0.34	0.88	0.32
HS WC	0.28	0.45	0.34	0.47	0.36	0.48	0.46	0.50
LS WC	0.19	0.39	0.23	0.42	0.20	0.40	0.19	0.39
HS BC	0.23	0.42	0.17	0.38	0.23	0.42	0.19	0.39
Agriculture	0.00	0.07	0.00	0.04	0.01	0.09	0.00	0.06
MEM	0.37	0.48	0.29	0.46	0.35	0.48	0.33	0.47
Construction	0.11	0.31	0.11	0.31	0.12	0.32	0.12	0.33
DTC	0.22	0.41	0.29	0.46	0.27	0.45	0.26	0.44
Finance	0.17	0.38	0.16	0.37	0.10	0.30	0.11	0.32
NMS	0.13	0.33	0.14	0.35	0.16	0.36	0.17	0.38
Firm size 1-10	0.09	0.28	0.13	0.34	0.15	0.36	0.13	0.34
Firm size 11-19	0.16	0.37	0.18	0.39	0.14	0.35	0.18	0.39
Firm size 20-49	0.15	0.36	0.10	0.30	0.16	0.36	0.11	0.31
Firm size 50+	0.58	0.49	0.57	0.49	0.53	0.50	0.56	0.50
Unempl 1y	0.04	0.18	0.04	0.20	0.03	0.17	0.03	0.17
Empl 1y	0.93	0.26	0.93	0.26	0.94	0.23	0.95	0.23
Observations	3612		9022		4950		14446	

Note: The characteristics of inter-regional workers in treated and control regions before and after 2008 are reported. Occupations are categorised into the high-skilled white-collar (HS WC), low-skilled white-collar (LS WC) and high-skilled blue-collar (HS BC). Sectors are categorised into Agriculture, Mining, Energy and Manufacturing (MEM), Distribution, Transportation and Communication (DTC), Finance and Non-Market Services (NMS). Source: ELFS data.

features are rather stable in the period before and after the treatment, except for education and occupation: the share of cross-border commuters with a tertiary level of education increased by 5 percentage points in control regions and by 10 percentage points in treated regions. Similarly, the share of high-skilled white collar increased by more than 5 percentage points in control regions and by 10 percentage points in treated regions. When looking at the destination of inter-regional commuters living in treated regions before and after the treatment, we observe (Table 3) that the increase in cross-border commuting to Switzerland not always came at the expense of commuting to another bordering region.[13] In some regions,

---

[13]This is the case for FR42, FR43, and ITC1, however in DE10, and FR71, commuting increases towards Switzerland as well as towards other bordering regions. Moreover, while in ITC2 and ITC4 commuting slightly decreased to Switzerland, it increased towards other contiguous regions in ITC2 and decreased in ITC4. Finally, in ITH1 commuting increased to Switzerland, and remain unchanged towards other contiguous regions.

Table 3. Destination of inter-regional commuters living in treated regions.

	Switzerland		Elsewhere	
	Pre-2008	Post-2008	Pre-2008	Post-2008
DE10	0.28	0.29	0.65	0.67
FR42	0.42	0.52	0.36	0.28
FR43	0.21	0.36	0.58	0.53
FR71	0.44	0.49	0.19	0.25
ITC1	0.12	0.19	0.78	0.70
ITC2	0.04	0.03	0.71	0.66
ITC4	0.27	0.26	0.14	0.17
ITH1	0.10	0.17	0.06	0.06

Note: Share of inter-regional commuters living in treated regions and commuting to a bordering region on the total number of inter-regional commuters living in treated regions before and after 2008.

commuting increased both nationally and across the border, in other regions, it increased in one but decreased in the other and viceversa. Overall, we do not find a clear-cut evidence of a substitution between commuting from contiguous national regions to commuting to Switzerland for inter-regional commuters living in treated regions as a consequence of the implementation of Schengen.

6   Results

The results of our estimations are reported in Table 4. In the first Column, we show the coefficients of the estimation of the baseline specification, where we control for regional and year fixed effects and we include the demographic characteristics described in Table 1 as controls. Our coefficient of interest, which is the coefficient of the interaction between the treatment variable and the treated group, *Treated Post-2008*, is positive and significant. Specifically, in line with the evidence of Figure 3, we find that the probability to commute cross-border to Switzerland is approximately 2.9 percentage points higher for inter-regional commuters who reside in regions which share the border with Switzerland, after the country joined the Schengen area. The high R-squared (34.8%) associated with this regression proves that we are able to explain a large share of the variation of our dependent variable.

In order to control for time-variant region-specific characteristics, we include in Columns 2 and 3 of Table 4 unemployment differentials (either total or youth) as well as an index of the quality of the road infrastructure. We would expect that the higher the average rate of (youth) unemployment in the regions within the same country relative to the regions in

Table 4. Interregional Commuters.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post-2008	0.026**	0.020	0.020	0.019	0.024*	0.028	0.037***
	(0.013)	(0.014)	(0.014)	(0.016)	(0.012)	(0.017)	(0.012)
Treated	0.318***	0.332***	0.330***	0.319***	0.320***	0.318***	0.225***
	(0.037)	(0.040)	(0.040)	(0.040)	(0.038)	(0.037)	(0.033)
Treated Post-2008	**0.029****	**0.028****	**0.031****	**0.033****	**0.026***	**0.031****	**0.025***
	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.012)	(0.014)
Road Network		−0.120	−0.113				
		(0.111)	(0.113)				
Youth Unem Differential*Age 16-24		−0.00002					
		(0.0001)					
Unem Differential			0.00005				
			(0.00004)				
Empl. Agriculture				−0.046			
				(0.036)			
Empl. MEM				0.015			
				(0.014)			
Empl. Construction				−0.059			
				(0.060)			
Empl. Finance				−0.001			
				(0.037)			
Empl. NMS				0.001			
				(0.073)			
House Prices					−0.037		
					(0.027)		
Exchange Rate						−0.027	
						(0.113)	
Closeness of Language							−0.006***
							(0.001)
Constant	0.007	0.116	0.110	0.021	0.040	0.032	0.641***
	(0.012)	(0.104)	(0.105)	(0.032)	(0.028)	(0.097)	(0.105)
Regional fixed effect	YES	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES
Individual characteristics	YES	YES	YES	YES	YES	YES	YES
Observations	138,904	138,904	138,904	138,904	138,904	138,904	138,904
Adjusted R^2	0.348	0.348	0.348	0.348	0.348	0.348	0.382

Note: Dependent variable is the probability of cross-border commuting. Standard errors are clustered at region-sector level.
In Column 1 we control for regional dummies, in Column 2 we control for road network and youth unemployment differential,
in Column 3 we control for unemployment differential, in Column 4 we control for employment share by sector, in Column 5
we control for house prices, in Column 6 we control for the exchange rate, in Column 7 we control for closeness of language.
Sectors are categorised into Agriculture, Mining, Energy and Manufacturing (MEM), Distribution, Transportation
and Communication (DTC), Finance and Non-Market Services (NMS). *p<0.1; **p<0.05; ***p<0.01.
The baseline cross-border commuting rate is 22%.

a foreign country, the higher the likelihood of (young) individuals to commute across the border. We would also expect younger individuals to be the category of workers who is more responsive to unemployment differentials across regions. We report that both the total unemployment differential and the youth unemployment differential, when interacted with the 16-24 age group dummy, are not significantly different from zero. However, the coefficient of interest is positive and significant across both specifications, and keeps the same magnitude. The variable which captures the quality of the infrastructure is also not significantly different from zero.

In Column 4 of Table 4, we expand our baseline specification by adding regional employment shares by sector. By including these controls, we aim at capturing the changes in the share of regional employment across sectors ascribable to the business cycle. Specifically, we want to capture the asymmetric impact of the great recession on European regions across economic sectors. We expect that whenever the share of employment in specific sectors is

higher in national regions compared to foreign regions, cross-border commuting to foreign regions is lower. We find that the coefficients of regional employment shares in agriculture, construction and Finance have a negative sign, even though they are not significantly different from zero. Nevertheless, our coefficient of interest which represents the Schengen effect is still positive, significantly different from zero and keeps the same magnitude. In Column 5 of Table 4, 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 but not significant, while the effect of Schengen is still positive and significant and keeps the same magnitude. In Column 6 of Table 4, we control for the exchange rate. In fact, the strong appreciation of the Swiss Franc in the period between 2007 and 2011 could have made commuting into Switzerland more attractive. Also in this case the coefficient is negative but not significantly different from zero, while the effect of Schengen is still positive and significant and keeps the same magnitude. Finally, in our last specification (Column 7), we 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 of the coefficient of interest to 2.5 percentage points. 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. We also report in Figure 5 the coefficients of the interaction between the treatment variable and each year in the period 2005-2015. These event study coefficients are obtained by estimating Equation 2. As expected, there is no significant effect on cross-border commuting before 2009, while we observe a positive effect although not significantly different from zero in 2010. The effect becomes larger and significantly different from zero starting from 2011.
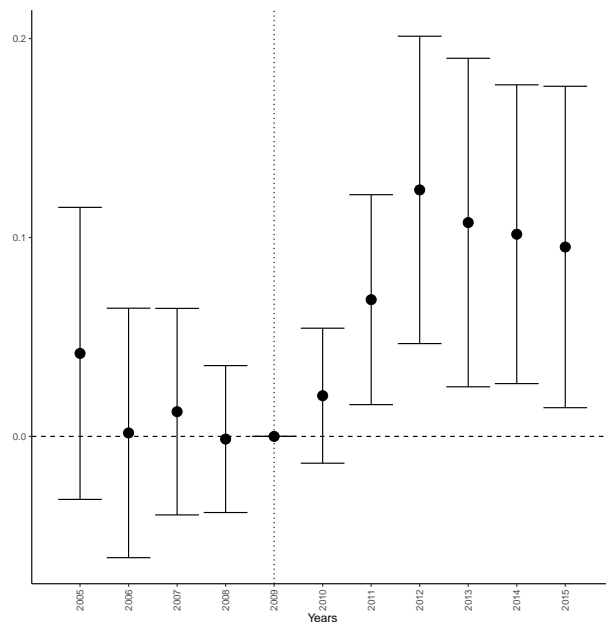
Figure 5. Event study on the effect of the treatment, i.e., the implementation of the Schengen agreement in Switzerland in December 2008, on the probability of cross-border commuting. Each dot represents the coefficient of the interaction between the treatment variable and the corresponding year in the period 2005-2015. Per each coefficient, the 95% confidence interval is also reported. Year 2009 has been set as the reference year.

6.1 Heterogeneous effects

As specific subgroups could have been affected differently by the Schengen implementation, we also estimate a set of triple Difference-in-Difference (Equation 3), as described in Section 4.3. Results are reported in Table 5. For our estimations, we use the baseline specification where we include regional and year fixed effects and demographic characteristics. We find that the probability of younger workers in the age category 25-34 to commute across the border after the implementation of Schengen is higher by 6.7 percentage points. We also find that the probability to commute across the border after the implementation of Schengen is 3.4 percentage points higher for females and 2.7 percentage points higher for males. Tertiary educated workers have a higher probability to commute across the border by 7.8 percentage points. We also perform triple Difference-in-Differences estimations by looking at the employment status of inter-regional workers one year before. We find that those workers who were employed the year before have a higher probability to commute cross-border after 2009 (by 3.1 percentage points). When looking at the professional status one year before, we find that it does not affect the probability to cross-border commute. Finally, we perform a triple

25

Table 5. Interregional Commuters - Heterogeneous effects.

	(1)	(2)	(3)	(4)	(5)	(6)
Age 15-24	−0.002					
	(0.034)					
Age 25-34	0.067***					
	(0.021)					
Age 35-49	0.027					
	(0.020)					
Age 50-64	0.005					
	(0.019)					
Female		0.034*				
		(0.019)				
Male		0.027*				
		(0.015)				
Primary			−0.015			
			(0.025)			
Secondary			0.024			
			(0.017)			
Tertiary			0.078***			
			(0.015)			
Empl 1y				0.031**		
				(0.015)		
Unempl 1y				−0.018		
				(0.035)		
Inactive 1y				−0.014		
				(0.032)		
Self-employed 1y					0.023	
					(0.025)	
Employee 1y					0.022	
					(0.016)	
Family worker 1y					−0.115	
					(0.071)	
Not employed 1y					−0.008	
					(0.023)	
Agriculture 1y						0.021
						(0.069)
MEM 1y						0.026
						(0.027)
Construction 1y						−0.023
						(0.030)
DTC 1y						−0.011
						(0.031)
Finance 1y						0.029*
						(0.016)
NMS 1y						0.038*
						(0.020)
Constant	0.017	0.007	−0.110*	−0.011	−0.001	0.018
	(0.012)	(0.012)	(0.063)	(0.017)	(0.015)	(0.014)
Observations	138,904	138,904	138,904	126,123	121,999	138,904
Adjusted R^2	0.349	0.348	0.349	0.347	0.338	0.355

Note: The dependent variable is the probability of cross-border commuting. We use the baseline specification where we control for regional and year fixed effects and we include demographic characteristics. Standard errors are clustered at region-sector level. Sectors are categorised into Agriculture, Mining, Energy and Manufacturing (MEM), Distribution, Transportation and Communication (DTC), Finance and Non-Market Services (NMS). *p<0.1; **p<0.05; ***p<0.01.
The baseline cross-border commuting rate is 22%.

Difference-in-Differences estimation by looking at the sector the workers were employed in one year before. We find that workers hired in Finance and non-market services are more likely to commute across borders after 2009 by approximately 2.9 and 3.8 percentage points, respectively. Evidence of the parallel trend assumption for these categories of workers are reported in Figures 16-21.

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 et al. (2018). 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 in December 2008. With data availability from 2005,[14] we can test whether the 2007 reform had an impact on cross-border commuting to Switzerland. We would expect the 2007 freedom of movement to have an effect on the probability to migrate to Switzerland as workers have now the possibility to work in Switzerland without working permits. However, we would not expect a positive effect on cross-border commuting as as the extension of the freedom of movement to all EU-15 and EFTA workers is not as relevant for the decision to cross-border commute from regions which do not share the border, due to distance issues. In fact, Beerli et al. (2018) claim that "CBC, as frequent commuters, are sensitive to geographical distance and rarely travel at a driving distance larger than 20-30 minutes". Nevertheless, we would expect the implementation of the Schengen agreement to significantly affect the probability to cross-border commute as the cost of crossing the border would be much lower, due to quicker and easier commuting trips. Specifically, the combination of the free movement of labour, which allows individuals to work without a permit, and the Schengen implementation, which allows individuals to travel without stopping at the border, is expected to be very beneficial for cross-border commuters.

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 6. Across all our specifications, we observe

---

[14]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.

no significant effect of our variable 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 7 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 et al. (2018), we have a clear picture of the policies which were effective in increasing the flow 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 unem-

Table 6. Inter-regional commuters - Placebo 2007.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post-2006	0.029***	0.020	0.019	0.033**	0.026***	0.023*	0.040***
	(0.009)	(0.013)	(0.013)	(0.013)	(0.009)	(0.012)	(0.010)
Treated	0.319***	0.336***	0.333***	0.323***	0.322***	0.322***	0.227***
	(0.039)	(0.042)	(0.042)	(0.042)	(0.039)	(0.039)	(0.035)
Treated Post-2006	**0.022**	**0.022**	**0.025**	**0.020**	**0.018**	**0.015**	**0.017**
	(0.016)	(0.017)	(0.018)	(0.017)	(0.017)	(0.015)	(0.017)
Road Network	NO	YES	YES	NO	NO	NO	NO
Unem Diff	NO	YES	NO	NO	NO	NO	NO
Youth Unem Diff	NO	NO	YES	NO	NO	NO	NO
Employment share	NO	NO	NO	YES	NO	NO	NO
House prices	NO	NO	NO	NO	YES	NO	NO
Exchange Rate	NO	NO	NO	NO	NO	YES	NO
Closeness of Language	NO	NO	NO	NO	NO	NO	YES
Regional fixed effect	YES	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES
Individual characteristics	YES	YES	YES	YES	YES	YES	YES
Observations	138,904	138,904	138,904	138,904	138,904	138,904	138,904
Adjusted R^2	0.348	0.348	0.348	0.348	0.348	0.348	0.382

Note: Dependent variable is the probability of cross-border commuting. Standard errors are clustered at region-sector level. In Column 1 we control for regional dummies, in Column 2 we control for road network and youth unemployment differential, in Column 3 we control for unemployment differential,in Column 4 we control for employment share by sector, in Column 5 we control for house prices, in Column 6 we control for the exchange rate, in Column 7 we control for closeness of language. *p<0.1; **p<0.05; ***p<0.01. The baseline cross-border commuting rate is 22%.

Table 7. Inter-regional commuters - Placebo 2008.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post-2007	0.027**	0.020	0.020	0.027*	0.023**	0.023	0.039***
	(0.011)	(0.014)	(0.014)	(0.016)	(0.011)	(0.014)	(0.010)
Treated	0.319***	0.335***	0.333***	0.323***	0.322***	0.321***	0.227***
	(0.038)	(0.041)	(0.041)	(0.041)	(0.039)	(0.038)	(0.034)
Treated Post-2007	**0.024**	**0.023**	**0.025**	**0.023**	**0.020**	**0.019**	**0.019**
	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)	(0.016)	(0.017)
Road Network	NO	YES	YES	NO	NO	NO	NO
Unem Diff	NO	YES	NO	NO	NO	NO	NO
Youth Unem Diff	NO	NO	YES	NO	NO	NO	NO
Employment share	NO	NO	NO	YES	NO	NO	NO
House prices	NO	NO	NO	NO	YES	NO	NO
Exchange Rate	NO	NO	NO	NO	NO	YES	NO
Closeness of Language	NO	NO	NO	NO	NO	NO	YES
Regional fixed effect	YES	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES
Individual characteristics	YES	YES	YES	YES	YES	YES	YES
Observations	138,904	138,904	138,904	138,904	138,904	138,904	138,904
Adjusted R^2	0.348	0.348	0.348	0.348	0.348	0.348	0.382

Note: Dependent variable is the probability of cross-border commuting. Standard errors are clustered at region-sector level. In Column 1 we control for regional dummies, in Column 2 we control for road network and youth unemployment differential, in Column 3 we control for unemployment differential,in Column 4 we control for employment share by sector, in Column 5 we control for house prices, in Column 6 we control for the exchange rate, in Column 7 we control for closeness of language. *p<0.1; **p<0.05; ***p<0.01. The baseline cross-border commuting rate is 22%.

ployment 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
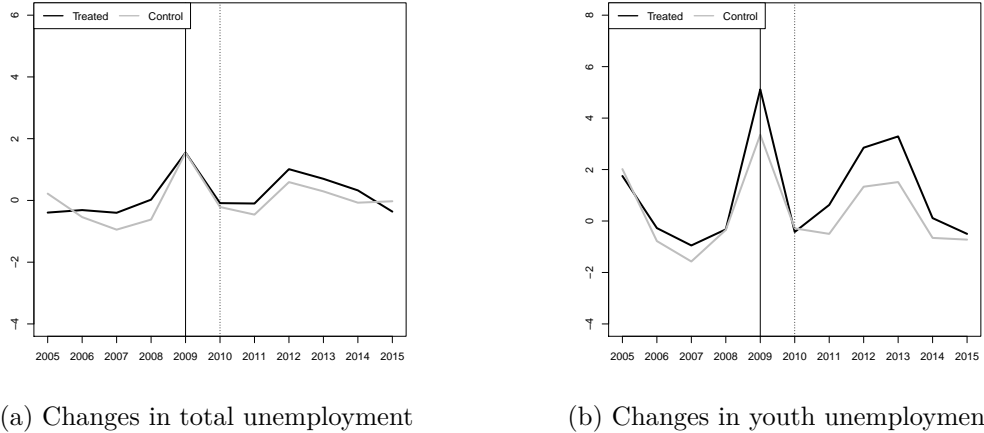
Figure 6. Unemployment trends in treated and control regions.
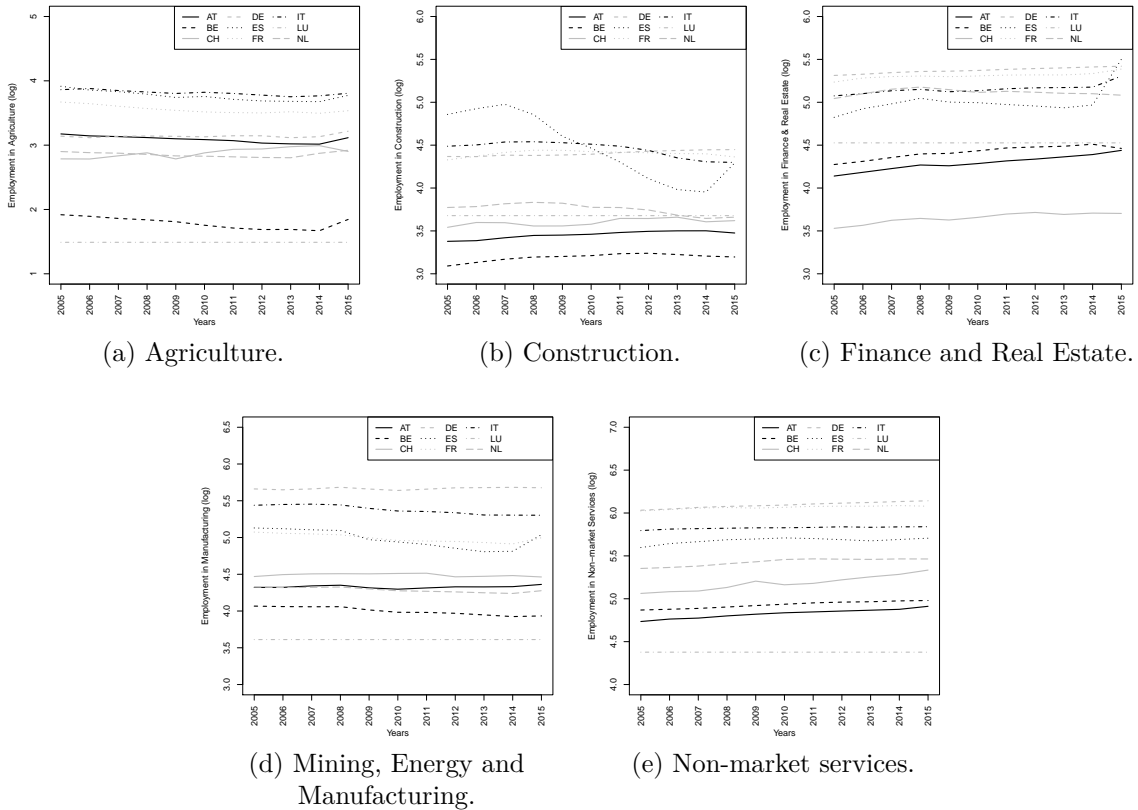
We compute the percentage point changes in the total unemployment rate and the youth unemployment rate in treated and control regions, as it is the annual change in these two indicators which might have had a stronger impact on the individual commuting decision.[15] Results are reported in Figures 6a and 6b. 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 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[16] 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,

---

[15]Nevertheless, we report also in Section 7 the analysis where we control for unemployment rates instead of differences.

[16]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.

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.[17]

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

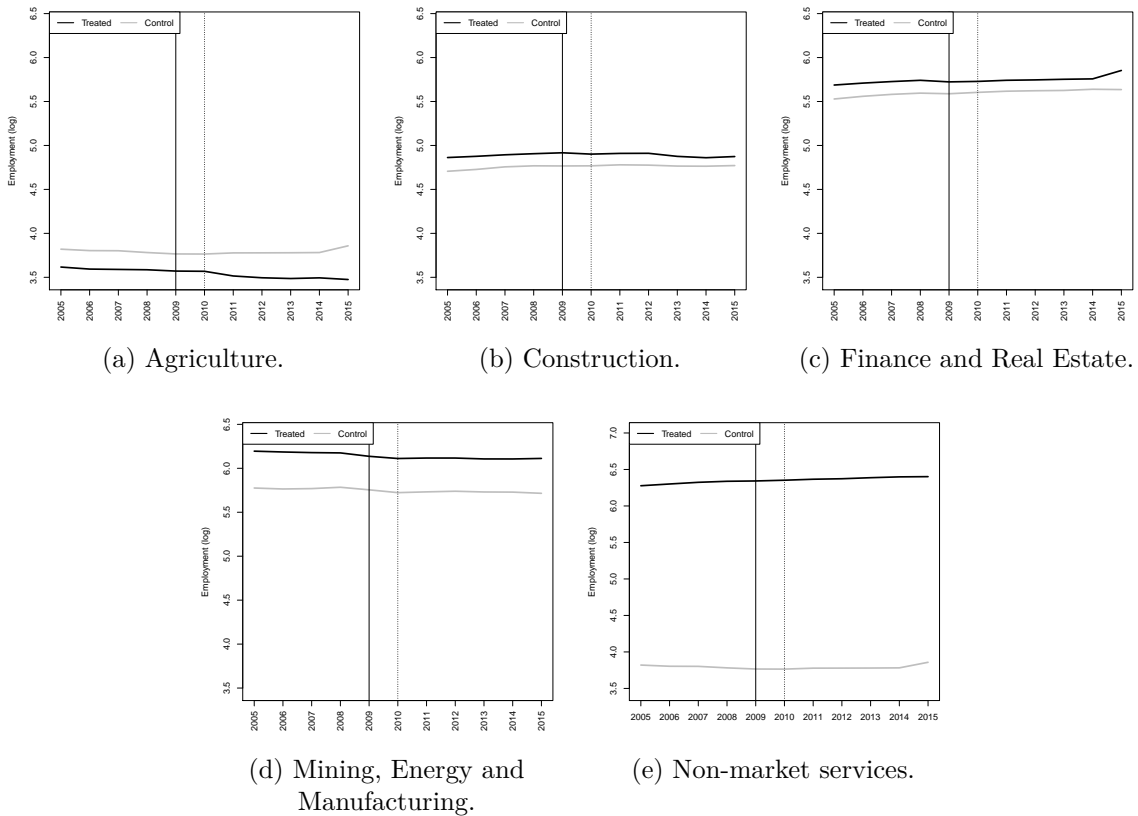(d) Mining, Energy and Manufacturing.   (e) Non-market services.

Figure 7. Employment (in logs) by country and sector.

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

---

[17]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.

across sectors by country (Figure 7), 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 7 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 8), we observe similar trends across the two 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 8. Employment (in logs) by sector in treated and control regions.

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 aim at splitting 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. One possible concern associated with this strategy is the endogeneity of the individual choice to work in a specific sector. In fact, workers might self-select themselves in specific sectors as a reaction to the decision of Switzerland to join the Schengen area. To address this issue and to quantify the magnitude of the flows of workers across sectors, we compute the average transition probabilities between sectors (Table 8). We observe that the probability to transit from a sector to another is on average between 2% and 3%, being agriculture the only sector with a higher rate of approximately 10%.

Table 8. Transition probabilities between sectors.

	Agriculture	Construction	DTC	MEM	Finance	NMS
Agriculture	**0.90**	0.01	0.03	0.03	0.01	0.01
Construction	0.00	**0.97**	0.01	0.01	0.01	0.00
DTC	0.00	0.00	**0.97**	0.01	0.01	0.00
MEM	0.00	0.00	0.01	**0.98**	0.01	0.00
Finance	0.00	0.00	0.01	0.01	**0.97**	0.01
NMS	0.00	0.00	0.01	0.00	0.01	**0.98**

Note: Share of workers changing sector of work between two consecutive years. Sectors are denoted as DTC=Distribution, Transportation and Communication; MEM as Mining, energy and Manufacturing, NMS as Non-Market Services. Source: ELFS data.

When we split the transitions in the periods before and after the treatment, we find similar results (Table 9). Hence, we are confident that the issue of endogeneity in the choice of the industry where to work is not relevant in our context. We therefore proceed by performing our analysis on two subsamples defined by the sectors either severely affected by the crisis, such as Manufacturing, Finance, Real Estate and Construction or not affected by the crisis, such as Agriculture, Mining and Non-Market Sector.

The results of our estimations are reported in Tables 10 and 11, respectively.

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 5.2 percentage points, while for

Table 9. Transition between sectors before and after the treatment.

	Agriculture	Construction	DTC	MEM	Finance	NMS
			Pre-2008			
Agriculture	**0.89**	0.01	0.03	0.03	0.02	0.01
Construction	0.00	**0.96**	0.01	0.02	0.01	0.00
DTC	0.00	0.00	**0.97**	0.01	0.01	0.01
MEM	0.00	0.00	0.01	**0.97**	0.01	0.00
Finance	0.00	0.00	0.01	0.01	**0.96**	0.01
NMS	0.00	0.00	0.01	0.00	0.01	**0.98**
			Post-2008			
Agriculture	**0.91**	0.01	0.03	0.03	0.01	0.01
Construction	0.00	**0.97**	0.01	0.01	0.01	0.00
DTC	0.00	0.00	**0.98**	0.01	0.01	0.00
MEM	0.00	0.00	0.01	**0.98**	0.00	0.00
Finance	0.00	0.00	0.01	0.01	**0.97**	0.01
NMS	0.00	0.00	0.01	0.00	0.01	**0.98**

Note: Share of workers changing sector of work between two consecutive years before and after 2008. Sectors are denoted as DTC=Distribution, Transportation and Communication; MEM as Mining, energy and Manufacturing, NMS as Non-Market Services. Source: ELFS data.

the subsample of sectors not affected by the crisis is approximately 3.85 percentage points. 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 augmentative, as the increase in the share of cross-border commuters ascribable to the crisis amounts to an additional 1.5 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.

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.

7 Robustness checks

In order to test for the robustness of our results, we carry out several additional tests. We estimate again the baseline model by either including additional controls, or changing the sample of individuals or the treatment date.

First, in order to understand whether there is a chance that the increase in the cross-

Table 10. Restricted sample with only workers in agriculture, mining and non-market services sectors.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post-2008	0.023	0.029	0.029	0.010	0.022	0.032	0.037**
	(0.019)	(0.026)	(0.026)	(0.019)	(0.019)	(0.033)	(0.016)
Treated	0.364***	0.352***	0.351***	0.435***	0.365***	0.363***	0.168***
	(0.023)	(0.033)	(0.034)	(0.040)	(0.023)	(0.023)	(0.052)
Treated Post-2008	**0.037***	**0.037***	**0.038***	**0.042***	**0.035**	**0.044***	**0.036***
	(0.022)	(0.021)	(0.022)	(0.021)	(0.022)	(0.021)	(0.020)
Regional fixed effect	YES	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES
Individual a 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: Dependent variable: probability to cross-border commute. Region-year clustered standard errors.
In Column 1 we control for regional dummies, in Column 2 we control for road network and youth unemployment differential, in Column 3 we control for unemployment differential,in Column 4 we control for employment share by sector, in Column 5 we control for house prices, in Column 6 we control for the exchange rate, in Column 7 we control for closeness of language. Significance levels: *p<0.1; **p<0.05; ***p<0.01.
The baseline cross-border commuting rate is 22%.

Table 11. Restricted sample with only workers in manufacturing, construction, Finance and real estate sectors.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post-2008	0.036	0.020	0.020	0.023	0.031	0.032	0.047**
	(0.023)	(0.024)	(0.025)	(0.030)	(0.021)	(0.034)	(0.020)
Treated	0.270***	0.307***	0.300***	0.272***	0.274***	0.271***	0.236***
	(0.078)	(0.081)	(0.080)	(0.084)	(0.078)	(0.078)	(0.077)
Treated Post-2008	**0.053***	**0.050***	**0.056***	**0.060***	**0.047***	**0.050***	**0.047***
	(0.024)	(0.024)	(0.024)	(0.027)	(0.027)	(0.023)	(0.022)
Regional fixed effect	YES	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES
Individual a characteristics	YES	YES	YES	YES	YES	YES	YES
Regional characteristics	YES	YES	YES	YES	YES	YES	YES
Observations	58,046	58,046	58,046	58,046	58,046	58,046	58,046
Adjusted R^2	0.383	0.383	0.384	0.383	0.383	0.383	0.406

Note: Dependent variable: probability to cross-border commute. Region-year clustered standard errors.
In Column 1 we control for regional dummies, in Column 2 we control for road network and youth unemployment differential, in Column 3 we control for unemployment differential,in Column 4 we control for employment share by sector, in Column 5 we control for house prices, in Column 6 we control for the exchange rate, in Column 7 we control for closeness of language. Significance levels: *p<0.1; **p<0.05; ***p<0.01.
The baseline cross-border commuting rate is 22%.

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 2010 as the year of the treatment. Results are reported in Column 1 of Table 12. We observe that the effect of Schengen is still positive and significant, but the magnitude of the coefficient is larger and up to 3.7 percentage points.

Next, we replace the regional unemployment and youth unemployment variables computed as the differentials with respect to the previous year with the rates. The results are

Table 12. Robustness checks.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treated	0.317***	0.328***	0.333***	0.341***	−0.038***	0.318***	0.104
	(0.037)	(0.040)	(0.039)	(0.008)	(0.013)	(0.038)	(0.077)
Post-2009	0.022*						
	(0.011)						
Treated Post-2009	**0.037*****						
	(0.012)						
Post-2008		0.020	0.020	0.025*	0.031*	0.028*	0.013**
		(0.014)	(0.013)	(0.013)	(0.016)	(0.014)	(0.006)
Treated Post-2008		**0.028***	**0.027***	**0.028****	**0.063*****	**0.030****	**0.035*****
		(0.014)	(0.016)	(0.013)	(0.020)	(0.015)	(0.012)
		(0.110)	(0.105)				
Youth Unem Rate * Age 16-24		0.030***					
		(0.009)					
Unem Rate			0.004				
			(0.011)				
Observations	138,904	138,904	138,904	138,904	91,317	127,138	265,487
Adjusted R^2	0.348	0.349	0.348	0.375	0.485	0.335	0.434
Year-Region-Sector Dummies	NO	NO	NO	YES	NO	NO	NO
Only contiguous regions	NO	NO	NO	NO	YES	NO	NO
All regions as control	NO	NO	NO	NO	NO	NO	YES
No Spain	NO	NO	NO	NO	NO	YES	NO
Regional fixed effect	YES	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES
Individual characteristics	YES	YES	YES	YES	YES	YES	YES

Note: The dependent variable is the probability of cross-border commuting. Standard errors are clustered at region-sector level. In Column 1 we set the treatment year in 2010, in Column 2 we control for youth unemployment rate, in Column 3 we control for unemployment rate. In Column 4 we include year, region, sector dummies, in Column 5 we restrict our sample to commuters to bordering regions and in Column 6 we exclude the regions bordering Spain. In Column 7 we include all regions of Italy, Germany and France who are not treated as control, while in Column 8 we include all workers in treated and control regions. Significance levels: *p<0.1; **p<0.05; ***p<0.01. The baseline cross-border commuting rate is 22%.

reported in Columns 2-3 of Table 12. While the unemployment rate is not significantly different from zero, as in our main specification, the youth unemployment rate become significantly different from zero when used in rates rather than in differentials. The coefficient is positive meaning that the higher is the youth unemployment rate in the regions of the same country compared to foreign regions, the higher is the probability of cross-border commuting. Nevertheless, the coefficient of interest keeps its sign and magnitude.

To understand how similar are treatment and control regions as well as their destination regions in terms of industry structure, we include industry-region-year dummies in the regression to absorb differentially shocks to industries and regions. The result is reported in Column 4 of Table 12. Again, the effect of Schengen is still positive and significant, and keeps the same magnitude.

As (Beerli et al., 2018) claim that "cross-border commuters rarely travel at a driving distance larger than 20-30 minutes", we consider a stricter definition of cross-border commuting which includes only bordering regions. Hence, 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. Our sample is down to 91,317 individuals and results are reported in

Column 5 of Table 12. We find that our coefficient of interest is still positive and significant. Moreover, the magnitude of the coefficient is 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 6.3 percentage points higher for individuals who reside in regions which share the border with Switzerland, after the country joined the Schengen area.

As an additional robustness check we exclude the regions which share the border with Spain from the control group, as Spain has been hit relatively more severely by the crisis, as shown in Figure 7. The results of this exercise are reported in Column 6 of Table 12. The coefficient of interest is still positive and significant and the magnitude consistent with the main estimation. In Column 7 of Table 12 we report the coefficients of the estimation obtained when all the regions of Italy, France and Germany which are not treated are included as controls. This exercise is meant to capture also those individuals who start commuting cross-border even though they do not reside in a bordering region. The Schengen effect is still positive and significant and the magnitude slightly higher compared to the baseline model.

All these additional tests lead to similar results: the implementation of Schengen significantly increased cross-border commuting to Switzerland among inter-regional commuters.

Finally, as the Schengen agreement made commuting into Switzerland as well as out of Switzerland easier and hence more attractive, we would expect commuting flows to increase in both directions. Figure 9 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, confirming our hypothesis of the importance of the treatment for both the directions 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 individuals 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. In
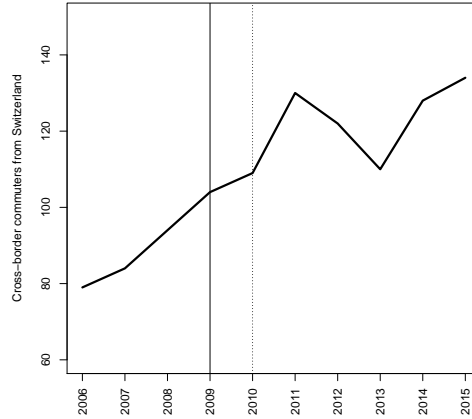
Figure 9. Cross-border commuters from Switzerland to bordering countries.

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. The numbers are very small across the entire period considered (no more than 15 per year), hence the hypothesis of cross-border commuting after migrating is 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 and among those we identify the ones who cross-border commute to a bordering country. Again, the numbers are very small across the entire period considered (no more than 10 each year), allowing us to rule out the migration/commuting hypothesis.

8 Labour market effects

In this section, we investigate whether the increased supply of cross-border commuters had positive effects on the efficiency of the labour market. We specifically analyze whether the average wage of cross-border commuters in treated regions has increased after Switzerland joined the Schengen area in December 2008. Unfortunately, we do not have a panel dataset, hence we do not observe the wages of the same individuals over time. Moreover, in the ELFS dataset wages are not reported, but only income classified in deciles, and in addition this information is missing for most of the observations. Hence, we use the Italian Labour Force

|	
(a) Cross-border versus all workers.	(b) Cross-border versus inter-regional commuters.
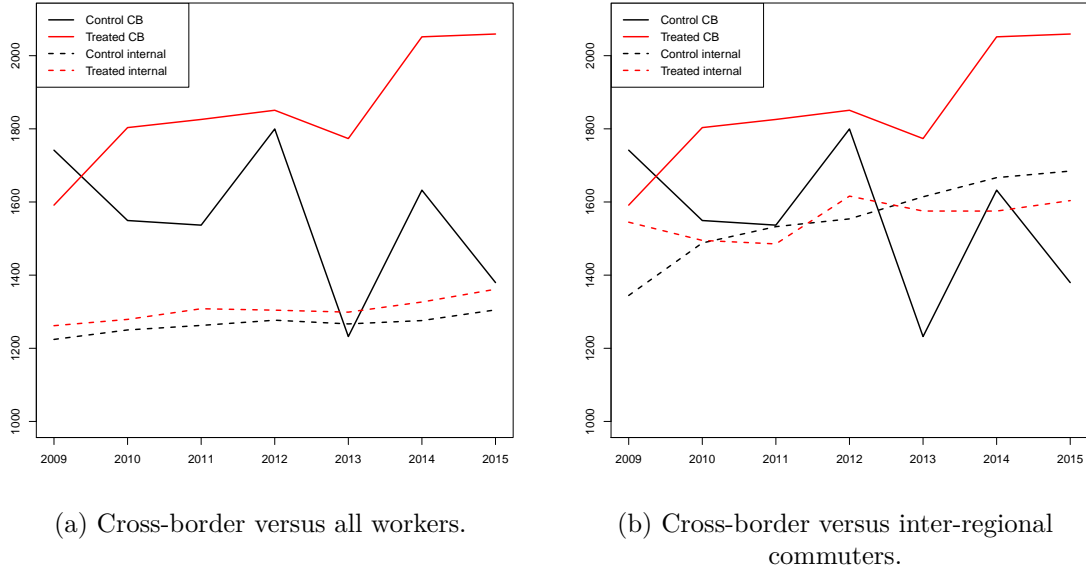
Figure 10. Monthly net wages of cross-border commuters, the sample of all workers and inter-regional workers in treated and control regions of Italy. The solid lines refer to cross-border commuters in treated (red) and control (black) regions. The dotted lines refer to workers (or inter-regional commuters) in treated (red) and control (black) regions. Source: Italian Labour Force Survey - *Rilevazione Sulle Forze di Lavoro*.

survey, which reports information on individual wages for all workers starting from 2009. The limits of this analysis are that (i) the information is limited to Italian workers, (ii) the information is only from 2009, which is the year of the treatment and (iii) we can only provide descriptive statistics, while we cannot infer a causal relationship between the implementation of Schengen and the change in the wage level. Nevertheless, we report in Figure 10 the average wage of cross-border commuters in treated and control regions, as well as the average wage of all workers (left panel) and inter-regional commuters (right panel) in treated and control regions. We clearly observe that the wage level of cross-border commuters has increased after 2009 much more in treated regions, compared to the wage level of cross-border commuters in control regions and of workers in both regions.

We also explore whether the effect is bigger for specific categories of workers, according to age, gender, education, occupation and sector. Results are reported in Figures 11-15. The wage level of cross-border commuters in treated regions is clearly higher for both males and females after 2009 (compared to cross-border commuters in control regions and inter-regional commuters). The effect is also evident for cross-border commuters in the age category 25-34
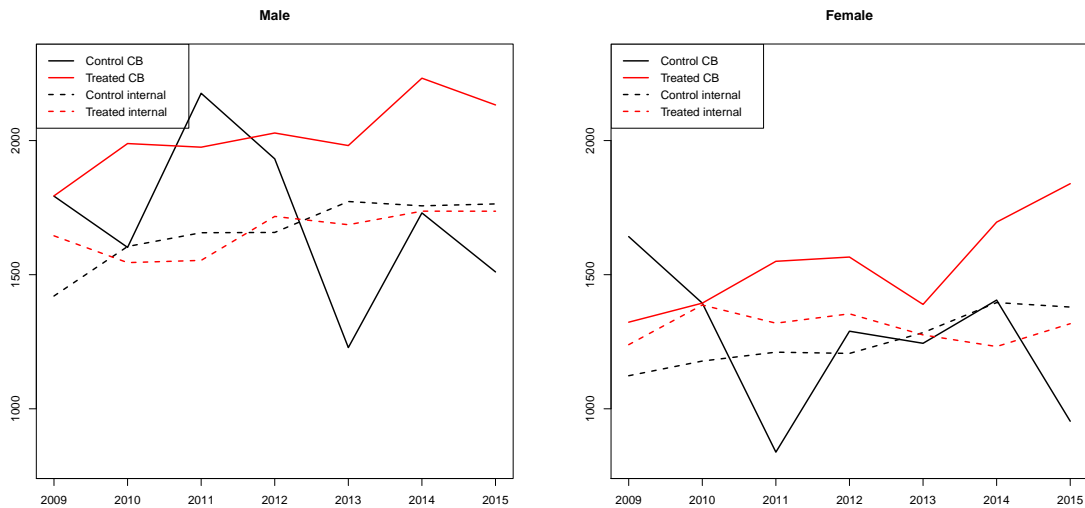
Figure 11. Monthly net wages of cross-border commuters in treated and control regions of Italy by gender. The solid lines refer to cross-border commuters in treated (red) and control (black) regions. The dotted lines refer to workers (or inter-regional commuters) in treated (red) and control (black) regions. Source: Italian Labour Force Survey - *Rilevazione Sulle Forze di Lavoro*.

and for high-skilled blue collar cross-border commuters. The effect is also evident for workers in Construction, Distribution, Transportation & Communication, Finance and Non-Market Services sectors. For the remaining categories, the effect is less clear-cut. This might be due to the fact that cross-border commuting did not have a significant impact on the wage level of certain categories of workers, or it could ascribable to data quality and reporting errors.

9 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 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 approximately 3

Figure 12. Monthly net wages of cross-border commuters in treated and control regions of Italy by age. The solid lines refer to cross-border commuters in treated (red) and control (black) regions. The dotted lines refer to workers (or inter-regional commuters) in treated (red) and control (black) regions. Source: Italian Labour Force Survey - *Rilevazione Sulle Forze di Lavoro*.

percentage points for inter-regional commuters 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 percentage points.

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 dis-

41

Primary Education

Secondary Education

Tertiary Education

Figure 13. Monthly net wages of cross-border commuters in treated and control regions of Italy by education. The solid lines refer to cross-border commuters in treated (red) and control (black) regions. The dotted lines refer to workers (or inter-regional commuters) in treated (red) and control (black) regions. Source: Italian Labour Force Survey - *Rilevazione Sulle Forze di Lavoro*.

entangle 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.
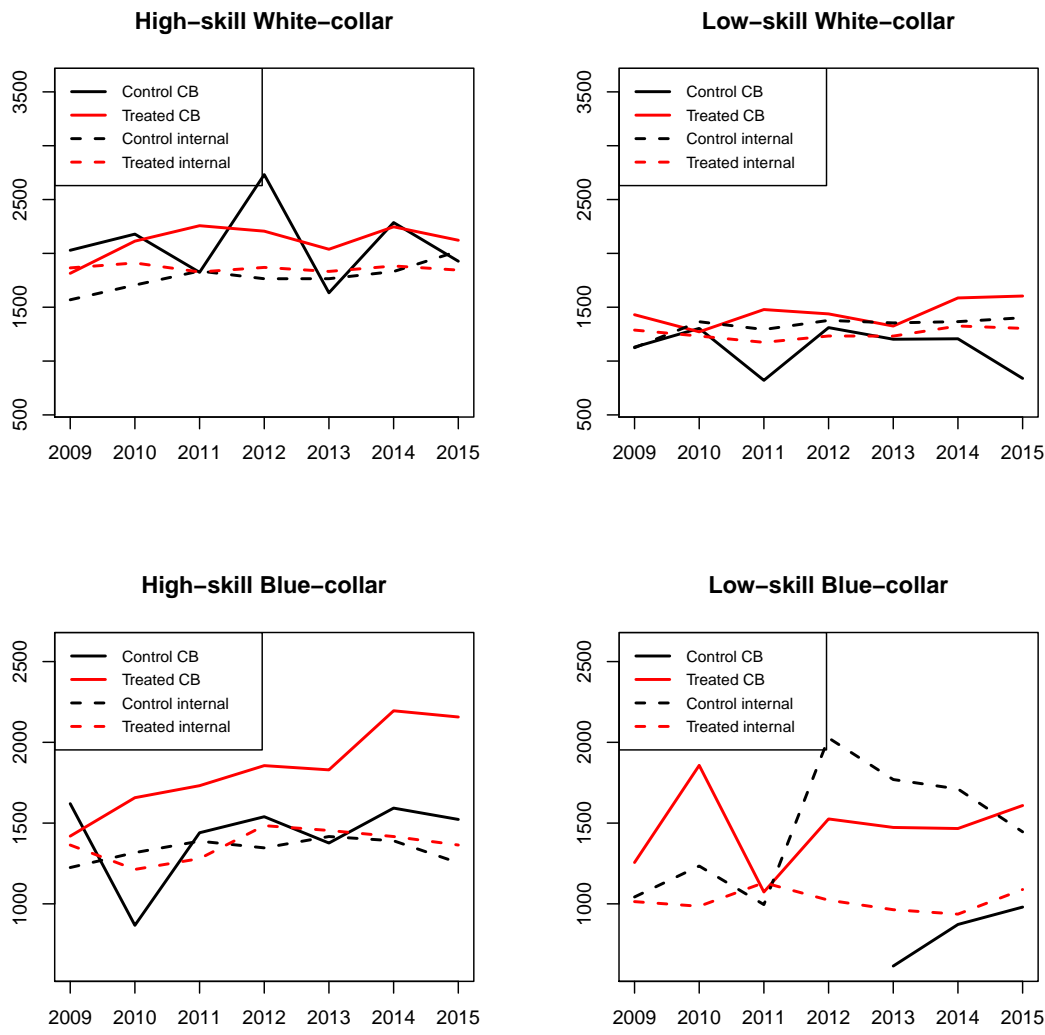
Figure 14. Monthly net wages of cross-border commuters in treated and control regions of Italy by occupation. The solid lines refer to cross-border commuters in treated (red) and control (black) regions. The dotted lines refer to workers (or inter-regional commuters) in treated (red) and control (black) regions. Source: Italian Labour Force Survey - *Rilevazione Sulle Forze di Lavoro*.

Due to data limitations, we are not able to perform causal inference on the effect of the implementation of Schengen on labour market efficiency, however we are able to provide evidence that wages among cross-border commuters residing in treated regions have increased more compared to wages of cross-border commuters residing in control regions and compared to all inter-regional commuters. This evidence is suggestive that cross-border commuting has the potential of improving the match between employers and employees, with positive effects on labour market outcomes.

This result is very important for several reasons. First, it represents a meaningful con-
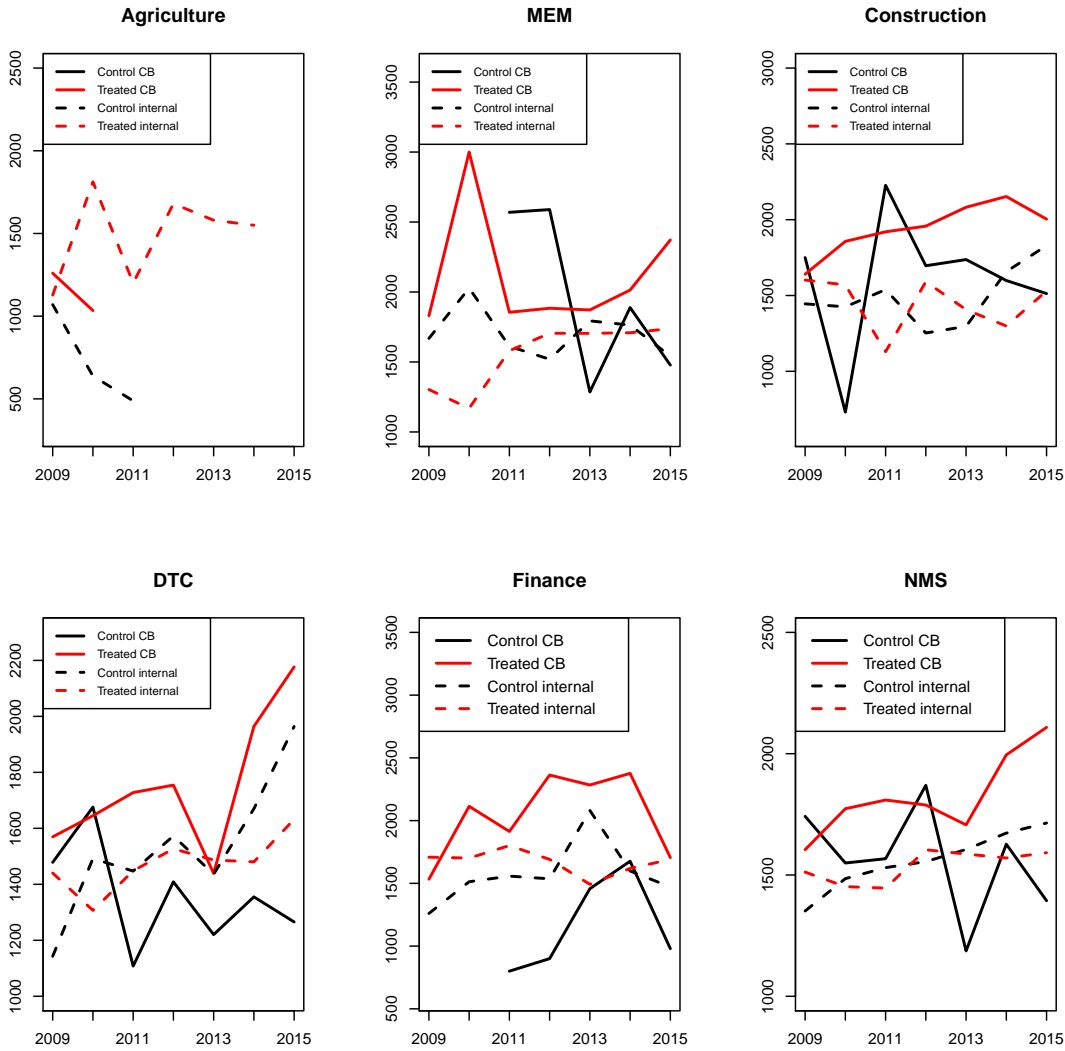
Figure 15. Monthly net wages of cross-border commuters in treated and control regions of Italy by sector. The solid lines refer to cross-border commuters in treated (red) and control (black) regions. The dotted lines refer to workers (or inter-regional commuters) in treated (red) and control (black) regions. Source: Italian Labour Force Survey - *Rilevazione Sulle Forze di Lavoro*.

tribution, 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 et al. (2018), 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. Fourth, it provides some evidence on the labour market effects of an immigration policy on mobile workers, and not on workers in the receiving countries, which is the focus of most of the literature, including the paper by Beerli et al. (2018).

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 wages, 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). Although we do not investigate this aspect, commuting could have the potential 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 et al. (2018) 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, as we have shown evidence of, 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.

References

Abadie, A., 2005. Semiparametric difference-in-differences estimators. The Review of Economic Studies 72 (1), 1–19.

Abu-Hayyeh, R., Murray, G., Fekete, L., 2014. Swiss referendum: Flying the flag for nativism. Race & Class 56 (1), 89–94.

Ademmer, E., Barsbai, T., Lucke, M., Stohr, T., 2015. 30 Years of Schengen: Internal Blessing, External Curse? Kiel Institute for the World Economy.

Bartz, K., Fuchs-Schündeln, N., 2012. The role of borders, languages, and currencies as obstacles to labor market integration. European Economic Review 56 (6), 1148–1163.

Baruffini, M., 2011. Cross-border commuting in the Swiss-Italian region; labour market effects of progressive integration. measuring geographical mobility in regional labour market monitoring: State of the art and perspectives.

Beerli, A., Ruffner, J., Siegenthaler, M., Peri, G., 2018. The abolition of immigration restrictions and the performance of firms and workers: Evidence from switzerland. Tech. rep., National Bureau of Economic Research.

Bertelsmann Foundation, 2016. Departure from the Schengen Agreement.

Bertrand, M., Duflo, E., Mullainathan, S., 2004. How much should we trust differences-in-differences estimates? The Quarterly journal of economics 119 (1), 249–275.

Bigotta, M., Oscar, G., Losa, F. B., 2012. Free movement of people: joy or sorrow? Tech. rep., USTAT.

Blanchard, O., Katz, L., 1992. Regional evolutions. Brookings Papers on Economic Activity 1, 1–75.

Bloomfield, M. J., Brüggemann, U., Christensen, H. B., Leuz, C., 2015. The effect of regulatory harmonization on cross-border labor migration: Evidence from the accounting profession, NBER Working Paper No. 20888.

Brian, K., Patrick, L., 2010. From Crisis to Recovery. The Causes, Course and Consequences of the Great Recession. OECD Publishing.

Centre for Future Studies, 2006. Social Demographics in 2016. Kent University Press.

Confederazione Svizzera, 2018. Conseguenze economiche e finanziarie dell'associazione della Svizzera a Schengen. Rapporto del Consiglio federale in risposta al postulato 15.3896 (Gruppo S). Confederazione Svizzera.

Davies, S., 2011. Regional resilience in the 2008-2010 downturn: Comparative evidence from European countries. Cambridge Journal of Regions, Economy and Society 4 (3), 369–382.

Decressin, J., Fatas, A., 1995. Regional labor market dynamics in Europe. European Economic Review 39 (9), 1627–1655.

Dijkstra, L., Garcilazo, E., McCann, P., 2015. The effects of the global financial crisis on European regions and cities. Journal of Economic Geography 15 (5), 935–949.

Dustmann, C., Schönberg, U., Stuhler, J., 2016. Labor supply shocks, native wages, and the adjustment of local employment. The Quarterly Journal of Economics 132 (1), 435–483.

Dyen, I., Kruskal, J., Black, P., 1992. An Indoeuropean classification: a lexicostatical experiment. Transactions of the American Philosophical Society 82, 1–132.

Eliasson, K., Lindgren, U., Olle, W., 2003. Geographical labour mobility: Migration or commuting? Regional Studies 37 (8), 827–837.

EPRS, 2016. The Cost of Non-Schengen: the Impact of Border Controls within Schengen on the Single Market. European Parliamentary Research Service.

Erbenova, M., 1995. Regional labour mobility, wages and unemployment in the Czech republic.

European Commission, 2009a. Economic crisis in Europe: Causes, consequences and responses. Tech. rep.

European Commission, 2009b. Scientific report on the mobility of cross-border workers within the EU-27/EEA/EFTA countries. Tech. rep.

European Commission, 2011. Mobility in europe. Report.

European Commission, 2016. Back to Schengen - A Roadmap.

Evrard, E., Nienaber, B., Sommaribas, A., 2018. The temporary reintroduction of border controls inside the schengen area: Towards a spatial perspective. Journal of Borderlands Studies, 1–15.

France Strategie, 2013. L'Evaluation Socioeconomique des Investissements Publics.

France Strategie, 2016. The Economic Cost of Rolling Back Schengen.

Gottholmseder, G., Theurl, E., 2007. Determinants of cross-border commuting: Do cross-border commuters within the household matter? Journal of Borderlands Studies 22 (2), 97–112.

Groot, S. P., Möhlmann, J. L., Garretsen, J., de Groot, H. L., 2011. The crisis sensitivity of European countries and regions: Stylized facts and spatial heterogeneity. Cambridge Journal of Regions, Economy and Society 4 (3), 437–456.

Huber, P., 2011. The self-selection of commuters. Tech. rep., University of Salzburg.

Imbens, G. W., Wooldridge, J. M., 2009. Recent developments in the econometrics of program evaluation. Journal of economic literature 47 (1), 5–86.

Jimeno, J. F., Rodríguez-Palenzuela, D., 2003. Youth unemployment in the OECD: Demographic shifts, labour market institutions and macroeconomic shocks. Tech. rep., European Network of Economic Policy Research Institute, Brussels.

Moulton, B. R., 1990. An illustration of a pitfall in estimating the effects of aggregate variables on micro units. The review of Economics and Statistics 72 (2), 334–338.

Niebuhr, A., Stiller, S., 2004. Integration and labour markets in European border regions.

Parenti, A., Tealdi, C., 2019. The role of job uncertainty in inter-regional commuting: The case of Italy. Growth and Change 50 (2), 934–671.

Parodi, G., Pastore, F., Tanveer Choudhry, M., Marelli, E., Signorelli, M., 2012. Youth unemployment rate and impact of financial crises. International journal of manpower 33 (1), 76–95.

Peri, G., 2014. Do immigrant workers depress the wages of native workers? IZA World of Labor, 42.

Persyn, D., Torfs, W., 2015. A gravity equation for commuting with an application to estimating regional border effects in Belgium. Journal of Economic Geography, 1–21.

Reinhart, C. M., Rogoff, K. S., 2009. The aftermath of financial crises. The American Economic Review 99 (2), 466.

Rouwendal, J., 1999. Spatial job search and commuting distances. Regional Science and Urban Economics 29 (4), 491 – 517.

Ruffner, J., Siegenthaler, M., 2017. From labor to cash flow? The impact of abolishing all immigration restrictions for EU workers on Swiss firms. SSRN working paper 3169314.

Scott, A., Barnett, S., De Broeck, M., Ivanova, A., Kim, D., Kumhof, M., Laxton, D., Leigh, D., Stehn, S. J., Symansky, S., 2008. World economic outlook: Financial stress, downturns, and recoveries. Tech. rep.

van Ommeren, J., Rietveld, P., Nijkamp, P., 1999. Job moving, residential moving, and commuting: A search perspective. Journal of Urban Economics 46 (2), 230 – 253.

Verick, S., 2009. Who is hit hardest during a financial crisis? the vulnerability of young men and women to unemployment in an economic downturn, IZA Discussion Paper No. 4359.

A   Appendix

A.1   The impact of individual characteristics

Table 13. Interregional Commuters 2005-2015 (with individual characteristics).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post-2008	0.026**	0.020	0.020	0.019	0.024*	0.028	0.037***
	(0.013)	(0.014)	(0.014)	(0.016)	(0.012)	(0.017)	(0.012)
Treated	0.318***	0.332***	0.330***	0.319***	0.320***	0.318***	0.225***
	(0.037)	(0.040)	(0.040)	(0.040)	(0.038)	(0.037)	(0.033)
Treated Post-2008	**0.029****	**0.028****	**0.031****	**0.033****	**0.026***	**0.031****	**0.025***
	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.012)	(0.014)
Female	0.010	0.010	0.010	0.010	0.010	0.010	0.009
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Single	−0.005	−0.005	−0.005	−0.005	−0.005	−0.005	−0.005
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Age 16-24	−0.028**	−0.029**	−0.028**	−0.028**	−0.028**	−0.028**	−0.017
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)
Age 25-34	0.045***	0.045***	0.045***	0.046***	0.046***	0.045***	0.052***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Age 35-44	0.036***	0.036***	0.036***	0.036***	0.036***	0.036***	0.039***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Secondary	−0.026**	−0.026**	−0.026**	−0.026**	−0.026**	−0.026**	−0.023**
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Tertiary	−0.070***	−0.070***	−0.070***	−0.070***	−0.070***	−0.070***	−0.060***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)
Road Network		−0.120	−0.113				
		(0.111)	(0.113)				
Youth Unemployment Differential		−0.00002					
		(0.0001)					
Unemployment Differential			0.00005				
			(0.00004)				
Empl. Agriculture				−0.046			
				(0.036)			
Empl. MEM				0.015			
				(0.014)			
Empl. Construction				−0.059			
				(0.060)			
Empl. Finance				−0.001			
				(0.037)			
Empl. NMS				0.001			
				(0.073)			
House Prices					−0.037		
					(0.027)		
Exchange Rate						−0.027	
						(0.113)	
Closeness of Language							−0.006***
							(0.001)
Constant	0.007	0.116	0.110	0.021	0.040	0.032	0.641***
	(0.012)	(0.104)	(0.105)	(0.032)	(0.028)	(0.097)	(0.105)
Observations	138,904	138,904	138,904	138,904	138,904	138,904	138,904
Adjusted R^2	0.348	0.348	0.348	0.348	0.348	0.348	0.382

Note: The dependent variable is the probability of cross-border commuting. Standard errors are clustered at region-sector level. In Column 1 we control for regional dummies, in Column 2 we control for road network and youth unemployment differential, in Column 3 we control for unemployment differential, in Column 4 we control for employment share by sector, in Column 5 we control for house prices, in Column 6 we control for the exchange rate, in Column 7 we control for closeness of language. *p<0.1; **p<0.05; ***p<0.01. The baseline cross-border commuting rate is 22%.

When looking at the sample of inter-regional commuters, in terms of individual characteristics, surprisingly we find that female workers are as likely as male workers to commute across border rather than internally (Table 13). Also being married or single does not affect the decision to commute cross-border. 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, in line with the findings of Gottholmseder and Theurl (2007) who 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 and secondary educated workers commute less across borders compared to primary educated individuals, in line with the descriptive statistics of cross-border commuters to Switzerland as provided by Beerli et al. (2018).

A.2 Parallel trend analysis for subgroups of workers
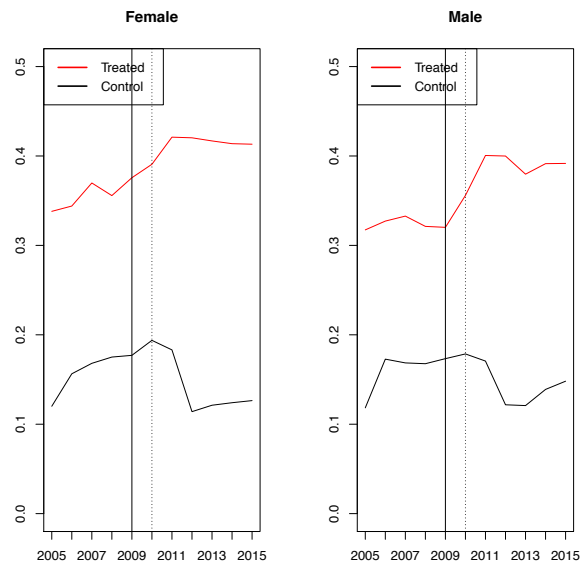
Figure 16. Parallel trends for subgroups of individuals defined according to gender.

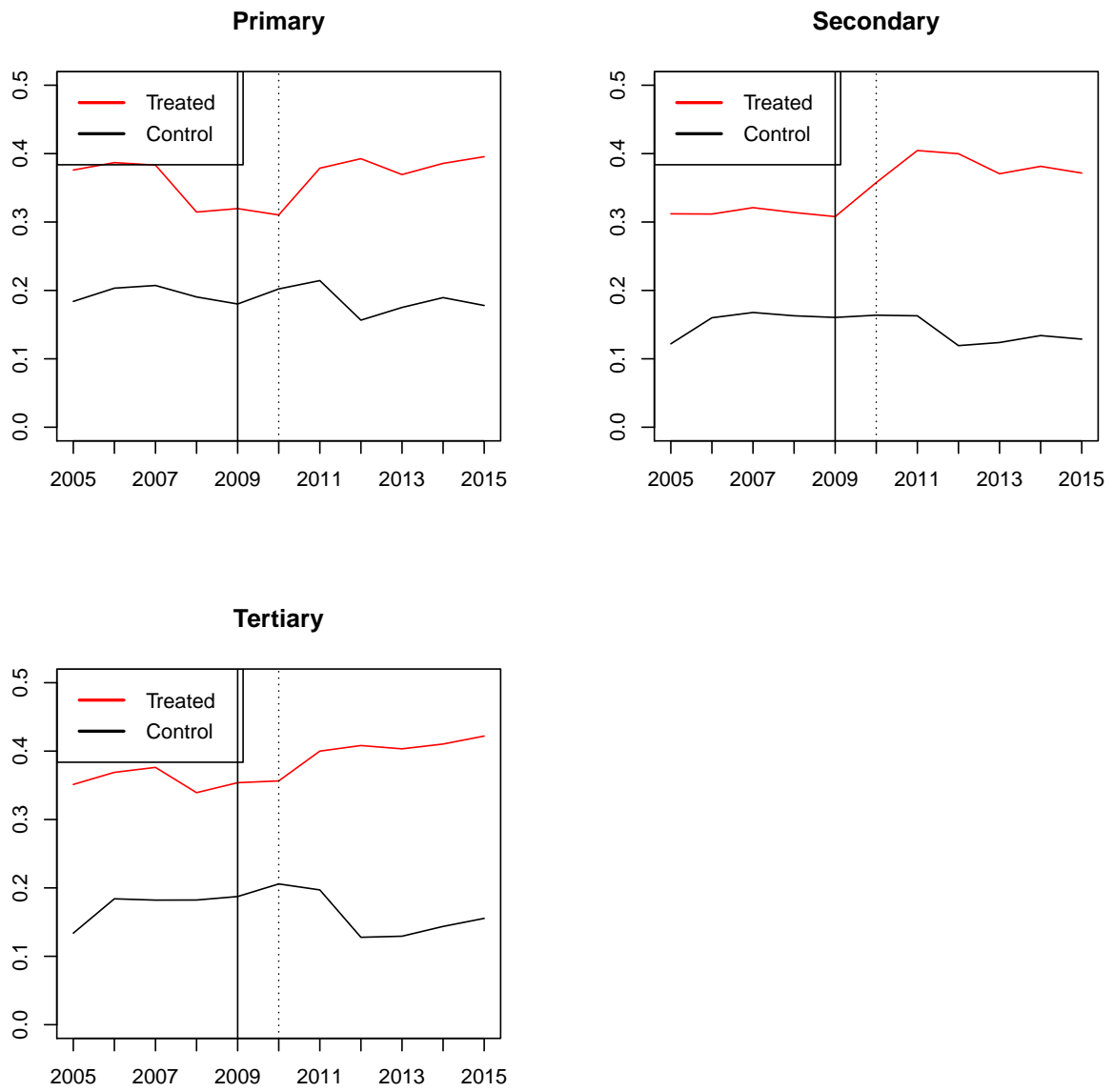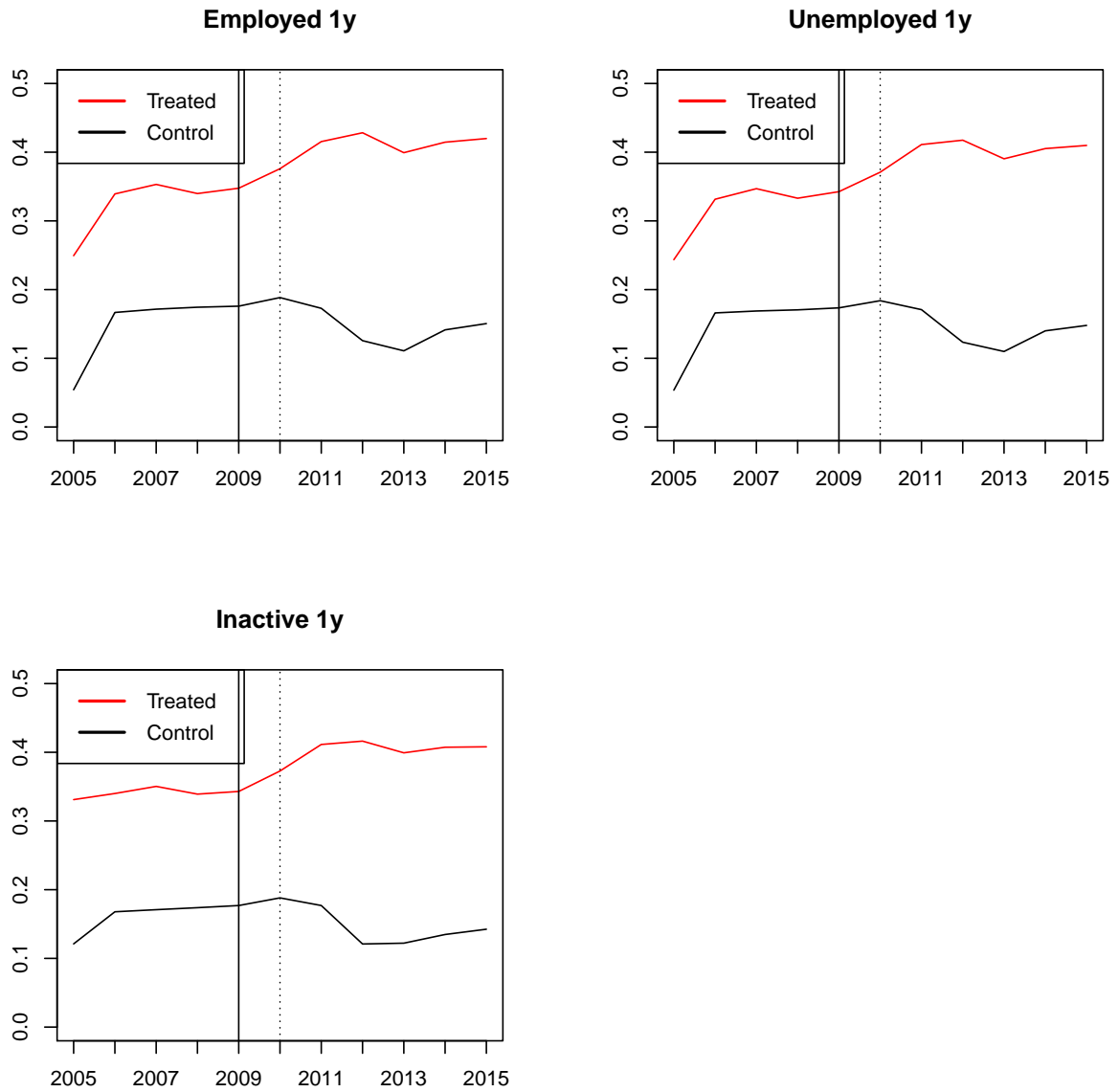**Figure 17.** Parallel trends for subgroups of individuals defined according to age.

Primary

Secondary

Tertiary

Figure 18. Parallel trends for subgroups of individuals defined according to education level.

Employed 1y

Unemployed 1y

Inactive 1y

Figure 19. Parallel trends for subgroups of individuals defined according to the employment status one year before.

Figure 20. Parallel trends for subgroups of individuals defined according to the professional one year before.
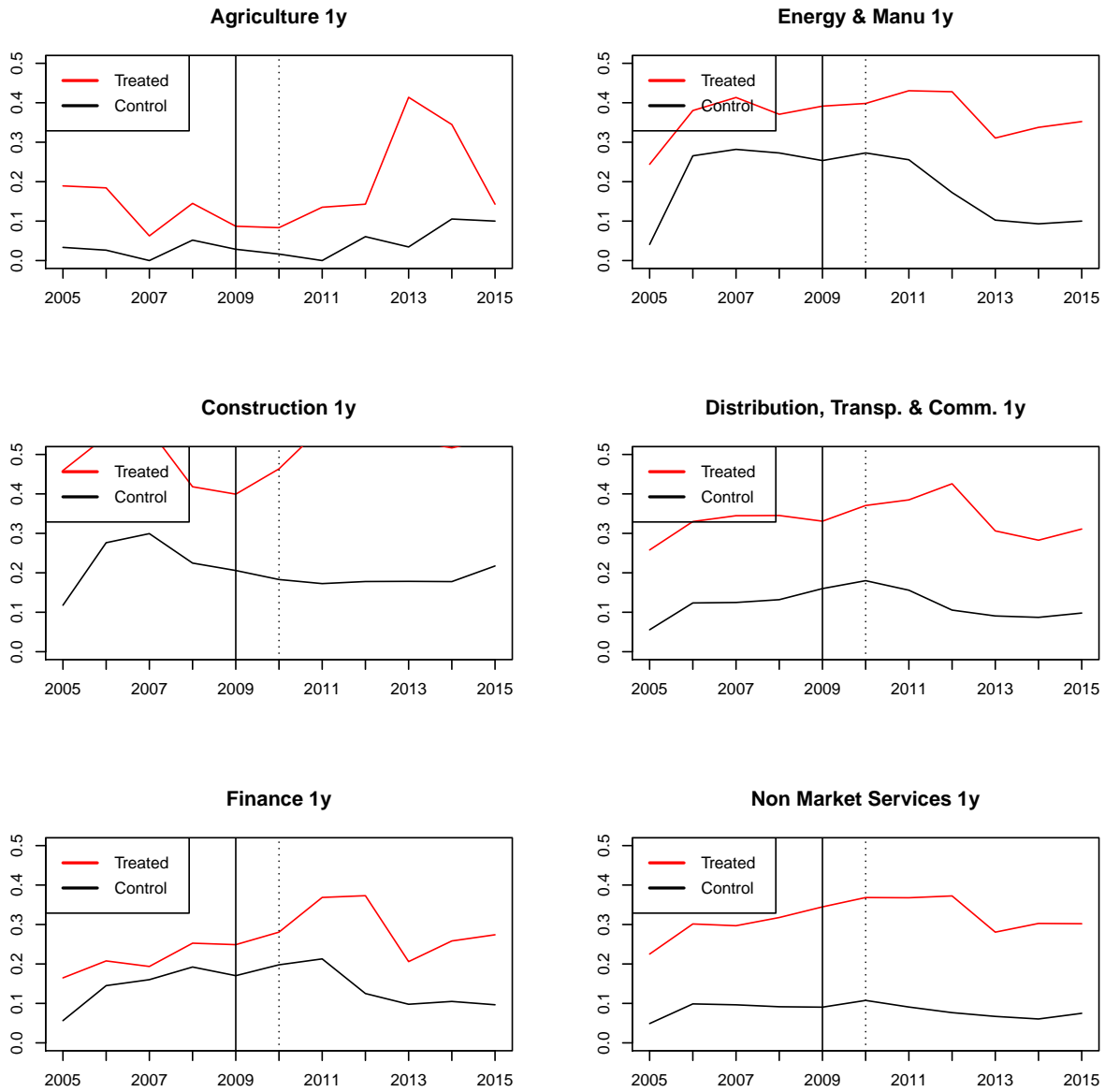
Figure 21. Parallel trends for subgroups of individuals defined according to the working sector.