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The Housing Market Effects of Public Transport Integration: Evidence from Geneva's Léman Express

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Abstract

I investigate how the housing market in a binational agglomeration responds to a large trans-border public transport connectivity improvement. For this, I exploit the recent introduction of the *Léman Express*, a suburban train service in the Greater Geneva area. The new line seamlessly connects the Swiss and the French side of the agglomeration, resulting in a substantial travel time reduction. I document locally concentrated construction booms and increasing prices at locations benefiting from the new service about two years in anticipation of the opening. I study the impact of the anticipated commuting cost decrease on residential mobility flows and discuss the resulting changes in neighborhood composition. Locations near soon well-connected stations experience a shift towards affluent, home-owning cross-border workers resulting in a gentrification push for these historically predominantly poor neighborhoods. This is largely driven by inflows from adjacent areas and internal relocations whereas trans-border relocation flows remain unimportant.

JEL classification: R1, R2, R3, R4

Keywords: Housing market, transportation, construction, real estate prices, travel time reduction, household relocation, cross-border working

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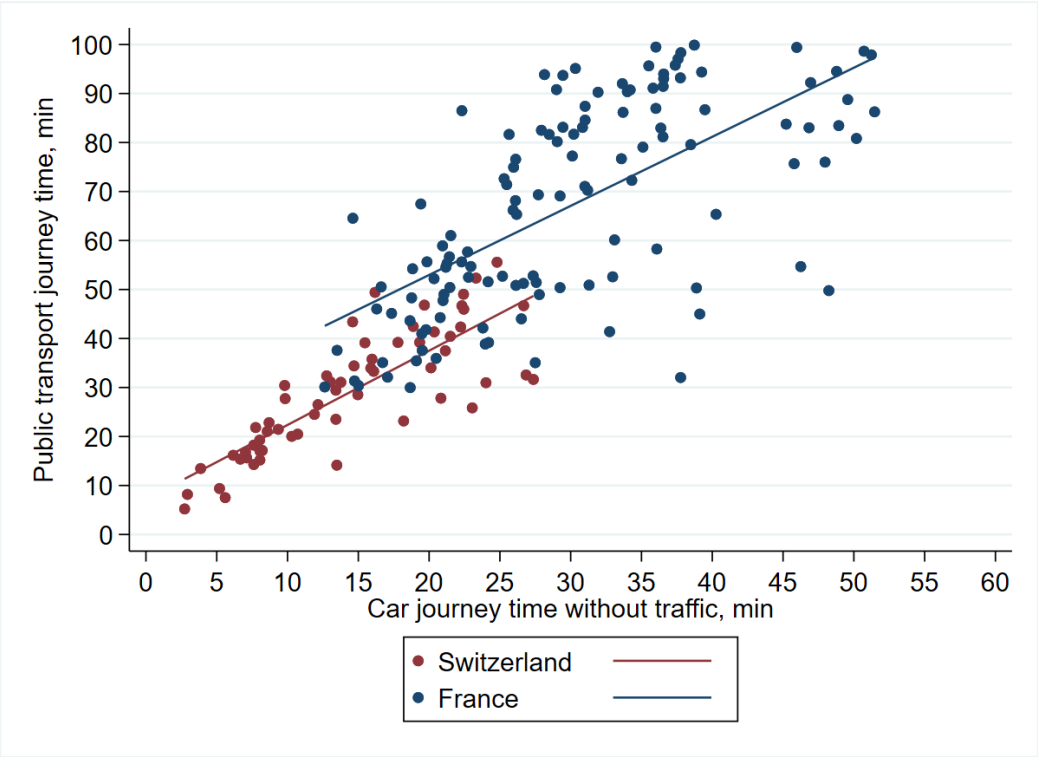

Figure 1: Public transport border penalty in Greater Geneva Area

1 Introduction

The Greater Geneva Area is a binational agglomeration located at the Swiss-French border. Despite a high prevalence of cross-border working from France to Switzerland, housing prices on the French side are barely half as high as on the Swiss side. What drives this substantial gap in housing prices? One important factor, in this traffic congestion plagued agglomeration, is the costliness of trans-border commuting due to poor public transport service. Until recently there was a 17min border penalty when commuting by public transport from a location in France compared to an equally distant location in Switzerland as illustrated in Figure 1. This paper studies the housing market effects of resolving this border penalty.

The *Léman Express* (LEX), a trans-border commuter rail service introduced in 2019, drastically reduces travel times from served French locations to downtown Geneva. The centerpiece of the new service is a new underground passage seamlessly connecting downtown Geneva to Annemasse, which is the main urban center on the French side. This provides the missing link to integrate the existing Swiss and French railway networks in a metropolitan area where cross-border workers heavily depended on car commuting. Housing prices on the French side are especially low in urban locations, some of which with the introduction of the LEX get better connected to jobs in Geneva. The new train service substantially reduces commuting cost and therefore provides an natural experiment to

study the effects of a trans-border market integration. The Geneva metropolitan area is not the only one suffering from poor public transport integration. Public transport planning often stops at national borders and there is little trans-national collaboration. A 2018 European Commission report identified a large number of missing rail links on EU borders that prevent the seamless moving of commuters between countries.[1][2]

What are the housing market effects of such a trans-border public transport integration? This paper studies how a reduction in commuting cost reshapes local housing markets. Does the convenient new commuting offer in France trigger a relocation wave of households escaping Geneva's tight housing market? Does this impose gentrification pressure on those newly well-connected locations in France? To what extend can this trans-border infrastructure integration foster housing market integration in the region? In a first step, I aim to understand the consequences of a commuting cost reduction for housing construction and housing prices. In a second step, I analyze the residential mobility response in terms of relocation flows and household characteristics to shed light on who reacts most strongly to the new train service and how this residential reshuffling affects neighborhood development. Understanding the consequences of transport integration (including unintended ones) provides the basis for policy advice.

My project relates to the literature on market integration policies, infrastructure induced gentrification and border effects. There is a growing literature on the effect of infrastructure improvements on economic outcomes by providing better market access. Historic railroad expansion has been studied in the context of good market access by Donaldson and Hornbeck (2016) for the U.S. and by Büchel and Kyburz (2018) for Switzerland. These papers find that access to an efficient long distance land transport technology crucially shaped industrialization and population growth. Concerning the mobility of people, Heuermann and Schmieder (2018) study the labor market effects of the German high-speed passenger rail roll out, which enabled inter-regional commuting. They find that firms in peripheral regions can benefit from the high speed train service since they gain access to a large pool of qualified workers with a preference for urban life, resulting in commuting of high-skilled workers to jobs in the periphery. This is in stark contrast to my findings for the Greater Geneva Area, where commuting from Geneva to neighboring France remains very uncommon. Intuitively this is due to the lack of jobs in France and much higher wages in Switzerland as well as the acute housing scarcity in Geneva. On intra-regional commuting there are papers studying suburbanization due to highways (e.g. Baum-Snow 2007 for the U.S. and Fretz et al. (2017) for Switzerland). They document that highways were the key driver of urban sprawl. This effect is also present in the Greater Geneva Area with Geneva essentially exporting its residential growth to neighboring France. In terms of intra-regional public transport commuting, Tsivanidis (2019) studies the aggregate and distributional welfare effects of a new bus network in Bogotá, using the concept of commuter market

[1] European Commission (2018)

[2] An example is the missing railway bridge across the Rhine river to connect Colmar, France and Freiburg im Breissgau, Germany. The two cities lie only 40km apart and there is a daily traffic grid lock due to intense car commuting.

access. Work in progress by Heblich, Redding and Sturm (2020) offers a quantifiable spatial general equilibrium model to analyze the impact of the railway introduction on economic activity and commuting in London. I build on the concepts used in this market access literature but shift the focus to the housing market.

There are various studies that estimate the local effects of public transport infrastructure improvements on real estate prices by comparing changes in neighborhoods near and far from stations (e.g. Gibbons and Machin (2005) for new train stations in London or Gupta et al. (2020) for a new metro line in New York). These studies typically find sizable housing price increases in close proximity to new stations. However, a major concern when studying the introduction of completely new lines is the endogeneity of route placement which can result in reversed causality. My project is less prone to this concern thanks to the fact that the location of the stops in France was predetermined since the Léman Express there operates on the original rail network from 1880. The state of the art in the transport infrastructure literature is to instrument the potentially endogenous location of the stations with least cost paths and historic transport network plans.[3] For stations in France, I do not have to rely on such an instrument as in my setting the route and location of stations is predetermined.

Moreover, I contribute to the scarce literature on infrastructure induced gentrification by shedding light on how transportation costs interact with other place-based features. Zuk et al. (2015), providing an overview of the literature on gentrification and place-based policies across sociology, urban planing and economics, note that few studies have addressed the role of transit investment in gentrification. One of the few is Kahn (2007) who discusses gentrification trends in new transit-oriented communities in U.S. cities. Work in progress by Balboni, Bryan, Morten and Siddiqi (2020) provides an urban commuting model to study transport infrastructure induced gentrification which they apply to evaluating the distributional effects of a new bus system in Dar es Salaam.[4] While these studies instructively describe the gentrification pressure due to better commuting services, they all focus on areas lying in the same jurisdiction. A crucial feature of my setting is that the affected region is divided by a national border, which gives rise to an array of additional margins that make households relocation decisions more complex (e.g. transportation, taxation, social security, culture, health care and schooling systems).

A newly emerging strand of literature studies the labor market effects of international market integration policies. For Switzerland, Beerli et al. (2021) find positive effects on the performance of Swiss firms and workers after liberalizing cross-border working from the EU in 2004. Hafner (2020) looks at labor market outcomes in France and finds increasing wages in the French border regions after this liberalization. The setting most similar to mine is the establishment of the Øresund Bridge between Denmark and Sweden studied by Bütikofer et al. (2019). They investigate how access to a larger labor market affects economic efficiency and equity. They find a large increase in cross-border

[3] See for example Tsivanidis (2019)

[4] On the firm side, Pogonyi (2018) study the growth versus displacement effect of a new London metro line on business units and employment.

commuting and an increase of wages for the low wage side. These studies focus only on the labor market effects of international market integration and do not address consequences for the housing market. An exception is Tricaud (2021), who studies the effect of intermunicipal cooperation in France and presents evidence on local costs of integration. She finds that forced integration increases the number of building permits granted, raising congestion in urban municipalities, but does not lead to a housing price decline. I borrow her approach to calculate local hedonic housing price indices. While Tricaud (2021) studies political integration, I focus on public transport integration. Understanding the housing market effects is important to inform the design of appropriate policies to complement market integration measures. This is particularly relevant in environments where the heterogeneity between locations is large. When low price locations get better connected to high price locations this bears a large potential for gentrification effects. To the best of my knowledge, my paper is the first to systematically measure the size of the housing price gap between Switzerland and France and tracking its evolution following better public transport integration.[5]

Finally, on border effects in transportation Loumeau (2020) studies the effect of regional borders on road network integration and commuting flows in France. He finds a substantial distance penalty when crossing regional borders due to decentralized planning of local transport networks translating into segmented labor markets. Calibrating a model to run policy simulations, he estimates that integrating local road transport networks would lead to 11.7% average growth in real per capita residential income. My paper relates to this by documenting a border penalty effect in public transport due to an important missing link in the rail network between two countries. Thanks to observing the introduction of the Léman Express, enabling an efficient trans-border commuting service, I do not need to rely on model counterfactuals but can directly measure the effect of the transport integration.

I first describe how housing prices and construction activity respond to the introduction of the new rail service. To measure treatment exposure, I have constructed a granular origin-destination matrix of travel time reductions using public transport timetable data. For the outcomes, I collected micro data on housing prices, rents and construction activity for both sides of the border. I leverage a dynamic Difference-in-Difference approach exploiting the timing of the introduction and spatial variation in travel time reduction to identify the effects on housing prices and housing supply. While in the pre LEX period proximity to a railway station in France was valued as a disamenity, this penalty flipped into a premium two years in anticipation of the LEX opening. Including basic hedonic controls, I find a sizable housing price increase near treated stations in France of about +550 €/m2 (+18%). On the other hand, no price effect of the LEX is detectable on the Swiss side of Greater Geneva. In terms of construction activity in France, I find that in the three years prior to the LEX opening, the housing stock in strongly treated locations grew faster then in comparison locations. In the last year before the opening the growth premium of treated locations amounted to 1.4pp. Also on

[5]Bütikofer et al. (2019) acknowledge a border housing price gap between Denmark and Sweden but neither quantify it nor study how it develops in response to the opening of the bridge.

the Swiss side, there was a surge in residential and commercial construction activity in anticipation of the opening but the effects are more spatially dispersed. In sum, I find locally concentrated residential construction booms and increasing housing prices at French locations strongly benefiting from the Léman Express in anticipation of the opening. Hence, the new train service seems to have the potential to profoundly reshape the urban landscape in the area. My results suggest that the new train service to some extend succeeds in promoting the attractiveness of locations in France and hence reduces the country price gap at least for newly well-connected locations. However, pace and magnitude of this adjustment are very modest.

I then use French Census data to analyze the residential mobility response triggered by the reduction in cross-border commuting costs to identify who reacts most strongly and understand the impact on local communities. In the past decades, the typical cross-border worker was middle-skilled, lived in a house in the French countryside and commuted to Geneva by car. My conjecture is that with the introduction of the attractive rail service cross-border workers start clustering around stations, which are located in the urban centers. In terms of relocation flows, I find that inflows to locations with a strong prospective public transport connection improvement increased strongly compared to comparison locations. This increase mostly originated from adjacent French areas, while there is little trans-border action. This is somewhat surprising as the commuting cost reduction thanks to the LEX is substantial and the housing market in Geneva is extremely tight. It suggests that differences in amenities and locally rooted preferences might play a big role in preventing Swiss residents to relocate to neighboring France. It appears that in France public transport unfriendly locations are losing attractiveness, while previous public transport friendly locations can more or less defend their appeal. In Swiss Greater Geneva, I find that relocation flows continued along long term trends and there is no LEX effect detectable.

In terms of household composition in France, I find that the anticipation of the LEX increases the cross-border worker share (+4.2pp) and the home ownership share (+9pp) in treated locations. This is due to both an inflow of affluent households but also upgrading of incumbent households. These dynamics take place around railway stations soon offering a convenient commuting service to Geneva, which pre LEX were relatively poor neighborhoods. Hence, the arrival of LEX is likely to launch this locations on a gentrification trajectory.

In order to understand who are the main beneficiaries of the LEX the skill composition of cross-border working is crucial. I document that the pre LEX, cross-border working was skill biased in the treatment areas – high-skilled workers were 23.1pp more likely to cross-border work – and argue that it is likely to stay this way. Hence, the LEX will mostly benefit high-skilled workers and is likely to increase inequality.

Section 2 describes the setting in the Greater Geneva Area, where there are large housing price and wage differences between the Swiss and the French part of the agglomeration. I provide evidence that one important reason for lower housing prices in France is the costliness of commuting to jobs in Geneva. Section 3 explains how I construct my treatment measure in terms of public transport

travel time reduction and which variation can be used to estimate the effect of the LEX. Section 4 provides the housing market results in terms of housing construction and housing prices. Section 5 analyses the residential mobility response in terms of relocation flows and household characteristics. Section 6 provides a discussion of the findings, briefly looks at welfare and sketches ideas for future research. Section 7 concludes.

2 Setting

Geneva is a prosperous Swiss city, located close to the border with France. Geneva offers high-paying jobs but is suffering from a notorious housing scarcity. The rule of thumb for a functional housing market is a vacancy rate of 2%, wheras the vacancy rate in Geneva has never been above 0.54% in the last 20 years.[6] The main reason for this are the very limited land resources in the canton, which are further reduced by zoning regulations imposing a minimal agricultural area. Hence, unsurprinsingly the urban agglomeration reaches well into the neighboring French territory. Together this constitutes the Greater Geneva Area, a dynamic bi-national metropolitan area with 1 million inhabitants of which 40% live in France. Figure 2 provides a context map depicting the Swiss territory in red, the French territory in blue, the national border in green and the extent of the Greater Geneva Area in yellow.[7]

A crucial feature of this bi-national agglomeration is that there are striking disparities in both the cost of housing and the wage level across the national border. On the French side, housing prices are only about half as high as on the Swiss side, while salaries in Switzerland are on average twice as high as in neighboring France. Figure 3, using housing transaction data for 2010-2018, plots the median housing price per square meter in the Greater Geneva Area, where a darker shade of blue indicates a higher price.[8] There are especially high prices in downtown Geneva but also in rest of Switzerland, whereas housing in neighboring France is substantially cheaper.

For my study, I exploit the recent introduction of the Léman Express (LEX), a commuter rail service connecting the Greater Geneva metropolitan area. The Léman Express, consisting of 230 km of tracks, operating 6 lines, and serving 45 stations, is currently the largest trans-border commuter rail network in Europe. The centerpiece of the new service is the new passage *CEVA* (the red link in Figure 3), which running mostly underground seamlessly connects downtown Geneva to Annemasse which is the main urban center on the French side.[9] This fills the missing link to integrate the existing Swiss and French rail networks in the region (the black network in Figure 3). Construction of the CEVA began in 2011 and operation of the Léman Express started in December 2019. Jointly with the LEX also a new trans-border tram line between Annemasse and downtown Geneva and a

[6] BFS - Leerwohnungszählung

[7] This extend of this territory is based on the members in the local cooperation group Grand Gèneve.

[8] I use individual level transaction data on the universe of appartment purchases from DVF (Demandes de valeurs foncières) for France and from the cantonal statistical office (OCSTAT) for Geneva.

[9] CEVA stands for Cornavin-Eaux-Vives-Annemasse.

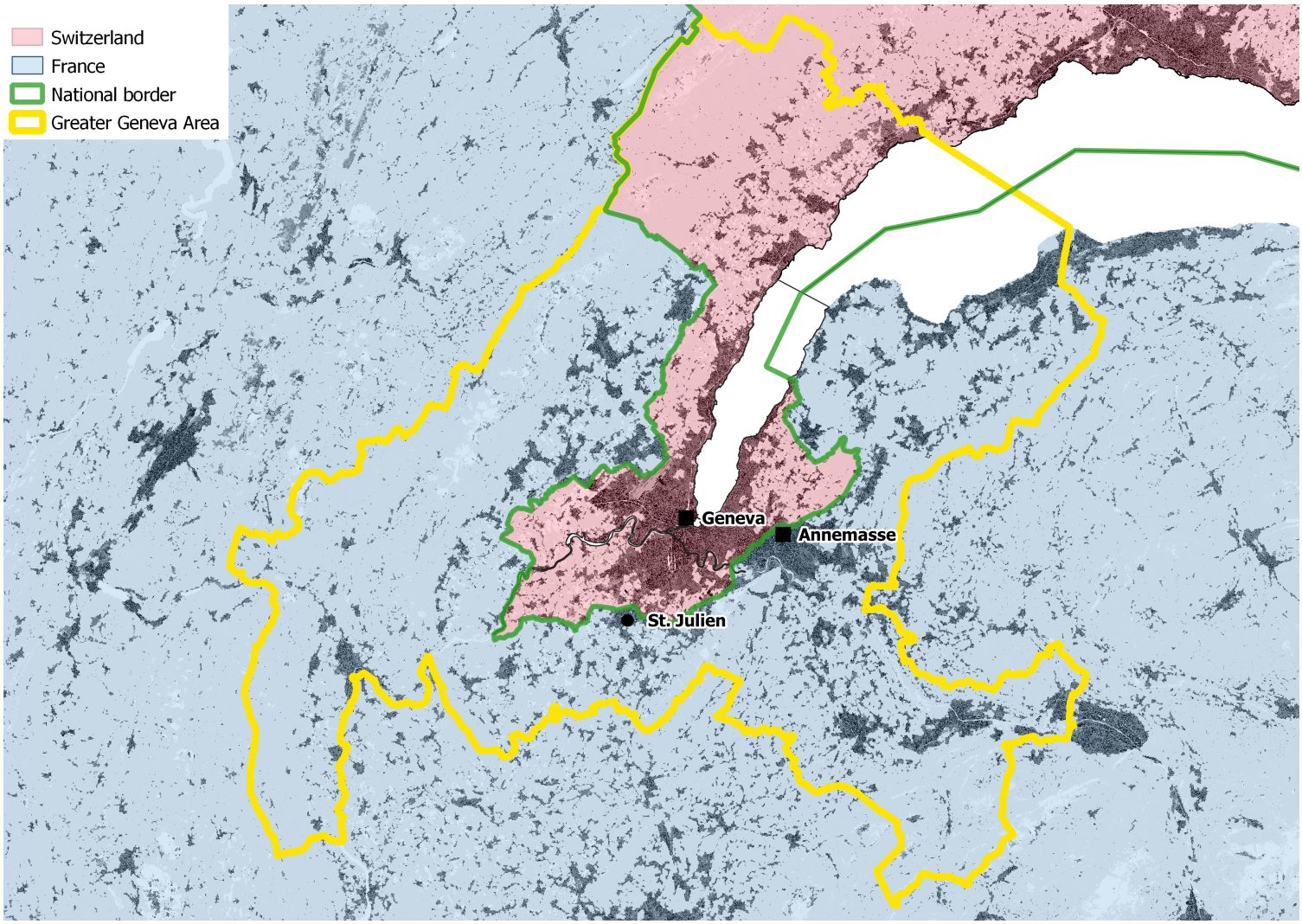

Figure 2: The Greater Geneva binational agglomeration

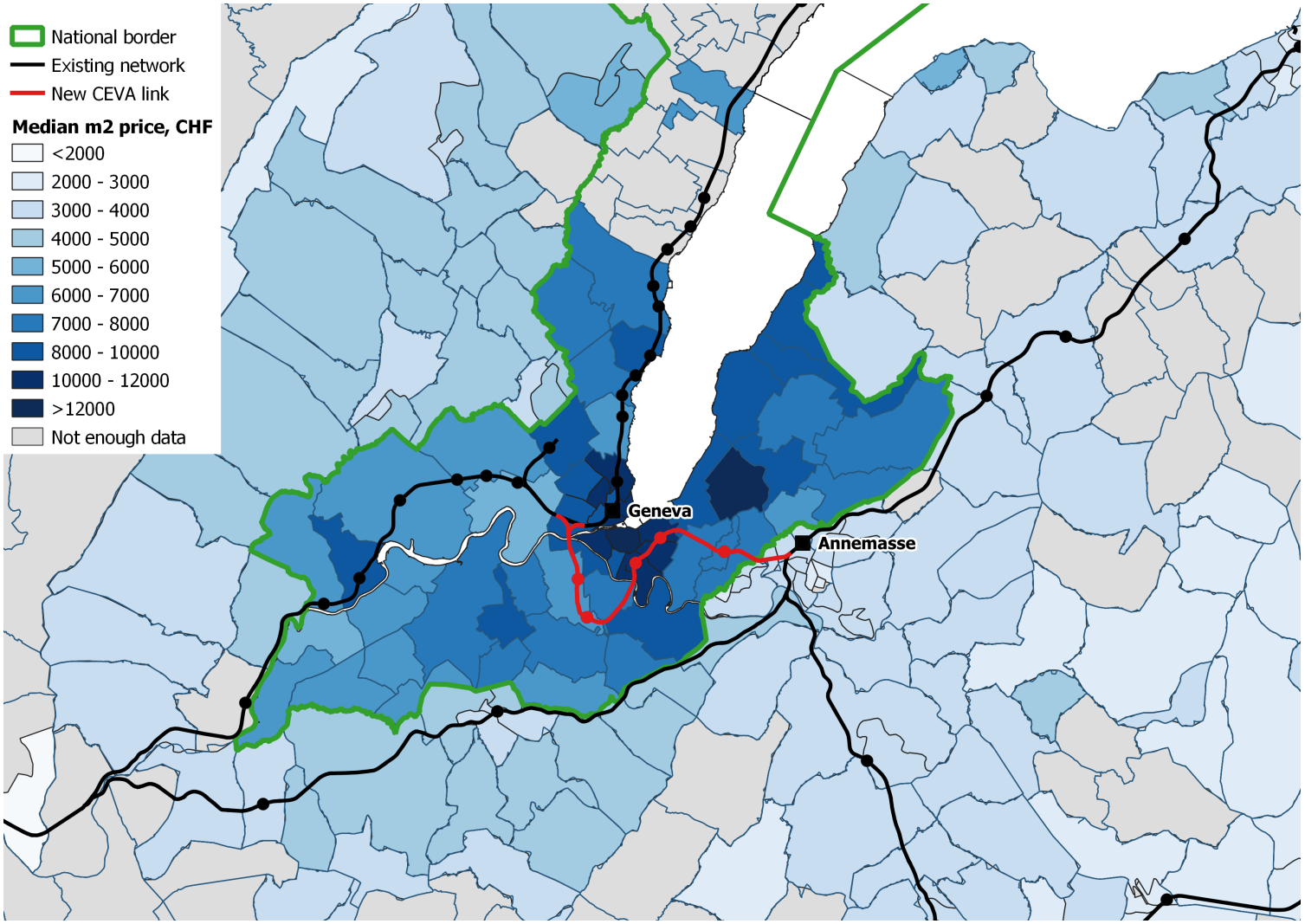

Figure 3: The Léman Express network and housing prices in Greater Geneva 2010-2018

few new local bus lines catering to the station in Annemasse were introduced. This complements the service of the LEX by providing a well coordinated granular network. In 2021Q2 after 1.5 years of operation, the LEX transported on average 40k passengers per day and surveys indicate that 77% of passengers use the service for work or study related commuting.[10] The financing of the total cost of 1.8bn CHF was split between France (14%) and Switzerland (86%) according to the share of track kilometers located in each territory. The policy aim of the LEX was to provide an efficient transport system to tackle the road traffic gridlock,[11] to facilitate cross-border movement of people and to promote housing development and jobs on both sides of the border. The LEX is a milestone in cross-border cooperation. The approval of CEVA's financing through popular vote in the Canton of Geneva in 2009 and the award of the 8th European Grand Prix for town planning to the Agglomeration Project in 2010 gave strong support and great credibility to cross-border cooperation in the region.

Figure 3 shows that the new rail link connects a high housing price area to a low price area. The urban area around Annemasse, has particularly low housing prices, even compared to adjacent French locations. Figure 4 plots the square meter housing price against traffic adjusted car journey time to downtown Geneva. I use car journey time as according to French Census data from 2016, 90% of cross-border workers (CBWs) from France to Geneva commuted by car or motorcycle before the introduction of the LEX. Car journey times were calculated using HERE's API by submitting trip planning requests from residence locations to downtown Geneva during morning rush hour accounting for delays due to traffic congestion.[12] Fitting a line for the Swiss and French side, a clear country effect is visible. Locations with identical car journey time to downtown Geneva had 50% lower housing prices in France before the introduction of the Léman Express. Take for example a car journey time of 25min, there the median square meter price on the Swiss side is 8.1k CHF versus only 4.1k CHF on the French side.[13] Figure 25 in the appendix shows the price gradient for one particular spatial cross-section. The housing price gradient from downtown Geneva towards downtown Annemasse is decreasing with a sharp housing price discontinuity (-46%) at the national border.

These disparities obviously create incentives to work in Switzerland but reside in France. Cross-border working is indeed very popular in the region, more than 30% of jobs in Geneva are filled with CBWs from France. However, despite the free movement of persons between the two countries since 2004, which liberalized immigration and cross-border working, these price disparities still persisted

[10] According to a client satisfaction surveys conducted by Lémanis.

[11] The canton on Geneva expects to be able to reduce road traffic by 12% thanks to the LEX.

[12] The residence locations are municipalities or where available IRIS in France and statistical sectors in the city of Geneva (see Section 3 for more details). The car travel time corresponds to the duration for arriving to Geneva Cornavin at 8am on a Wednesday in September 2019.

[13] Note that these lines show a raw correlation as they were fitted without any controls. Analysis of dwelling characteristics shows that dwellings in neighboring France tend to be smaller than in Geneva. Combined with the fact that smaller dwellings tend to have higher square meter prices, this results in a slight overestimation of prices in France.

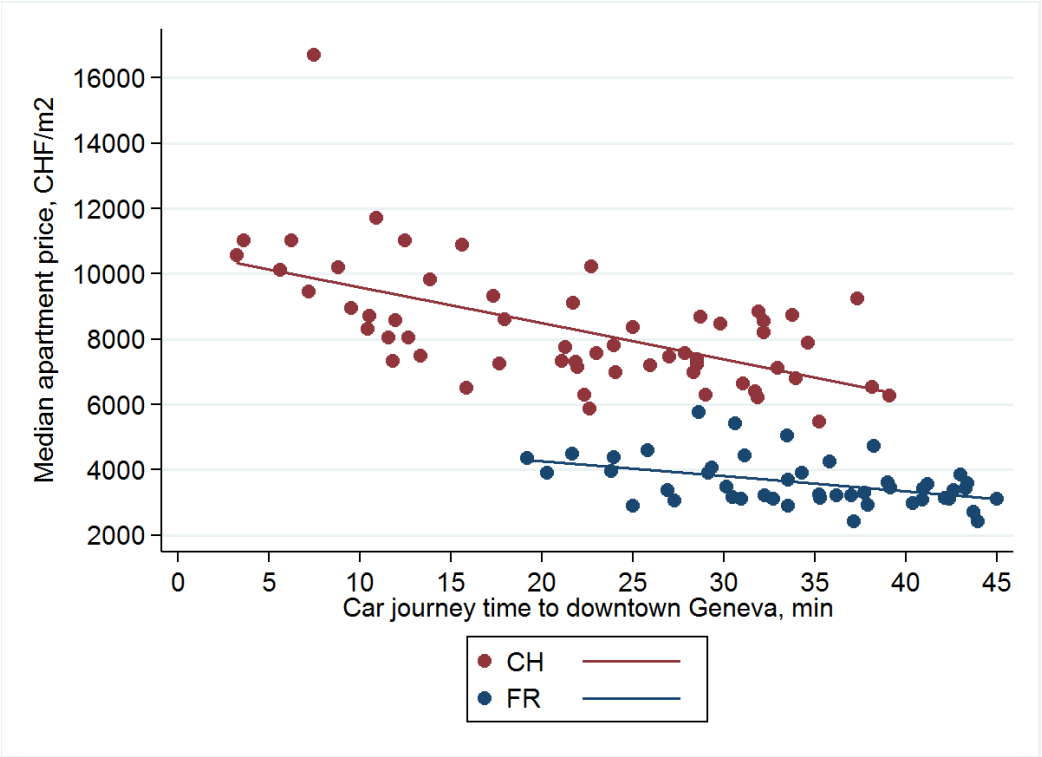

Figure 4: Country effect in housing prices in Greater Geneva 2010-2018

even after a decade. The evolution of prices is depicted in Figure 26 in the appendix.[14] The square meter price of a reference apartment remained consistently about 50% lower in France. As this price gap persisted over the years, there must to be large differences in the attractiveness of residing in the French versus the Swiss part of the Greater Geneva Area. One relevant factor is certainly the costly commute due to poor cross-border public transport service and severe road congestion during rush hours. Other relevant factors include amenities such as public services (health care, education, law enforcement), taxation, culture and social institutions, which are different in France and Switzerland. Figure 1 in the introduction plots the the public transport journey time against the traffic free car journey time from residence locations to downtown Geneva.[15] I find a 17min public transport border penalty when commuting from an equally distant origin in France versus one in Switzerland. Unsurprisingly, in 2016, 90% of CBWs to Geneva commuted in their private car. This is where the LEX comes in. The new train service substantially reduces cross-border commuting cost and should therefore substantially increase attractiveness to reside in neighboring France. The effect will be a combination of faster public transport service and less road traffic congestion. Due to the relatively random realization timing of the LEX, this provides a natural experiment to study how residents respond to a commuting time reduction.

[14]For detail how these hedonic price indices were constructed see Section 4.2

[15]See Section 3 for a detailed description how these measures were constructed. See Figure 27 in the appendix for an illustration of the car border penalty due to heavy traffic around border crossings. The border penalty is about 4min for close locations but then fades out.

3 Travel time reduction

The new train service foremostly reduces public transport travel time between Annemasse and downtown Geneva, where the vast majority of jobs are located.[16] Before the introduction of the LEX the only trans-border public transport connection between Annemasse and Geneva was a bus service, which was unattractive due to low comfort and delays due to heavy road traffic on this route. The LEX reduces the public transport travel time between downtown Geneva and Annemasse by 20min (-47%) and triples the connection frequency but also other locations enjoyed substantial improvements. The reduced public transport travel times are competitive with car travel times. For example, the trip from Annemasse to downtown Geneva takes 23min with the LEX versus 39min by car (including traffic delays). Another advantage is that a train journey unlike a car journey does not require the commuters attention. So she is free to relax or work.[17] Moreover, the Léman Express trains offer a high level of comfort including air conditioning, power outlets to charge mobile devices and comfortable seats. See Figure 28 in the appendix for an impression of the LEX interior. Moreover, thanks to reliably delivering according to timetable, another advantage of the LEX is that commuting time is highly predictable. When commuting by car there can be considerable variation due to traffic delays. Hence, the LEX is a very attractive alternative to commuting by car.

To identify which locations were most affected by the service improvement, I calculated a granular origin-destination matrix of travel time changes using public transport feeds. As my spatial unit of analysis, I use municipalities or where existing statistical sectors in Geneva and IRIS units in France.[18] I used the application Open Trip Planner to integrate train, tram and bus timetable feeds into one consistent public transport network using data from SBB, SNCF, TAC, Sibra, BUT and ProximiTi. Using such a multi-mode approach, allows for a holistic analysis and allows to also capture the new tram and bus lines and any modifications on existing lines. I submit route planning requests to Open Trip Planner's API for every residence location to downtown Geneva during Wednesday morning rush hour. I calculate multi-mode public transport travel times before and after the introduction of the LEX. From this I constructed an exposure measure based on the travel time reduction which following Büchel and von Ehrlich (2018) also incorporates the connection frequency. They suggest that the journey time is augmented with waiting time to account for connection frequency. The measure of travel time is

$$\text{Travel Time}_i = \frac{120\text{min}}{\#\text{Available Connections}_i} + \text{Journey Time}_i,$$

where Journey Time_i is the duration of the fastest public transport trip from origin i to downtown Geneva between 7am and 9am on Wednesdays including walking time from the trip origin to the

[16] Geneva is by far most important travel destination for residents of neighboring France, where >40% are CBWs to Geneva.

[17] A survey among LEX passengers in 2021 indicated that 23% use the time on board to work and 77% to relax or enjoy leisure.

[18] The INSEE has defined IRIS units to subdivide municipalities with more then 5k inhabitants into areas of 1.8k-5k residents.

closest public transport stop. As trip origin locations I used the political center of the spatial units.[19] #Available Connections$_i$ is number of available connections arriving in downtown Geneva from origin i between 7am and 9am. I calculate the change in travel time from a series of requests in 2019Q3 for the pre LEX situation compared to 2020Q1 when the LEX was in operation.
This treatment intensity of change in travel time is depicted in Figure 5. In dark green are locations that experienced a substantial public transport travel time reduction of at least 30%, these are the most directly affected locations. In light green are locations with a moderate public transport travel time reduction between 20% and 30%. The largest reductions are along the two main routes feeding into the new CEVA link in France. There is also one location where the travel time to Geneva actually substantially increased, the reason being that before the LEX a commuter bus service from Annemasse to Geneva used to run through there, which was discontinued with the introduction of the LEX.

Next, I discuss which variation can be used to identify the effect of the LEX. When studying the introduction of new transit lines, a major concern is the endogeneity of route placement which can result in reversed causality. A strength of my setting is the exogeneity of the stops in France since the Léman Express there operates on the original rail network from 1880. The preexistence of the network and the stops in France for more than a century alleviates concerns that the LEX stations were build in those locations that also without the LEX would have been the most dynamic.[20] While the route of the new CEVA link is more prone to endogeneity, the eventually realized link is closely matching a path that has been planed since 1923 as illustrated in Figure 6 and three out of the five new stations follow historic infrastructure. There was a series of historic plans which were only partially implemented. The "Grand Serpentin" route was planned in 1876 but only the Annemasse – Eaux-Vives part was realized in 1888. The "Treaty of 1912" route was planned in 1923 but only Cornavin – La Praille part was realized in 1949.[21] Hence, we see that both ends of the CEVA 2019 were predetermined since at least 1949 and only in the exact shape of middle part there was scope for adjustment. The stations Pont-Rouge, Eaux-Vives and Chêne-Bourg follow historic infrastructure, the remaining two stations are targeted to serve modern time important sites: the Bachet station to connect the Stade de Gèneve and the Champel station to connect the university hospital. The exact timing of finally completing the link is arguably somewhat random as there have been several attempts stopped by external circumstances before and the construction duration of 8 years entailed considerable uncertainty. However, we can not completely rule out that the timing of the realization is influenced by demand effects.

[19] The political center (chef lieu) of a spatial unit in the case of a municipality is the major's office and in the case of a statistical sector is the closest road point to the geographic centroid. Using the political center rather than the geographic centroid for municipalities improves precision since especially in rural areas large parts of a municipality may be uninhabited and I aim to measure commuting time from the main inhabited location.

[20] Of course the railway network connected major cities back then but did not account for economic dynamics more than 100 years later. To further alleviate the concern of network endogeneity, I could could include historic controls (e.g pop size, growth).

[21] The reasons why the previous attempts of connecting Geneva and Annemasse failed are diverse. Reasons include lack of money, the Great Depression and the World Wars.

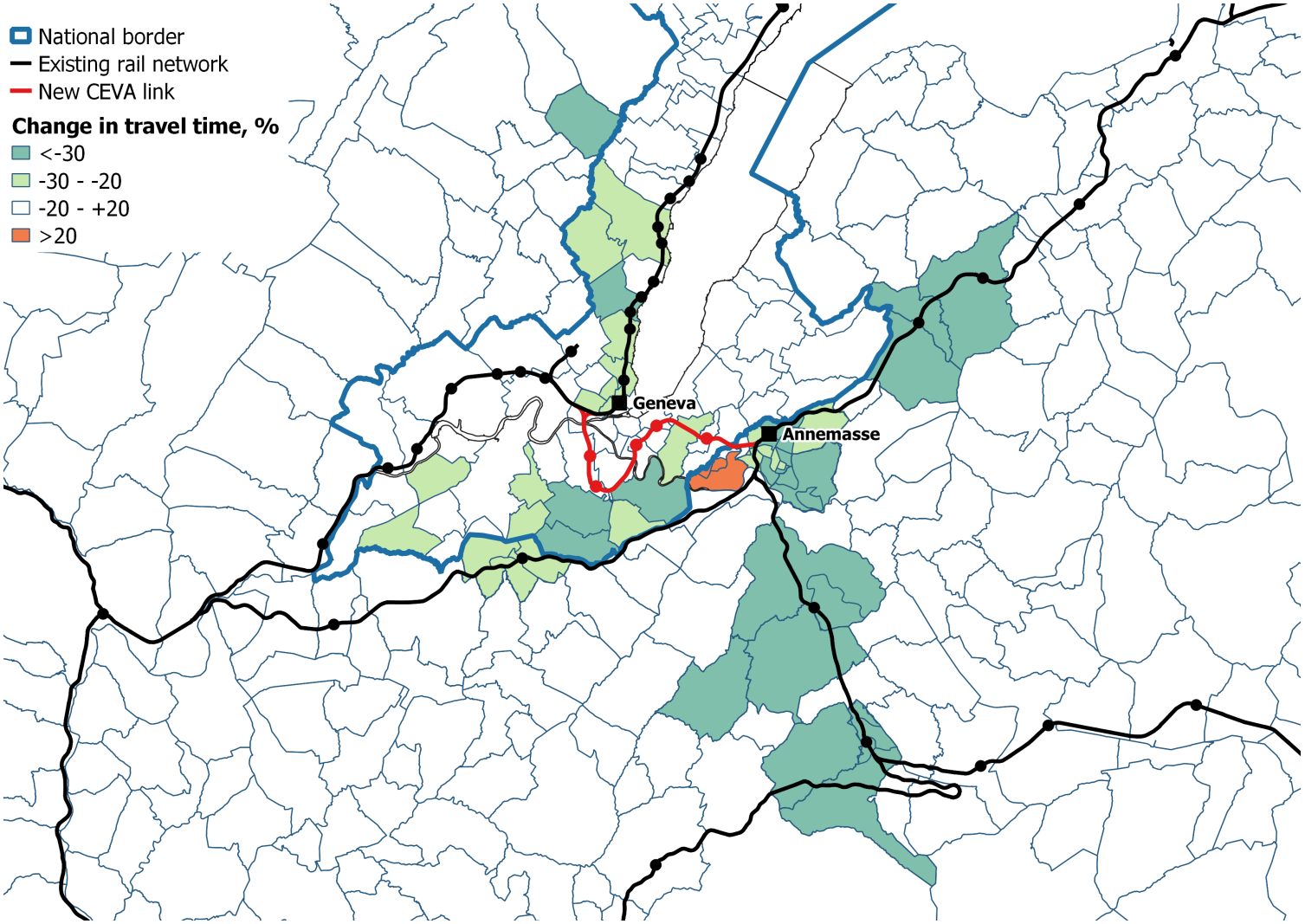

Figure 5: Change in public transport travel time to downtown Geneva pre versus with Léman Express

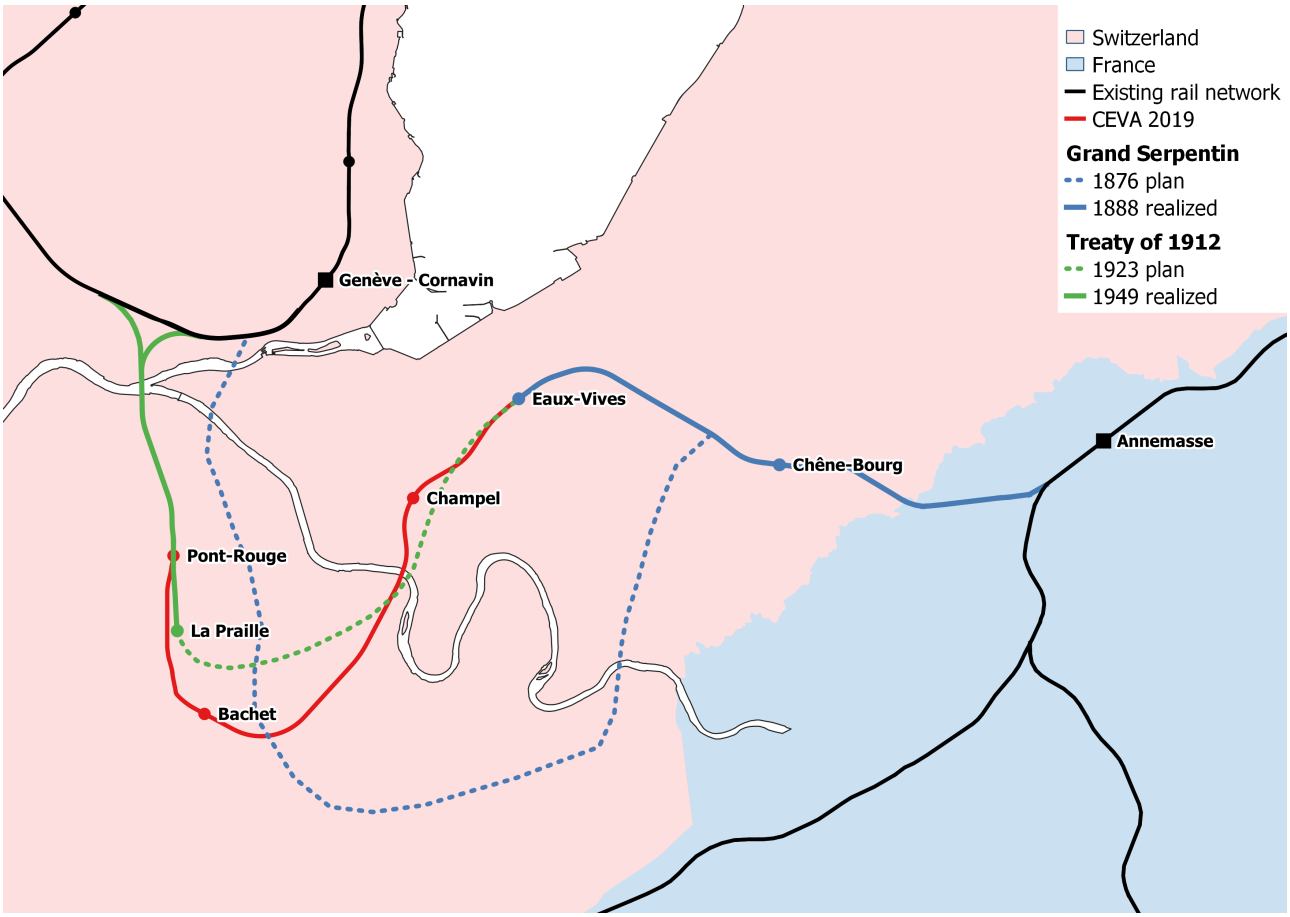

Figure 6: Historical plans to connect Geneva and Annemasse

In order to estimate the effect of the LEX on housing market outcomes such as housing construction, housing prices and residential relocation flows, I exploit the timing of the LEX opening and the geographically varying treatment exposure for identification via a Difference-in-Difference strategy. I compare the evolution of high versus low LEX exposure locations over time

$$Y_{it} = \alpha_i + \gamma_t + \sum_t \delta_t D_i \times T_t + \epsilon_{it},$$

where $D_i = 1$ if the LEX exposure of location i is high, δ_t are the coefficients of interest, γ_t are time fixed effects and α_i are location fixed effects. I cluster on location i level and weight by location's population or housing stock size.[22] Due to the recency of the LEX opening, my analysis will focus on anticipation effects of the new service and only at a later stage it will be possible to evaluate the period of operation. We should certainly expect anticipation effects as the project was announced in 2001 and construction started in 2011. It is also likely that there are some indirect effects, i.e. spillovers to neighboring locations. Hence, the Difference-in-Difference estimator is going to capture the relative effect between high and low exposure locations which can be interpreted as the reduced form general equilibrium effect of the LEX, i.e. how the LEX affected the treated locations compared to other locations in the Greater Geneva Area.

Figure 7 depicts the distribution of changes in public transport travel time that came along with the LEX. I choose 30% to be the cutoff for a strong treatment.[23] Hence, as the treatment group I define high exposure locations, which experience a public transport travel time reduction of at least 30% with the LEX and already pre LEX were within 90min public transport travel time from downtown Geneva.

In the comparison group are low exposure locations with a pre LEX public transport travel time to downtown Geneva of less than 90min but which do not experience a major reduction with the LEX. Hence, the Difference-in-Difference estimator compares already connected but unchanged locations to already connected but now substantially better connected locations.[24] Figure 8 illustrates treatment (yellow) and comparison group (blue) in France. Even though, for a Difference-in-Difference estimation what matters is parallel pre trends, it is also insightful to look at characteristics of the two groups in levels. Table 5 in the appendix shows that treatment and comparison group in France are well balanced in terms of pre LEX commuting and housing characteristics and have very similar pre trends in terms of population growth.[25]

[22] A location is either a municipality or where available a statistical zone in Switzerland or an IRIS unit in France.

[23] Other cutoffs yield similar results.

[24] Alternatively, I could use the entire cross-border worker zone as a comparison group but that would imply much more unbalanced observables since locations without a public transport connection to downtown Geneva are much more more rural.

[25] Column CBW20 provides the alternative comparison group of all remaining locations with at least 20% CBW share.

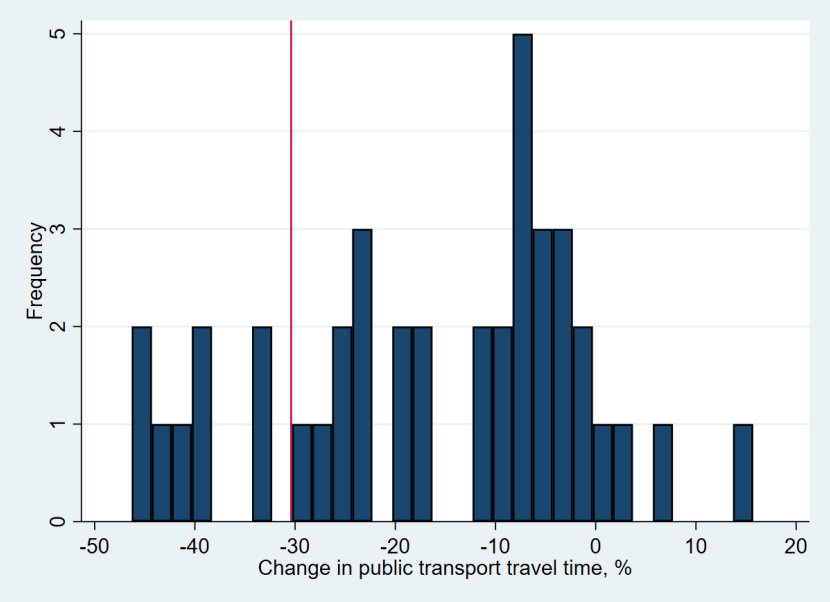

Figure 7: Distribution of changes in public transport travel time

4 Housing construction, prices and rents

The first part of this paper assesses the effect of the new train service on housing market outcomes. I estimate the effect on housing construction and housing prices using micro data. This micro data contains information on housing characteristics such as inhabitable surface, number of rooms and year of construction. This enables comparing similar objects when calculating treatment effects. Crucially, this data is geolocated which allows studying effects on a very granular level.

4.1 Housing construction

In order to track the development of housing supply, I use residential building permit data from Sitadel 1994-2020 for France and from the cantonal statistical office's construction statistics 1996-2020 for Geneva.[26] The Sitadel data is produced and published as open data by the Data and Statistical Studies Service (SDES) of the French government based on construction permits collected by local authorities. The Genevan data is restricted access data based on permits filed to the cantonal building authorization office. It has been made available for this project based on a data protection contract. Both data sets contain permit level geolocated information on the number of new residential dwellings constructed, date of authorization, date of construction start, nature of project (new or transformation), type of building (single family home or multifamily home) and the floor-space area for non-residential projects (commercial and industrial).

From these housing starts notifications, I calculate the yearly growth rate of the housing stock

[26] Sitadel stands for Système d'Information et de Traitement Automatisé des Données Élémentaires sur les Logements et les locaux. The Genevan data set is called Statistique de la construction.

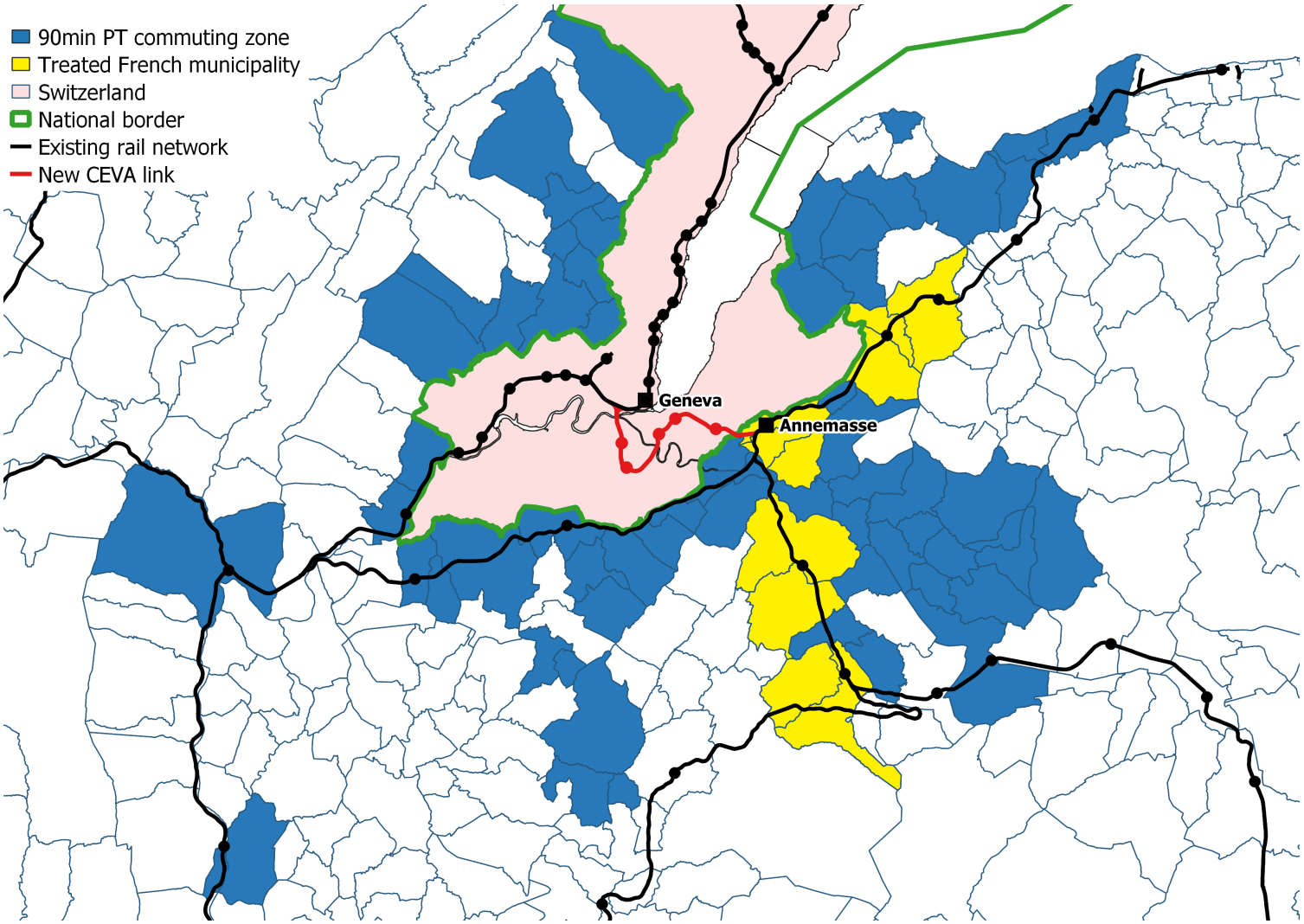

Figure 8: Treatment and comparison group in France

in high and low LEX exposure locations as defined in Figure8. Assuming that construction of a residential unit is typically completed within 1 year, the growth rate is calculated as the yearly change of the housing stock due to housing starts in the previous year. In France, I find a housing supply boom around the newly well-connected stations launching about 3 years prior to the opening of the new train service. This is in line with the timing of housing construction related to infrastructure improvements found in other studies (Gupta et al. 2020, Agostini and Palmucci 2008, Yiu and Wong 2005). In Figure 9, we see the annual growth rate of high exposure compared to low exposure locations in France using the treatment groups based on travel time reduction defined in Section 3. For the period 1996-2017 the housing stock growth in high an low LEX exposure locations closely tracked each other, providing the prerequisite of parallel pre trends for a Difference-in-Difference estimation. Housing construction is disproportionately booming in locations that are strongly treated by the Léman Express 3 years in anticipation of the opening. In 2019, the raw growth rate premium of treated locations amounted to 1.1pp (61%).[27] One year before the opening, there is a moderate slowdown (-0.3pp) in housing growth in low LEX exposure locations, which could be the result of negative spillovers from the high exposure locations. Some construction activity that would have happened in low LEX exposure locations in absence of the LEX, might have been diverted to the more dynamic high LEX exposure locations.

To account for general time trends, I employ a Difference-in-Difference estimator. Figure 10 plots the additional housing stock growth of high exposure locations compared to low exposure locations based on a Difference-in-Difference estimation with 2016 as the base year. Plotted are the interaction coefficients δ_t from the following specification

$$Y_{it} = \alpha_i + \gamma_t + \sum_{t=1996}^{2020} \delta_t D_i \times T_t + \epsilon_{it},$$

where Y_{it} is the housing stock growth of location i in year t, $D_i = 1$ if the LEX exposure of location i is high and $D_i = 0$ if low, γ_t are year fixed effects and α_i are location fixed effects. Standard errors are clustered on location i level and the regression is weighted by location's dwelling stock size.[28] The estimation results are reported in Table 6 in the appendix. In 2019 (2020), the housing stock in strongly treated locations grew 1.42pp (1.2pp) more then in the little treated locations. In terms of magnitude, a total of 4.6k new dwellings were built in the treatment locations from 2017-2020, of which 85% were apartments and 15% houses. In my further analysis, I refer to the period 2017-2019 as the *LEX anticipation period*, as during this period there was a clear response in housing supply at treated locations in anticipation of the LEX opening.[29]

In terms of non-residential construction activity, there are no signs of a boom near treated locations in anticipation of the LEX. Hence, there is little evidence that firms relocate from Geneva to neighboring France to take advantage of the increased labor supply there or that stations in

[27] This is a simple first difference between high and low exposure locations.
[28] A location is either a municipality or where available a statistical zone in Switzerland or an IRIS unit in France.
[29] Recall that he LEX started operation in December 2019.

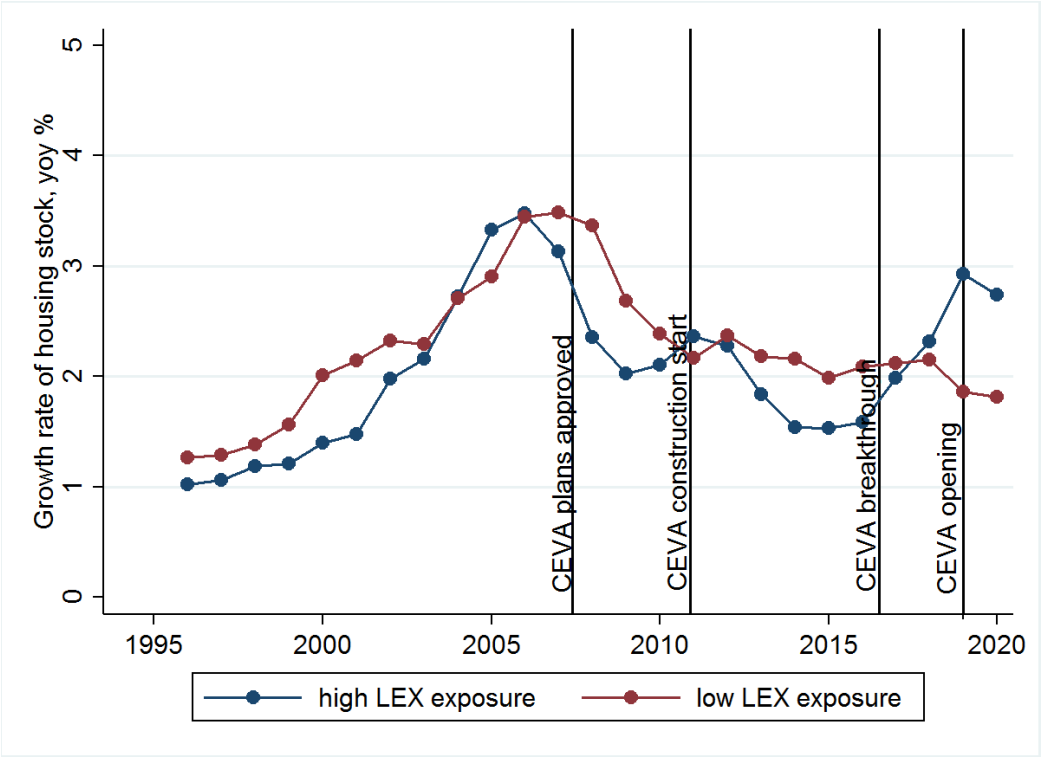

Figure 9: Housing stock growth in high vs low LEX exposure locations

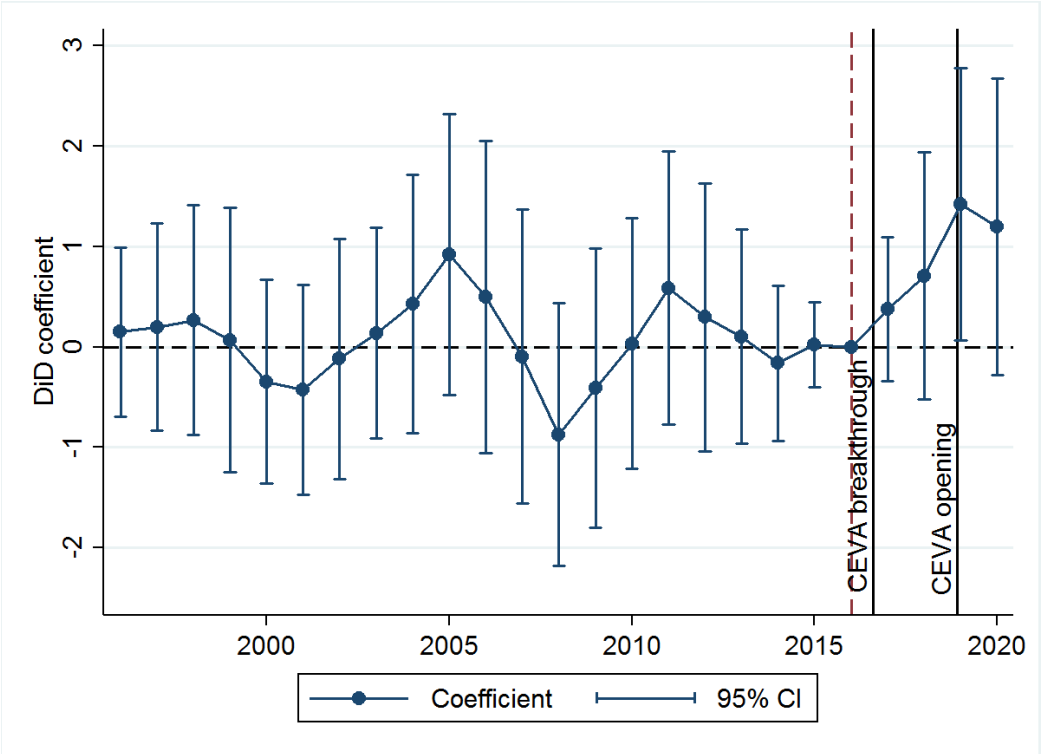

Figure 10: Differential housing stock growth in high exposure locations

France are becoming new hubs of commercial activity.

Analyzing the construction development in anticipation of the LEX opening for the Swiss side of Greater Geneva requires a slightly different approach since the main benefit of the LEX there is not a travel time reduction to downtown Geneva. In the city it is rather a general connectivity improvement between the different neighborhoods and establishment of the LEX stations as new local centers. Therefore, I resort to comparing locations within a 1km distance from a LEX station to locations further away, rather than using a treatment group based on travel time reduction. Figure 30 in the appendix plots the number of new dwellings authorized from 2000-2020. A surge in 2017 more than doubles the number of authorized dwellings, which is driven by a large number of residential projects near LEX locations. As the Difference-in-Difference requirement of parallel pre trends does not seem to hold between the two groups on the Swiss side, I abstain from reporting numerical estimates as they would not be meaningful.

Figure 29 in the appendix shows there is also a strong boom in authorizations of commercial surface near LEX stations in Geneva in 2017 and 2018. However, unlike the broadly distributed residential construction response, the commercial construction boom is largely driven by two large scale projects near LEX stations. In 2017, the approval of a 30k m2 retail and office space project directly at the Eaux-Vives station and in 2018, the approval of a 75k m2 retail and office space project in Vernier.[30]

I conclude, that residential housing construction was booming on both the Swiss and the French side of Greater Geneva about 3 years in anticipation of the LEX opening. Commercial construction boomed near stations in Geneva but not in France.

4.2 Prices

To track housing prices, I use individual level transaction data on the universe of housing purchases from DVF for France and from the cantonal statistical office's real estate transaction statistics for Geneva available since 2010.[31] The DVF data is produced and published as open data by the Directorate General of Public Finances of the French government based on notarial deeds and cadastral information. The Genevan transaction data is restricted access data based on the land registry and supplemented with information from notaries. It has been made available for this project based on a data protection contract. Both data sets contain information on the transaction date, sales price (excluding fees), geolocation or physical address, type of premise (house, apartment), floor-space and land surface, number of main rooms and sometimes the construction year. I used official cadastral data to geocode the physical addresses provided in the OCSTAT data, attaining a 97% match rate. Tables 7 and 8 in the appendix provide summary statistics of this housing transaction data after excluding some outliers as suggested by the data producers.

[30] See Quartier de l'Étang www.evolutionplus.ch

[31] DVF stand for Demandes de valeurs foncières. The Genevan data set is called Statistique cantonale des transactions immobilières.

To estimate the value of proximity to a railway station, I use prices from these geocoded dwelling transactions in a basic hedonic regression. To quantify how the proximity value is affected by the introduction of the LEX, I estimate the following dwelling-level dynamic Difference-in-Difference specification for the price per square meter

$$p_i = \sum_{t=2}^{4} \alpha_t Q_{t,i} + \gamma_t + \sum_{k=1}^{K} \beta_k X_{k,i} + \sum_{t=2014}^{2019} \delta_t D_i \times T_{t,i} + \epsilon_i,$$

where proximity to station $D_i = 1$ if the road distance to the closest station from dwelling i is at most 500m, $Q_{t,i}$ is a dummy for the quarter of sale (omitting the first quarter), $T_{t,i}$ is the year of sale (omitting 2014) and $X_{k,i}$ are dwelling characteristics (habitable surface, N rooms, construction year, municipality fixed effects). I separately estimate this for treated and for control locations. I restrict the sample to existing dwellings. Excluding newly built dwellings, avoids picking up premia due to potentially higher quality of new units near treated stations. The coefficients of interest, the distance-time interactions δ_t, are plotted in Figure 11 and the regression results are reported in Table 9 in the appendix. We see that in France, proximity to a railway station was in fact a disamenity prior to arrival of the Léman Express. This disamenity was of similar size near treated and control stations, about -200 €/m^2 in the 4 years prior to the CEVA tunnel breakthrough. As the opening of the LEX approached, this proximity penalty flipped into a premium at prospective well-connected stations. It might not be a coincidence that prices start reacting right after the tunnel breakthrough was achieved, as this largely resolved uncertainty about the opening date of the new service. The results suggest that proximity to a treated railway station, soon offering fast commuting to jobs in Geneva, became a major driver of housing prices two years in advance of the opening. In 2019, the proximity premium at treated stations was 396 €/m2 compared to further away locations (13% higher prices) and 735 €/m2 higher compared to control stations. This is consistent with magnitudes found in the literature. Duncan (2008) estimates that properties near railway stations in San Diego, California sell at premiums of about 10%. The flipping of the proximity premium in Geneva translates into a price increase near treated stations of about +550 €/m2 (+18%). My results are robust to using a continuous measure of distance or travel time instead of the 500m threshold. The effect is shared broadly across all of the treatment stations and not driven by a specific one. Of course the value of proximity to stations could have increased due to reasons unrelated to the LEX but the timing of the effect and comparison to the development in less affected locations suggests that the effect is likely to indeed be related to the LEX. However, it could still be that it is improved amenities around treated stations rather than facilitated commuting that is driving the result. Amenities around strongly affected stations could have improved more than at less affected locations for example due to the redevelopment of the stations themselves providing new commercial surface for retail shops and services. In Section 5, I look at the characteristics of arrivals to these newly well-connected locations and find an increase in CBWs, suggesting that at least part of the increased attractiveness is indeed due to better commuting access to Geneva.

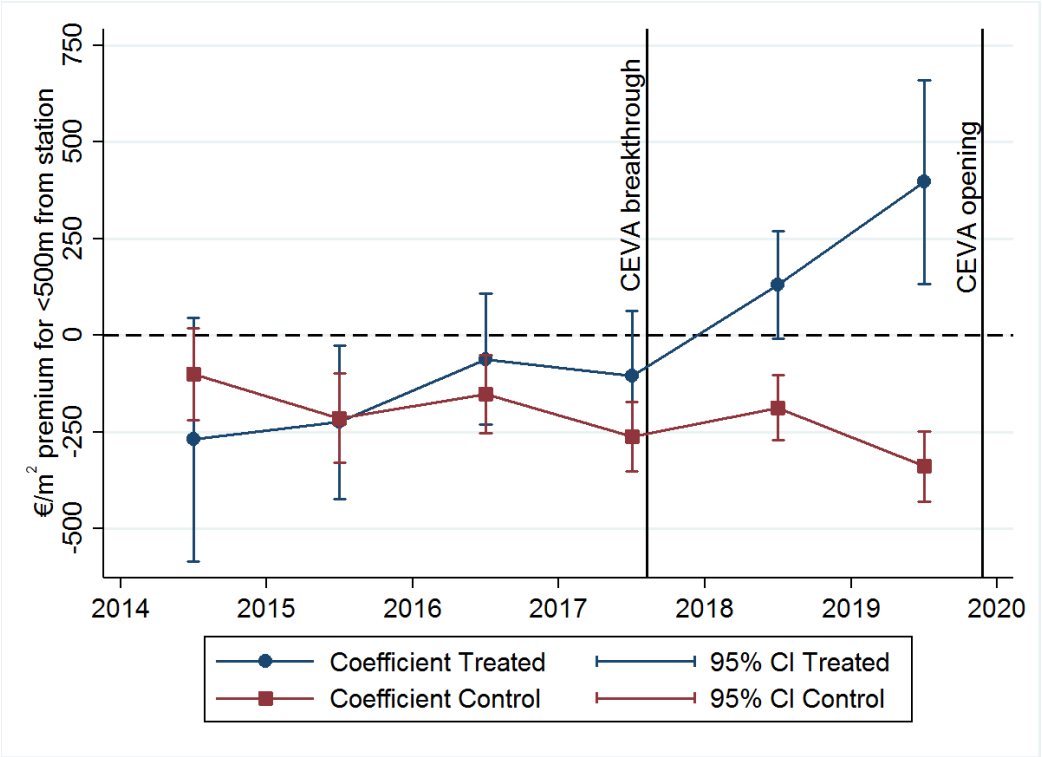

Figure 11: Value of proximity to a railway station in French Greater Geneva

Furthermore, from the analysis of the evolution of commercial construction in Section 4.1, we know that there was no increase in commercials surface growth near treated stations in anticipation of the LEX. This limits the scope for a large commercial amenity effect. However, some contribution through increased amenity quality cannot be ruled out.

Hence, the housing price response in France is best compatible with a story of improved job market access to Geneva, making neighborhoods around these newly well-connected railway stations attractive resident locations. I will further investigate this effect in the second part of my project addressing residential relocation flows and and household characteristics.

On the other hand, in Geneva there is no such emerging of an access to station premium detectable. See Figure 31 in the appendix.

To track the evolution of housing prices in different areas, I largely follow the method used by Tricaud (2021) to calculate hedonic spatial housing price indices. I run the following regression

$$lnp_i = \sum_{k=2}^{4} \alpha_k Q_{k,i} + \beta Y_i + \gamma R_i + \delta F_i + \epsilon_i,$$

where lnp_i is the log m2 price of dwelling i, $Q_{k,i}$ are dummies for the quarter of transaction, Y_i the construction year, R_i is the number of rooms and the F_i is floor-space area in m2. I center all explanatory variables by subtracting the means and dividing by the standard errors. The procedure is to first run the hedonic regressions for each year separately and then compute the mean of the

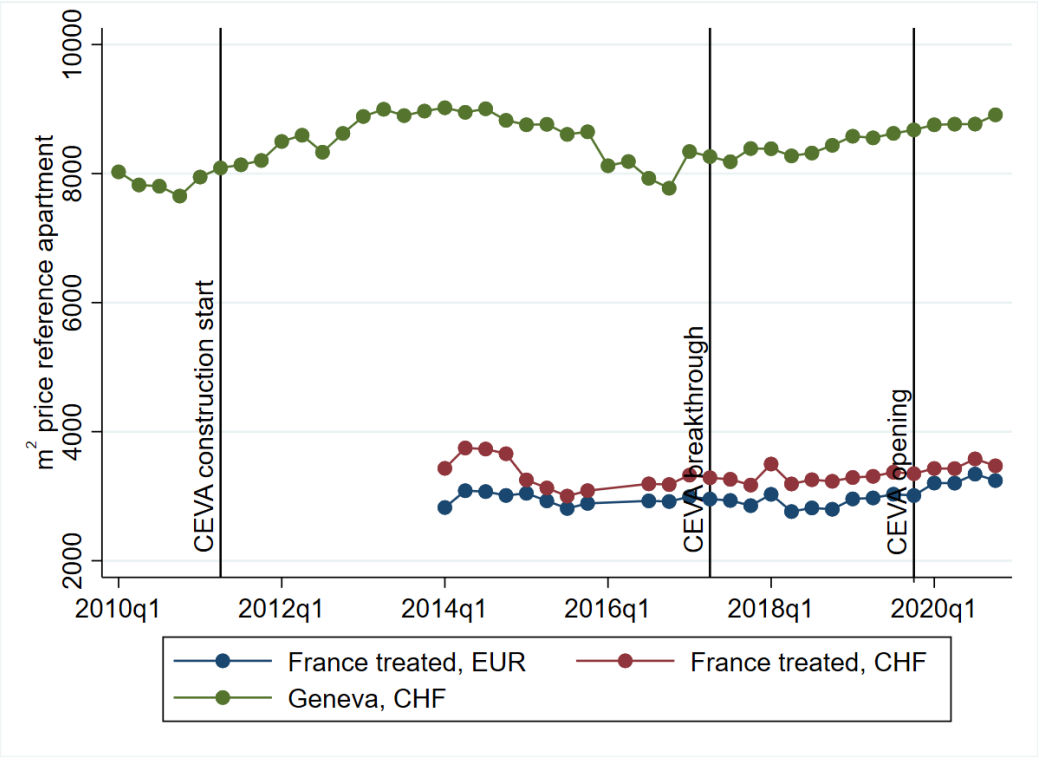

Figure 12: Price for reference apartment in treated France vs Geneva

residuals for each area. Adding the regression constant to this yields a quarterly price index. Using centered explanatory variables, the resulting indices can be interpreted as a price per square meter for a reference dwelling.[32]

To check for convergence in housing prices between treated areas in France and high price Swiss Greater Geneva, I compare the change in local housing price indices between the pre period and the anticipation/post period. For the pre period, I use the 4 year period 2014q1-2017q4 before there was a housing price effect around treated stations in France and the anticipation/post period is the subsequent 3 year time frame 2018q1-2020q4. Housing prices on the Swiss side of Greater Geneva on average increased by 1.2% from the pre to the anticipation/post period, while on the French side prices on average increased by 2.9% in the treatment area overall. As estimated above the effect within 500m from strongly treated stations is as large as 18%. Plotting the price development of treated locations in France and locations in Switzerland in Figure 12, shows that part of the price increase in France is counteracted by a weakening of the Euro relative to the Swiss Franc during this period. The price increase in treated locations in France expressed in Swiss Francs only amounts to 1.5%. Hence, it seems that the housing price gap between the French and the Swiss side, described in Section 3, is indeed shrinking with better public transport integration but at a very modest pace (except for locations in very close proximity to newly well-connected stations). Given the many differences between Switzerland and France in terms of institutions, the price gap is likely to remain

[32]For more details see Tricaud (2021) Appendix D. Housing price indices.

substantial in the future even with seamless public transport integration.
In terms of housing prices, I conclude that in France there are significant housing price increases around affected stations in anticipation of the opening, while prices in Geneva on the other hand remained broadly stable. This suggest that the new train service to some extent succeeds in promoting the attractiveness of locations in France and hence reduces the country price gap at least around newly well-connected locations.

Taking stock, the evidence so far suggests that the new train service seems to reduce the housing price gap between the Swiss and the French side of the agglomeration by increasing housing prices at newly well-connected locations in France about 2 years in anticipation of the LEX operation start, while leaving prices on the Swiss side unaffected. Around soon well-connected stations there is a pronounced construction boom about 3 years in anticipation, which reshapes the urban landscape and enables residential reshuffling due to new housing supply.

5 Residential relocation response

This section describes how the introduction of the LEX reorganizes spatial allocation of population and labor in the Greater Geneva Area. To track the residential relocation response in anticipation of the commuting cost reduction, I use individual-level data from the French Census[33] and the Swiss Structural Survey[34]. These yearly data contain individuals' current and previous residence location for a representative sample of the population. Moreover, these data provide a battery of demographic, socioeconomic and housing characteristics for each household. Among the most interesting characteristics are the work municipality (including the municipalities of CBWs to Switzerland), the mode of transport used to commute to work, home ownership and dwelling living surface. The Swiss Structural Survey samples 8% of households yearly. In 2016, 18.2k households were surveyed in the Swiss part of Greater Geneva, out of a total of 230k. The French Census samples about 14.8% of households yearly. In 2016, 25k households were surveyed in the French part of Greater Geneva, out of a total of 169k. Household sampling weights provided by the data producers allow imputing representative measures for the entire population.

These data allow to assess whether not only housing prices reacted but also how residents respond and how this changed the composition of neighborhoods. Since 2018, more than 4000 new dwellings near newly well-connected stations in France were completed. This corresponds to a 9% increase of the dwelling stock and can accommodate about 9000 new residents. The French Census data can answer who moves into locations near the newly well-connected stations in France. While these locations should be mainly attractive to CBWs it is not clear ex ante to what extent these are going to be CBWs relocating from less well-connected locations in France (to take advantage of the new train service) or workers previously residing in Geneva moving their residence across the border (escaping unsatisfying housing situations in Geneva). Over the past years CBWs in the Greater

[33] INSEE Recensement de la population
[34] BFS Strukturerhebung

Geneva Area typically used to live in a house in the French countryside and commute to Geneva by car. My conjecture is that with the LEX they will start clustering in apartment buildings around stations providing new high quality housing and convenient commuting. However, due to many other factors households are confronted with a complex decision where to reside.

In order to understand the residential developments on the French side of the Greater Geneva metro region, I define Geneva's sphere of influence as municipalities with a CBW share of at least 20%.[35] We split this sphere into three groups. In the *treatment* group are locations that experience a public transport travel time reduction of at least 30% post LEX and already pre LEX were within 60 min public transport travel time from downtown Geneva.[36] In the *public transport friendly comparison* group (PT) are locations with a pre LEX public transport travel time to downtown Geneva of less than 60 min but which do not experience a major travel time reduction with the LEX. Finally, in the *non public transport friendly comparison* group (nonPT) are locations with a pre LEX public transport travel time to downtown Geneva of more than 60 min but which still have a cross-border worker share of more than 20%.[37] Figure 13 shows the spatial location of the three groups. The treated group is depicted in blue, the public transport friendly comparison group in red and the public transport friendly comparison group in green.

Comparing the characteristics of the treatment and comparison groups before the introduction of the LEX shows that nonPT locations are comparable in terms of housing price level and connectivity to Geneva but have substantially lower resident populations and a higher share of single family houses. This is consistent with the fact that they are more rural. PT locations on the other hand are comparable in terms of urbanness but have a better public transport connection to Geneva, higher CBW share and higher house prices and rents (see Table 1). The new train line materializes in a lower public transport journey time for the treatment group, which reaches a similar mean as in the PT comparison group (a decrease compared to pre LEX of 37%).

To assess the consequences for neighborhood compositions, note that the treatment group locations had a 8.5pp lower cross-border worker share than locations in the PT comparison group. Also note that the median apartment m2 price is 415 EUR (12%) and the m2 rent is 3.3 EUR (17%) lower in the treatment group compared to the PT comparison group, reflecting the fact that the treated locations are relatively poor. The low income of the treatment group can also be seen in Figure 14 plotting the medium disposable income from INSEE Filosofi. Especially the area around Annemasse, which happens to be the most urban one, pre LEX had substantially lower incomes than the surrounding locations (20% lower than the average in the department of Haute-Savoie and 50% lower than in the canton of Geneva). The inflow of higher income households in contrast to the relatively poor incumbent population in these neighborhoods implies a large gentrification potential.

[35] This is more economically relevant then using the entire extend of the Greater Geneva Area depicted in Figure 2 which is a political construct.

[36] A 2018 survey among French cross-border workers showed that 75% commute for less than 60 min (L'observatoire des Frontaliers 2018).

[37] The number of municipalities in the treated, the PT comparison and the non-PT comparison are 11, 29 and 108, respectively.

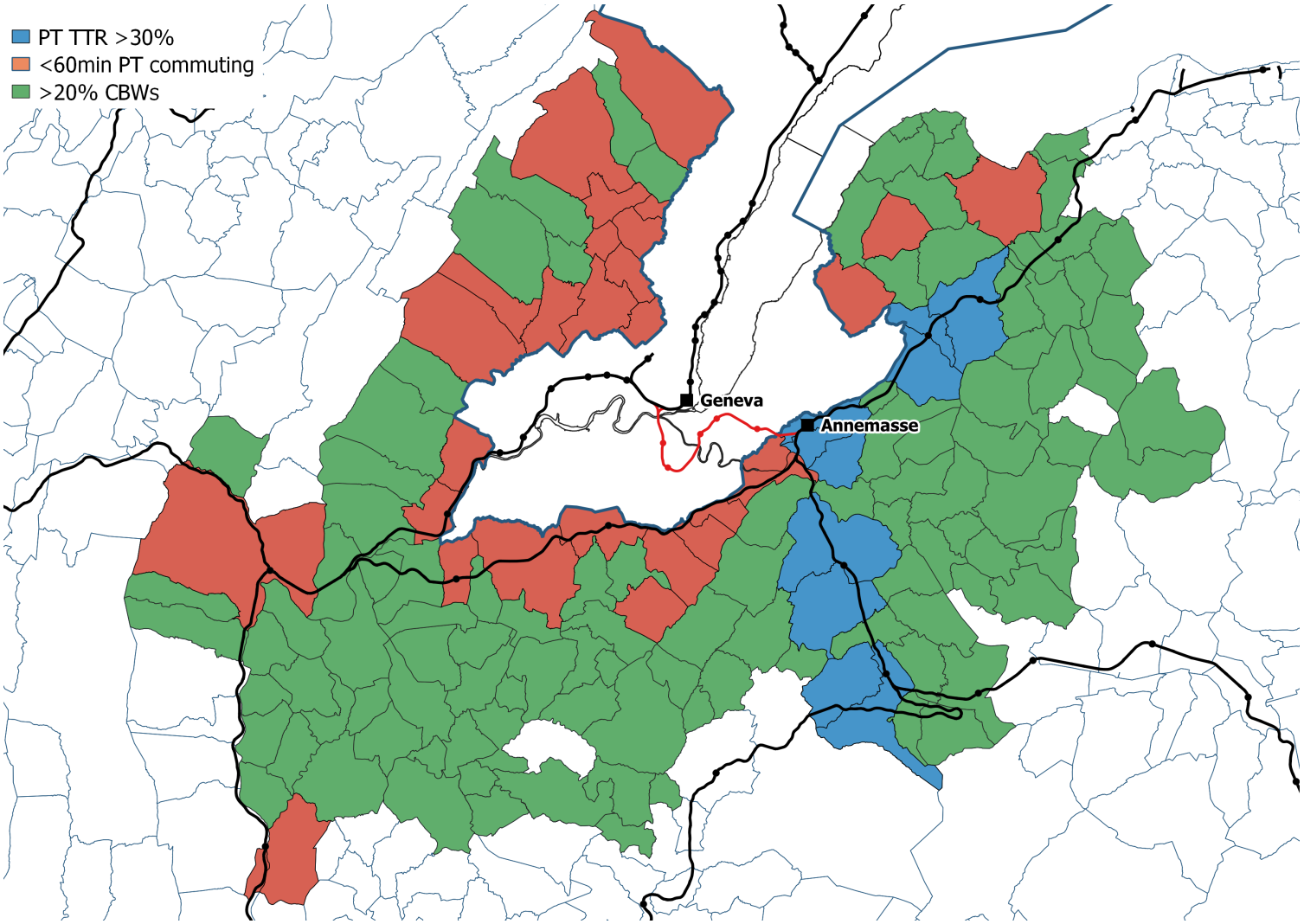

Figure 13: LEX exposure treatment and comparison groups

	Treatment [T]	PT [C1]	nonPT [C2]	T-C1	N1	T-C2	N2
Resident population	8346.39	5424.89	1284.99	-2921.51	40	-7061.41	119
	(9337.19)	(4293.88)	(1057.83)	(2868.90)		(2709.03)**	
Pop growth, % yoy	2.18	2.54	2.07	0.36	40	-0.10	119
	(0.72)	(2.14)	(1.82)	(0.45)		(0.27)	
Commuting							
CBW share, %	40.37	48.86	37.35	8.49	40	-3.02	119
	(9.46)	(14.71)	(12.92)	(3.92)**		(3.01)	
Public transport share, %	11.98	14.79	5.45	2.81	40	-6.53	119
	(9.89)	(9.63)	(6.92)	(3.43)		(2.95)**	
PT journey time, pre	72.35	46.17	80.23	-26.19	40	7.88	50
	(18.92)	(8.35)	(11.82)	(5.79)***		(5.87)	
PT journey time, post	45.86	44.89	75.64	-0.97	40	29.78	59
	(9.94)	(8.30)	(13.57)	(3.32)		(3.51)***	
PT connection frequency	4.36	4.12	0.69	-0.24	40	-3.67	119
	(2.66)	(2.07)	(1.22)	(0.87)		(0.78)***	
Car journey time	46.72	41.83	54.07	-4.90	40	7.35	119
	(4.30)	(9.87)	(7.26)	(2.24)**		(1.43)***	
Housing							
Share houses, %	50.39	50.33	77.75	-0.06	40	27.36	119
	(26.96)	(19.23)	(11.45)	(8.73)		(7.89)***	
Owner occupant share, %	64.02	62.53	78.70	-1.49	40	14.68	119
	(16.75)	(10.89)	(6.57)	(5.34)		(4.90)***	
Vacancy rate, %	6.65	6.97	7.06	0.32	40	0.41	119
	(1.04)	(2.45)	(2.37)	(0.55)		(0.38)	
Median apt m2 price	3102.81	3518.00	3116.30	415.19	40	13.49	78
	(237.76)	(764.98)	(590.65)	(159.46)**		(100.30)	
Median apt surface	68.45	67.10	71.30	-1.35	40	2.84	78
	(10.58)	(8.86)	(14.95)	(3.53)		(3.59)	
Median apt m2 rent	15.41	18.67	15.33	3.26	40	-0.08	101
	(0.92)	(3.42)	(2.19)	(0.70)***		(0.35)	
Median rental apt surface	53.05	52.96	60.06	-0.09	40	7.02	101
	(5.68)	(8.88)	(12.20)	(2.36)		(2.09)***	
N municipalities	11	29	108				

Table 1: Treatment, PT and nonPT comparison group characteristics

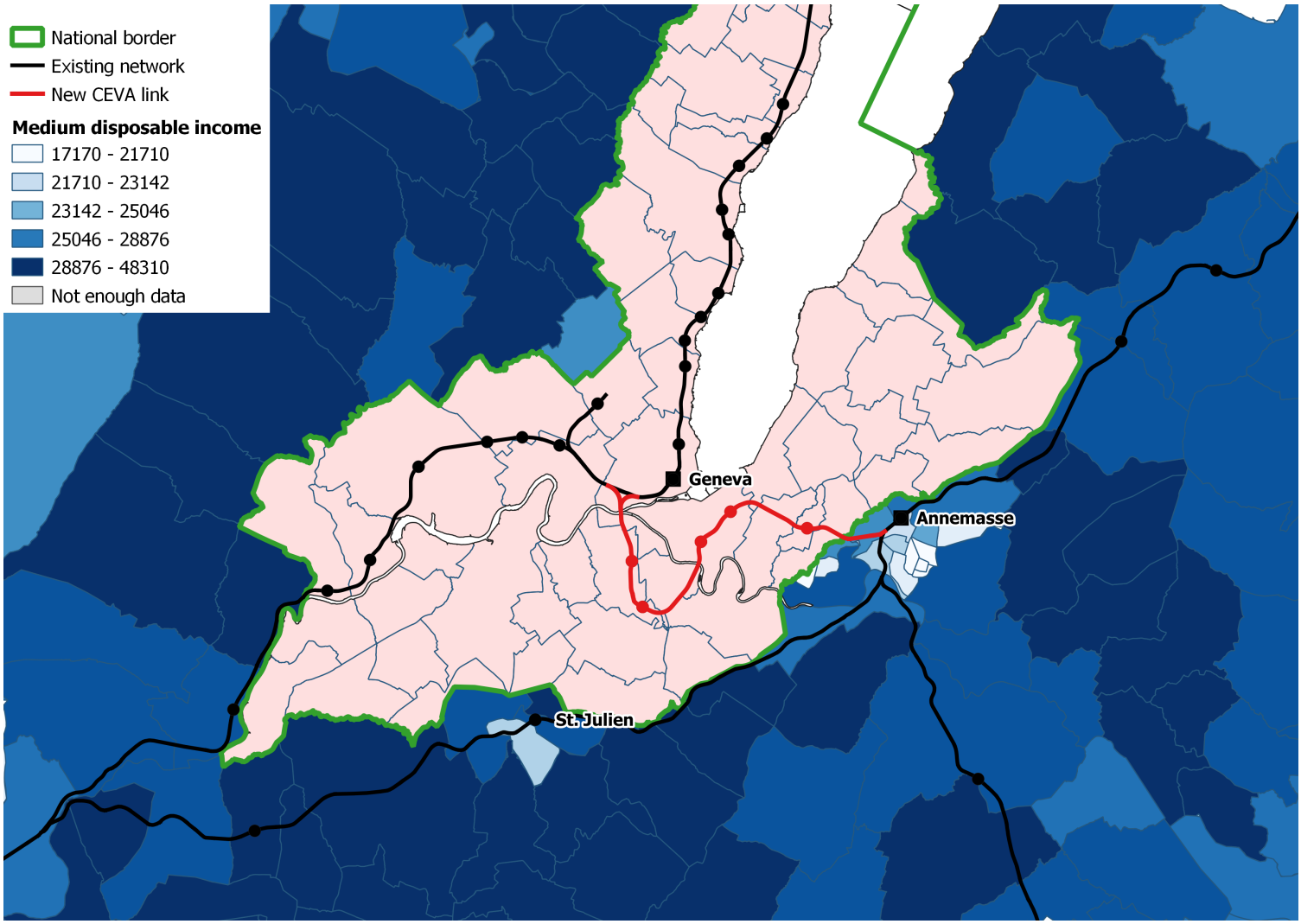

Figure 14: Pre LEX medium disposable income in France

The mechanism being reduced public transport travel time to jobs in downtown Geneva increases the residential attractiveness of Annemasse, which increases demand, resulting in higher housing costs favoring the inflow of richer households. This could potentially drive out poorer households (strong gentrification) or at least lead to a disproportional inflow of rich households (weak gentrification).

In the following, I first analyze the magnitude and relative importance of residential relocation flows in anticipation of the reduction in commuting costs and then compare household characteristics in order to address the compositional consequences for neighborhoods.

5.1 Relocation flows

I define a *relocating* household as a household which experienced a change of resident municipality for at least one household member compared to the previous year. To later compare characteristics of arrivals and incumbents, I also define *incumbent* households. In the Swiss data, an incumbent

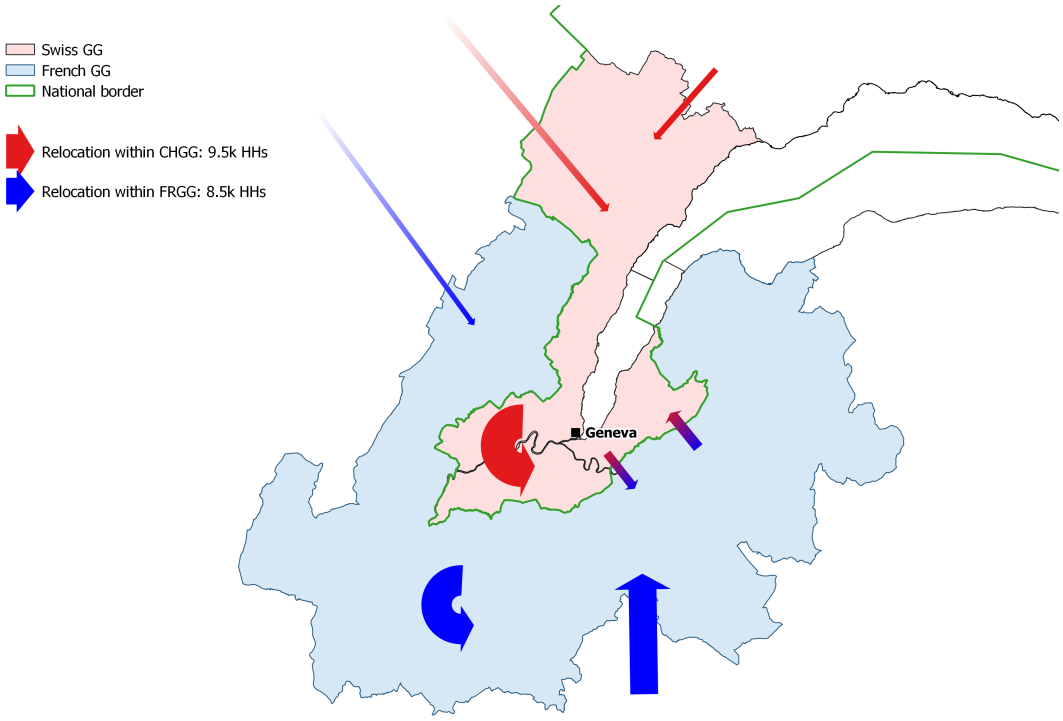

Figure 15: Yearly average residential relocation flows pre LEX (2014-2016)

household is one for which the interviewed person has been in the municipality for at least 5 years and it is not a relocating household. And in the French data, a household which has been established at least 5 years ago and is not a relocating household. One limitation of the data is that the origin municipality is unobserved for international moves.[38] Hence, precise net flows cannot be calculated but since international moves are of low importance empirically, as shown below, this is not a major issue. To obtain the magnitude of flows, I extrapolate the sample to the full resident population using the household weights provided by the data producers.

Figure 15 depicts the relocation flows in the Greater Geneva area in the pre LEX period (2014-2016). The Swiss territory of the Greater Geneva influence sphere and Swiss relocation flows are depicted in red while the French equivalents are depicted in blue. Most of the relocations are internal turnover but there is also a sizable inflow from the rest of France to the French side of Greater Geneva. The cross-border flows are of moderate magnitude with a net flow from the French part to the Swiss part. Figure 16 depicts the relocation flows in the LEX anticipation period (2017-2019). The big picture remains largely unchanged. In terms of magnitudes, there is little difference to the pre period. There is a moderate increase in internal turnover on both the French and the Swiss side and a slight increase in trans-border movers from the Swiss to the French part as well as from third countries to the French part.

Looking at the evolution of arrivals on the Swiss side in Figure 17, decomposed by origin loca-

[38] For international moves the data only provides the origin country.

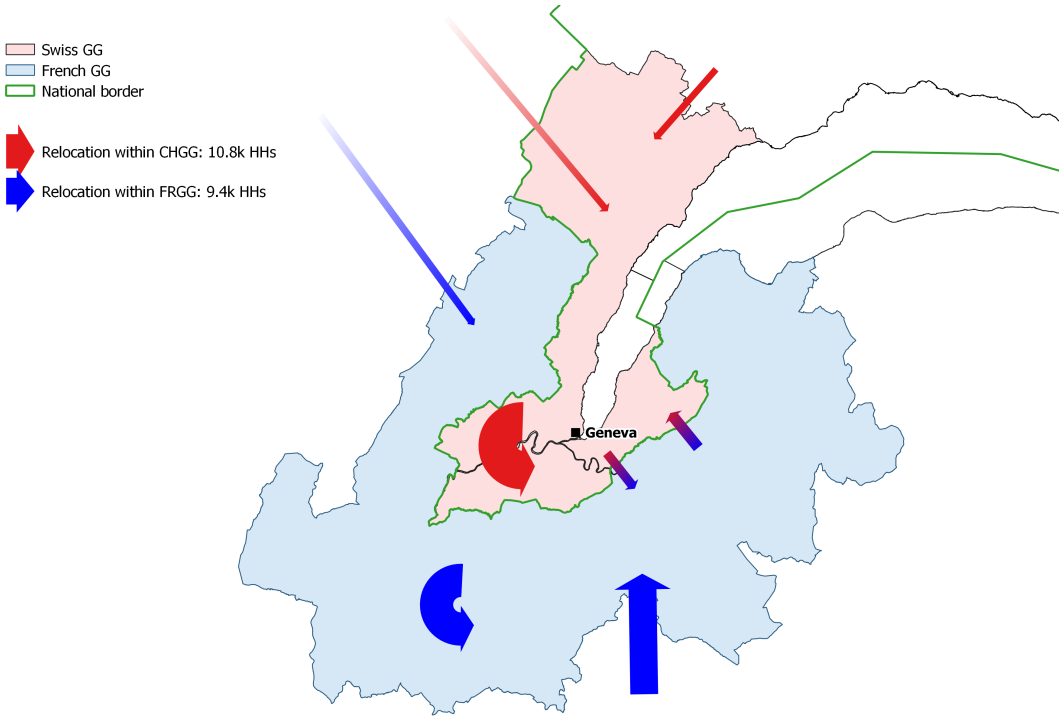

Figure 16: Yearly average residential relocation flows in anticipation of LEX (2017-2019)

tion, we see that the largest share of arrivals is from within the Swiss Greater Geneva region and the arrivals from France, from the rest of Switzerland and from third countries are about equally important. In terms of dynamics, we see a generally increasing trend without any noticeable structural breaks.

Looking at arrivals on the French side in Figure 18, decomposed by origin location, we see that the most important origin locations are French Greater Geneva and the rest of France, both to a similar extent. Arrivals from Switzerland and from third countries are less important. Hence, out of region arrivals from within the same country (the green line) are a lot more important in the French than in the Swiss part of Greater Geneva.

In terms of dynamics, we see a stable number of arrivals between 2011 and 2015. In 2016, there is a first increase and in 2018 another one. While the 2016 increase is mainly driven by arrivals from Switzerland and from third countries, the 2018 increase is mainly driven by increased internal turnover and arrivals from the rest of France but there is also a slight increase in Swiss origin arrivals in 2018 which continues in 2019. Overall, there are no strong signs of a LEX anticipation effect on relocation flows at this aggregate level. Next, I show that the action is happening within the French part, by decomposing the flows into treated versus comparison locations.

Figure 19 decomposes the number of arrivals in French Greater Geneva into the three groups defined at the beginning of this section, where flows between them are netted out. In 2017, the treatment group clearly started gaining attractiveness, while the nonPT comparison group abruptly

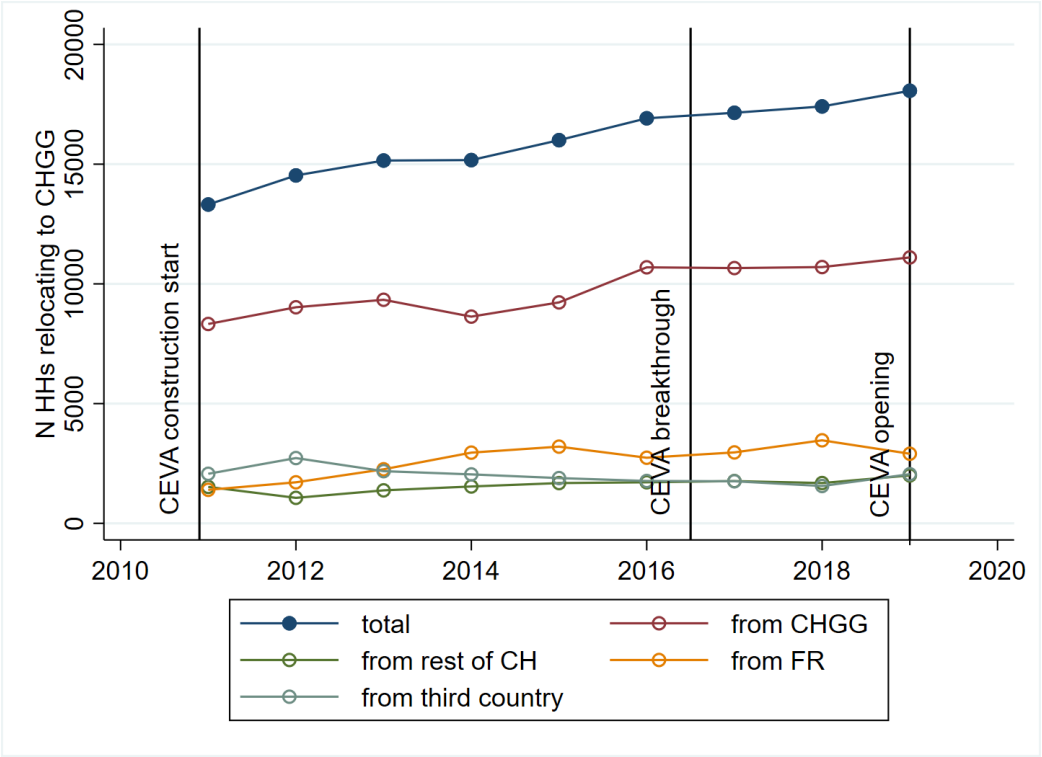

Figure 17: Number of households arriving in Swiss Greater Geneva by origin

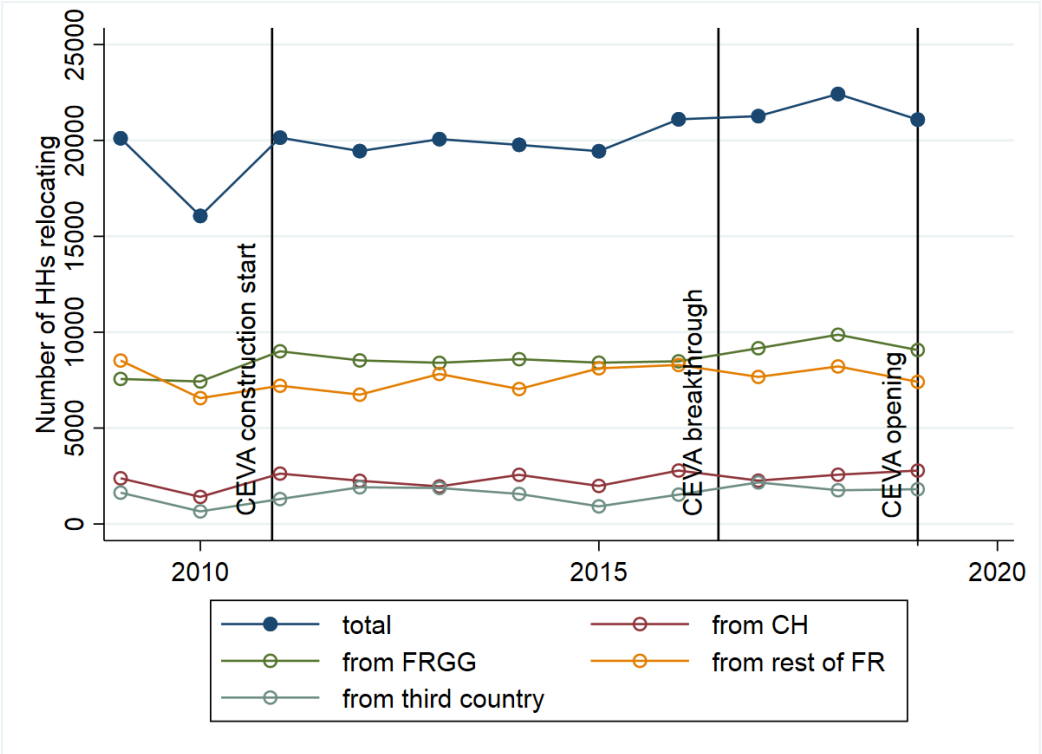

Figure 18: Number of households arriving in French Greater Geneva by origin

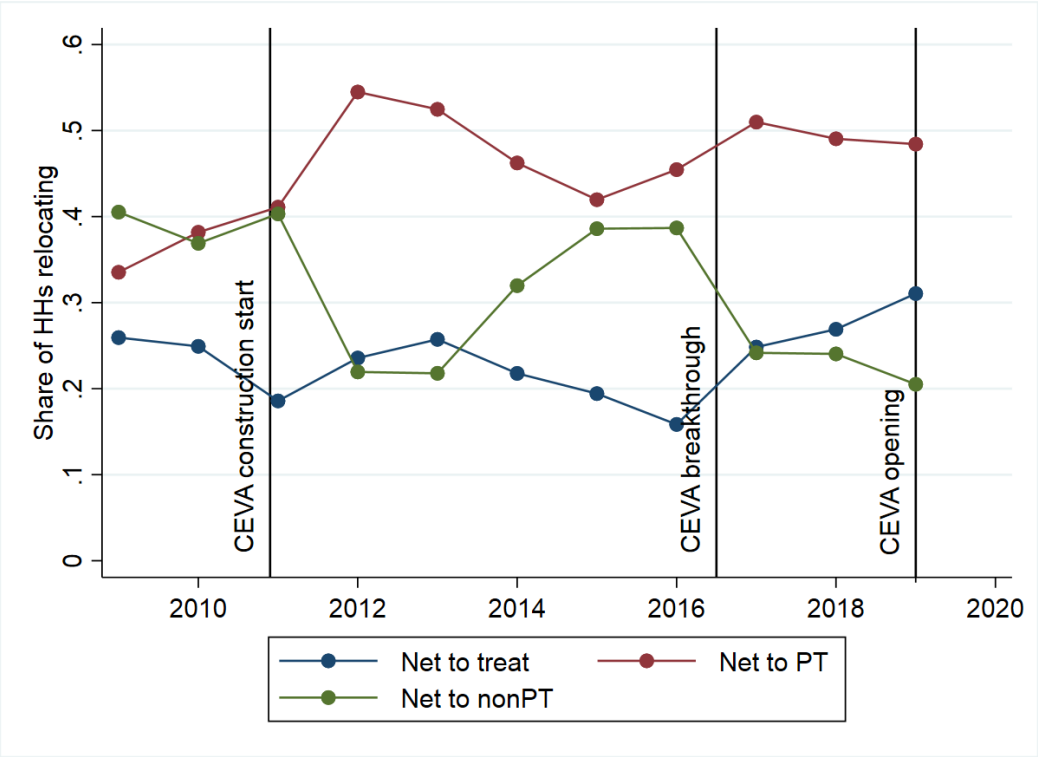

Figure 19: Destination choice of arrivals to French Greater Geneva

lost ground. However, the majority of arrivals still settles in the PT comparison region.[39]

In terms of magnitude, estimating the additional arrival flow to treated locations by a simple event study yields a cumulative net inflow of 8k households. In terms of relative changes from 2016 to 2019, Figure 20 indexing the flows at 2016, shows that arrivals in the treatment group increased by 108% compared to 13% in the PT group and -44% in the nonPT group. In terms of destination market share the treated location expanded from 15.8% in 2016 to 31.1% in 2019 (+15.3pp) This suggests that the LEX provided a substantial attractiveness boost to treated locations, partly at the expense of nonPT locations, while leaving the appeal of PT locations broadly unaffected.

Having a closer look at the arrivals in the treated locations in Figure 21 reveals that the 2017-2019 surge was mainly driven by an increase in internal relocation but also arrivals from the rest of France, from Switzerland and from third countries increase slightly. The contributions to the total arrival growth of 2.2k are 60% from French Greater Geneva, 23% from rest of France and 17% from abroad with only 9% originating from CH. Hence, the role of relocations from the Swiss to the French side of Greater Geneva remains quite limited. This might come as a bit of a surprise

[39]As a robustness check, I exclude the municipality of Saint-Julien-en-Genevois, the second largest city in FRGG, since media reports suggest that it is on its own growth trajectory with a new tram connection to downtown Geneva under construction (expected opening in 2024). It is arguably one of of most attractive resident locations in French Greater Geneva which it is unlikely to lose due to the LEX since it has its own public transport improvement under way. See Figure 32 in the appendix for a version of Figure 19 where Saint-Julien-en-Genevois is excluded. Indeed, the remaining PT locations fare considerably worse in anticipation of the LEX.

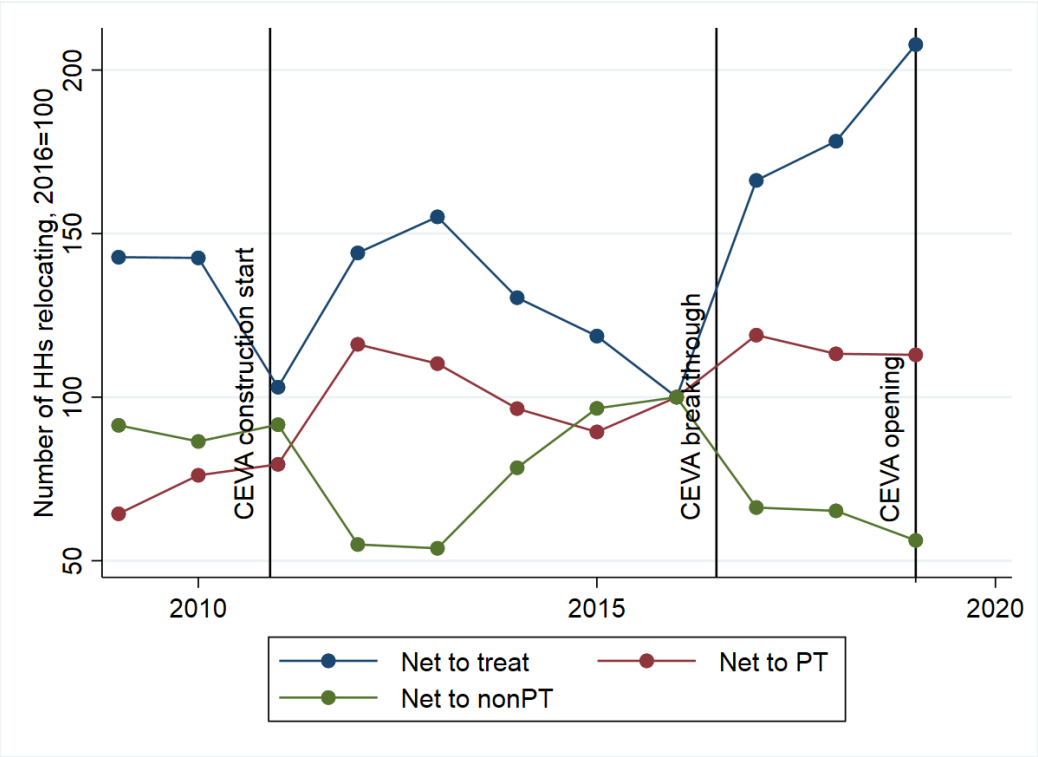

Figure 20: Relative change in destination choice of arrivals to French Greater Geneva

given the tight housing market in Geneva and the larger pool of potential movers from Swiss Greater Geneva (230k) than from French Greater Geneva (169k). CH residents seem to be reluctant to move across the border. Rather it is households that already reside in France that respond most to the new opportunity. This might have to do with higher moving frictions for trans-border moves due to different institutions and higher amenities in Switzerland. Potentially relevant dimensions include public services (health care, education, law enforcement), taxation, social institutions and last but not least locally rooted preferences.

Further decomposing the origin of arrivals to the treated region across the three groups in French Greater Geneva in Figure 22 shows that the increase is mostly driven by an increase in within treatment group turnover but also inflows from both comparison groups (PT and nonPT) pick up in 2017.

Figure 23 plots the net flows between the treated and the two comparison groups.[40] In the pre LEX period there were net outflows from the treated to both the PT and the nonPT locations. However, starting from 2017 in line with an anticipation effect of the LEX this quickly reversed and the treatment locations became net receivers of households from the other locations.

The decrease in arrivals to the nonPT comparison group is mainly due to a reduction in arrivals

[40]The red line represents the net flow from the public transport friendly to the treated group and similarly in green for the non-public transport friendly group. The blue line is the total of the public transport friendly and non-friendly net flows to the treated area.

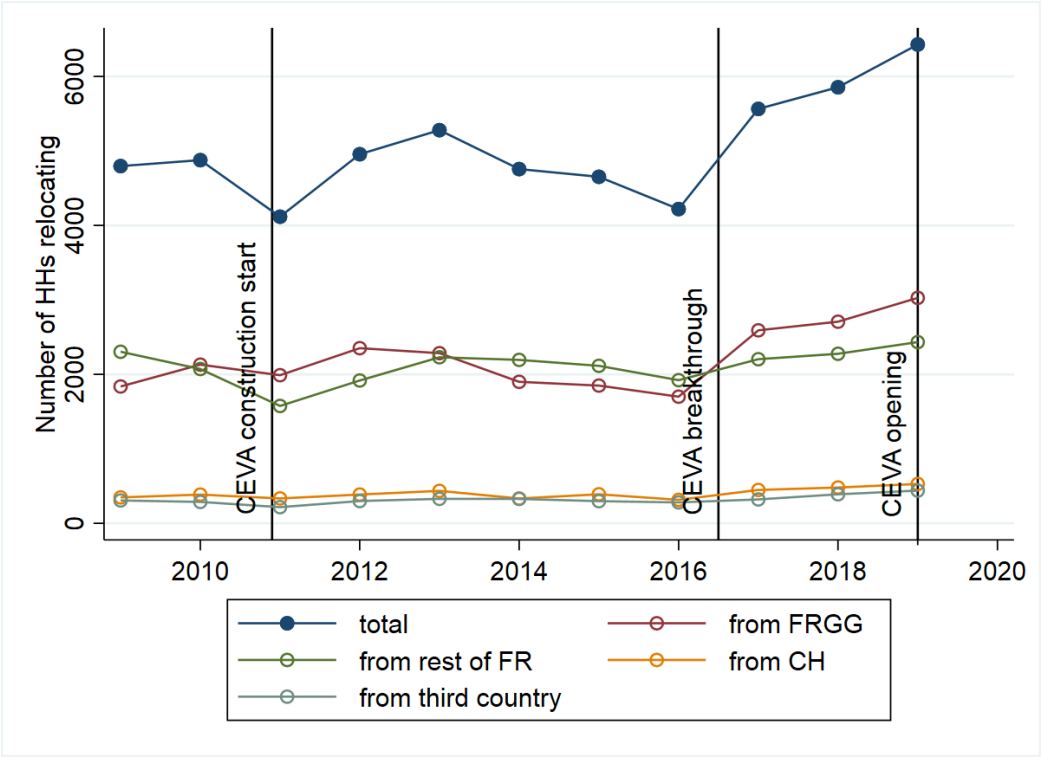

Figure 21: Arrivals to treated group by origin

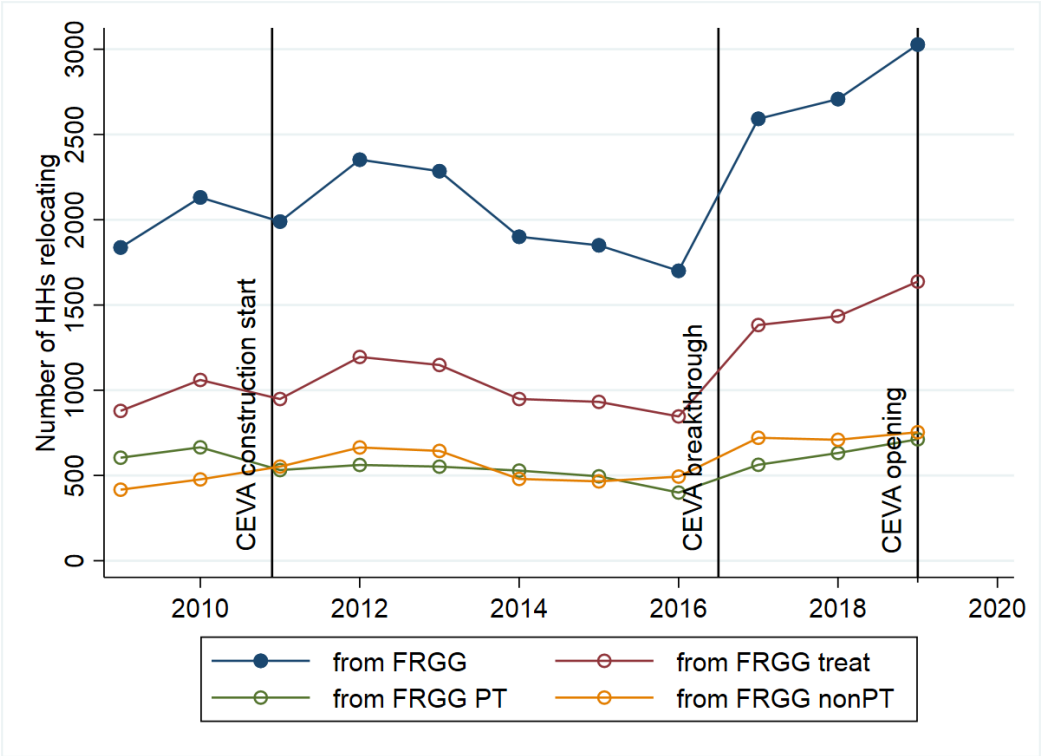

Figure 22: Arrivals to treated group by within French Greater Geneva origin

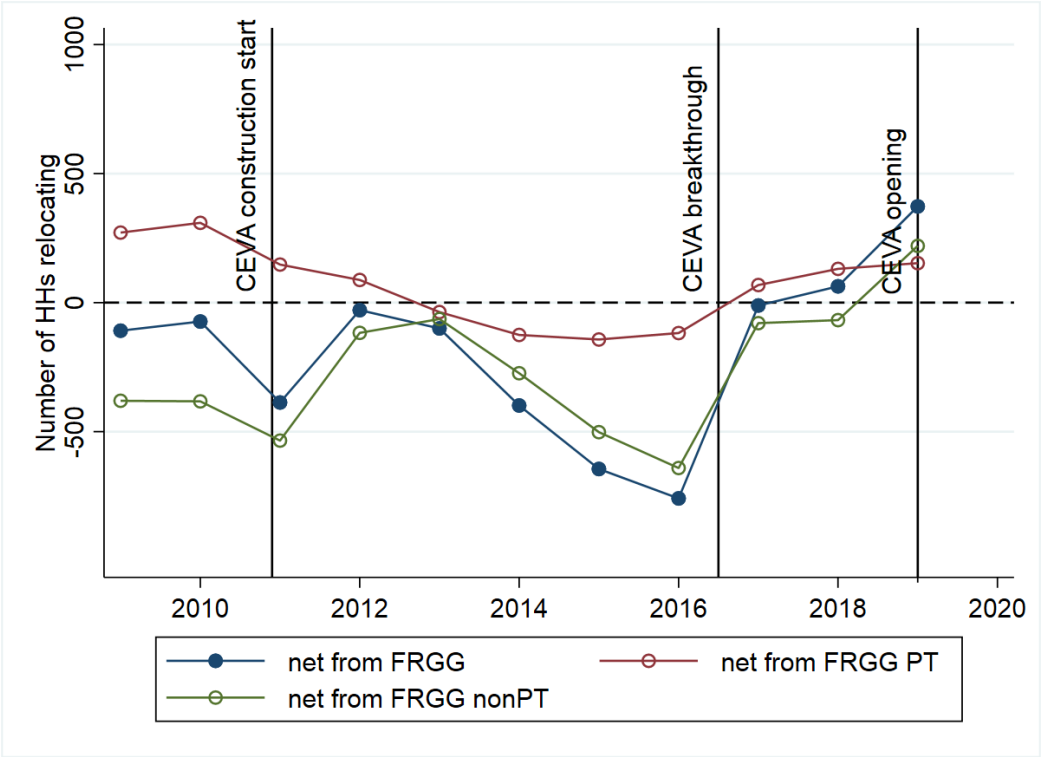

Figure 23: Net arrivals to treated group by within French Greater Geneva origin

from French Greater Geneva and from the rest of France. Both internal relocation and arrivals from the treated group decrease sharply in 2017 (see Figures 33 and 34 in the appendix). Together with the increased inflow of households from nonPT to treated locations, this suggests a loss of attractiveness of the public transport unfriendly relative to the treated locations. Also note that nonPT locations are generally relatively less popular destinations for arrivals from the rest of France compared to households from French Greater Geneva but more popular for Swiss origin households compared to other foreign origins. This is consistent with these locations being attractive to locally rooted cross-border workers realizing their dream of home ownership, whereas for outsiders these locations are likely too remote to move there directly.

The high level of inflows to the PT comparison group is about equally coming from the rest of France and French Greater Geneva and to a lesser extend from Switzerland and third counties. The 2016-2017 arrivals increase is driven by all origins except for the treated locations (see Figures 35 and 36 in the appendix). Together with the increased inflow of households from PT to treated locations, this suggests that public transport friendly locations are very attractive resident destinations but the anticipation of the LEX counteracted this force for the flows to and from treated locations.

Finally, specifically looking at the destination choice of Swiss origin households in Figure 24, we see a similar pattern as for total arrivals. Starting from 2017, arrivals to treated locations increase substantially, while arrivals to nonPT decrease and arrivals to PT remain roughly constant. In terms of destination market share for Swiss origin households the treated location increased from

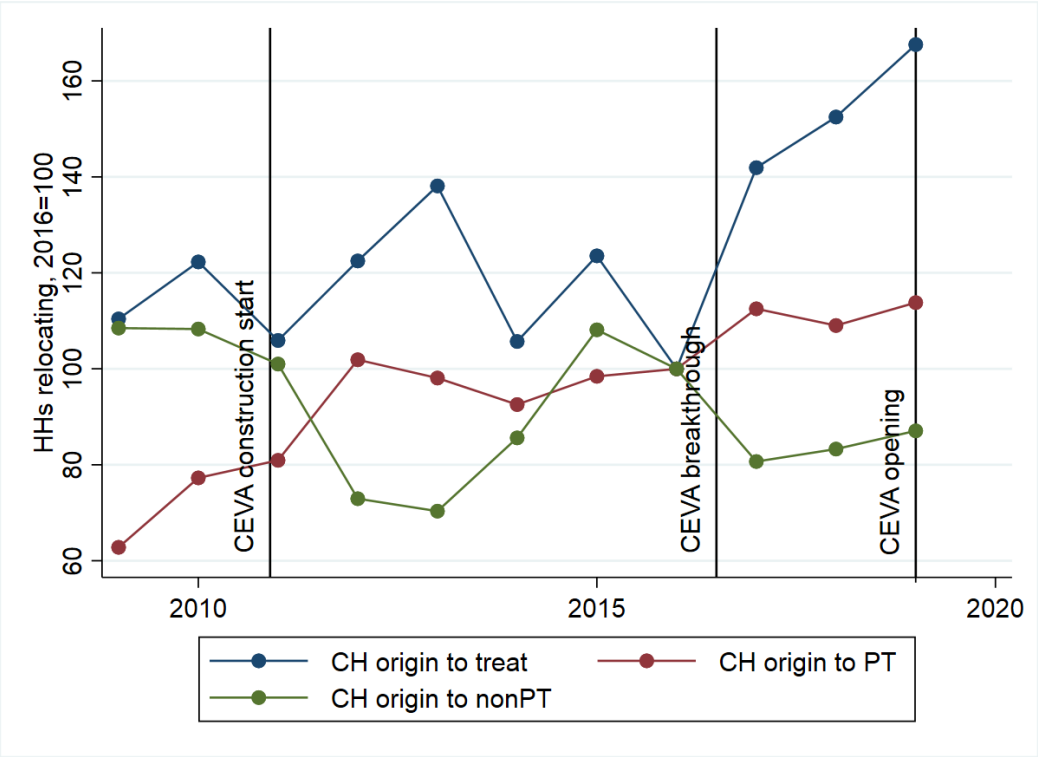

Figure 24: Relative change in destination choice of Swiss origin arrivals to French Greater Geneva

13.5% in 2016 to 19.8% in 2019 (+6.4pp). However, given the small magnitude of relocation flows from the Swiss to the French side of Greater Geneva this does not substantially contribute to the attractiveness boom of treated locations in France.

In terms of relocation flows, I conclude that inflows to locations with a strong future public transport connection improvement increased strongly compared to comparison locations. This increase mostly originated from the adjacent French areas, while there is relatively little trans-border action. It also appears that the non-PT friendly French locations are losing attractiveness, while the PT friendly French locations can more or less defend their appeal. This is consistent with CBWs discovering the treated locations as new attractive residence locations, while more rural (badly connected) locations are losing out. In Swiss Greater Geneva relocation flows continued along long term trends and there is no LEX effect detectable.

5.2 Relocation composition

Next, I analyze the composition of moving and incumbent households in the Greater Geneva area using household characteristics on family structure, demographics, socioeconomics, commuting and housing. For the composition analysis, households are weighted by the household weights provided by the data producers. The analyzed household characteristics are the household type, where I partition the sample into seven mutually exclusive groups. I define households with school children as households that have at least one child aged 6 to 15. Households with pre school children have

at least one child which is below the age of 6 but no schooling age children. Households with post school children only have children that are above the age of 15. Childless couples are households of two individuals declaring to live as a couple without any children in the household. Non-family households are households with at least two adult individuals who declare to not live as a couple. Single households are individuals living alone. These six groups are based on the reference person not being retired.[41] The last group captures households were the reference person is retired. In terms of socioeconomic characteristics, the median household age is the median age among all adult household members. High school degree and tertiary degree capture the share of adult household members who have attained a baccalauréat degree or university degree, respectively.[42] High socioeconomic status captures the share of household members who in terms of professional position are classified as executives, high rank bureaucrats, or independent professions. Two full-time couples are households who declare to be a couple and both work full time. Unemployment, is the share of household members who declare to be unemployed. CH citizenship and FR citizenship are households with at least one member being a Swiss or French citizen, respectively. CBW to Swiss Greater Geneva are households with at least one member cross-border working to Swiss Greater Geneva. PT commuter are households where the reference person reports to be using public transport to commute to work. In terms of housing characteristics, home owners are households that own the dwelling they live in. Single family home households live in a detached single family house. Surface per person is the living surface of the dwelling divided by the number of household members. Overoccupation refers to the situation where the number of household members exceeds the number of rooms in the dwelling. Dwelling age is the number of years elapsed since the construction of the dwelling.

Regarding household composition in treated locations in France, there are two dimensions that are interesting to describe. First, what is the effect of the anticipated commuting time reduction on the composition of households relocating to these locations. I approach this leveraging a Difference-in-Difference design exploiting timing and treatment exposure. The question is how the composition of arrivals to treated locations changes from the pre LEX period to the anticipation period relative to comparison locations. This sheds light on who responds most strongly to the new commuting service. Second, how do treated neighborhoods develop in anticipation of the LEX.

Composition of relocating households

First, to study the effect of the LEX on the composition of relocating households, I apply a Difference-in-Difference estimator exploiting the difference between movers to treatment and comparison locations and the difference between movers in the pre and anticipation period. This captures the general equilibrium reduced-form effect of the LEX and all other things that changed with it (e.g. zoning, housing construction, new amenities) on relocation flows. I estimate the following specification ,

$$Y_{it} = \alpha + \beta D_{it} + \gamma T_{tt} + \delta D_{it} \times T_{it} + \epsilon_{it},$$

[41] The INSEE defines the reference person of a household as the oldest working person (or unemployed and looking a job) with a spouse; failing that, the oldest person having a spouse; failing that, the oldest working (or unemployed and looking a job) person; failing that, the oldest person.

[42] The baccalauréat is equivalent to the A levels in the UK, the German Abitur or the Swiss Matura.

where $D_{it} = 1$ if household i relocated to a treatment location and $D_{it} = 1$ if to a comparison location, $T_{it} = 1$ if the relocation took place in the anticipation period and $T_{it} = 0$ if in the pre period. δ is the coefficient of interest capturing the change due to the anticipation of the LEX. I weight by the household weights provided by the data producer. I estimate the specification separately for the PT and the nonPT comparison group.The conjecture is that locations with a strong future public transport travel time reduction to downtown Geneva mainly gain attractiveness for high-skilled, public transport inclined CBWs, who own their home, which was recently built. An increase in public transport inclined CBWs as they can directly benefit from the new train service for commuting to Geneva. High-skilled households due to the skill bias in cross-border working and due to the housing price increases documented in Section 4.2, which favor affluent households. An increase in home owners since the ownership rate in the treated locations was low in the pre period and the well-earning CBWs are more likely to be able to afford buying. Newer dwellings due to the construction boom in treated areas documented in Section 4.1. Table 2 shows the results which differ sightly depending on which comparison group is used but are mostly robust. I find that among arrivals, LEX exposure is associated with a 3.5-5.5pp higher share of households with school children, a 6.9-7.7pp reduction in the share of single households, a 9-9.3pp increase in the probability of home ownership, a 7-11pp increase in the probability of living in a single family house, 1y-1.2y newer dwellings and a 0.8-1.2pp higher probability of being Swiss citizens. Compared to PT comparison locations, treatment location arrivals have a 4pp higher probability of being French citizens and compared to nonPT locations, they have a 4.2pp higher probability of cross-border working.

Instead of a Difference-in-Difference approach one could also leverage a simple event study by comparing arrivals in the anticipation period 2017-2019 to arrivals in the pre period 2014-2016. This also suggest that anticipation arrivals are more likely to be CBWs, more likely to own their home, more likely to live in a newer dwelling, less likely to be single households and more likely to be families with young children (see Table 10 in the appendix). Furthermore, performing the same pre versus anticipation period comparison of arrival characteristics for the two comparison groups (see Tables 11 and 12 in the appendix) shows that the household composition in PT locations remained largely unchanged, consistent with the findings on relocation flows. In non-PT locations on the other hand, again consistent with the findings on relocation flows, there are signs of a diversion of households to treated locations as the change of composition there is roughly the flip side of the change in treated locations (less school children, more single households, less CBWs, less home ownership, less single family houses).

In sum, these findings indicate an increased attractiveness of treated locations in anticipation of the LEX for richer households, mainly based on higher probability of cross-border working and a the higher home ownership rate, and this boom goes partly at the expense of nonPT locations. The fact that the CBW share only increases relative to nonPT locations makes sense since as we have seen in the relocation flow analysis the PT locations could maintain their attractiveness. Most salient is

the substantial increase in home ownership which is also consistent with data from quarterly surveys among real estate developers in France[43] showing that in high LEX exposure locations the number of dwellings sold increased by 106% in 2018 and 2019 compared to the average of the previous years. Not only are arrivals to treated locations more likely to own their dwelling but they are also more likely to live in a single-family house suggesting they are richer. Being more likely to be families with young children could suggest the emergence of a more locally connected community. I do not find a higher public transport inclination among anticipation movers in treated locations. This is likely due to the fact that the LEX is not operating yet and hence even public transport affine CBWs still have to commute to Switzerland by car. I also do not find a higher skill level or higher socio-economic status, but the higher CBW share alone already implies a substantial increase in incomes.

Neighborhood development

Second, to study the effect of the LEX on neighborhood development, I apply the same Difference-in-Difference estimator but now for the the entire resident population. The conjecture is that treatment locations overall are experiencing an increase in CBW share, an increase in home ownership and a decrease in dwelling age. Partly due to the substantial inflow of households with these characteristics and partly due to incumbents also reorienting in this direction. Table 3 shows the results which again differ sightly depending on which comparison group is used but are mostly robust. I find that households in treatment locations in anticipation of the LEX are 3.8-4.7pp less likely to be single households, have a 3.7-4.2pp lower probability of unemployment, a 0.6-1.2pp higher probability of being Swiss citizens, a 1.2-2.7% higher probability of cross-border working, a 8.5-12.3pp higher probability of home ownership, a 11.6-12pp higher probability of living in a single family house and live in 0.3y-0.4y newer dwellings. These findings are perfectly in line with the effects found for movers.

The found effects can stem from both changes in the arrival flows but also from changes in the incumbent composition. To see the role of arrivals versus incumbents in this neighborhood change, I apply the same Difference-in-Difference estimator but only for the incumbents. Also for incumbents the treated locations experienced a reduction in the share of single households, a reduction in the unemployment rate, an increase in the CBW share, an increase in home ownership rate, an increase in the living surface as well as single family home share (see Table 13 in the appendix). Hence, not only arrivals are responding to the LEX but also the incumbents in the treated locations are adjusting in the same direction, in particular more cross-border working and more home ownership.

Purely descriptively, I compare arriving households to incumbent households in treated locations in France in the anticipation period (2017-2019) in Table 4.[44] The conjecture here is that the arriving households in locations with a strong future public transport travel time reduction to downtown Geneva are substantially younger, are more likely to have young children, are higher skilled, are less likely to be owners, are living in newer dwellings, are more likely to cross-border work and use public

[43] L'enquête sur la commercialisation des logements neufs (ECLN)

[44] This is a simple first difference.

	DiD PT	N1	DiD nonPT	N2
Household type				
Pre school children	0.018	12988	0.024	11400
	(0.014)		(0.015)	
School children	0.035	12988	0.055	11400
	(0.016)**		(0.016)***	
Post school children	0.015	12988	0.008	11400
	(0.009)*		(0.009)	
Childless couple	0.013	12988	-0.003	11400
	(0.019)		(0.019)	
Non-family HH	0.000	12988	0.003	11400
	(0.013)		(0.012)	
Single HH	-0.069	12988	-0.077	11400
	(0.022)***		(0.021)***	
Retired HH	-0.012	12988	-0.010	11400
	(0.009)		(0.009)	
Sociodemographics				
Median HH age	1.122	12973	1.263	11389
	(0.541)**		(0.526)**	
High school degree	-0.008	12973	-0.012	11389
	(0.019)		(0.019)	
Tertiary degree	-0.021	12973	0.003	11389
	(0.021)		(0.020)	
High socio-eco status	-0.010	11297	-0.010	10046
	(0.018)		(0.017)	
Two full-time couple	0.009	6662	0.009	6601
	(0.032)		(0.030)	
Unemployment rate	-0.022	12041	-0.021	10636
	(0.015)		(0.014)	
CH citizenship	0.008	12988	0.012	11400
	(0.011)		(0.010)	
FR citizenship	0.040	12988	-0.015	11400
	(0.017)**		(0.015)	
CBW to CHGG	0.002	12988	0.042	11400
	(0.023)		(0.022)*	
PT communter	-0.017	10645	-0.022	9505
	(0.021)		(0.018)	
Housing				
Home owner	0.093	12988	0.090	11400
	(0.019)***		(0.019)***	
Single family home	0.065	12988	0.109	11400
	(0.015)***		(0.016)***	
Surface per person	-0.305	12988	-0.333	11400
	(0.873)		(0.847)	
Overoccupation	0.013	12988	0.013	11400
	(0.013)		(0.012)	
Dwelling age	-1.227	4721	-0.996	4111
	(0.265)***		(0.264)***	

Table 2: DiD arrivals pre vs anticipation period and treatment vs comparison groups

	DiD PT	N1	DiD nonPT	N2
Household type				
Pre school children	0.005	100853	0.004	100685
	(0.005)		(0.004)	
School children	-0.004	100853	0.007	100685
	(0.006)		(0.006)	
Post school children	0.006	100853	0.010	100685
	(0.004)*		(0.004)**	
Childless couple	0.008	100853	0.007	100685
	(0.006)		(0.005)	
Non-family HH	0.004	100853	0.002	100685
	(0.004)		(0.003)	
Single HH	-0.047	100853	-0.038	100685
	(0.007)***		(0.007)***	
Retired HH	0.028	100853	0.009	100685
	(0.007)***		(0.006)	
Sociodemographics				
Median HH age	1.995	100780	1.089	100630
	(0.281)***		(0.261)***	
High school degree	0.002	100780	-0.004	100630
	(0.007)		(0.007)	
Tertiary degree	-0.005	100780	-0.006	100630
	(0.007)		(0.006)	
High socio-eco status	0.012	73558	-0.004	73866
	(0.007)		(0.006)	
Two full-time couple	0.037	46735	0.012	51076
	(0.012)***		(0.011)	
Unemployment rate	-0.037	79023	-0.042	78038
	(0.006)***		(0.005)***	
CH citizenship	0.006	100853	0.012	100685
	(0.003)		(0.003)***	
FR citizenship	0.038	100853	-0.002	100685
	(0.005)***		(0.005)	
CBW to CHGG	0.012	100853	0.027	100685
	(0.008)		(0.007)***	
PT communter	-0.045	69875	-0.027	70353
	(0.007)***		(0.006)***	
Housing				
Home owner	0.123	100853	0.085	100685
	(0.008)***		(0.007)***	
Single family home	0.120	100853	0.116	100685
	(0.007)***		(0.006)***	
Surface per person	2.444	100853	1.353	100685
	(0.389)***		(0.373)***	
Overoccupation	-0.030	100853	-0.019	100685
	(0.005)***		(0.004)***	
Dwelling age	-0.390	27998	-0.327	25030
	(0.096)***		(0.095)***	

Table 3: DiD resident population in pre vs anticipation period and treatment vs comparison groups

transport than the incumbents. More likely to cross-border work and use public transport since one key feature attracting them to this location is supposedly convenient cross-border commuting.[45] They should be younger and have younger children since young households are more mobile as they are still looking for a place to settle and moving is less costly when children are not in school yet. This should go along with lower home ownership due to being less senior and less settled. Given the treated areas were predominantly poor, arrivals are likely to be higher skilled. Hence, treated locations are likely to experience a gentrification wave with the arrival of new skilled CBWs.

Using French Census data, I find that arrivals are 7.5pp more likely to have pre-school children but are 4.5pp less likely to have school children. Arrivals are 10.7pp more likely to be childless couples and also 13.8pp more likely to be single households. Arrivals are 28pp less likely to be retired and their median age is 19.6 years lower. This is consistent with the conjecture that younger households are arriving and increasing moving costs once children attend school. Arrivals are 21.9pp more likely to have a high school degree and 15.9pp more likely to have tertiary education, confirming the conjecture that they are higher skilled.[46] Arrival households are 3.5pp more likely to have two full-time workers, 24.2pp more likely to be employed, 15.5pp more likely to cross-border work and 8.9pp more likely to use public transport to commute. This suggests that arrivals are eager to exploit labor market opportunities in Geneva. Furthermore, arrivals are 5.4pp less likely to have French citizenship, 38.6pp less likely to be home owners, 23.2pp less likely to live in a singe-family house and their average surface per person is 11.9 m2 lower. This is all in line with the conjecture that they are less settled and have not reached the top of their housing career yet. However, given they are hard working, they are likely to improve their housing situation in the future. Finally, arrivals live in dwellings that are on average 3.4 years newer, mainly because 21.5% of arrivals live in a dwelling that is at most 1 year old.

So what is the effect of the LEX on residential composition in the French part of the commuting zone. The increasing arrival flow and shifting composition in both arrivals and incumbents in the treated locations yields the potential for a gentrification push. This is mainly rooted in the higher skill level of arrivals compared to incumbents and the increasing CBW share of the entire population, which is going hand in hand with higher current and likely also higher future incomes. Home ownership among arrivals increased substantially in anticipation of the LEX. Due to the young age of the majority of arrival households, they have not yet made large investments in their housing (they are still less likely to own their home and live in smaller dwellings than incumbents) but future upgrading can be expected and among incumbents such upgrading can already be observed.[47]

The LEX also affected the preferred residence location of CBWs. Pre LEX, 38.2% of CBWs were living in nonPT locations (i.e. locations without public transport service to downtown Geneva). The narrative being that in the idyllic French countryside they could afford living in their own single-

[45] However, recall that the LEX only went into operation in December 2019. Hence, the higher public transport use captures public transport affinity rather than usage of the LEX.

[46] Partly this is due to the general trend that younger cohorts have higher education. Controlling for household age the educational advantage of arrivals is only 2.6pp for high school and 3.4pp for tertiary.

[47] Of course some of these new affluent households might also move away again to realize this upgrade.

	mover	incumbent	mover-incumbent	N
Household type				
Pre school children	0.120	0.044	0.075	15677
	(0.325)	(0.206)	(0.008)***	
School children	0.151	0.196	-0.045	15677
	(0.358)	(0.397)	(0.009)***	
Post school children	0.048	0.076	-0.028	15677
	(0.213)	(0.264)	(0.005)***	
Childless couple	0.232	0.125	0.107	15677
	(0.422)	(0.331)	(0.010)***	
Non-family HH	0.079	0.047	0.032	15677
	(0.270)	(0.211)	(0.007)***	
Single HH	0.332	0.194	0.138	15677
	(0.471)	(0.395)	(0.012)***	
Retired HH	0.039	0.318	-0.280	15677
	(0.193)	(0.466)	(0.006)***	
Sociodemographics				
Median HH age	35.408	54.985	-19.577	15669
	(12.004)	(16.329)	(0.319)***	
High school degree	0.671	0.452	0.219	15669
	(0.418)	(0.444)	(0.011)***	
Tertiary degree	0.442	0.283	0.159	15669
	(0.444)	(0.403)	(0.011)***	
High socio-eco status	0.185	0.199	-0.015	10290
	(0.361)	(0.365)	(0.010)	
Two full-time couple	0.386	0.351	0.035	6710
	(0.487)	(0.477)	(0.017)**	
Unemployment rate	0.134	0.107	0.027	10972
	(0.292)	(0.273)	(0.008)***	
CH citizenship	0.048	0.042	0.006	15677
	(0.213)	(0.200)	(0.005)	
FR citizenship	0.865	0.919	-0.054	15677
	(0.342)	(0.273)	(0.009)***	
CBW to CHGG	0.469	0.314	0.155	15677
	(0.499)	(0.464)	(0.012)***	
PT communter	0.171	0.083	0.089	9795
	(0.377)	(0.275)	(0.011)***	
Housing				
Home owner	0.273	0.659	-0.386	15677
	(0.446)	(0.474)	(0.011)***	
Single family home	0.171	0.404	-0.232	15677
	(0.377)	(0.491)	(0.009)***	
Surface per person	36.605	48.547	-11.942	15677
	(19.000)	(26.166)	(0.505)***	
Overoccupation	0.094	0.066	0.027	15677
	(0.291)	(0.249)	(0.008)***	
Dwelling age	5.872	9.249	-3.377	3032
	(4.165)	(2.571)	(0.177)***	

Table 4: Characteristics of arrivals and incumbent in treated area in anticipation period

family house and they would commute to jobs in Geneva by car. Indeed in nonPT locations pre LEX, 79.5% of CBWs owned their home, 77.9% lived in a single family house and 89.8% commuted by car. Pre LEX, the CBW share near train stations was 8pp lower compared to less central locations.[48] In fact, CBWs were underrepresented in urban locations. In the anticipation period the residence allocation of CBWs shifted more towards urban locations with only 27.2% of CBWs living in rural locations and CBWs no longer being underrepresented in urban locations. Plausibly the LEX makes urban locations more attractive to CBWs, resulting in a clustering of CBWs around LEX stations. This inflow of high income households to urban centers due to attractive commuting and high quality housing suggests a urban revival due to the LEX.

In terms of household composition in France, I conclude that, in anticipation of the LEX, the CBW share and home ownership rate are increasing in treated locations. This is due to both an inflow of affluent households and upgrading of the incumbent households. These dynamics take place around railway stations soon offering a convenient commuting service to Geneva, which pre LEX were relatively poor neighborhoods. Hence, the arrival of LEX is likely to launch this locations on a gentrification trajectory.

Swiss side

Comparing the composition of movers in the pre versus anticipation period on the Swiss side of Greater Geneva shows that there were no major changes due to the LEX there (see Table 14 in the appendix). Anticipation movers are 3.4pp more likely to have tertiary education, are 3.9pp more likely to have French citizenship and pay 1.5CHF/m2 higher rent but this is in line with general longer term trends.

Moreover, I can compare the characteristics of movers who in anticipation of the LEX choose to settle in strongly treated locations in France to those settling on the Swiss side. The idea being that the strongly treated locations in France are a good substitute to living in Geneva in terms of commuting time. They are certainly competitive in terms of cost of housing and cost of living overall. Restricting the analysis to movers ensures capturing households that are mobile in the sense that they recently made their location decision. The composition among arrivals in Swiss Greater Geneva and in the French treated locations is similar in terms of household types. However, movers settling in Switzerland are 9.7pp more likely to have tertiary education despite being 4.8 years older. They are 19.2pp more likely to have high socioeconomic status and live in dwellings offering 5.8m2 more surface per person. This suggests that they are higher-skilled and richer than the movers settling in French treated locations. This makes sense as richer households have less difficulties affording life on the Swiss side. However, arrivals on the Swiss side are 11.2pp less likely to be home owners, consistent with the sustantially higher housing prices in Geneva making home ownership less feasible than in France. Furthermore, movers settling in Switzerland are 29.6pp more likely to use public transport for commuting, which makes sense as Geneva is much more urban and public transport is readily available, again keeping in mind that the LEX was not operating yet in this period. These

[48] See Figure 39 in the appendix for the spatial distribution of pre LEX CBW share.

findings are consistent with the story that households who can afford it, locate in Switzerland but if the goal is home ownership, then this is much more feasible in France.

6 Discussion

In this section I discuss my results in a bigger picture including margins that are beyond the scope analyzed in this paper.

One should keep in mind that besides the documented direct effects of the Léman Express on transportation, namely faster public transport commuting to jobs in Geneva, there are also potentially important general equilibrium effects. One is that a modal shift from road to rail may result in less traffic congestion on roads and hence shorter travel times also for car commuters. Indeed, planing documents indicate that the canton on Geneva expects to be able to reduce road traffic volume by 12% thanks to the LEX.[49] This is likely to boost the attractiveness of the entire metropolitan area, where the traffic grid lock is a prominent issue.

Reducing spatial frictions potentially also has vast implications for economic growth. Hsieh and Moretti (2019) study the cost labor misallocation due to housing supply shortages in high productivity U.S. cities. They predict large real GDP growth potential if people could move to equalize wages. As a promising alternative to further densification, often challenging in strictly regulated urban areas, which certainly applies to the case of Geneva, they suggest the construction of efficient commuting links to the suburbs in order to extend the size of the labor market. The Léman Express does exactly that by allowing the highly productive but spatially constraint city of Geneva to expand on French territory. This suggest that the LEX should boost economic growth in the metro area by easing the tight housing constraint in the Canton of Geneva. Hence, for the Greater Geneva area a trans-border public transport integration provides a major step towards an integrated labor and housing market across national borders. Indeed the new train service seems to further promote cross-border working and there are signs of price convergence between newly well-connected locations in France and Geneva.

The natural experiment provided by the introduction of the LEX also provides an interesting setting to study market integration frictions. In future research, I aim to develop a method to back out the most relevant remaining obstacles which hinder housing market integration between the Swiss and the French part of the metropolitan region and hence curtail Greater Geneva's growth. The basic idea is to leverage a revealed preference type of argument and hence making inference about the most relevant obstacles based on the observed residential mobility flows. Specifically, exploiting information on previous resident location, personal and dwelling characteristics and comparing the realized moving probability to a baseline probably constructed from group size. For instance, underproportional inflow of young families from Geneva into treated locations in France could suggest differential schooling quality to be an important obstacle to relocation. An underpro-

[49] www.swissinfo.ch/fre/mobilit%C3%A9-transfrontali%C3%A8re_le-l%C3%A9man-express-va-faire-sortir-gen%C3%A8ve-de-ses-murs/45325432

portional inflow of Swiss citizens from Geneva might suggest a home bias due to cultural identity. If incumbent CBWs that used to commute to Geneva by car are overproportionally likely to move to treatment locations and start commuting by public transport this could suggest that road congestion was an important friction. Shedding light on the relevant border frictions and amenity differences could provide general lessons to understand what it takes for a successful integration of trans-border metropolitan areas.

A brief exploration of the differences between internal movers in the Swiss part of Greater Geneva and trans-border movers to the French part shows that for trans-border movers general mobility inclinations are even more pronounced. Trans-border movers are are younger, more likely to be childless coupes, have a higher employment share and a higher share of two full-time couples. This makes sense as a higher mobility inclination is required in order to overcome the higher mobility frictions of moving trans-border. Trans-border movers are also less likely to have CH citizenship but more likely to have FR citizenship indeed suggesting a home bias in location preferences. However, untypically for movers they have a much higher probability of home ownership. This is likely due to the much lower housing prices in France making ownership affordable and confirming that the main motive for a trans-border move is to improve the household's housing situation. With the introduction of the LEX the composition of trans-border movers seems to upgrade to richer, higher-skilled households reflecting the attractivity gain.

6.1 Welfare

A full fledged welfare analysis goes beyond the scope of this paper. A simple way to nevertheless shed some light on the welfare effect of the LEX is to compare the commuting time savings to the increase in housing prices. I illustrate this for the case of Annemasse, the largest municipality in French Greater Geneva and also the most strongly treated one. First, we approximate the potential yearly commuting time savings by multiplying the travel time reduction at this location by the LEX anticipation period CBW population and the number of yearly commuting trips. In the case of Annemasse the LEX travel time is likely to undercut the post LEX car travel time, whereas the two modes were about equally fast in the pre LEX period. I assume that in equilibrium CBWs chose the fastest mode, namely public transport and hence benefit from a travel time reduction of 20 minutes. Assuming 470 work commuting trips per year for each of the 10.1k CBW households in Annemasse, this results in travel time savings of 1.58 mio hours per year for the entire municipality. According to data from CLAMEUR rents in the municipality increased by 0.5 EUR per m2 in the anticipation period, resulting in 1.2 mio EUR higher total rents. Hence, a 1h yearly travel time reduction is associated with an additional 9.1 EUR rent per year. However, an important distinction to be made for this matter is between renters and homeowners. Renters in treated areas are facing a trade off between better access to jobs in Geneva versus higher housing costs. For home owners, on the other hand, due to increasing housing prices the LEX effect is entirely positive. They gain from the valuation gain on their dwelling and benefit from better connectivity to Geneva. Hence, the LEX is

likely to increase inequality in treated locations.

6.2 Winners and losers

Hence, while extending Geneva's labor market promises large efficiency gains, distributional consequences are likely to be less favorable. It is important to understand who are the main beneficiaries of the LEX and which groups might lose. Better connectivity to Geneva increases housing prices near LEX stations in France. The pronounced housing construction response reshapes the urban landscape and fosters the reshuffling of residential allocation, which is likely to take the direction of gentrification pressure in treated French locations. The better connectivity fuels residential sorting through the formation of affluent cross-border worker neighborhoods around newly well-connected stations in France, applying pressure on incumbent residents.

A crucial dimension to understand the distributional impact of the LEX is the skill composition of cross-border working. Pre LEX, cross-border working was heavily skill biased in the treatment areas: 43.4% of the high skilled cross-border worked compared to only 20.1% of the low skilled.[50] Put differently, CBWs were 25.4pp more likely to be high skilled than local workers. Hence, if the composition of jobs in Switzerland remains broadly unaffected and no major relocation of low skilled workers from Geneva to France occurs then cross-border working will remain skill biased. The findings in Section 5.1 confirmed that there is only very limited relocation movement from the Swiss to the French side (at least during the anticipation period). Looking at the characteristics of residents in the treated group in the anticipation period, I find a slight reduction in the skill gap between CBWs and local workers to 24.1pp (-1.3pp) but the gap remains large. Furthermore, high skilled CBWs were slightly (2pp) more likely to use public transport for commuting than low skilled CBWs, who commuted more by car. Not only are the high skilled more likely to cross-border work and use public transport but they also value travel time reduction more due to higher opportunity cost of time. Therefore, it is likely that the LEX will mostly benefit high-skilled workers. Low-skilled workers, on the other hand, are less likely to benefit from the commuting cost reduction and are more vulnerable to housing cost increases since they spend a larger share of their income on housing. This suggests that the LEX is likely to be pro rich.

There is also an interesting gender dimension. Pre LEX, cross-border working was clearly male biased: 42% of male workers cross-border worked but only 35% of female workers. This is consistent with evidence from Le Barbanchon et al. (2021) that females prefer shorter commutes. At the same time males seem to be less public transport affine. Males are 10pp more likely to commute by car than females. Eventhough, breaking this down by work location shows that the male car bias is especially pronounced among local workers (+18pp) and much less among CBWs (only +5pp). Nevertheless, the new public transport service may foster female workers willingness to cross-border work.

Better understanding the heterogeneous impact of the LEX is important for the design of appropriate

[50] Where high skilled are defined as workers with at least a high school degree (baccalauéat).

complementary policies. Possible measures to buffer the gentrification pressure could be to promote the supply of affordable housing or to make the taxation schedule more progressive. It will be interesting to observe the future development of the housing market in this region.

7 Conclusion

I study the effects of a trans-border public transport infrastructure integration in the binational Greater Geneva Area. I document that before the introduction of the Léman Express there was a 50% housing prices gap between the Swiss and the French side of the region and a 17min border penalty when commuting by public transport from locations in France compared to equally distant locations in Switzerland. I estimate the effect of the Léman Express on and housing prices and construction activity, applying a dynamic Difference-in-Difference approach. I find locally concentrated residential construction booms and increasing housing prices at French locations anticipating a substantial travel time reduction to downtown Geneva thanks to the Léman Express. The new train service promotes the attractiveness of treated locations in France and hence reduces the price gap between the Swiss and the French side of the agglomeration at least for newly well-connected locations. The pace and magnitude of this adjustment however is very modest. While increasing housing prices and construction booms around stations can already be interpreted as evidence for gentrification, to understand the dynamics it is crucial to directly observe relocation behavior. Hence, I describe the residential mobility response and its impact on local communities. I find that locations near newly well-connected stations experience a shift towards more affluent, home-owning cross-border workers, resulting in a gentrification push for these historically predominantly poor neighborhoods. This is largely driven by inflows from adjacent areas and internal upgrading whereas trans-border relocation flows remain unimportant.

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Appendix

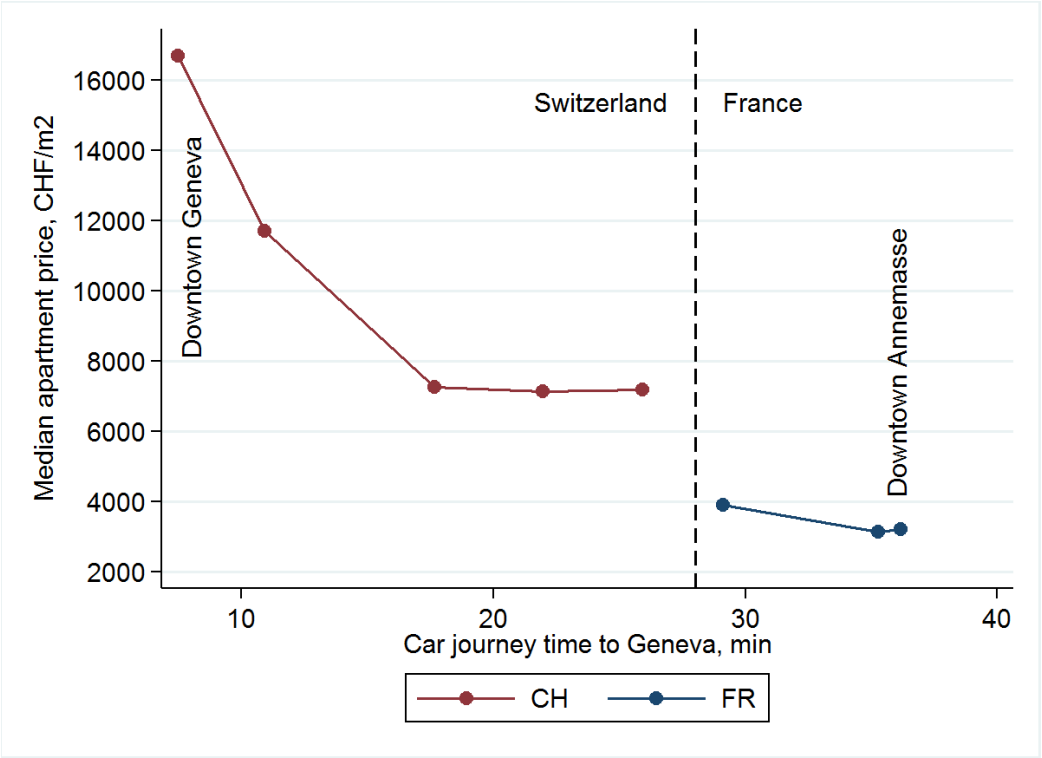

Figure 25: Housing price gradient from Geneva to Annemasse

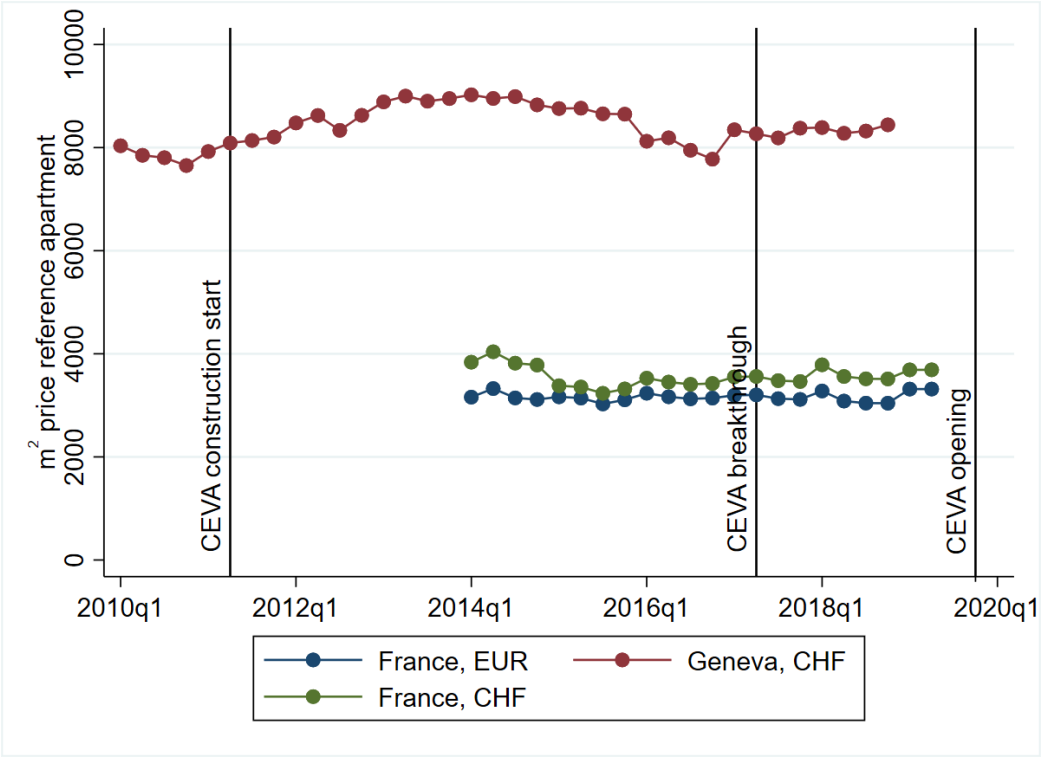

Figure 26: Evolution of price for reference apartment on Swiss vs French side

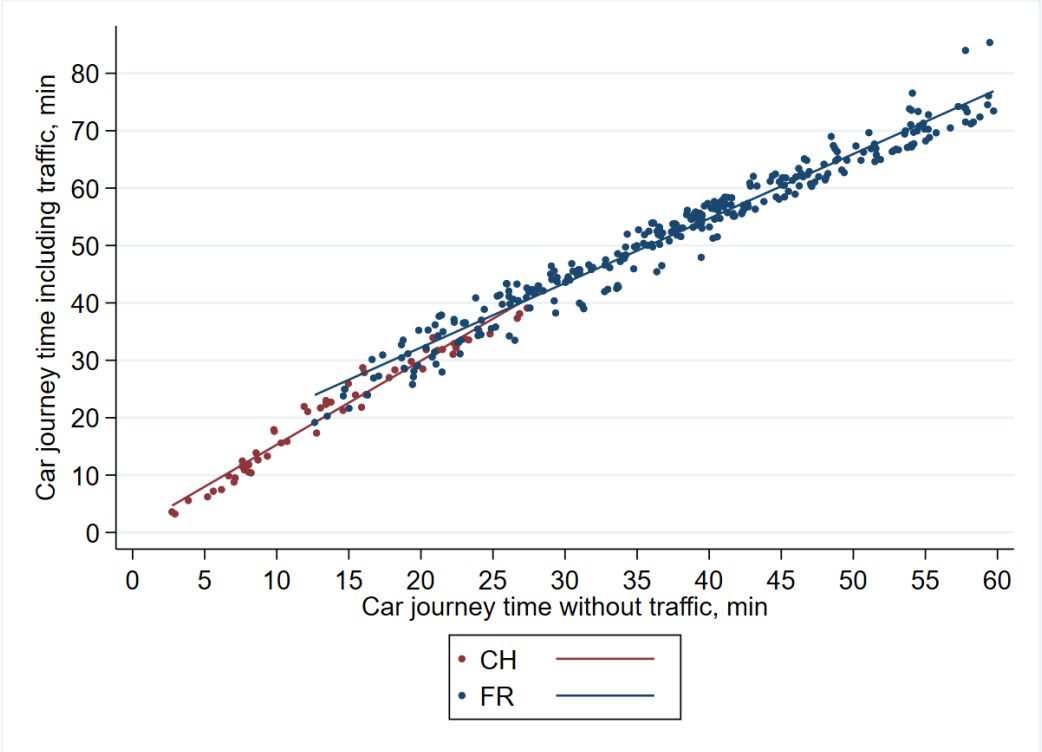

Figure 27: Pre LEX road traffic border penalty

Credit Photo: Région AURA/Michel Pérès

Figure 28: Interior of Léman Express train

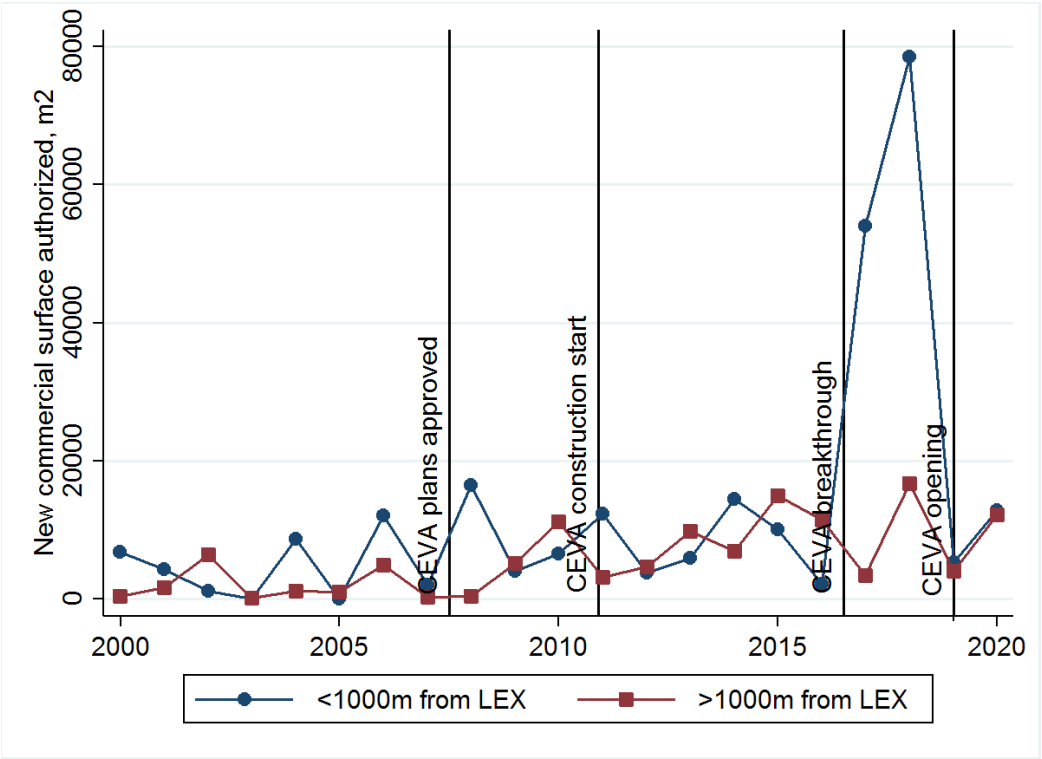

Figure 29: Commercial surface authorized in Swiss Greater Geneva

	Treatment [T]	preJT90 [C1]	CBW20 [C2]	T-C1	N1	T-C2	N2
Resident population	8346.39	4094.02	1045.12	-4252.37	77	-7301.27	88
	(9337.19)	(5213.74)	(816.65)	(2795.32)		(2716.90)**	
Pop growth, % yoy	2.18	2.16	2.00	-0.02	77	-0.17	88
	(0.72)	(1.94)	(1.92)	(0.32)		(0.30)	
Commuting							
CBW share, %	40.37	40.39	36.79	0.02	77	-3.58	88
	(9.46)	(17.42)	(13.00)	(3.50)		(3.13)	
Public transport share, %	11.98	10.68	5.00	-1.29	76	-6.98	88
	(9.89)	(9.15)	(7.31)	(3.10)		(3.00)**	
PT journey time, pre	72.35	62.91	98.08	-9.44	77	25.73	19
	(18.92)	(16.93)	(7.46)	(5.89)		(6.31)***	
PT journey time, post	45.86	61.68	77.10	15.82	77	31.23	28
	(9.94)	(18.47)	(14.77)	(3.69)***		(4.67)***	
PT connection frequency	4.36	2.95	0.12	-1.42	77	-4.24	88
	(2.66)	(2.00)	(0.44)	(0.81)*		(0.77)***	
Car journey time	46.72	49.18	55.56	2.46	77	8.83	88
	(4.30)	(14.21)	(7.06)	(2.16)		(1.49)***	
Housing							
Share houses, %	50.39	60.02	80.29	9.63	77	29.90	88
	(26.96)	(19.18)	(10.11)	(8.20)		(7.93)***	
Owner occupant share, %	64.02	68.48	79.64	4.46	77	15.62	88
	(16.75)	(11.70)	(6.28)	(5.09)		(4.92)***	
Vacancy rate, %	6.65	7.21	7.29	0.56	77	0.64	88
	(1.04)	(3.21)	(2.56)	(0.50)		(0.42)	
Median apt m2 price	3102.81	3283.72	3044.89	180.91	70	-57.92	52
	(237.76)	(758.39)	(627.37)	(121.14)		(120.83)	
Median apt surface	68.45	69.16	69.93	0.71	70	1.47	52
	(10.58)	(10.04)	(17.64)	(3.35)		(4.16)	
Median apt m2 rent	15.41	16.53	15.17	1.12	76	-0.23	71
	(0.92)	(3.55)	(2.44)	(0.52)**		(0.41)	
Median rental apt surface	53.05	55.99	60.49	2.95	76	7.44	71
	(5.68)	(9.46)	(13.44)	(2.03)		(2.41)***	
N municipalities	11	66	77				

Table 5: Treatment and comparison group characteristics

	stockgrowth	SE
treated	1.057**	(0.414)
y1996treated	0.148	(0.424)
y1997treated	0.198	(0.516)
y1998treated	0.265	(0.574)
y1999treated	0.066	(0.661)
y2000treated	-0.347	(0.509)
y2001treated	-0.429	(0.524)
y2002treated	-0.117	(0.600)
y2003treated	0.136	(0.526)
y2004treated	0.427	(0.644)
y2005treated	0.920	(0.703)
y2006treated	0.494	(0.781)
y2007treated	-0.098	(0.734)
y2008treated	-0.871	(0.656)
y2009treated	-0.412	(0.697)
y2010treated	0.032	(0.627)
y2011treated	0.585	(0.682)
y2012treated	0.294	(0.669)
y2013treated	0.103	(0.534)
y2014treated	-0.162	(0.388)
y2015treated	0.021	(0.213)
y2017treated	0.377	(0.360)
y2018treated	0.707	(0.616)
y2019treated	1.419**	(0.680)
y2020treated	1.195	(0.740)
Year FEs	yes	
Municipality FEs	yes	
Cluster	Municipality	
# observations	2067	
# regressors	33	
Adjusted R^2	0.418	
Mean	2.380	
Standard deviation	2.100	

Notes: Robust standard errors in parentheses
***, **, * denote statistical significance on the 1%, 5%, and 10% level, respectively.

Table 6: DiD housing stock growth high vs low LEX exposure

	#Obs	Median	Mean	SD	Min	Max
Houses						
Price, EUR thousands	1736	348	356.7	177.9	2	1710
Price per m^2, EUR	1736	3451	3424.2	1617.4	23	20152
Built Surface, m^2	1736	104	110.0	41.1	20	300
Number of rooms	1736	5	4.5	1.3	1	11
Terrain Surface, m^2	1736	659	727.1	564.3	25	9638
Apartments						
Price, EUR thousands	5695	172	186.0	83.9	2	1191
Price per m^2, EUR	5695	2962	2988.6	818.6	20	14145
Built Surface, m^2	5695	63	63.0	23.2	10	200
Number of rooms	5695	3	2.7	1.1	1	8

Table 7: Housing transactions in treated French Greater Geneva 2010-2020

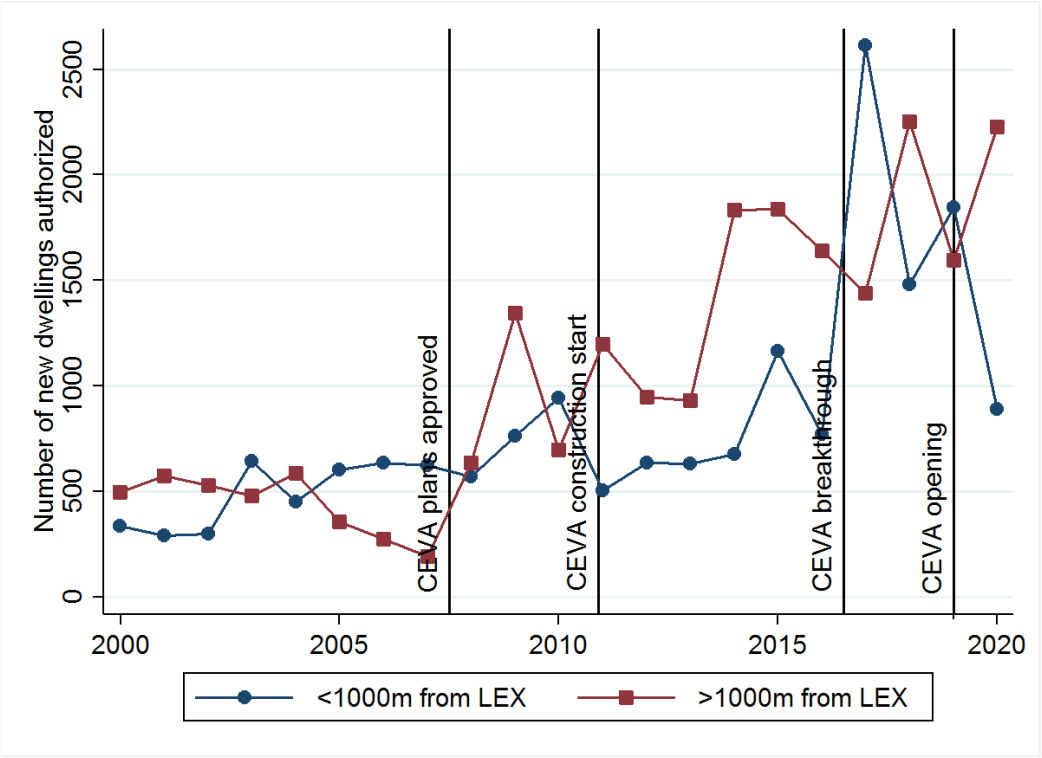

Figure 30: New dwellings authorized in Swiss Greater Geneva

	#Obs	Median	Mean	SD	Min	Max
Houses						
Price, CHF thousands	4972	1518	1653.3	883.5	5	11300
Price per m^2, CHF	4972	9261	9946.2	5405.7	82	50000
Built Surface, m^2	4972	174	177.9	60.0	20	300
Terrain Surface, m^2	4972	496	676.4	694.7	2	10477
Apartments						
Price, CHF thousands	11567	900	991.7	487.2	35	6100
Price per m^2, CHF	11567	8015	8496.2	2836.4	752	33439
Built Surface, m^2	11567	120	117.7	39.5	10	200

Table 8: Housing transactions in Canton of Geneva 2010-2020

	Treated Price per m^2, EUR	Control Price per m^2, EUR
Habitable Surface	-9.526***	-3.109***
	(1.256)	(0.679)
N rooms	160.589***	13.163
	(28.351)	(15.712)
$y2014_r dist$	-269.926*	-100.756*
	(160.775)	(60.768)
$y2015_r dist$	-224.817**	-213.980***
	(101.599)	(58.647)
$y2016_r dist$	-61.537	-151.454***
	(85.974)	(51.538)
$y2017_r dist$	-105.412	-262.710***
	(85.568)	(46.006)
$y2018_r dist$	129.495*	-187.366***
	(70.821)	(43.170)
$y2019_r dist$	396.172***	-339.015***
	(134.039)	(46.349)
Year FEs	Yes	Yes
Quarter FEs	Yes	Yes
Municipality FEs	Yes	Yes
# observations	3,798	12,983
# regressors	25	81
Adjusted R^2	0.068	0.375
Mean	2986.304	3160.447
Standard deviation	838.767	1179.642

Notes: Robust standard errors in parentheses
***, **, * denote statistical significance on the 1%, 5%, and 10% level, respectively.

Table 9: Distance to station effect on housing prices

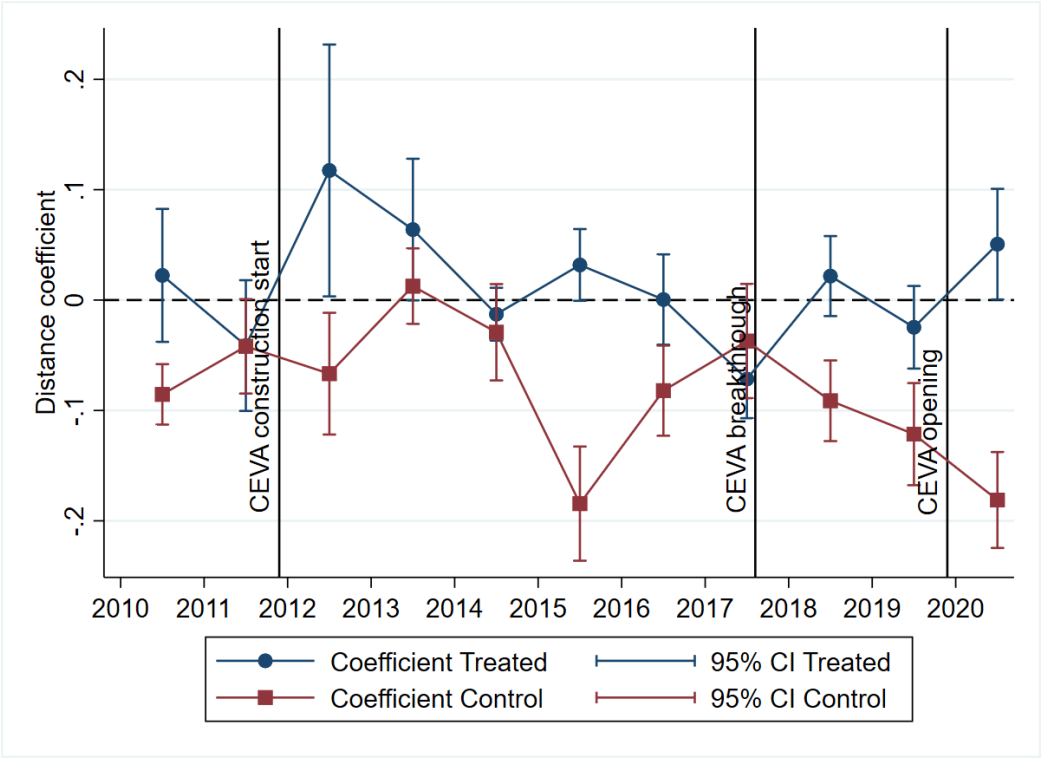

Figure 31: Value of proximity to a railway station in Swiss Greater Geneva

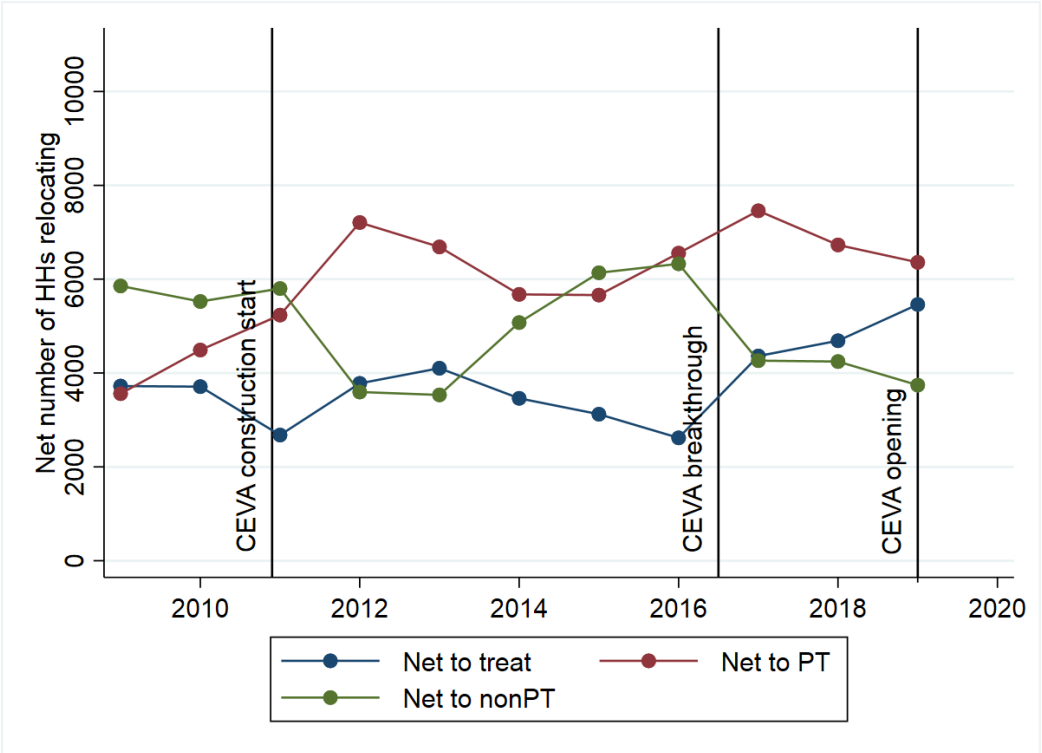

Figure 32: Destination choice of arrivals to French Greater Geneva (without Saint-Julien-en-Genevois)

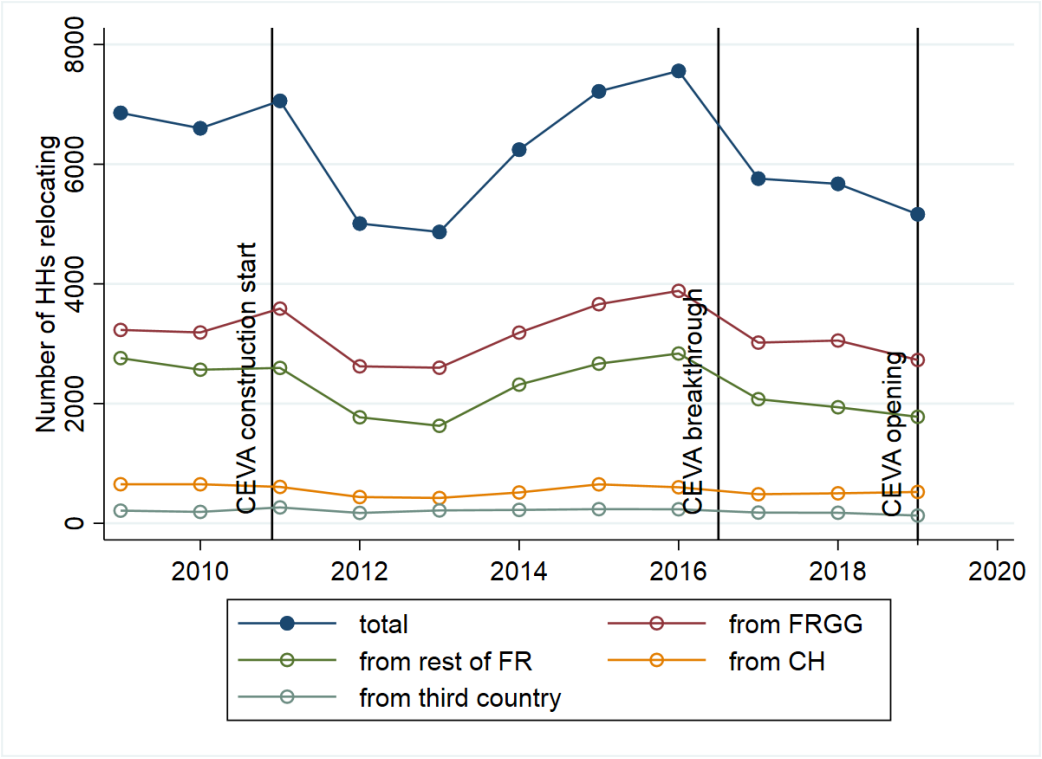

Figure 33: Arrivals to nonPT group by origin

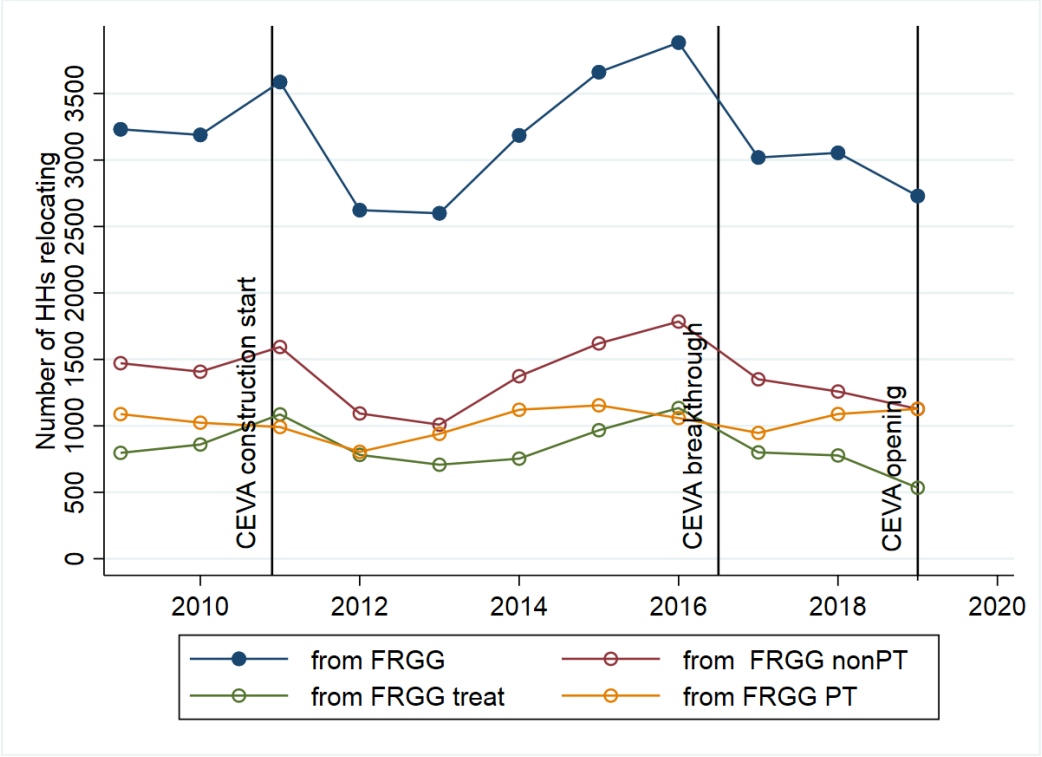

Figure 34: Arrivals to nonPT group by within FRGG origin

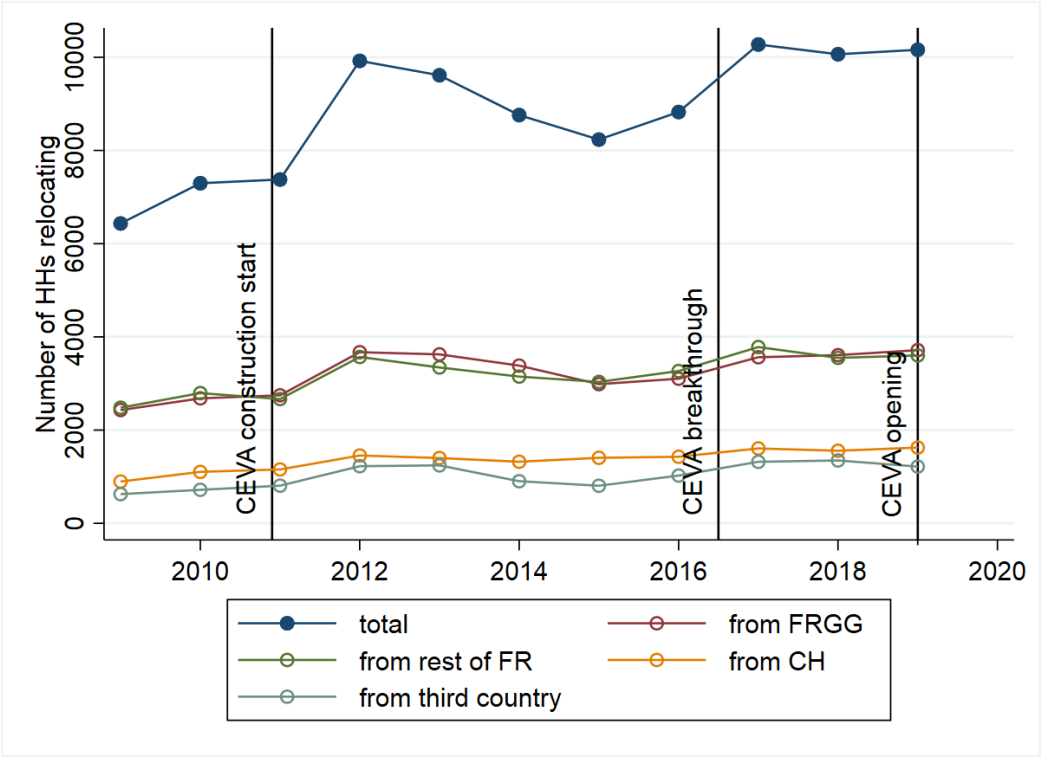

Figure 35: Arrivals to PT group by origin

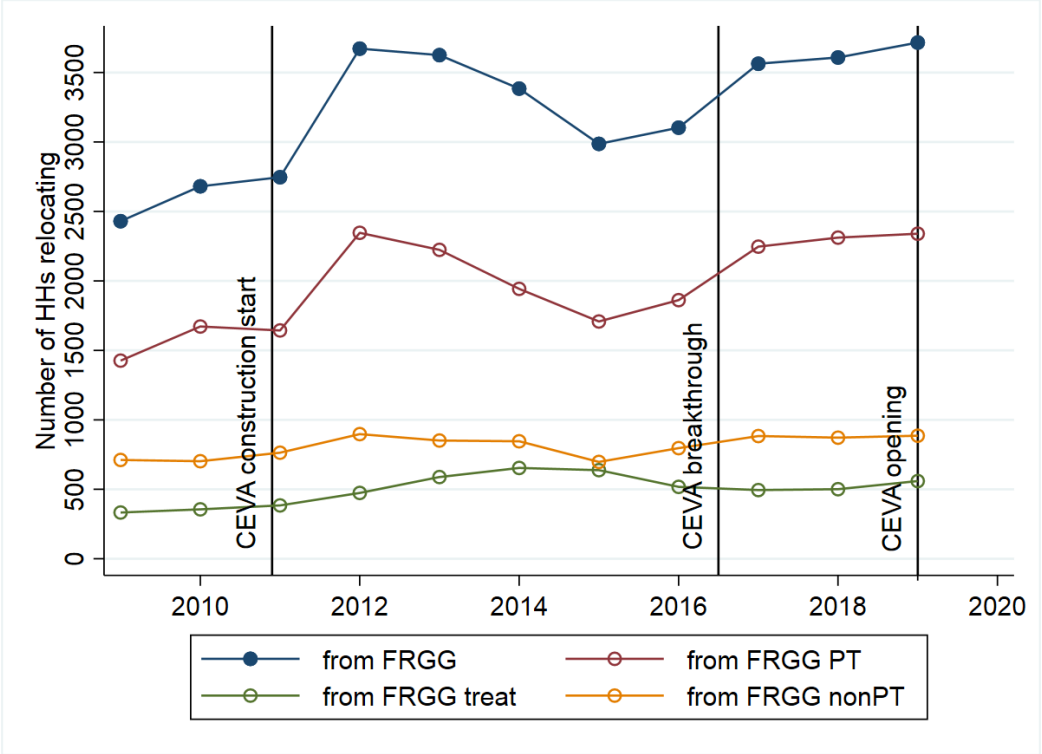

Figure 36: Arrivals to PT group by within FRGG origin

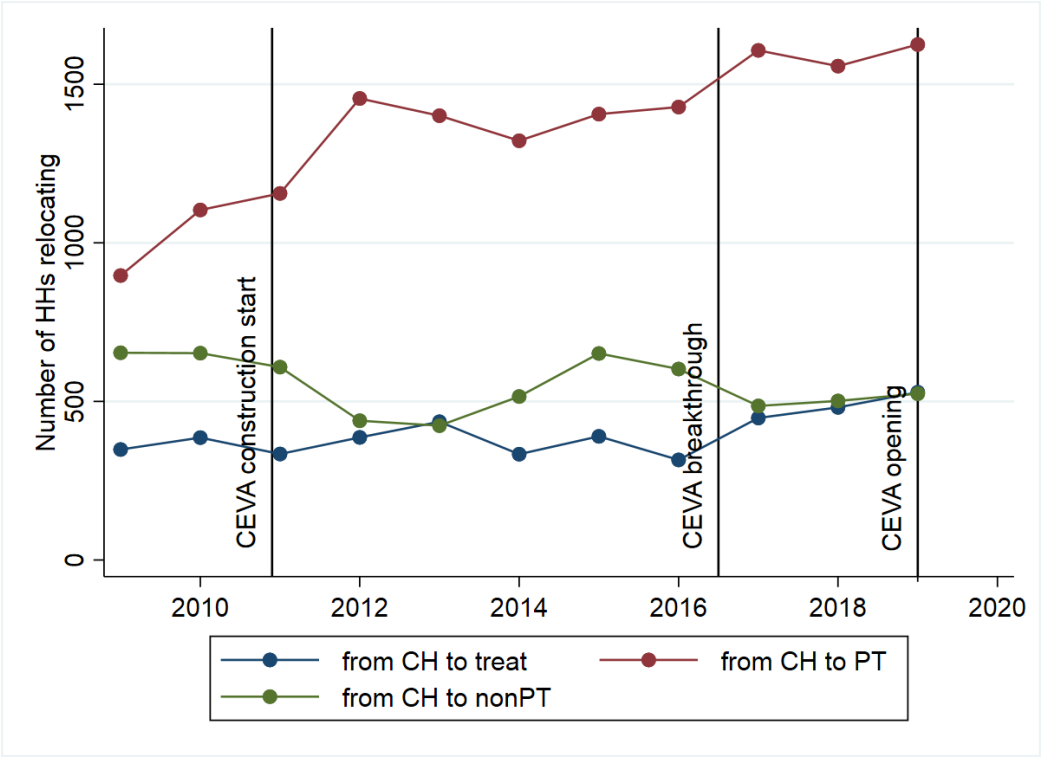

Figure 37: Destination choice of Swiss origin arrivals to French Greater Geneva

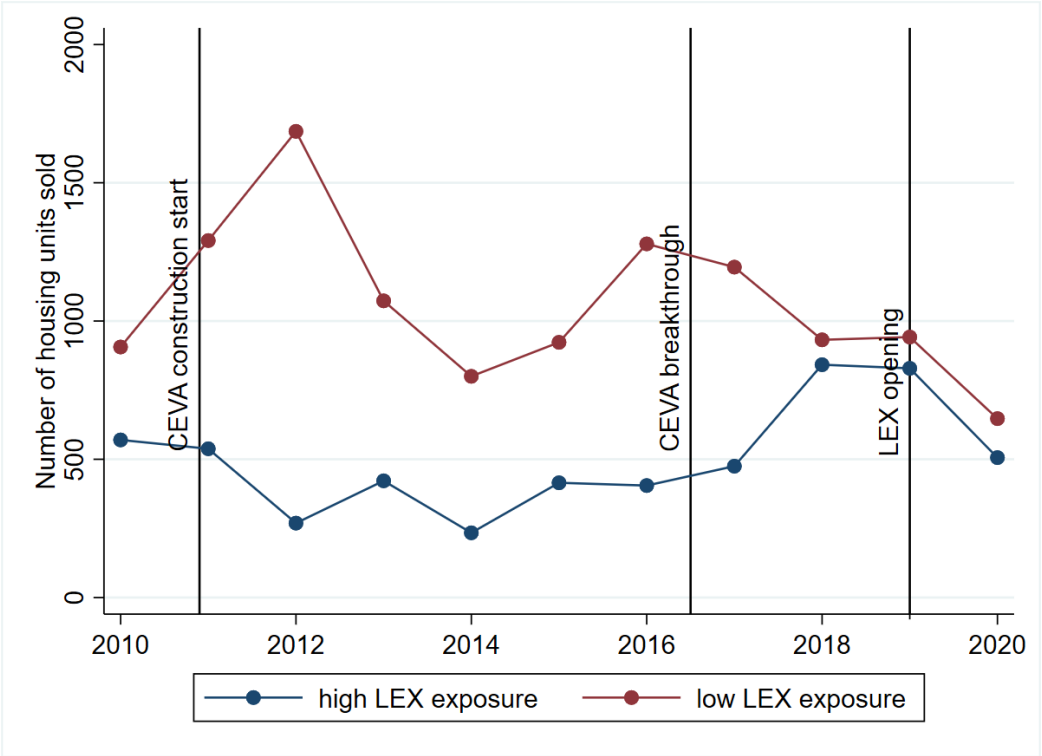

Figure 38: Housing sales by LEX exposure

	anticip	pre	anticip-pre	N
Household type				
Pre school children	0.120	0.100	0.019	4107
	(0.325)	(0.301)	(0.012)	
School children	0.151	0.124	0.026	4107
	(0.358)	(0.330)	(0.013)**	
Post school children	0.048	0.037	0.010	4107
	(0.213)	(0.190)	(0.007)	
Childless couple	0.232	0.223	0.009	4107
	(0.422)	(0.416)	(0.016)	
Non-family HH	0.079	0.079	0.000	4107
	(0.270)	(0.270)	(0.011)	
Single HH	0.332	0.392	-0.059	4107
	(0.471)	(0.488)	(0.018)***	
Retired HH	0.039	0.044	-0.006	4107
	(0.193)	(0.206)	(0.007)	
Sociodemographics				
Median HH age	35.408	34.057	1.351	4101
	(12.004)	(12.158)	(0.444)***	
High school degree	0.671	0.663	0.008	4101
	(0.418)	(0.422)	(0.016)	
Tertiary degree	0.442	0.428	0.014	4101
	(0.444)	(0.448)	(0.017)	
High socio-eco status	0.185	0.175	0.009	3445
	(0.361)	(0.356)	(0.015)	
Two full-time couple	0.386	0.371	0.015	1966
	(0.487)	(0.483)	(0.027)	
Unemployment rate	0.134	0.165	-0.031	3746
	(0.292)	(0.327)	(0.013)**	
CH citizenship	0.048	0.047	0.001	4107
	(0.213)	(0.211)	(0.007)	
FR citizenship	0.865	0.875	-0.010	4107
	(0.342)	(0.331)	(0.013)	
CBW to CHGG	0.469	0.429	0.040	4107
	(0.499)	(0.495)	(0.019)**	
PT communter	0.171	0.190	-0.018	3260
	(0.377)	(0.392)	(0.017)	
Housing				
Home owner	0.273	0.188	0.085	4107
	(0.446)	(0.391)	(0.015)***	
Single family home	0.171	0.109	0.062	4107
	(0.377)	(0.312)	(0.012)***	
Surface per person	36.605	35.643	0.962	4107
	(19.000)	(18.256)	(0.679)	
Overoccupation	0.094	0.091	0.003	4107
	(0.291)	(0.288)	(0.011)	
Dwelling age	5.872	6.191	-0.318	1454
	(4.165)	(3.238)	(0.223)	

Table 10: Characteristics of arrivals in treated area in pre and anticipation period

	anticip	pre	anticip-pre	N
Household type				
Pre school children	0.113	0.112	0.001	8881
	(0.317)	(0.315)	(0.008)	
School children	0.152	0.161	-0.009	8881
	(0.359)	(0.367)	(0.009)	
Post school children	0.045	0.050	-0.005	8881
	(0.207)	(0.217)	(0.005)	
Childless couple	0.230	0.233	-0.003	8881
	(0.421)	(0.423)	(0.011)	
Non-family HH	0.070	0.070	-0.001	8881
	(0.255)	(0.256)	(0.007)	
Single HH	0.349	0.339	0.009	8881
	(0.477)	(0.474)	(0.012)	
Retired HH	0.041	0.035	0.006	8881
	(0.199)	(0.184)	(0.005)	
Sociodemographics				
Median HH age	36.584	36.354	0.229	8872
	(12.362)	(11.835)	(0.310)	
High school degree	0.724	0.708	0.016	8872
	(0.405)	(0.411)	(0.011)	
Tertiary degree	0.543	0.508	0.035	8872
	(0.454)	(0.455)	(0.012)***	
High socio-eco status	0.263	0.244	0.019	7852
	(0.413)	(0.404)	(0.011)*	
Two full-time couple	0.387	0.381	0.006	4696
	(0.487)	(0.486)	(0.017)	
Unemployment rate	0.116	0.126	-0.009	8295
	(0.270)	(0.278)	(0.008)	
CH citizenship	0.101	0.108	-0.007	8881
	(0.301)	(0.311)	(0.008)	
FR citizenship	0.719	0.769	-0.050	8881
	(0.450)	(0.421)	(0.011)***	
CBW to CHGG	0.594	0.556	0.038	8881
	(0.491)	(0.497)	(0.013)***	
PT communter	0.171	0.172	-0.001	7385
	(0.377)	(0.378)	(0.012)	
Housing				
Home owner	0.275	0.283	-0.008	8881
	(0.447)	(0.450)	(0.011)	
Single family home	0.236	0.239	-0.003	8881
	(0.425)	(0.426)	(0.010)	
Surface per person	40.401	39.133	1.267	8881
	(22.064)	(21.390)	(0.548)**	
Overoccupation	0.074	0.084	-0.011	8881
	(0.261)	(0.278)	(0.007)	
Dwelling age	5.759	4.850	0.909	3267
	(3.926)	(3.016)	(0.144)***	

Table 11: Characteristics of arrivals in PT area in pre and anticipation period

	anticip	pre	anticip-pre	N
Household type				
Pre school children	0.165	0.169	-0.004	7293
	(0.371)	(0.375)	(0.009)	
School children	0.180	0.209	-0.029	7293
	(0.384)	(0.407)	(0.009)***	
Post school children	0.066	0.064	0.002	7293
	(0.248)	(0.244)	(0.006)	
Childless couple	0.263	0.251	0.012	7293
	(0.441)	(0.434)	(0.010)	
Non-family HH	0.048	0.051	-0.003	7293
	(0.214)	(0.220)	(0.005)	
Single HH	0.229	0.212	0.018	7293
	(0.420)	(0.409)	(0.010)*	
Retired HH	0.049	0.044	0.005	7293
	(0.215)	(0.205)	(0.005)	
Sociodemographics				
Median HH age	37.654	37.566	0.088	7288
	(12.269)	(11.725)	(0.282)	
High school degree	0.691	0.671	0.020	7288
	(0.398)	(0.403)	(0.009)**	
Tertiary degree	0.465	0.454	0.011	7288
	(0.436)	(0.433)	(0.010)	
High socio-eco status	0.233	0.214	0.019	6601
	(0.374)	(0.365)	(0.009)**	
Two full-time couple	0.488	0.482	0.006	4635
	(0.500)	(0.500)	(0.015)	
Unemployment rate	0.096	0.106	-0.010	6890
	(0.239)	(0.253)	(0.006)	
CH citizenship	0.072	0.083	-0.011	7293
	(0.258)	(0.276)	(0.006)*	
FR citizenship	0.905	0.900	0.005	7293
	(0.293)	(0.300)	(0.007)	
CBW to CHGG	0.492	0.494	-0.002	7293
	(0.500)	(0.500)	(0.012)	
PT communter	0.038	0.035	0.003	6245
	(0.191)	(0.183)	(0.005)	
Housing				
Home owner	0.476	0.481	-0.005	7293
	(0.500)	(0.500)	(0.012)	
Single family home	0.495	0.542	-0.047	7293
	(0.500)	(0.498)	(0.012)***	
Surface per person	42.010	40.715	1.295	7293
	(21.490)	(21.745)	(0.507)**	
Overoccupation	0.039	0.050	-0.011	7293
	(0.195)	(0.219)	(0.005)**	
Dwelling age	5.069	4.391	0.678	2657
	(4.225)	(3.102)	(0.142)***	

Table 12: Characteristics of arrivals in nonPT area in pre and anticipation period

	DiD PT	N1	DiD nonPT	N2
Household type				
Pre school children	0.002	55471	-0.002	63168
	(0.005)		(0.004)	
School children	-0.017	55471	0.001	63168
	(0.009)*		(0.008)	
Post school children	0.009	55471	0.014	63168
	(0.006)		(0.005)**	
Childless couple	0.008	55471	0.012	63168
	(0.007)		(0.007)*	
Non-family HH	-0.003	55471	-0.003	63168
	(0.005)		(0.004)	
Single HH	-0.032	55471	-0.028	63168
	(0.009)***		(0.008)***	
Retired HH	0.032	55471	0.006	63168
	(0.010)***		(0.009)	
Sociodemographics				
Median HH age	1.580	55443	0.593	63144
	(0.363)***		(0.330)*	
High school degree	0.005	55443	-0.003	63144
	(0.010)		(0.009)	
Tertiary degree	0.007	55443	-0.003	63144
	(0.009)		(0.008)	
High socio-eco status	0.012	35306	-0.005	41487
	(0.010)		(0.009)	
Two full-time couple	0.030	23820	0.003	30052
	(0.016)*		(0.015)	
Unemployment rate	-0.052	37794	-0.055	43590
	(0.008)***		(0.008)***	
CH citizenship	0.001	55471	0.010	63168
	(0.005)		(0.004)**	
FR citizenship	0.033	55471	-0.002	63168
	(0.007)***		(0.005)	
CBW to CHGG	0.025	55471	0.031	63168
	(0.010)**		(0.009)***	
PT communter	-0.039	33420	-0.022	39431
	(0.009)***		(0.007)***	
Housing				
Home owner	0.111	55471	0.074	63168
	(0.011)***		(0.009)***	
Single family home	0.128	55471	0.123	63168
	(0.010)***		(0.009)***	
Surface per person	2.838	55471	1.159	63168
	(0.567)***		(0.524)**	
Overoccupation	-0.031	55471	-0.018	63168
	(0.006)***		(0.005)***	
Dwelling age	-0.075	10010	0.138	9992
	(0.108)		(0.104)	

Table 13: DiD incumbents in pre vs anticipation period and treatment vs comparison groups

	anticip	pre	anticip-pre	N
Household type				
Pre school children	0.113	0.114	-0.001	7057
	(0.317)	(0.318)	(0.009)	
School children	0.151	0.156	-0.005	7057
	(0.358)	(0.363)	(0.010)	
Post school children	0.111	0.107	0.004	7057
	(0.314)	(0.309)	(0.007)	
Childless couple	0.211	0.212	-0.001	7057
	(0.408)	(0.409)	(0.011)	
Non-family HH	0.059	0.054	0.005	7057
	(0.235)	(0.226)	(0.007)	
Single HH	0.288	0.286	0.002	7057
	(0.453)	(0.452)	(0.014)	
Retired HH	0.067	0.071	-0.004	7057
	(0.250)	(0.257)	(0.007)	
Sociodemographics				
Median HH age	40.168	40.024	0.144	6939
	(13.206)	(12.954)	(0.347)	
High school degree	0.671	0.619	0.052	7057
	(0.470)	(0.486)	(0.013)***	
Tertiary degree	0.539	0.504	0.034	7057
	(0.439)	(0.443)	(0.013)***	
High socio-eco status	0.377	0.348	0.029	5944
	(0.485)	(0.476)	(0.015)*	
Two full-time couple	0.317	0.312	0.004	4292
	(0.465)	(0.464)	(0.015)	
Unemployment rate	0.119	0.113	0.005	6520
	(0.276)	(0.270)	(0.008)	
CH citizenship	0.590	0.565	0.025	7053
	(0.492)	(0.496)	(0.015)*	
FR citizenship	0.243	0.204	0.039	7057
	(0.429)	(0.403)	(0.012)***	
PT communter	0.467	0.459	0.008	4330
	(0.499)	(0.498)	(0.018)	
Housing				
Home owner	0.161	0.147	0.014	7057
	(0.368)	(0.355)	(0.009)	
Single family home	0.129	0.137	-0.008	7055
	(0.335)	(0.344)	(0.009)	
Surface per person	42.423	43.505	-1.081	6995
	(28.441)	(28.418)	(0.818)	
Rent per m2	25.286	23.756	1.530	5197
	(13.267)	(11.816)	(0.441)***	
Overoccupation	0.117	0.111	0.006	7057
	(0.322)	(0.314)	(0.010)	
Dwelling age	42.745	41.913	0.831	7055
	(31.084)	(30.108)	(0.894)	

Table 14: Characteristics of arrivals in CHGG in pre and anticipation period

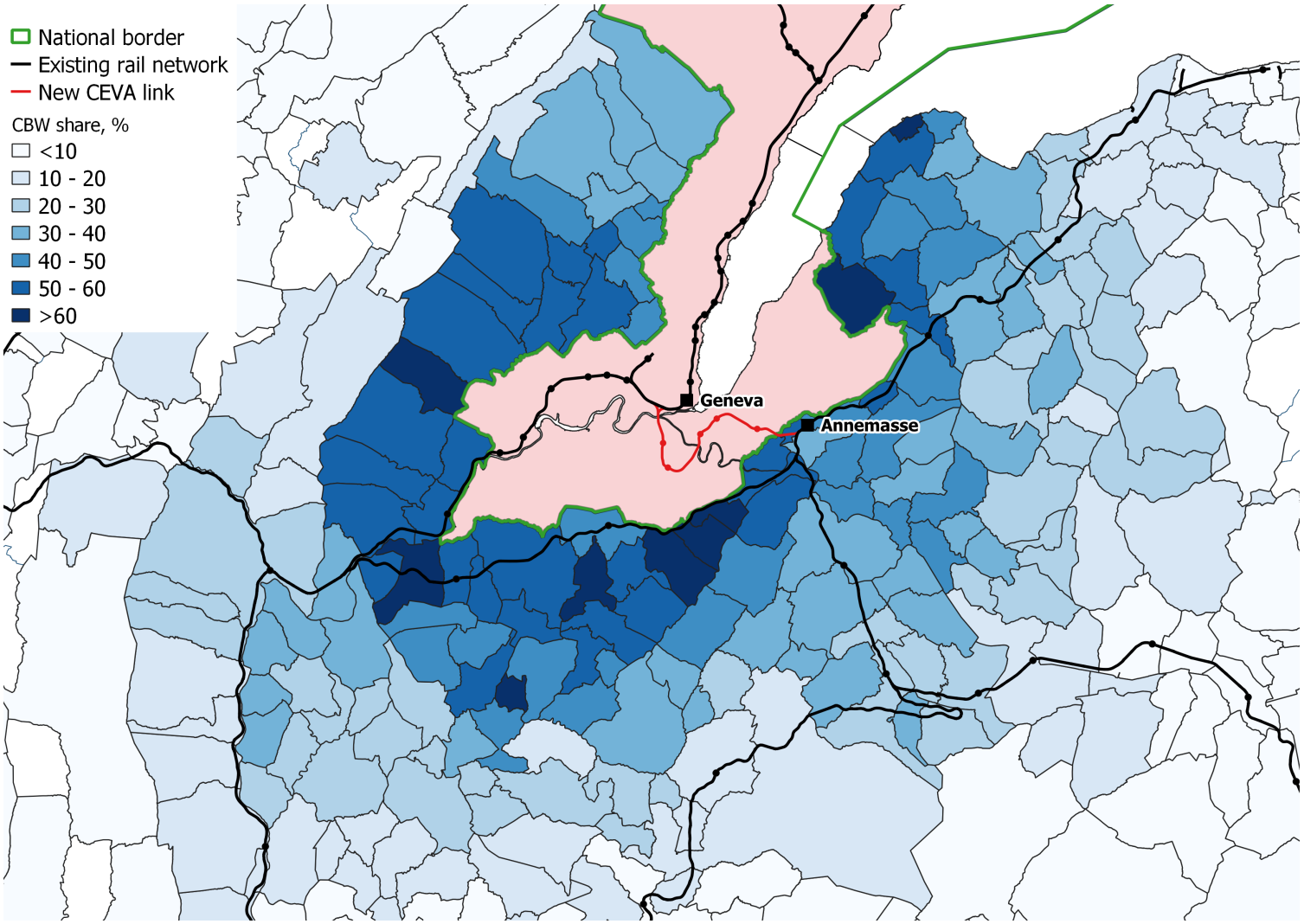

Figure 39: Pre LEX cross-border worker share