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The effects of entry deregulation: evidence from passenger transport*

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Abstract

We study the effects of entry deregulation in the Finnish interurban bus market. We find that the number of operators increased on routes connecting large and mid-sized cities. Increased competition resulted in 29% lower prices in the interurban bus market. Consistent with our evidence on entry, we find that prices decreased on routes connecting large and mid-sized cities, while on routes connecting smaller cities, we find no significant change in prices. We also study how the reform affected the long-distance railway market and find that increased intermodal competition resulted in a 22% price decrease. Overall, we find that the entry deregulation benefited consumers.

Keywords: Competition, Deregulation, Entry restrictions, Interurban bus services, Railway services

JEL Codes: L43, L50, L98

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1 Introduction

When a firm considers whether to enter a market, it compares the private costs and revenues associated with entry. However, market entry also affects other market participants. A new service provider might steal business from existing providers. It may also increase consumer surplus by reducing market prices or increasing the availability of services. This wedge between private and social benefits can motivate governments to regulate entry (Mankiw and Whinston, 1986). Although there may be good reasons to regulate entry, government entities can be captured politically and may pursue goals other than maximising social welfare. A particular concern is that entry restrictions are the result of regulatory capture and serve to maximise industry profits (Stigler, 1971).

Although entry regulations are common in many service sectors, such as pharmacies, notaries, and transport, there is relatively little empirical evidence on their impact on efficiency and welfare. In this paper, we study the deregulation of entry in the Finnish interurban bus and coach passenger transport market in 2014. Before deregulation, local governments granted firms permits to operate a given route in their region. The stated goal of the old policy was to ensure the availability of interurban bus services in less densely populated areas, by bundling the obligation to serve routes connecting smaller cities with monopoly rights to serve routes connecting large cities. To study the effects of the reform, we collect route-level data on prices, quantities, and entry of intercity bus and railway operators in Finland. We supplement the data set with aggregate price information from other European countries in which there were no significant policy changes during our observation period.

We begin our empirical analysis by documenting how entry patterns change after the removal of the entry restrictions. We find that the number of operators increases particularly on routes connecting large and mid-sized cities, while we find no evidence that access to transport services decreases in less densely populated areas. The increase in the number of operators on routes connecting mid-sized and large cities is driven by the entry of a new operator, which expanded its network quickly after the reform.

After documenting the changes in the entry patterns, we study the effect of the reform on prices. To control for other potential changes in the transport sector that could affect prices, we create a synthetic Finland from a pool of other European countries with no major market or policy changes in the long-distance bus or train market during our observation period. By comparing the price development in Finland with the synthetic Finland, we find that the deregulation of entry resulted in a 29% decrease in prices in the long-distance bus market. In the long-distance train market prices decrease by 22%. We also find evidence of market expansion, with the number of passenger kilometres increasing by 16% in the bus market and by 3% in the train market.

Furthermore, we study the heterogeneity of the price effects of the reform. A particular interest is how the policy change affected prices in different types of regions. We find that the reform did not have a significant effect on bus prices on the routes connecting municipalities that had a combined population below 100,000. On routes connecting municipalities with a combined population between 100,000 and 500,000, we find that the reform resulted in a 28% drop in prices, while on routes connecting cities with a combined population of more than 500,000, prices decreased by 38%. These findings are consistent with our previous result that the number of operators increased primarily on routes connecting mid-sized and large cities.

We also estimate the reform's effect on profits, and find that the reform more than halved the operating profits in the long-distance bus market. Based on our calculations, the decrease in industry profits is not large enough to offset our lower-bound estimate for the increase in the consumer surplus. Therefore, our findings suggest that the removal of the entry restrictions had a positive effect on total welfare in the Finnish long-distance passenger market.

Our paper contributes to several strands of literature. There is a growing empirical literature studying the effects of entry restrictions. Hsieh and Moretti (2003) study the US real estate agent industry, which is characterised by fixed commissions and free entry. They show that in an industry with fixed prices, free entry can be excessive and restricting entry could increase welfare. Schaumans and Verboven (2008) study the Belgian pharmacy and physician markets and find that the removal of entry restrictions, combined with a reduction in regulated markups, would generate a large shift in rents to consumers without reducing the availability of pharmacies. Schivardi and Viviano (2011) find that entry barriers in retail trade are associated with substantially higher profit margins and lower productivity. Seim and Waldfogel (2013) study the Pennsylvania Liquor Control Board, a public monopoly that is tasked with regulating the number of liquor stores in Pennsylvania. They find that the regulator puts a higher weight on industry profits than on consumer welfare when making decisions on entry. Verboven and Yontcheva (2022) study entry restrictions in the notary profession. Similarly to Seim and Waldfogel (2013), they find that entry restrictions primarily serve producer interests. Unlike most previous studies in the literature, we study a realised change in entry regulation instead of estimating the effects of a potential regulatory change. Overall, similarly to our results, many previous studies have found that entry regulation often benefits the industry rather than consumers.

Our paper is also related to research studying deregulation in the transport market. There are several descriptive studies that investigate the effects of market liberalisation in the interurban bus market. These include studies from France (see, e.g., Blayac and Bougette, 2017), Norway (see, e.g., Aarhaug and Fearnley, 2016), Germany (see, e.g., Dürr et al., 2016), Italy (see, e.g., Beria et al., 2018), and the UK (see, e.g., White and Robbins, 2012).[1] There is also a similar literature on the effects of deregulation in the US airline market (Borenstein, 1992; Borenstein and Rose, 2011; Rose, 2012; Rose, 1988). Compared to the previous literature on regulatory reforms in the transport market, our paper makes two contributions. First, our paper differs methodologically from previous studies, which have relied on simple before-and-after comparisons, whereas we compare the development

[1]The Finnish reform has been discussed previously in a policy brief by the Research Institute of the Finnish Economy (Valmari, 2019). Some of the descriptive results in this paper were published in a policy report of the Finnish Competition and Consumer Authority (Buri et al., 2022).

of outcomes to a plausible counterfactual scenario. Second, unlike previous studies, we use route-level data that allows us to estimate the heterogeneous effects of removing entry restrictions in the transport sector. In general, our finding that deregulation led to lower prices is consistent with previous research.

One of our key findings is that the liberalisation of the long-distance bus market also resulted in a large decrease in train ticket prices. This finding is linked to a large literature in transport economics that studies the substitutability of different modes of transport. Most of the previous literature has focused on substitutability between trains and aeroplanes (see, e.g., Abrate et al., 2016; Bergantino et al., 2015; and Capozza, 2016), with only a few studies providing results on substitutability between bus and train transport (see, e.g., Gremm (2018)). Finally, our paper is also related to studies that examine the effects of competition in the transport sector in general. Several papers study the effect of competition in the airline sector, particularly in the United States (see, e.g. Goolsbee and Syverson, 2008; Gil and Kim, 2021). One of the few articles that studies competition in the interurban bus market is de Haas et al. (2022), which studies the effect of a major merger in the German interurban bus market.

The remainder of the paper is organised as follows. Section 2 gives an overview of the Finnish interurban bus and coach market and its deregulation. Section 3 presents our data and some descriptive evidence. Then, Section 4 presents our empirical methodology. In Section 5, we present results from our empirical analysis. Finally, Section 6 concludes.

2 Institutional background

Between 2005 and 2019 the interurban bus and coach market in Finland had annually around 8.2 million passengers and an average aggregate turnover of 82.3 million euros. A closely connected market is the long-distance train market, where the annual average number of passengers was 12.9 million and the aggregate turnover 295.0 million euros. The main cost components in the interurban bus market are labour, diesel, and the fixed cost of acquiring the buses. In the train market, electricity is used instead of diesel and, compared to the interurban bus market, the cost of acquiring the transportation equipment is considerably higher. In general, in the passenger market, the marginal cost of an additional passenger is close to zero. Due to the cost structure, the profitability of an operator is closely linked to the occupancy rate, which is measured as the ratio of the number of passengers on board to the total number of seats.

Historically, the long-distance passenger transport market has been heavily regulated in Finland. The Finnish state-owned railway company continued as a legal monopoly in long-distance train passenger services until January 2021. Entry in the long-distance bus market was effectively deregulated in 2014. Before the reform, a bus operator was allowed to operate regular bus services only on routes for which it had applied and obtained a license.[2] The permits were granted by the local offices of the Finnish Centre for Economic Development, Transport and Environment. Licences were granted case by case considering existing traffic, including the effect of the new operator on the economic viability of existing operators.[3] The process involved hearings of existing operators, which played a key role in determining whether new traffic permits were granted for the route.[4] This led to local offices effectively granting only one licence per route, and typically the permits were automatically renewed for incumbent operators. The stated goal of the entry regulation was to cross-subsidise traffic in less populated areas. The operation of popular routes was bundled with the obligation to serve less popular routes, which aimed to ensure that less populated areas also had access to long-distance bus services.

Before deregulation, pricing in the market was based on list prices issued by Matkahuolto, a bus service and marketing company owned at the time by the Finnish Bus and Coach Association. Matkahuolto issued new list prices annually or biannually. The list contained

[2]This was stated in the section 6a, subsection 3 of the Act 343/1991.
[3]This is stated in the section 9a, subsection 2 of the Act 343/1991.
[4]See government proposal HE 110/2009, p. 7/I.

per-kilometre prices for routes of different lengths, with separate prices for students and pensioners. Around 75% to 85% of the firms in the market followed the list prices issued by Matkahuolto to at least some extent.

The reform was initiated by EU regulation on public passenger transport services by rail and road.[5] After the reform, entry into the long-distance bus market was effectively free. Regular bus services still required a route-specific permit, but this was granted in principle to all applicants. The reforms were included in the Public Transport Act (869/2009), which had a transition period between 2009 and 2019. During the transition period, operators were given the option of continuing to operate on the basis of their old licence until its end if they made a transitional operating agreement with the local authority. Most transitional licences expired on June 30, 2014, when market entry was effectively deregulated (MINTC, 2012). During the transition period, some incumbent bus operators tried to block the entry of a new operator. Onnibus, a new market entrant, was denied access to the shared ticketing and parceling system and platform run by Matkahuolto.[6] The Finnish Competition and Consumer Authority (FCCA) started investigating this arrangement in 2014, and in 2019 the Finnish Supreme Administrative Court (FSAC) imposed a 10-million euro fine on a group of seven incumbent firms, the Finnish Bus and Coach Association, and Matkahuolto.[7] The market entrant had, however, been given access to the shared infrastructure prior to the decision of the FSAC.

Ex-ante, the potential welfare effects of the reform are ambiguous. First, incentives to operate in rural regions are reduced because operators no longer receive exclusive rights to high-demand routes to compensate for the obligation to serve rural regions. This could lead to exit from routes connecting smaller regions. At the same time, under free entry, the number of operators on high-demand routes is likely to increase. Increased exit from rural routes would harm consumers, while increased entry into high-demand routes is likely

[5] Regulation (EC) No 1370/2007 of the European Parliament and of the Council on public passenger transport services by rail and by road and repealing Council Regulations (EEC) Nos 1191/69 and 1107/70.

[6] The cartel members also agreed that incumbent operators would not enter new routes.

[7] See Supreme Administrative Court decision KHO:2019:98.

to benefit consumers through lower prices and increased availability of services. For firms, increased competition and lower prices on high-demand routes will decrease their profits, whereas exit from unprofitable routes in rural regions will increase them. Route-level entry and exit can also affect industry productivity. If the reform shifted supply to more popular routes with higher occupancy rates, it would lead to a reduction in the per-passenger costs of the industry. However, increased competition can also result in a lower number of passengers per operator, which would reduce productivity. In the following sections of the paper, we examine these hypotheses empirically.

3 Data and descriptive evidence

3.1 Route-level data

In our empirical analysis, we use two primary data sets. The first is a route-level data set of prices and quantities from Finland. This data set was collected from five large Finnish interurban bus operators.[8] Four of the operators were already active in the market before deregulation and one entered the market afterwards.[9] For the incumbent operators, our data set covers 31 operator-route pairs from 29 different routes in years 2010-2019.[10] For the entrant, our data covers years 2014-2019 and contains its 70 most popular routes. For the passenger train market, we have data from Finland's only operator. The data covers its 10 largest routes and years 2012-2019.[11]

For each operator, we observe the monthly number of passengers and the turnover at the route level.[12] We calculate the average price by dividing the route-level turnover by the number of passengers. Due to differences in firms' data management, there is a slight

[8] Many of the five operators are corporations which consist of several firms.

[9] We only have data from five large operators because the smaller operators either do not systematically save price data at the route level, or lacked data from the period before the deregulation.

[10] For one operator the data starts in 2012 and for one in 2013.

[11] Data from less popular routes was not available for the time period before the bus market deregulation.

[12] For one incumbent bus operator only annual data is available.

difference in how routes are defined in the data between the incumbent bus operators and the market entrant. For the incumbent bus operators, a route is defined as the whole trip from the departure to the end station, including all possible intermediate stops, regardless of where the passenger leaves. For the market entrant and the train operator, a route follows the departure and destination of the customer. On the basis of our discussions with the operators, on shorter routes this makes only a small difference because typically all customers travel the whole route. However, on longer routes, the price level of the only passenger train operator and the entrant are overestimated compared to the incumbent bus operators because the data of the incumbent operators contain passengers who travelled only a part of the route. Overestimation of the entrant's prices compared to the incumbent bus operators will bias our price-effect estimate upward, and thus make our results conservative. We discuss this in more detail in Appendix A6.

We supplement our route-level price and quantity data with information on costs at the aggregate level. Our data set includes the cost index of the Finnish interurban bus transport calculated by Statistics Finland. In the cost index, the highest weights are given to fuel and labour costs. In addition, we have collected annual information on the development of electricity and diesel fuel prices from Statistics Finland. We have also collected information on the route-level market entry. The Finnish Transport and Communications Agency (Traficom) maintained registry data of all operator-service pairs (VALLU database). The data includes information on the date that a given operator entered a particular route.

Table 1 shows the summary statistics for our route-level data. Overall, we observe 628 route-year observations in the interurban bus passenger market and 80 route-year observations in the train market. The total number of trips in our dataset is 70.8 million, and the aggregate turnover is 1.17 billion euros. Before the reform, the average price in our data set is 13.8 euros, or 6.3 euro cents per kilometre. After the reform, these drop to 10.1 euros and 5.1 euro cents, respectively. The prices in the train market are also lower in the post-reform period, with the average ticket price dropping from 32.1 euros to 27.0 euros, and the per-kilometre price dropping from 9.9 euro cents to 8.2 euro cents. While prices have fallen, costs have not changed drastically. We assess the coverage of our data by comparing it with the total number of passengers and aggregate turnover figures from the Finnish Public Transport Statistics. In the long-distance passenger train market in Finland, our data coverage is around 34% of both the number of passengers and the turnover. For the interurban bus market in Finland, our data coverage is higher. For the period after the deregulation, our data covers 51% of the total number of trips and 58% of the industry turnover. For 2013, the final year before the deregulation, the coverage is 39% for the number of trips and 47% for the turnover. The increase in data coverage is explained by the entrant winning market share from smaller operators that were not in our data before the reform.

Table 1: Summary statistics for the route-level data

		Pre		Post	
Transport mode		Mean	SD	Mean	SD
Bus	Price (EUR)	13.8	3.6	10.1	3.9
	Price per kilometer (EUR cent/km)	6.3	2.7	5.1	1.7
	Route length (km)	258.9	142.6	227.8	127.9
	Price of diesel (EUR/litre)	1.4	0.1	1.3	0.1
	Bus cost index (2010=100)	108.4	4.3	112.0	1.8
Train	Price (EUR)	32.1	11.2	27.0	10.6
	Price per kilometer (EUR cent/km)	9.9	1.5	8.2	1.5
	Route length (km)	343.9	165.0	343.9	162.2
	Price of electricity (EUR cent/kWh)	7.3	0.0	6.7	0.3

Notes: Price is calculated as route turnover divided by the number of passengers. Price per kilometer is price divided by route length, which is obtained from Google Maps for bus routes. For train routes, track length is obtained from the Finnish Transport Infrastructure Agency's publication on accessibility between cities (FTIA, 2019). The prices of diesel and electricity are annual average prices from Statistics Finland. Bus cost index is the interurban bus cost index from Statistics Finland.

3.2 Aggregate price data

Our second data set is an annual panel of European countries for the years 2005-2019[13] The main variables in this data set are price indices and modal shares for trains and buses

[13]We choose the year 2019 as the endpoint because the global COVID-19 pandemic had a significant impact on passenger transport in the year 2020.

obtained from Eurostat and national statistical agencies. We collect price information from a total of 30 countries.[14] For each country, we use the price index available at the most detailed COICOP classification level.[15] For bus transport, we find price indices at the long-distance bus transport level (07.3.2.1.2) for two countries, including Finland. For eight of the 30 countries, we find data at the level of passenger transport by bus and coach (07.3.2.1). For the rest of the countries, we use a price index that contains all passenger transport by road (07.3.2). This index also includes taxi travel. For train transport, we find a price index that contains passenger transport train travel (07.3.1.1) for six of the 30 countries. For the rest, we use a price index that includes all passenger rail travel (07.3.1). Passenger rail travel also includes metros and trams.

As explained in Section 2, before the reform, pricing was largely based on the pricing recommendations given by the bus service and marketing company Matkahuolto. On the basis of our inspection of the Finnish price index, it was also based on Matkahuolto's list prices. Between 2011 and 2014, the Finnish price index was updated five times. On all five occasions, the update occurred in the same month as Matkahuolto issued a new price recommendation. We show the evolution of the interurban bus price index and the timing of the new price recommendations in Appendix A2. After Matkahuolto stopped publishing its pricing recommendations in 2014, Statistics Finland did not update its data collection method for some time. For an almost four-year period, between July 2014 and February 2018, the price index remained at the same level. From February 2018 onwards, the price index began to change monthly.

Because the official price index is unlikely to give a correct picture of how prices changed after the deregulation, we opt to use our route-level price data to construct the index for the post-deregulation period. We start by calculating a weighted average price for all train and

[14] For two countries, Albania and Bosnia and Herzegovina, we do not find a separate price index for road and rail transport, and thus we exclude them from our sample.

[15] The Classification of individual consumption by purpose, abbreviated as COICOP, is a classification developed by the United Nations Statistics Division to classify individual consumption expenditures according to their purpose.

bus routes separately, using the number of trips by different operators as weights. Then we calculate a price index for every train and bus route using the year 2013 as the base year. Next, we take an average of the route-level price indices to construct one price index for both trains and buses. Finally, we combine the official price index for the pre-period (2005-2013) with the price index constructed from our route level data for the post-period (2014-2019) with both having 2013 as the base year.[16]

A potential worry in using our route-level data to construct the price index is that our data consist of only the largest firms and could therefore potentially include a higher share of routes connecting larger cities. In Appendix A5, we compare the routes in our price data to the VALLU dataset, which contains information on all the routes that were operated in Finland just before and after the reform. Based on our analysis, the route-level price data is not significantly skewed to routes connecting larger cities. Furthermore, in Appendix A7 we provide results where we construct the price index for Finland from aggregate industry statistics, which also contain the smaller firms.

A second key variable in the data set is the modal share of buses and trains collected from Eurostat. The modal share figures also contain local traffic. We supplement the price and modal share information with other variables that potentially affect demand and prices in bus or train passenger transport. We collect information on GDP per capita, the price of fuel and electricity, and the urban share of the population. From the initial sample of 30 countries, we exclude Serbia and North Macedonia because they lack data on some of the variables. We also exclude countries where, based on the previous literature, there have been significant market or policy changes, either in the long-distance train or interurban bus market. These countries include France (see, e.g., Blayac and Bougette, 2017), Germany (see, e.g., Dürr et al., 2016), Italy (see, e.g., Bergantino et al., 2015; Beria et al., 2016; Beria et al., 2019; and Beria et al., 2022), Austria (see, e.g., Tomeš and Jandová, 2018), Slovakia (see, e.g., Kvizda and Solnička, 2019), Sweden (see, e.g., Vigren, 2017), and the

[16]We show in Appendix A7 that our results are robust to using only our route-level data to contruct the price index for Finland.

Czech Republic (see, e.g., Tomeš et al., 2016; Tomeš and Jandová, 2018; and Tomeš and Fitzová, 2019). After this, we have data on 21 countries for a period of 15 years.

Table 2 shows the summary statistics for our final sample of 20 countries in continental Europe and Finland. For Finland, both the bus and train price indices are lower for the post-period than for the pre-period, whereas for the sample of other European countries, the price indices are considerably higher in the post-period. In Finland, the modal shares of buses and trains are higher in the post-period, whereas for the sample of European countries, the modal shares are lower in the post-period. Finland has a slightly higher GDP per capita and an urban share of the population than the other European countries, while fuel and electricity prices seem to evolve similarly in Finland and in our sample of European countries.

Table 2: Summary statistics for the country-level data

	Pre		Post	
	Finland	European sample	Finland	European sample
Modal share of buses	10.0	12.4	10.3	11.6
Modal share of trains	5.1	5.9	5.5	5.8
GDP per capita	35,191	26,690	40,478	32,301
Fuel price (2013=100)	85.4	83.2	91.0	89.8
Electricity price (2013=100)	82.3	83.5	105.5	103.6
Urban share of population	83.8	71.6	85.3	73.3
Bus price index (2013=100)	86.6	87.0	79.0	105.0
Train price index (2013=100)	87.0	84.7	83.3	105.3

Notes: Table reports variable means separately for pre and post periods and for Finland and our European sample. Modal shares are the the percentage shares of each mode of transport in total inland transport, expressed in passenger-kilometres. GDP per capita is the gross domestic product per capita, measured at market prices. Fuel price is the price index "Fuels and lubricants for personal transport equipment" (07.2.2). Electricity price is the price index for electricity (04.5.1). Urban population is measured as percentage of total population. Bus and train price indices are our constructed price indices for train and bus ticket prices.

3.3 Other data sources

We supplement our primary data sets with information from two other data sources. In order to study the effects on product quality and the availability of services, we use a customer survey commissioned by Traficom. The survey has been conducted every second year since 2011, with approximately 5,000 respondents. Respondents are asked to rate their satisfaction with the quality and price level of transport services. Our second supplementary data set is the Financial Statement Database (FSD). FSD is collected by Statistics Finland and contains information from the financial statements of companies. It covers 95% to 99% of Finnish firms. We collect information on operating profits, turnover, total wage bill, and number of employees. We collect these variables for the period 2006-2019 for firms whose main industry is long-distance bus traffic, charter bus traffic, or local passenger transport.

3.4 Descriptive evidence

Figure 1 shows the evolution of the average number of operators within the origin-destination pairs of different sizes, measured by the sum of the population in the origin and destination municipalities. Under the old system, the regulator rarely issued more than one permit to serve a specific route. However, on routes connecting large cities, there was on average more than one operator even before the reform. This is explained by longer routes generally having several intermediate stops in larger cities.[17] After the deregulation of entry, the number of operators starts to increase, particularly in origin-destination pairs connecting mid-sized and large cities. In 2018, the average number of operators serving origin-destination pairs with a population of more than 500,000 was already 2.53, and the average number of operators serving origin-destination pairs with a population between 100,00 and 500,000 was 1.87. This increase in the number of operators is driven by the entrant rapidly expanding to new routes after the deregulation. In origin-destination pairs with population less than 100,000 inhabitants, we observe only a slight increase in the number of operators.

We have also evaluated the evolution of service availability using the consumer survey. Respondents from rural areas appear to be largely as satisfied with the availability of services after the reform (average score 3.17) as before (average score 3.2). The scale ranges from one to five, with a higher score indicating higher satisfaction. Furthermore, satisfaction with

[17]For example, a route from Helsinki to Pori might stop in Turku. In the old system, one operator was issued a permit to serve the Helsinki-Turku route and one Helsinki-Pori, and thus effectively two operators were driving the Helsinki-Turku origin-destination pair.

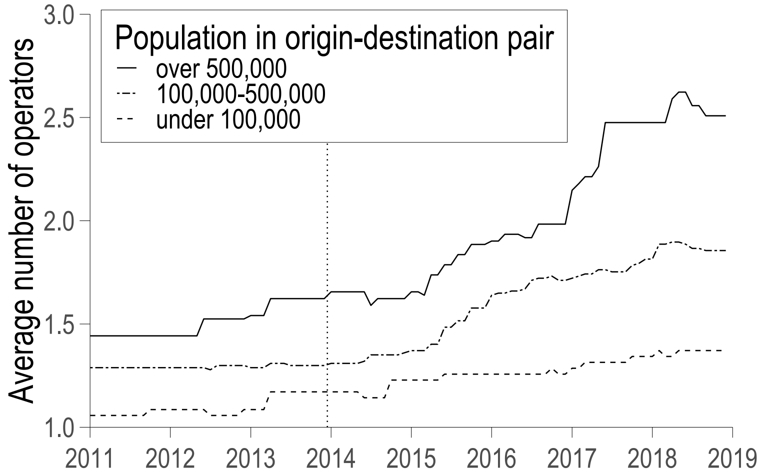

Figure 1: Evolution of number of competitors per origin-destination pair

Note: The figure graphs the evolution of the average number of operators on large, medium and small origin-destination pairs. The population is equal to the the sum of the population in the origin and destination municipalities. Only those origin-destination pairs for which there are observations for each month, are included in calculating the averages. The average number of operators are calculated from 35 small, 97 medium, and 61 large origin-destination pairs.

the suitability of timetables was similar before the reform (average score 2.8) and after the reform (average score 2.89). The results from the survey, including other questions regarding service quality, are discussed in more detail in Appendix A9.

Figure 2 shows the evolution of the average price per kilometre separately for the incumbent bus operators, the entrant, and the national railway operator. Before the reform, the per-kilometre prices of the incumbent bus operators and the train operator gradually increase. From 2014 onwards, we observe the prices from the market entrant. Initially, the market entrant charges 20% to 25% lower prices than the incumbent bus operators. After the reform, however, the prices of the incumbent bus operators start to slowly converge to the price level of the entrant. In 2019, the average price per kilometre of the incumbents is around 1.8 cents, which is 28.0% lower than in 2013. Although the prices of the incumbent bus operators start to decrease in 2014, the prices of the national railway operator start to slope downward only from 2015 onwards. In 2019, the average price of the railway operator is 2.6 cents, which is 25.6% lower than in 2013.

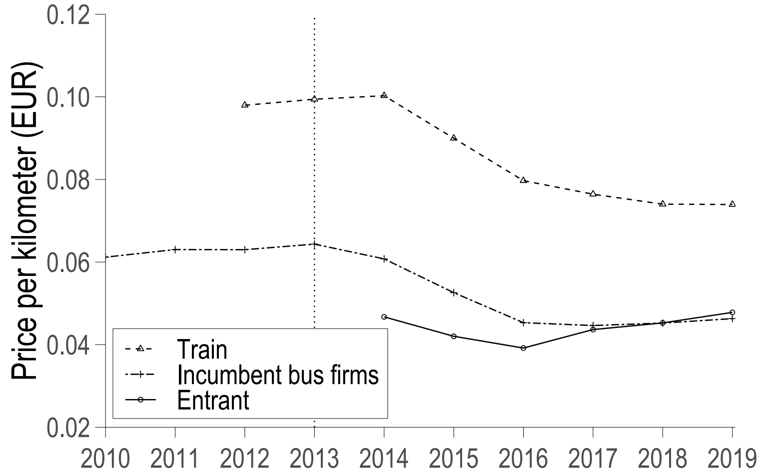

Figure 2: The development of train and bus prices

Note: The figure graphs the evolution of average prices per kilometer for train, for incumbent bus operators, and for the entrant. For the entrant, the average price is calculated for routes on which we also have data of incumbent prices.

Panel A of Figure 3 shows the evolution of the number of passengers in the interurban bus and long-distance train markets. In the bus market, the trend in the number of passengers is slightly downward sloping before the reform. After the reform, the number of passengers starts to increase. In 2017, the number of passengers in the interurban bus market has already increased to 11.5 million, which is 4.7 million and 68% higher than in the last year before deregulation. After 2017, the number of passengers decreases slightly but remains considerably higher than before derugulation. In the long-distance train market, the number of passengers slopes slightly upward before the derugulation of the bus market. After the reform, the number of passengers starts to decrease, and in 2017, the number of passengers in the train market is 1.1 million and 8% lower than in 2013. After this initial drop in demand, train prices decrease and the number of passengers starts to increase. In 2019, the number of passengers is already 0.7 million and 5% higher than before the reform.

Panel B of Figure 3 shows the evolution of occupancy rates. Before the reform, the occupancy rates in both the interurban bus and the train market were very stable. After the reform, the occupancy rates start to increase. This development can be explained by operators serving more high-demand routes between large and mid-sized cities after the reform. This suggests that entry regulation distorted the allocation of resources in the Finnish interurban bus market. This finding is linked to the literature studying the misallocation of resources arising from market regulation.[18]

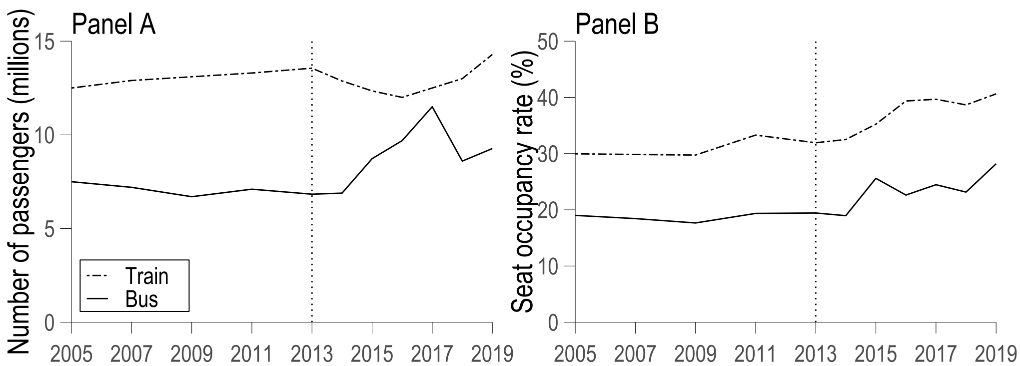

Figure 3: Evolution of number of passengers and seat occupancy rates during 2005-2019

Note: Data is from the Finnish Public Transport Statistics. Prior to 2013, it was published biennially.

Next, we study the effects of the reform more formally, with a focus on prices, profits, and demand. Given that the old system restricted the number of bus operators to one per route by design, we assume that our descriptive evidence of the change in the number of operators can already be interpreted as the causal effect of the policy. However, prices, profits, and quantities change over time, depending also on the development of demand and cost factors. Thus, a simple pre-post analysis might lead to a biased assessment of the impact of the reform on these outcomes.

4 Empirical strategy

Our goal is to estimate the effects of the removal of entry restrictions in the Finnish interurban bus market. Estimating the effect of the policy requires constructing a plausible counterfactual of how the interurban bus and long-distance railway market would have evolved

[18]For a review of the literature see Restuccia and Rogerson (2017) and Hopenhayn (2014).

without the reform. We estimate the effect on prices and modal shares, using a difference-in-differences framework, where we compare the development of the Finnish interurban bus and the long-distance train market with a sample of European countries without major market or policy changes in the two sectors.[19] The traditional difference-in-differences estimator constructs a counterfactual using an unweighted average of the outcome variable from the control group. A key assumption behind the estimator is the assumption of parallel trends. In our setting, this requires that, in the absence of the reform, the Finnish long-distance bus and train markets would have evolved similarly to our sample of European countries. If the untreated units do not follow the same trend as the treated units, the difference-in-differences estimate will be biased. In our setting, this could be the case if the control units were systematically exposed to different demand and supply shocks compared to the shocks that affect the Finnish transport market.

To alleviate concerns about differing trends in Finland and in our comparison countries, we use the synthetic control method (Abadie and Gardeazabal, 2003; Abadie et al., 2010; Abadie et al., 2015). The synthetic control method relaxes the common trends assumption by allowing the effects of unobserved confounders on the outcome variable to vary over time. This is achieved by weighting the control group so that, before treatment, it resembles Finland in a number of key predictors of the outcome variable and has similar paths and levels of this variable.[20]

We create in total four synthetic controls, with separate synthetic controls for the train and bus markets and for prices and modal shares.[21] Synthetic controls are constructed as follows. Let $J+1$ represent the number of European countries in our sample, indexed by j, with $j = 1$ denoting Finland. For each observation, we have data for time periods $t = 1, 2, ..., T$, with data prior to the treatment $t = 1, 2, ..., T_0$, as well as after the treatment

[19] In Appendix A1 we discuss some alternative empirical strategies.

[20] Usually the synthetic control is required to match both the level and the path of the outcome variable. However, in our case, with the price index as the outcome variable, the levels match automatically.

[21] Estimating weights separately for each outcome is a common practise in the literature. See, e.g., Grier and Maynard (2016) and Bueno and Valente (2019), who, similarly to us, use the synthetic control method to estimate effects on several outcome variables.

$t = T_0 + 1, T_0 + 2, ..., T$. Synthetic Finland is formed as a weighted average of the comparison group countries $j = 2, ..., J + 1$, with a vector of weights $W = w_2, ..., w_{J+1}$ that satisfies $0 \leq w_j \leq 1$ and $w_2 + ... + w_{J+1} = 1$.[22]

The weight vector W is chosen so that the sum of squared differences between the pre-reform characteristics of Finland and the comparison countries is minimised in the pre-treatment period, subject to the above constraints. As predictors, we use the GDP per capita, the percentage share of the urban population, the modal shares of buses and trains, and the prices of fuel and electricity. We average the four key predictors during the period 2005-2013. Finally, we add to the list of predictors three lagged years of price index values or modal shares: 2005, 2008, and 2011. The predictors are assigned weights based on their relative importance. We jointly choose the vector of predictor weights V and the vector of country weights W, so that they minimise the mean squared prediction error (MSPE) of the outcome variable over the entire pre-treatment period. Specifically, we use a statistical package for R called tidysynth to find V and W (Dunford, 2021).

There are two potential concerns with our approach. First, we are only able to exclude countries with recognised significant reforms or market changes from the comparison group. There is no comprehensive data set of all political reforms that affect the transport sector, so it is possible that the comparison group still includes countries with market changes occurring during the observation period. To alleviate this concern, we test the robustness of our results by excluding each country from the comparison group one by one. A second concern is that the Finnish long-distance passenger market may have experienced country-specific cost and demand shocks that were not related to the reform. Such shocks would bias our estimate of the effect of the reform. To alleviate this concern, we also present an alternative approach to construct the counterfactual for the price development.

The alternative counterfactual utilises the fact that, before the reform, pricing in the

[22] We rely on Abadie (2021) as a guide for best practises for the application of the synthetic control method. Billmeier and Nannicini (2013) use a methodology similar to ours to study the effect of an economy-wide liberalisation on GDP in the context of developing countries. See also Andersson (2019), who uses a very similar approach to estimate the effect of introducing a carbon tax in Sweden.

interurban bus market was largely based on the price recommendations of Matkahuolto. Matkahuolto's price recommendations followed the bus cost index, published by Statistics Finland, which, in turn, is calculated based on the weighted average prices of different inputs. As a result, the bus cost index is not affected by productivity changes.[23] In our alternative analysis, we construct the counterfactual of the policy using the cost index of the interurban bus cost index and essentially assume that without reform, prices in the interurban bus market would have continued to follow the cost index.[24]

A potential concern in this approach is that the reform could also have affected the prices of some of the cost factors. For many of the inputs used by bus firms, such as fuel and spare parts, prices are at least partly determined outside of Finland and the reform is unlikely to have significantly affected them. The largest production factor, and also one potentially affected by the reform, is wages. In Appendix A4, we look at the wage effects, and find no evidence that the reform would have significantly affected wages in the industry. Given this, we view that the development of the cost index provides a plausible counterfactual for prices.

The reform potentially affected rural and urban areas differently. We investigate the heterogeneous price effects of the reform by comparing the development of synthetic Finland and the cost index to the price development on different types of routes. We group the routes according to the sum of the population on the route. Because the pre-reform prices were similarly determined in all routes, we do not construct separate synthetic controls for different sized routes. Essentially, we assume that without the reform, prices on different types of routes would have continued to develop similarly.

We also explore how the reform affected operating profits. For this purpose, we use the FSD database. Our treatment group consists of firms in the long-distance bus market. To construct a counterfactual, we use firms in the charter bus market as a control group. Firms

[23]The weights assigned to different cost factors have also not changed after the reform.

[24]Borenstein and Rose (2011) use a similar empirical strategy to evaluate the effects of deregulation in the US airline market.

in the charter bus market provide a plausible counterfactual because they face costs similar to our treatment group, and the reform did not directly affect the charter bus market. We aggregate the operating profits at the market level. Our difference-in-differences estimate of the reform's effect on profits is then simply the change in operating profits in the treatment group minus the change in the operating profits in the control group. We also study how the reform affected operating profits at the firm level. This analysis is discussed in Appendix A3.

5 Results

5.1 Price effects

Figure 4 shows the evolution of the prices of bus and train tickets in Finland and the donor pool of 20 European countries during the sample period. The prices of bus and coach tickets in Finland followed a trend similar to the average prices of road and bus passenger transport in our European sample. For train ticket prices, the fit is poorer. We find that in the train market the trend is statistically significantly different between Finland and the donor countries, while in the bus market we find no evidence of diverging trends.[25] The diverging trends in the train market could imply that the parallel trends assumption underlying the difference-in-differences estimator is violated.

Next, we turn our focus to the synthetic control method. Synthetic control potentially improves the pre-treatment fit by comparing Finland with its synthetic version. First, Figure 5 compares the development of prices in Finland and synthetic Finland. It shows that, prior to the removal of entry restrictions on the Finnish interurban bus market, prices in Finland and Synthetic Finland closely follow each other. The average (absolute) difference between Finland and synthetic Finland is only around 0.61 for bus prices and 0.52 for train prices. The synthetic control improves the pre-treatment fit, particularly in the train market.

[25]See Appendix A8 for the result from a difference-in-differences estimate of the treatment effect.

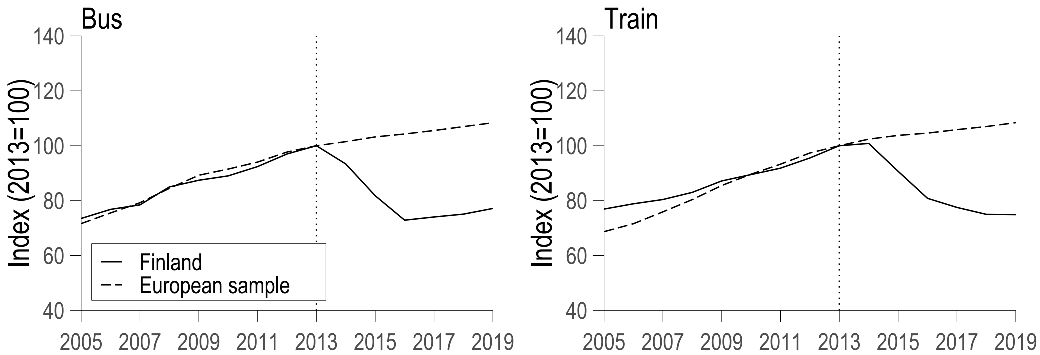

Figure 4: Evolution of prices in rail and road passenger transport during 2005-2019: Finland versus the European average of our 20 donor countries

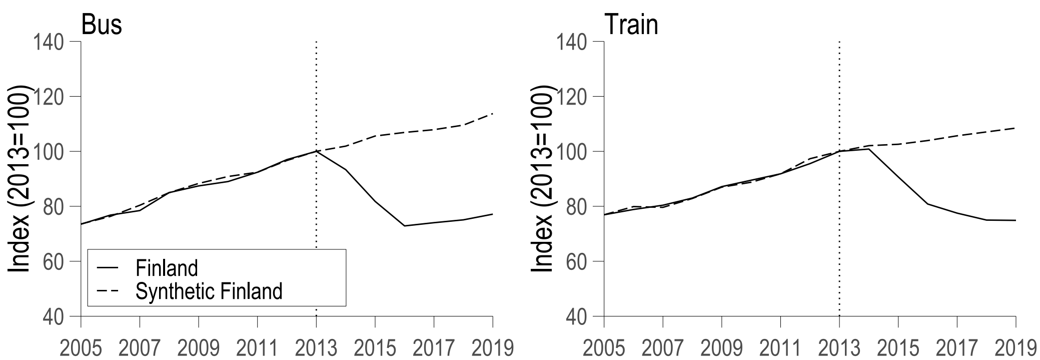

Figure 5: Evolution of prices in rail and road passenger transport during 2005-2019: Finland versus synthetic Finland

To further assess the functioning of our synthetic controls, Table 3 compares the values of key price predictors for Finland with those of synthetic Finland before deregulation. In the last column, we report the predictor weights V (in percentages) for each variable. Almost all predictors in both the train and bus market have nearly identical values for Finland and its synthetic counterpart.[26] Finally, Table 4 reports the country weights W used to construct the two synthetic controls. In the synthetic control for bus prices, the countries with largest weights are the Netherlands, Denmark, and Belgium, while in the synthetic control for train prices they are Belgium, Portugal, and Luxembourg.

[26]The small weight assigned to the electricity price variable for the synthetic control of train prices may explain the discrepancy between Finland and its synthetic version on this variable.

Table 3: Price predictor means before the reform

Transport mode	Variables	Finland	Synth. Finland	Weight (%)
Bus	Modal share of buses	10.0	10.0	12.4
	GDP per capita	35,191	35,193	15.1
	Fuel price (2013=100)	85.4	85.4	25.5
	Urban share of population	83.8	83.8	12.1
	Bus price 2005 (2013=100)	73.5	73.6	2.5
	Bus price 2008 (2013=100)	85.0	85.0	7.5
	Bus price 2011 (2013=100)	92.4	92.4	24.9
Train	Modal share of trains	5.1	5.3	0.1
	GDP per capita	35,191	35,187	15.9
	Electricity price (2013=100)	82.3	85.2	0.1
	Urban share of population	83.8	83.8	31.5
	Train price 2005 (2013=100)	76.9	76.9	19.6
	Train price 2008 (2013=100)	83.0	82.8	1.5
	Train price 2011 (2013=100)	91.8	91.8	31.4

Notes: All variables except lagged price index values are averaged for the period 2005–2013. Modal shares are the the percentage shares of each mode of transport in total inland transport, expressed in passenger-kilometres. GDP per capita is the gross domestic product per capita, measured at market prices. Fuel price is the price index "Fuels and lubricants for personal transport equipment" (07.2.2). Electricity price is the price index for electricity (04.5.1). Urban population is measured as percentage of total population. The third column reports the averages for the 20 countries in the donor pool. The last column reports the predictor weights V (in percentages) for each variable.

Next, we use the synthetic controls to estimate how the Finnish reform affected prices in the long-distance train and bus markets in Finland. The difference between Finland and its synthetic counterpart in Figure 5 measures the reduction in prices in Finland after the reform. This is further illustrated in the gap and permutation plot in Figure 6. The average reduction during the post-treatment period is 28.5% in bus ticket prices and 21.7% in train ticket prices. Furthermore, the gap is largest in the last years of our sample, 36.6% for bus prices and 33.6% for train prices. Our analysis shows that prices in the Finnish long-distance passenger transport market decreased economically significantly after the reform.

To assess the validity and statistical significance of our results, we perform a series of tests. First, we perform a permutation test, in which the treatment is reassigned iteratively to every country in the donor pool, and then the synthetic control method is used to construct the synthetic counterparts. This allows us to evaluate the statistical significance of our results by establishing whether the results obtained for the Finnish transport market are unusually large. We obtain p-values by measuring the fraction of countries with results greater than that obtained for the treated country (Abadie et al., 2015).

Table 4: Country weights in synthetic Finland

Country	Weight train	Weight bus	Country	Weight train	Weight bus
Belgium	0.429	0.123	Luxembourg	0.190	0.045
Bulgaria	0.042	0.036	Netherlands	0.001	0.295
Croatia	0	0.003	Norway	0.001	0.010
Denmark	0.003	0.294	Poland	0.001	0.004
Estonia	0.064	0.021	Portugal	0.196	0.005
Greece	0.060	0.005	Romania	0.002	0.004
Hungary	0.001	0.004	Slovenia	0	0.002
Ireland	0.001	0.004	Spain	0.003	0.008
Latvia	0.001	0.114	Switzerland	0.001	0.004
Lithuania	0	0	United Kingdom	0.006	0.018

Note: With the synthetic control method, no extrapolation is allowed so all weights are between $0 \leq w_j \leq 1$ and $\sum w_j = 1$.

Figure 6 shows the results of the permutation test. For some countries in the donor pool, the synthetic control method is unable to find a convex combination of countries that will replicate the evolution of prices in the pre-treatment period. The post-treatment gaps in the price indices for buses and coaches and for trains are the largest for Finland. This translates into a p-value of $1/21 = 0.048$ for the treatment effect, the smallest possible p-value with our sample size. The only country where the post-treatment gap is even close to Finland is Croatia, where train ticket prices have dropped almost 20% between 2013 and 2019.

Then, we examine the ratio of post-treatment MSPE to pre-treatment MSPE (Abadie et al., 2010). Compared to the permutation test, the ratio test better takes into account the fact that the synthetic control sometimes fits poorly on some control units during the pre-treatment period. Figure 7 shows that Finland has by far the largest ratio of all countries in the donor pool, again giving us the p-value of $1/21 = 0.048$. Next, we perform a leave-one-out test (Abadie et al., 2015), where we remove one by one each of the control countries from our sample, to verify that our results are not driven by one or a few influential controls. Our main results are robust to the elimination of each individual donor pool country. For bus

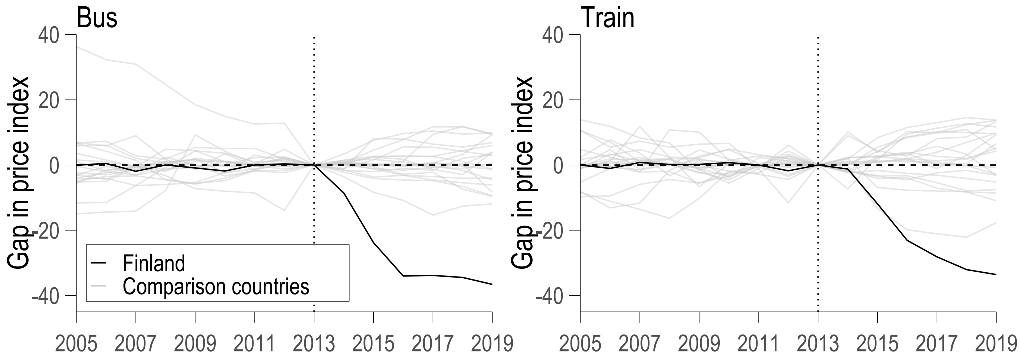

Figure 6: Gap plot and permutation test: Gap in price indices for Finland and placebo gaps for the comparison countries

prices, the largest difference occurs if Belgium is not included in the donor pool, resulting in an estimated price decrease of 25.2%. This is still close to our main result of 28.5%. For train prices, the largest deviation occurs if Croatia is eliminated from the donor pool, which results in a drop in prices of 24.8%, compared to our main result of 21.7%. Eliminating any other country leaves the estimates close to our main results, ranging from 28.0% to 29.6% for the bus prices and from 20.2% to 23.7% for the train prices.

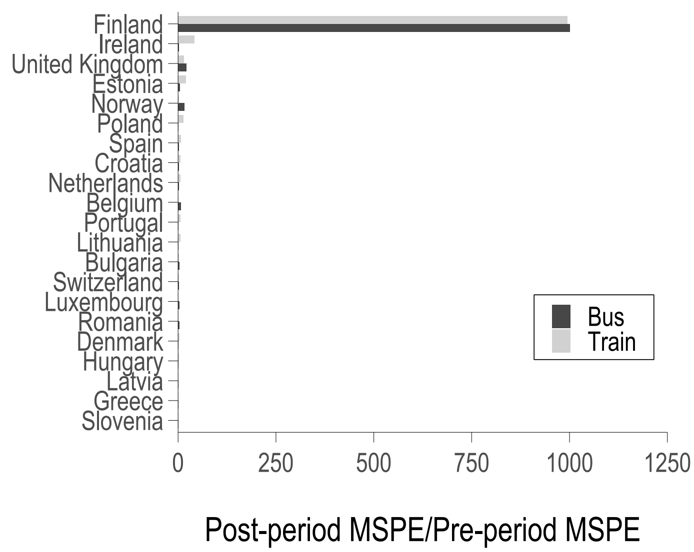

Figure 7: Ratio test: Ratios of post-treatment MSPE to pre-treatment MSPE: Finland and 20 European control countries

Finally, for our last robustness check, we use the full sample of the 27 European countries to construct the synthetic Finland. Rerunning the estimations with the full sample gives practically the same results as before: predictor means, gap plot, and path plot look very similar to our main results.[27] In the synthetic control of train prices, the only country we had previously excluded, now receiving a significant weight, is Germany with a weight of 0.26. In the synthetic control for the bus prices, all of the countries we had previously excluded get a weight smaller than 0.05. Overall, we find that the results from the synthetic control method are statistically significant and that the results are robust to changes in the specification. Furthermore, in Appendix A7, we show that our results are robust to using alternative sources of information for the evolution of prices in Finland.[28] In addition, we show that our results are robust to changes in the specification of how our price index was constructed.

In Figure 8, we report the results of our alternative analysis, where we compare bus prices with the development of the cost index. The mean absolute difference between the two is -1.3% before treatment. After the reform, the trends clearly diverge. The cost index continues to gradually increase, while prices drop significantly. The mean absolute difference between the two indices in the post-treatment period is 21.4%. Also on the basis of this alternative analysis, the reform led to a considerable decrease in prices in the long-distance bus market. However, the estimate is slightly smaller than in our main analysis.

5.2 Heterogeneous price effects

In Section 3.4, we saw that after the reform, the number of operators increased on the routes connecting large and mid-sized cities, while the routes connecting smaller cities continued to be operated by only one operator. In Figure 9, we plot the evolution of prices on routes

[27] Path plot is shown in Appendix A8. Other results are available upon request.

[28] We also report results from a specification where the data for the control units is collected from a database maintained by the International Union of Railways (UIC).

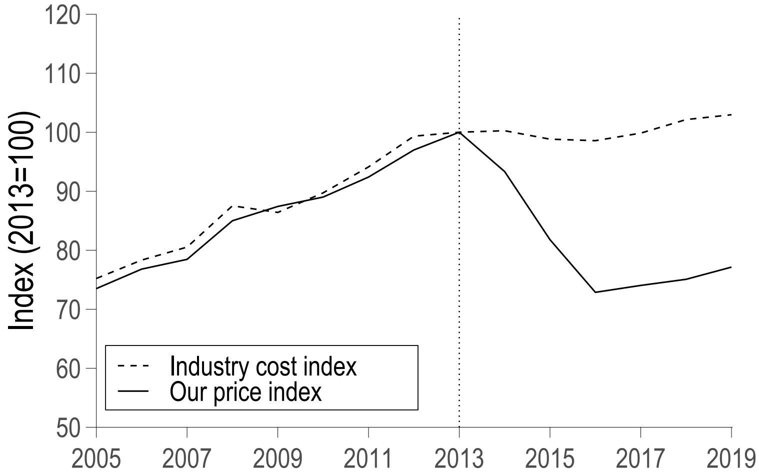

Figure 8: Comparing the development of interurban bus cost index and prices

of different sizes, measured by the sum of population on the route.[29] After the reform, prices on routes connecting large and mid-sized cities begin to decrease. On average, prices on routes connecting cities with a combined population of more than 500,000 inhabitants are 30.7% lower after the reform. On routes connecting cities with a combined population between 100,000 and 500,000 inhabitants, prices are 20% lower, while on routes connecting cities with a population under 100,000 inhabitants, prices are 2.9% higher.

If we assume that prices in all groups evolved similarly to synthetic Finland, our estimate on how much the reform decreased prices is 38.3% for routes connecting large cities, 27.8% for routes connecting mid-sized cities, and 4.7% for routes connecting small municipalities.[30] If instead we use the evolution of the cost index as the counterfactual, the estimated reductions are 31.3 and 20.6% for the routes connecting large and mid-sized cities, respectively. In this case, the estimate of the effect on small routes flips sign and turns from a small decrease to a small increase of 2.4%.

Overall, this analysis strongly suggests that the reform decreased prices on routes con-

[29] For routes connecting cities with a combined population below a 100,000 inhabitants, we only have data from 2013 onwards.

[30] The result for routes connecting smaller municipalities has still the largest MSPE-ratio by a small margin. However, there are now several countries that have a placebo gap as negative as the post-treatment gap of Finland.

necting large and mid-sized cities. On routes connecting smaller cities, where the number of operators did not increase, we find that the reform had a negligible effect on price. This result is consistent with firms setting monopoly prices on these routes before and after the reform.

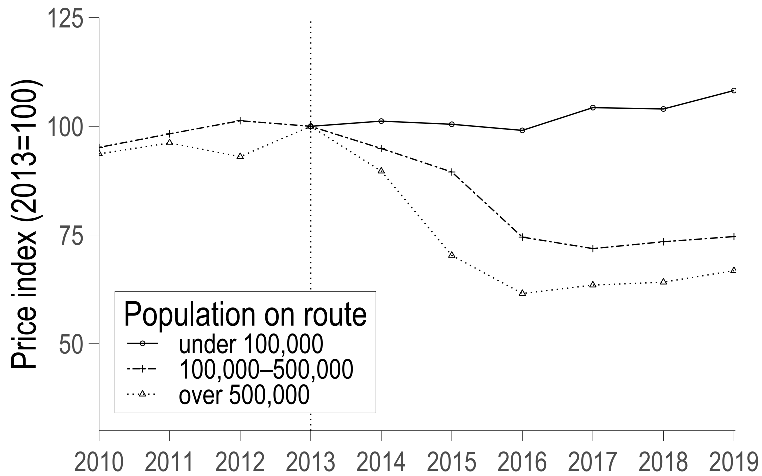

Figure 9: Evolution of prices on routes of a different population size

Note: The figure graphs the evolution of average prices in small, medium and big routes based on population size. Our dataset includes only three small routes that have a population of under 100,000 inhabitants, and we observe them only from 2013 onwards. For medium and big routes the indices are based on 10 and 16 routes, respectively.

5.3 Modal share and the number of passengers

Next, we will study how the reform affected the number of passengers in the interurban bus and the long-distance train markets. In panel A of Figure 10, we show the evolution of the modal share of buses in Finland and in our donor pool of 20 European countries during 2005-2019. Before the reform, the average European modal share decreases from 0.135 to 0.120, while in Finland it remains nearly constant at around 0.10. After the reform, the European average continues to slowly decline, while in Finland it increases to 0.12 in 2016, and then decreases slightly in 2017.[31]

[31]It seems that the bus modal share reacts with delay compared to the bus passenger numbers, reported in the Figure 3, which began to increase a year earlier in 2015.

Panel B of Figure 10 compares the evolution of the modal share of buses in Finland and synthetic Finland. Prior to the reform, the level and path of the bus modal share are closely matched between Finland and its synthetic counterpart. Before treatment, the average (absolute) difference between Finland and synthetic Finland is only 0.18 percentage points.[32] After treatment, there is a clear gap between Finland and synthetic Finland. The average post-treatment gap is 1.61 percentage points. Finland has the highest post-MSPE to pre-MSPE ratio (around three times higher than the second highest value), indicating that the result is statistically significant with a p-value of $1/21 = 0.048$. As the modal shares are calculated as a share of total passenger kilometres, this effect can be translated into a percentage increase in passenger kilometres.[33] The 1.61 percentage point increase in modal share translates to an increase of around 1,232 million passenger kilometres. Compared to the pre-treatment average, this amounts to an increase of 16.3%.[34]

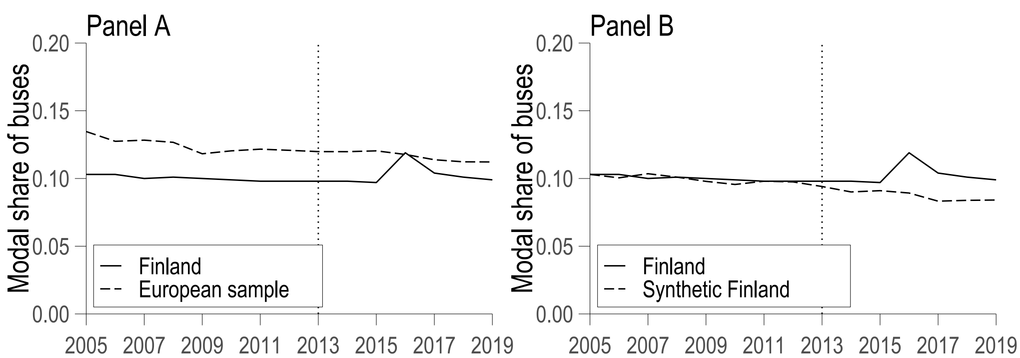

Figure 10: Evolution of modal shares of buses: Finland versus the European average of our 20 donor countries and synthetic Finland

[32]The values of the predictor variables are again almost identical between Finland and its synthetic version. The highest weights in the donor pool are given to Belgium (0.28), The Netherlands (0.26), Spain (0.12), Luxembourg (0.08), and Switzerland (0.05).

[33]The average annual bus passenger kilometres were 7,540 million in the five latest pre-treatment years, while the average modal share was 0.0986. Most of the 7,540 million passenger bus kilometres are composed of local bus traffic. The annual average long-distance passenger kilometres were 626 million during the same period. The average annual passenger kilometres were 76,491 million in total.

[34]When we calculate the increase in the number of passengers, we hold the total number of passenger kilometers in Finland fixed. This has a very limited effect on our results because the modal share of the long-distance bus market is very small, and therefore even a considerable increase in the number of passengers in the long-distance bus market has a very limited effect on the total number of passenger kilometers.

In panel A of Figure 11, we show the evolution of the modal shares of the trains in Finland and our European sample. In the pre-treatment period, the European average modal share remains nearly constant around 0.059, while in Finland it increases slightly from 0.048 to 0.053. In the post-treatment period, the European average decreases slightly to 0.057, while in Finland it increases gradually to 0.062 in 2019. Panel B of Figure 11 compares Finland with synthetic Finland. Before the reform, the modal shares of trains in Finland and synthetic Finland closely follow each other. The average (absolute) difference between Finland and its synthetic version is only 0.10 percentage points.[35] Compared to the bus modal share, the post-treatment gap between Finland and synthetic Finland is smaller. The average post-treatment gap between Finland and the synthetic Finland is only 0.14 percentage points. The gap starts to widen at the end of our sample period and is 0.6 percentage points in 2019. However, this result is not statistically significant, with a p-value of $12/21 = 0.571$. The 0.14 percentage point increase in the modal share would translate to 107.1 million and a 2.7% increase in passenger kilometers.[36] If we focused only on the last year of our sample period, the corresponding figures would be 458.9 million and 11.6%.

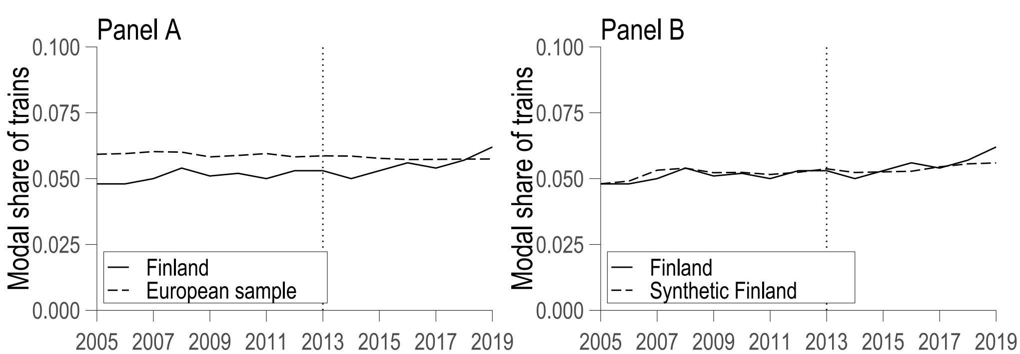

Figure 11: Evolution of modal shares of trains: Finland versus the European average of our 20 donor countries and synthetic Finland

[35]The countries with the highest weights are Belgium (0.36), Luxembourg (0.22), Greece (0.17), Poland (0.15), and Estonia (0.08). With the exception of the price of electricity, Finland and its synthetic version have almost identical values of predictor variables.

[36]The average train passenger kilometres were 3,961 million in the five latest pre-treatment years, while the average modal share was 0.0518. In comparison, the average number of passenger kilometres in long-distance train traffic was 3,054 million kilometres during the same period.

5.4 Operating profits

In Figure 12, we plot the operating profits at the market level in the interurban and charter bus industries. Our difference-in-differences estimate of the effect of the reform on aggregate profits in the long-distance bus market is -8.1 million euros.[37] We have also estimated the effect of the reform on incumbent operators at the operator level. Based on our estimates, the operating profit as a percentage of the turnover more than halved for the incumbent operators after the reform. These results are discussed in more detail in Appendix A3.

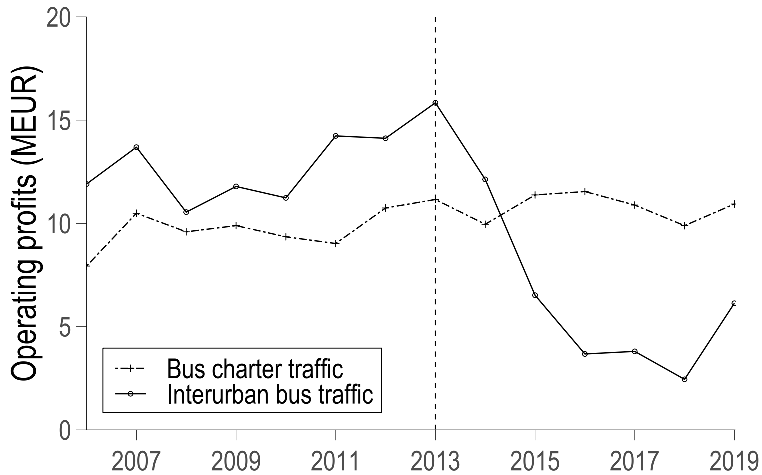

Figure 12: Evolution of operating profits in the interurban bus and charter bus industries

Note: The figure plots the evolution of aggregate operating profits by market. The data is obtained from the Statistics Finland Financial Statement Database.

Estimating how the reform affected the operating profit of the only train operator is not straightforward. The incumbent train operator only publishes its operating profit for the entire passenger division, and the figure also contains its profits from the local train passenger market and the bus market. Furthermore, we lack a control group.[38] Before the reform,

[37]In our comparison group the mean operating profits were 9.8 million euros pre-reform and 10.8 million euros post reform, a difference of 1.0 million euros. Similarly, in our treatment group, the mean operating profits were 12.9 million euros prior to the reform and 5.8 million euros after the reform, a difference of -7.1 million euros. This translates to a difference-in-differences estimate of -8.1 million euros.

[38]One candidate for a control group is composed of other European train operators, but there does not exist a comprehensive dataset which contains information on the operating profits of European railway operators.

between 2008 and 2013, its average operating profit was 32.3 million euros, while it was 41.5 million euros in the post-period 2014-2019. A back-of-the-envelope calculation would thus suggest that the profits of the train operator increased post-reform. If we assumed that the profitability of the train operator decreased to a similar extent as that of the interurban bus operators (slightly less than 10% of revenue), the loss in operating profits for the train operator would be 32 million euros. Given that the price decrease was larger in the interurban bus market, this estimate can be seen as an upper bound on the effect of the reform on the profits of the train operator. This upper bound is also equal to the total pre-reform operating profit of the train operator.

5.5 Welfare implications

To assess the change in consumer welfare, we follow Kang and Vasserman (2022). They provide bounds for a change in consumer welfare from a price change under different functional-form assumptions. To construct the bounds, we need two price-quantity pairs (p_0, q_0) and (p_1, q_1). In our setting, (p_0, q_0) refers to the pre-reform prices and quantities, and (p_1, q_1) to the post-reform prices and quantities. We calculate these points separately for the long-distance bus and train market, using aggregate figures from The Finnish Public Transport Statistics and our estimates of the change in price and the number of passengers.

We calculate the upper and lower bounds of the change in consumer welfare under six different functional form assumptions.[39] The highest upper bound is 100 million euros and the smallest lower bound is 95 million euros. We discuss the construction of these bounds in more detail in Appendix A10. Our consumer welfare calculations are abstracted from changes in service quality and availability of services. Given the descriptive evidence that the reform had only a negligible effect on quality and service availability, we find that this approach is a fair approximation.

[39]The first category includes demand functions that satisfy Marshall's second law, the second category demand functions that satisfy decreasing marginal revenue, the third category log-concave demand functions, the fourth category concave demand functions, the fifth category convex demand functions, and the sixth category log-convex demand functions.

In the previous section, we discussed how the reform affected firm profits. Our upper bound estimate was that the reform decreased the combined profits of the long-distance bus and train operators by around 40 million euros. Using our lower-bound estimate of the change in the consumer surplus and our upper-bound estimate of the effect on the producer surplus, we can construct a lower bound for the effect of the reform on total welfare. The lower bound on the change in total welfare is around 60 million euros annually. In our analysis, we ignore the potential environmental impact of the reform. Substituting private motoring with public transport reduces CO2 emissions. Based on our estimates, the reform increased the modal share of public transport. Taking the environmental effects into account would increase our estimate of the welfare effects of the reform.

The positive welfare effects are likely a combination of several factors. First, the reform resulted in an increase in the number of operators in urban regions, whereas in rural regions we do not find evidence of increased exit. Second, increased competition in urban regions led to significantly lower prices. Third, the negative effect of the decrease in price on profits is partially offset by the increased demand. Fourth, the reform increased traffic relatively more on routes connecting large cities. This has increased the average occupancy rate, which in turn has led to a decrease in the average per-passenger costs and an increase in productivity.

6 Conclusions

Entry restrictions are still common in many sectors. Retrospective studies of entry deregulation can inform policymakers about the welfare implications of restricting entry. This paper studies the deregulation of the Finnish interurban bus market. After the reform, the number of operators increased particularly on routes connecting mid-sized and large cities, while no change is found in rural regions. This indicates that firms found operating in rural regions profitable, at least in the short run, even under free entry. Therefore, the main effect of the regulation was to block competition on high-demand routes. To study the price effects of the removal of the entry restrictions, a synthetic Finland was created from a pool of European countries without major market or policy changes in the transport sector. Comparison of Finland with synthetic Finland shows that the reform resulted in 29% lower prices in the interurban bus market. Prices decreased on routes connecting mid-sized and large cities, with no effect observed on routes linking smaller municipalities. Interestingly, the reform also had a significant effect on substitute markets. Prices in the long-distance train market decreased by 22%. The decrease in prices resulted in an increase in the modal share of public transport in Finland.

This paper also studies the effect of the reform on firm profits and finds that the profits of long-distance bus operators more than halved post-reform. Finally, this paper compares the change in consumer welfare with the decrease in firm profits. The welfare analysis shows that the increase in consumer welfare clearly offsets the decrease in firm profits, indicating that the reform had a positive effect on total welfare. Consistent with the theory on regulatory capture, the results suggest that entry regulation benefited firms to the detriment of consumers.

The results of this paper have several policy implications. First, they illustrate that removing entry regulations can result in large increases in welfare and that regulators should use entry restrictions with caution. Second, they show that removing entry regulations can have highly heterogeneous effects in different geographical markets. Third, they demonstrate that the analysis of entry regulations should take into account their effect on substitute markets. The effects of entry deregulation are dependent on several market-specific characteristics. Because of this, the results of this paper cannot be directly applied to the analysis of other product markets. Furthermore, this paper does not reveal the first-best level of entry in the Finnish interurban bus market and whether it is achieved under the free entry model. Therefore, it cannot be determined whether an alternative regulatory system could be used to further increase social welfare. The study of optimal entry regulations within the transport sector remains an important avenue for future research.

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Appendix

A1 Alternative empirical strategies

In this section, we discuss alternative empirical strategies that could have been used to estimate the price effect of the reform. In our main analysis, we compare the development of the Finnish interurban bus and the long-distance train market with a sample of European countries without major market or policy changes. An alternative empirical strategy would be to use the staggered policy rollout to compare the routes where entry restrictions were removed in the early years of the transition period with the routes where entry restrictions were removed later. The problem with this approach is that in a high share of routes, entry restrictions were removed simultaneously in June 2014.

A second potential approach is to compare prices on the routes where the entrant entered after the removal of entry restrictions with the routes where the entrant was not active. The problem with this approach is that the threat of entry can already initiate a price change from the incumbent firms. Figure 13 shows the evolution of the average incumbent prices at the route level before and after the entry of the new market entrant. The sample is restricted to routes where the entrant started operating during 2015 and 2016. The x-axis shows the time in months relative to the start of the entrant's service on the route. Incumbent prices start to decrease several months before the arrival of the entrant. This could be the result of incumbent firms reacting to the threat of entry. Goolsbee and Syverson (2008) finds a similar anticipatory effect in the US airline market.

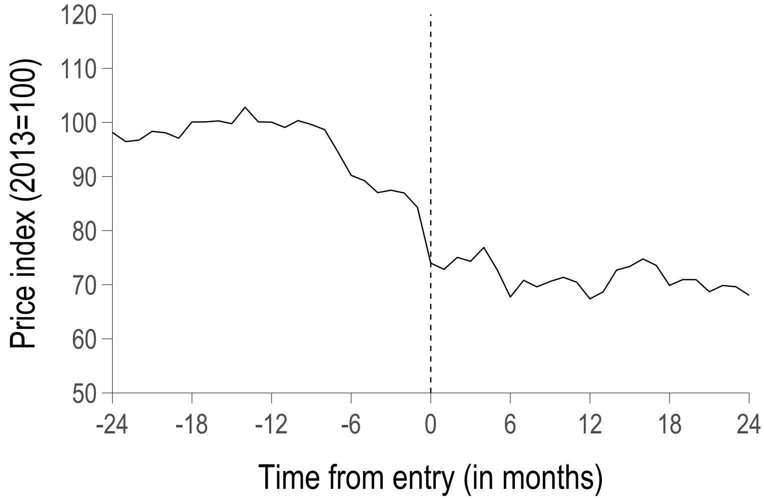

Figure 13: Evolution of incumbent prices before and after the arrival of the entrant

A2 The Finnish interurban bus price index and price recommendations

Figure 14 compares the evolution of the Statistic Finland price index for long-distance bus traffic to the timing of Matkahuolto's price recommendations. The vertical lines mark the dates on which Matkahuolto published a new price recommendation. Before the reform, changes in the index coincide exactly with the publication of a new price recommendation. Matkahuolto stopped publishing new pricing recommendations after July 2014. After the reform, the index stayed at the same level for around four years. In 2018, the index starts to change. We interpret this to indicate that Statistics Finland eventually remodelled their data collection process and started collecting market prices.

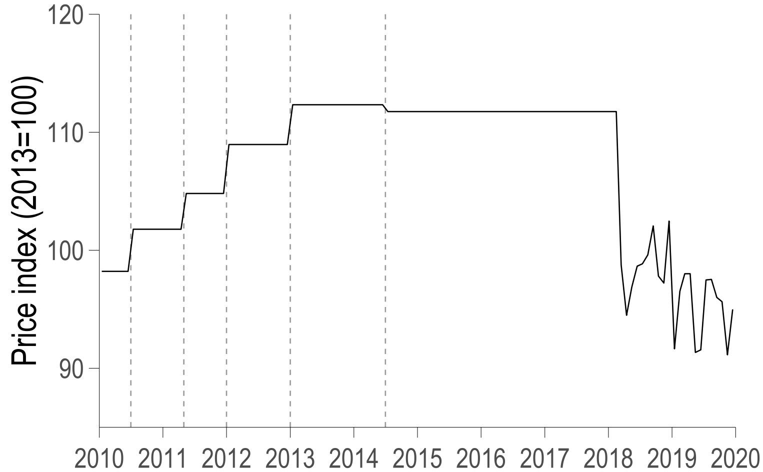

Figure 14: Interurban bus prices and price recommendations

A3 The effect on the profits of the incumbent bus operators

In this section, we estimate the effects of the reform on the operating profits of the incumbent interurban bus operators. We use the difference-in-differences method, where our control group consists of firms in the charter bus market. Firms in the charter bus market provide a plausible counterfactual because they face similar costs as our treatment group but were not affected by the reform. In our analysis, we use the Financial Statement Database (FSD).

We estimate the following difference-in-differences regression:

$$y_{it} = \alpha_i + \delta_t + \beta\, T_{it} + \epsilon_{it} \tag{1}$$

where y_{it} is the operating profit as a share of the turnover of the firm i in year t. α_i and δ_t are firm and year fixed effects, respectively. T_{it} is equal to one for firms in the interurban bus market after 2013, and zero otherwise. ϵ_{it} is an unobserved error term. Our coefficient of interest is β, which estimates the effect of the reform on firm profits. We have winsorized the outcome variable at the 95% level. We choose to do this because the data contains some spurious outliers that are possibly due to mistakes in the data entry. We cluster standard errors at the firm level. In all regressions, we weight the observations by firm turnover in 2013, the last pre-treatment year.[40] The sample includes only firms that operated in the market before the reform.

Table 5 shows our difference-in-difference estimates. The first column shows the result of our main specification, where the control group consists of charter bus operators. Our estimate indicates that the operating profits of the incumbent bus operators decreased by 2.8 percentage points. The point estimate is statistically significantly different from zero at the 5% level. Before the reform, the average operating profit in the industry was 4.8% of the turnover. Thus, our estimates indicate that operating profits as a share of turnover have more than halved due to the reform.

In the second column of Table 5, we report the result of an alternative specification, where we construct the control group of operators in the local passenger transport market. Using this alternative control group does not change our point estimate. The point estimate is now statistically significantly different from zero at the 10% level. Our analysis indicates that the operating profits of the incumbent firms in the interurban bus market were negatively affected by the reform.

Table 5: Difference-in-difference estimates of the effect on operator profits

	(1)	(2)
Treatment	-0.028	-0.029
	(0.013)	(0.016)
Observations	5228	2387
R^2	0.44	0.49

Notes: Dependent variable is the operating profit divided by turnover. Both regressions have operator and year fixed effects. Standard errors (in parenthesis) are clustered by operator. In column (1) the control group is firms registered under the charter bus industry and in column (2) firms in the local passenger transport market.

Interpreting our estimates as the causal effect of the reform relies on the assumption that

[40] We have also estimated the model using the annual turnover as weights. The results are very close to our main specification.

without the reform, operating profits in the interurban bus market would have evolved similarly to those of the control group. One way to assess the credibility of this assumption is to examine whether the treated and untreated groups had similar trends before the treatment. We do this by estimating the following event study regression:

$$y_{ij} = \alpha_i + \sum_s \beta_s D_{it}^s + \epsilon_{ijt} \tag{2}$$

where D_{it}^s is a dummy variable for an interurban bus operator i at time $t + s$. α_i and ϵ_{it} denote firm fixed effects and the unobserved error term, respectively. As before, we weight observations by the last pre-treatment year turnover.

In Figure 15, we plot the β_s coefficients from the estimated equation (2). We find no evidence of differing pretrends between the treated and untreated groups. None of the estimated seven pre-treatment coefficients are statistically significantly different from zero at the 5% confidence level. After treatment, we find several significant coefficients at the 5% confidence level. These results are also robust to the use of operators in local passenger transport as the control group.

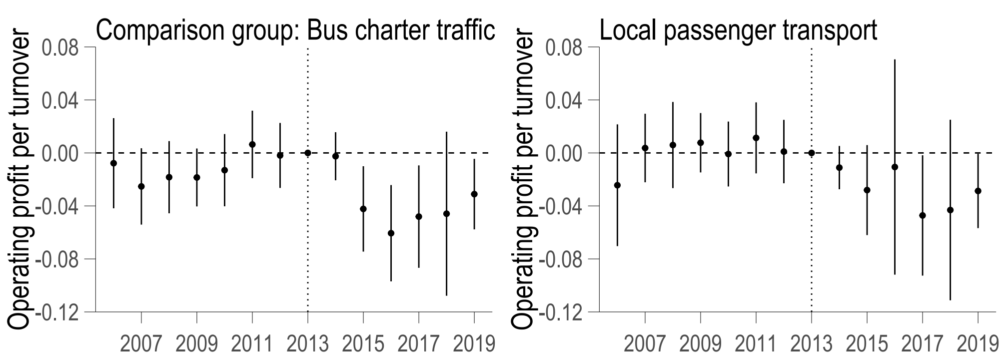

Figure 15: Difference-in-differences estimate of the effect on operator profits

Note: Figure plots the regression coefficients from equation (2). Error bars are the 95% confidence intervals.

One drawback of using the FSD database is that some firms operate in multiple industries.

In particular, firms in our treatment group also operate in the control group markets. The average aggregate annual turnover of firms registered under the long-distance bus market in the FSD database was around 230 million euros between 2014 and 2019. This is almost three times the turnover generated from the long-distance bus operations in the same time period. Therefore, this would indicate that most of the turnover generated by firms registered in the long-distance bus market comes from the charter bus and local passenger transport markets. In the FSD dataset, there is no way to identify how much of the operating profit of a given firm is generated from different industries.

To evaluate how this affects our difference-in-differences analysis, we introduce some notation. We denote by t the treatment effect of the reform on a firm that operates only in the long-distance bus market. λ_i denotes the share of revenue generated by the firm i from the long-distance bus market. The aggregate effect of the reform on operating profits is given by $T = \sum_{i=1}^{N} \lambda_i \, t$. Next, we denote the pre-reform profits of the long-distance bus market by π_{01}, and the pre-reform profits of the charter bus market by π_{00}. Under the assumption of common trends, without reform, profits in both industries would have increased by α. Given these assumptions, our difference-in-differences estimate at the aggregate level is given by:

$$\beta^{A,DiD} = (\pi_{11} - \pi_{01}) - (\pi_{10} - \pi_{00}) = (\pi_{01} + T + \alpha - \pi_{01}) - (\pi_{00} + \alpha - \pi_{00}) = T \qquad (3)$$

This shows that our difference-in-differences estimate correctly captures the effect of the reform on the aggregate profits of the long-distance bus market.

However, repeating this same analysis at the firm level shows that our firm-level difference-in-differences estimate recovers $\beta^{F,DiD} = \lambda_i t$. Therefore, we cannot recover the effect of the reform on a firm that operates only in the long-distance bus market because our estimate is scaled by the average share of revenue generated by firms in the treatment group from the long-distance bus market. de Chaisemartin and D'Haultfoeuille (2018) develop methods to recover the difference-in-difference estimate in fuzzy settings. However, these methods are not applicable in our setting because we do not observe exposure to treatment at the firm level. To assess the bias, we rescale our firm-level difference-in-differences estimate by the average λ_i, which we calculate by dividing the aggregate turnover of the long-distance bus market by the aggregate turnover of firms registered under the long-distance bus market. This yields the result that the effect of the reform on a firm that only operates in the long-distance bus market is $-0.028/0.36 = -0.078$. It is also possible that some firms registered in the charter bus or local transport industries also operate in the long-distance bus market. If some of the firms in the control group also operated in the long-distance bus market, this would introduce downward bias into our estimate. However, we believe that this is unlikely to be the case. The large firms in our route-level data set, which cover more than half of the market, are all registered in the long-distance bus industry. The remaining turnover is most likely generated by smaller firms, also registered under the long-distance bus industry.

A4 The effect on wages

In this section, we estimate the effect of the reform on wages in the interurban bus market. We use a similar difference-in-differences analysis as in Appendix A3, where we estimated the effect on operator profits. The control group again consists of firms in the charter bus market, and we use the FSD data set.

First, in Figure 16, we plot the average wages at the industry level in the interurban and charter bus industries. Average wages in these two industries have evolved quite similarly before and after the reform. In our comparison group, the average wage was 21,618 euros before reform and 26,955 euros after reform, a difference of 5,337 euros, while in our treatment group, the average wage was 28,430 euros before reform and 32,657 euros after reform, a difference of 4,227 euros.

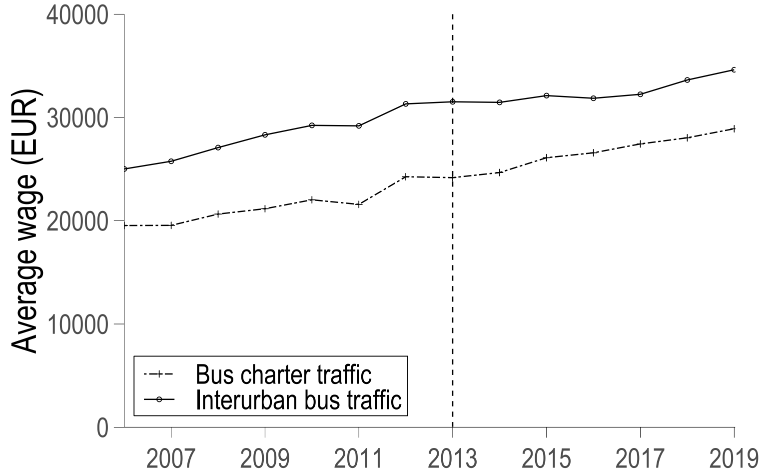

Figure 16: Evolution of average wages in the interurban bus and charter bus industries

Note: The figure graphs the evolution of average wages by market. The data is obtained from the Financial Statement Database, constructed by the Statistics Finland. The wage is calculated as the sum of firm wages divided by the number of employees. To calculate the average market wage, firms have been grouped by their stated main industry.

To study the effect of the reform on wages more formally, we estimate equation (1) using the natural logarithm of firm-level average wage as the dependent variable. We have winsorized the outcome variable at the 95% level, as the data contains some spurious outliers. We weigh the observations by the number of employees in the firm in 2013, the last pre-treatment year. The sample includes only firms that operated in the market prior to the reform.

Table 6 shows our difference-in-differences estimates. The first column reports the result of our main specification, where the control group is constructed from charter bus operators. Our point estimate of the reform's effect on wages is not statistically significantly different from zero. We also report the results of an alternative specification, where the control group consists of operators in the local passenger transport market. These are shown in the second column of the table. When we use this alternative control group, the sign of the point estimate flips, but the result remains statistically insignificant. In general, we do not find any evidence that the reform had a statistically significant effect on wages.

Table 6: Difference-in-difference estimates of the effect on wages

	(1)	(2)
Treatment	-0.016	0.027
	(0.031)	(0.025)
Observations	3958	2074
R^2	0.69	0.70

Notes: Dependent variable is the natural logarithm of total firm wages divided by the number of personnel. Both regressions have operator and year fixed effects. Standard errors (in parenthesis) are clustered by operator. In column (1) the control group is firms registered under the charter bus industry and in column (2) firms in the local passenger transport market.

A5 Representativeness of the route-level data

A concern with the route-level data is that it consists of only the largest firms and could potentially include a higher share of popular routes connecting large cities. To alleviate this concern, we check the representativeness of our route-level data. First, we estimate the relationship between the number of passengers and the population in our route-level data for 2013 using a simple linear regression. Second, we predict the number of passengers for each route in 2013 in the VALLU database, which contains information on the routes that the firms operate. Third, we compare the share of passengers on routes of different population sizes in our data set with the predicted passenger shares in the VALLU database.

We use the same population size categories as in the main text, i.e. routes with a population over 500,000 inhabitants, routes with a population between 100,000 to 500,000 inhabitants, and routes with a population under 100,000 inhabitants. Using the VALLU data, we find that the passenger shares predicted for these categories are 67%, 31% and 2%, respectively. In our data, the corresponding shares are quite close to these (73%, 25%, and 2%). Consequently, based on this analysis, our route-level data is not significantly skewed to routes connecting larger cities.

In Figure 17, we show the results when we include weights for routes of different sizes. We calculate the weights so that the passenger shares correspond exactly to the predicted shares from the VALLU data.[41] Using the weights, we find that the prices have decreased on average 27%, which is close to our main result of 28.5%).

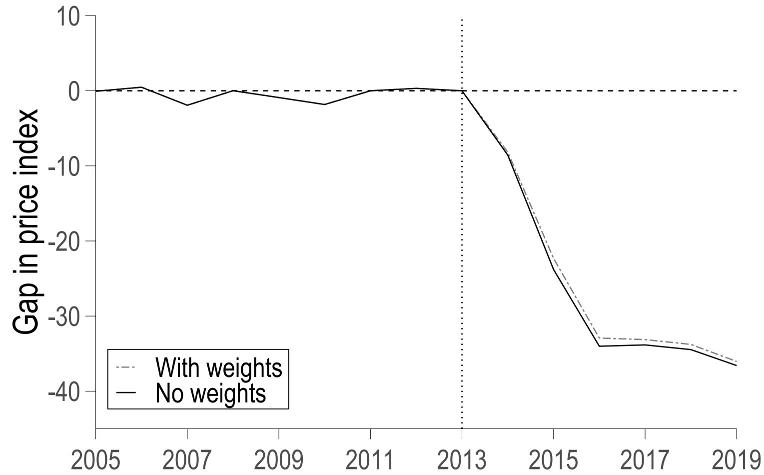

Figure 17: Results with and without weights

A6 Comparing the price data of the incumbent bus operators and the market entrant

The prices of the incumbent bus operators and the entrant are measured slightly differently in our route-level data. For the market entrant, a route follows the origin and destination of the customer. For incumbent operators, the turnover is aggregated for the entire route from the departure to the end station, including all possible intermediate stops. Therefore, when we calculate the price for the incumbent operators, it is a slight underestimate of the price of travelling from the departure to the end station, given that the data of the incumbent operators also includes customers who travel only part of the whole route.

We construct the price index for Finland using 2013 as the base index year. The prices in the post-reform years are then compared to the price level in 2013. We do not have price data for the market entrant before the reform. Thus, the prices of the market entrant post-reform are compared to the average price level of the incumbents in 2013. As explained above, in

[41]Weights are 0.92, 1.24, and 1.10 for big, medium and small routes, respectively

this comparison, the incumbent prices are slightly downward biased. This means that we underestimate the decrease in prices that resulted from the market entrant introducing lower prices.

Based on our data, the price levels of the entrant and the incumbent operators are quite close to each other in 2019. We estimate the magnitude of the bias in our data by collecting information on current prices. We collect the prices of the entrant, the incumbent bus operators, and the national railway operator from the five most popular routes in our data (Helsinki-Tampere, Helsinki-Turku, Helsinki-Jyväskylä, Helsinki-Pori, Turku-Jyväskylä). We collect four separate price points, depending on the time of purchase: one for the day of departure, one for the day before departure, one for a week from departure, and one for a month from departure.

The price difference between the entrant and the incumbent bus operators for a ticket bought on the day of departure or the day before departure is very small. However, the price difference is significant for tickets purchased some time in advance. For a ticket bought a month before the trip, the price difference is up to 50% and for a ticket bought a week earlier, about a third. We do not observe when consumers buy their tickets on average, and thus we cannot calculate the exact price difference. The average value of the price differences for these four different comparison days is approximately 20% to 25%. Consumer purchases are likely to be more concentrated closer to the day of departure, so the difference in the average price between the incumbents and the entrant could currently be between 10% and 20%.

Over time, the market entrant increased its turnover to around 30 million euros. This is around a third of the entire market. If we overestimate the price level of the entrant compared to the incumbent operators by 10%, then our overall estimate of the price level would be biased upward by 3%. If the bias is 20%, then the upward bias is 6%. These upward biases at the current price level translate into lower estimates (in absolute terms) of the effect of the reform on prices.

A7 Robustness of the results to the use of alternative data sources

In this section, we estimate the effect of the reform using alternative data sources. In our main analysis, we construct our price index for Finland by combining our route-level price data for the years 2013-2019 with the official price index for the years 2005-2013. We do this for three reasons. First, the official Finnish price index did not track price changes between 2014 and 2018 due to a mistake in data collection. This is illustrated in Appendix A2. Second, as we explain in the main text, before the reform, the price index accurately reflects the market price development. This is due to the fact that prior to the reform, pricing was largely based on Matkahuolto's price recommendations, as was the official price index. Third, the synthetic control method requires observing several post-treatment periods, and if we were to use only our route-level data, we would have data only from 2010 onwards.

First, we examine how our estimate of the price effect would change if we did not make a correction to the Finnish price index. Figure 18 shows the evolution of the official Finnish price index and synthetic Finland. Because synthetic Finland is constructed using only pre-treatment data, the composition of synthetic Finland remains the same as in our main specification. The average post-treatment gap between Finland and synthetic Finland is 12.2% for buses and 9.6% for trains. If we focus only on the years 2018 and 2019, the gap between synthetic Finland and Finland is 24.5% for buses and 19.0% for trains. This analysis illustrates that our finding that the reform had an economically significant effect on prices is also robust to using the official price index.

Next, we examine how our results change if we were to construct the price index for Finland from prices obtained by dividing the aggregate market turnover by the aggregate number of passengers. These statistics are published in the Finnish Public Transport Statistics for both the long-distance train and bus markets. Before 2018, they were published only every two years. We impute the missing observations using linear extrapolation. The results are shown in Figure 19. In this specification, we continue to use the same price measure for our comparison countries.

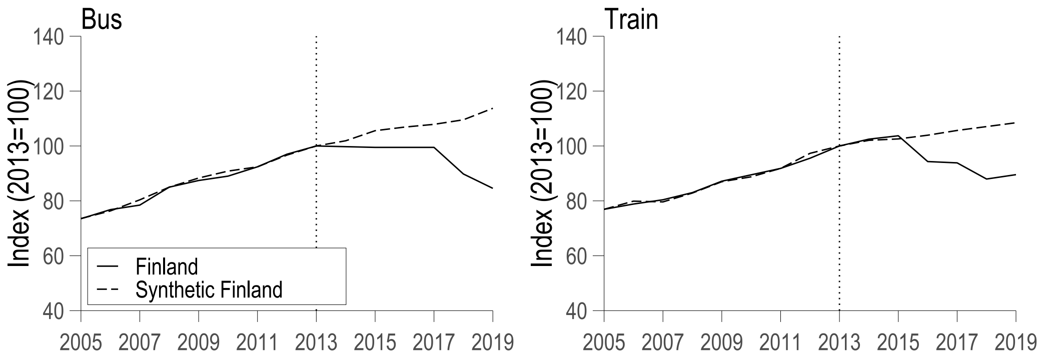

Figure 18: Evolution of prices in rail and road passenger transport: the official Finnish price index versus synthetic Finland

Because we use a different price measure for the pre-treatment period for Finland, the compositions of our synthetic controls change. In this alternative specification, a combination of Belgium (0.59), Slovenia (0.23), and Norway (0.15) forms the synthetic control for bus prices, while the synthetic control for train prices is formed by a combination of Belgium (0.50), Lithuania (0.45), and the Netherlands (0.05). The post-treatment gap between synthetic Finland and Finland is 40.4 for buses and 23.0 for trains. This specification thus yields even a higher estimate of the effect of the reform on prices in the bus and train market. Before treatment, synthetic Finland followed the price development of Finland relatively well in the bus market. However, for the train market, the synthetic control is now unable to find a convex combination of countries that will replicate the evolution of prices in the pre-treatment period. At the end of this section, we provide alternative results for the train market, where we also use a similar price measure for the comparison countries.

We also estimate the effect of the policy using only our route-level data to construct the price index. The difference is that now the pre-treatment index is also constructed from our sample of prices in the route-level data. Otherwise, the construction of the index is identical to our main analysis. Because the synthetic control method relies on observing several pre-treatment periods, we use the traditional difference-in-differences approach. We include all donor countries in the control group.

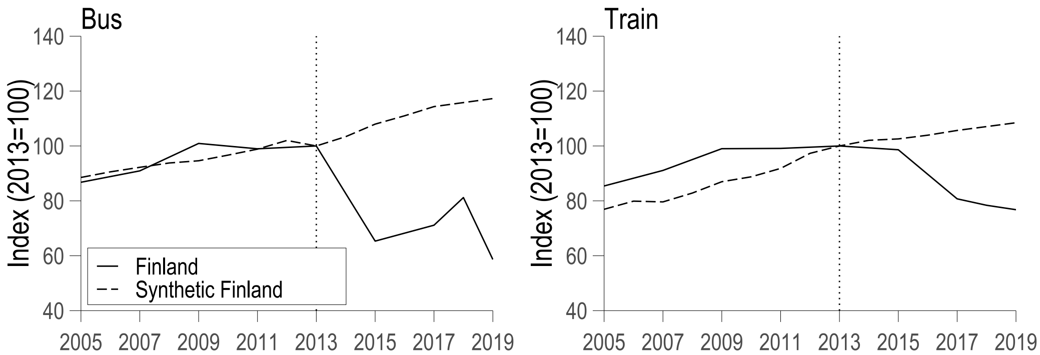

Figure 19: Evolution of prices in rail and road passenger transport: Finnish Public Transport Statistics versus synthetic Finland

We estimate the following regression equation:

$$y_{jt} = \alpha_j + \delta_t + \beta T_{jt} + \epsilon_{jt} \tag{4}$$

where y_{jt} is the price index of the country j in year t. α_j and δ_j are country and year fixed effects, respectively. T_{jt} is a dummy variable equal to one for Finland after 2013, and ϵ_{jt} is an unobserved error term. Due to the relatively small number of clusters (21), standard errors are bootstrapped using the six-point distribution suggested by Webb (2014), which may improve inference when the number of clusters is small.

The results are shown in the first two columns of Table 7. In this specification, we find that the reform decreased prices by 30.3% in the bus market and 22.7% in the train market. Both estimates are statistically significant at the 5% level. Our finding that the reform significantly decreased prices is thus also robust to using only information from our route-level data for Finland.

As we saw in Figure 19, the synthetic control was unable to reproduce the pre-treatment train prices when we used the aggregate turnover per passenger kilometre as an alternative to the prices. Therefore, we examine how our results change if we use turnover divided by the number of passengers as a price measure also for the control group. The International Union

Table 7: Comparing our sample of prices to aggregate price data from different sources

	Our sample		log(Turnover/passenger km)
	Bus	Train	Train
	(1)	(2)	(3)
Treatment	−30.225	−22.651	−0.198
	(1.426)	(1.188)	(0.062)
Observations	310	308	96
R^2	0.81	0.81	0.91

Notes: In the first two columns the dependent variable is the price index for buses and trains, respectively. In the third column the dependent variable is the natural logarithm of the aggregate industry turnover divided by the number of passengers. All regressions have country and year fixed effects. Standard errors (in parenthesis) are clustered by country. Because of the small number of clusters, standard errors are bootstrapped using the six-point distribution suggested by Webb (2014).

of Railways maintains a database that contains information on the number of passengers and turnover in different countries. We construct our alternative price variable from these two by dividing the turnovers by the total number of passengers. We were able to collect this information from Bosnia and Herzegovina, Croatia, Ireland, Portugal, Slovenia, and Spain.[42] As already mentioned, a similar variable can be constructed for Finland using data from the Public Transport Statistics. We estimate the regression equation (4) using the natural logarithm of this alternative price variable as our dependent variable. The results are shown in the third column of Table 7. The point estimate is -0.198 and is statistically significantly different from zero at the 5% level. Again, we find that our finding is robust to alternative specifications.

In Figure 20 we show the difference-in-differences event study estimates for the effect on train ticket prices using the alternative source for prices for both the control and the

[42]The data set contains some implausibly large changes in our price variable. We choose to exclude countries that have more than 50% annual changes. We also exclude the same countries as in our main analysis.

treatment group. These have been obtained by estimating the following regression:

$$y_{ij} = \alpha_i + \sum_s \beta_s D_{it}^s + \epsilon_{ijt} \tag{5}$$

where y_{jt} is the natural logarithm of the aggregate turnover as a share of passenger kilometres in country j in year t. D_{it}^s is a dummy variable for Finland i at time $t+s$. α_i and ϵ_{it} denote country fixed effects and the unobserved error term, respectively.

When we use the same price measure (turnover / passenger km) for both the control and treatment groups, we find no evidence of differing pretrends between the treated and untreated groups. None of the estimated seven pre-treatment coefficients are statistically significantly different from zero at the 5% confidence level. After treatment, we find several significant coefficients at the 5% confidence level.

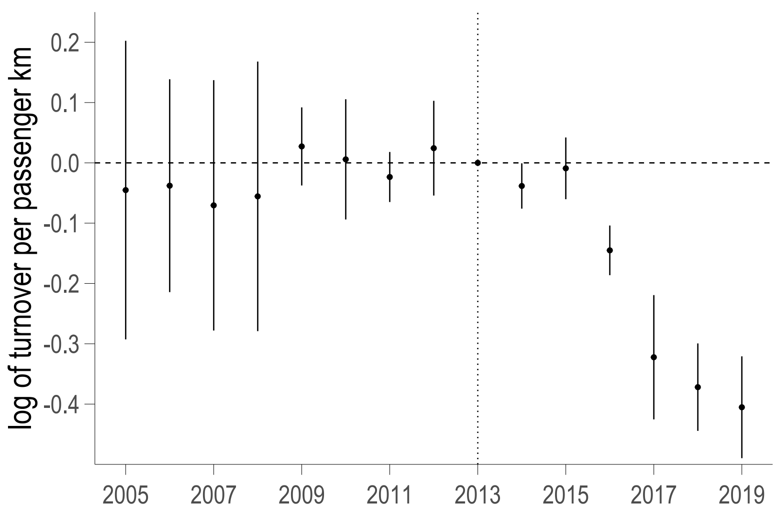

Figure 20: Event study estimates using the aggregate turnover per passenger kilometer as the price variable

Note: Figure plots the regression coefficients from equation (5). Error bars are the 95% confidence intervals.

A8 Additional results for synthetic control

In this section, we report some additional results from our synthetic control analysis. In Figure 21, we show the difference-in-differences event study estimates for the effect on the price of bus and train tickets. These have been obtained by estimating the following regression separately for buses and trains.

$$y_{ij} = \alpha_i + \sum_s \beta_s D_{it}^s + \epsilon_{ijt} \tag{6}$$

where D_{it}^s is a dummy variable for Finland i at time $t + s$. α_i and ϵ_{it} denote country fixed effects and the unobserved error term, respectively.[43] We see that these look very similar to our synthetic control estimates. Using difference-in-differences, we find that bus prices decreased 28.5%, which is identical to our synthetic control estimates. For train prices, we get a slightly larger reduction, 29.3%, compared to our main result of 21.7%. However, as we see in the figure, there are statistically significant differences in the trends between Finland and our comparison countries prior to treatment. This makes it more likely that the trends would not have been parallel without the treatment, which would bias the difference-in-differences estimate.

Second, Figure 22 shows the results of the leave-one-out test, where we remove one by one each of the control countries from our sample. We see that our results are robust to the elimination of every individual donor pool country. The biggest differences occur when we do not include Belgium in the donor pool for the synthetic control for bus prices, and we do not include Croatia in the donor pool for train prices. For the bus prices, we then get a somewhat smaller drop in prices of 25.2%, compared to our main result of 28.5%. For the train prices, we get a somewhat larger drop in prices of 24.8% compared to our main result of 21.7%. When we remove any other country, the estimated decrease in prices stays close to our main results, ranging from 28.0% to 29.6% for the bus prices and from 20.2% to 23.7%

[43] We cluster standard errors by country level. However, due to the relatively small number of clusters (21), they are bootstrapped using the six-point distribution suggested by Webb (2014).

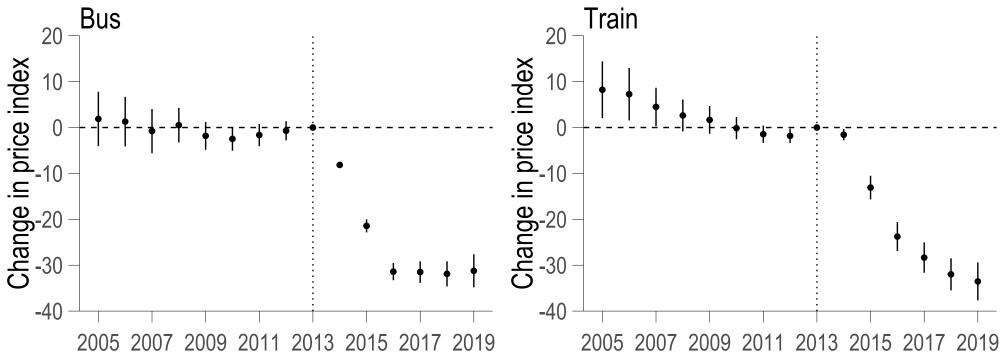

Figure 21: Difference-in-differences estimate of the treatment effect

Note: Figure plots the regression coefficients from equation (6). Error bars are the 95% confidence intervals.

for the train prices.

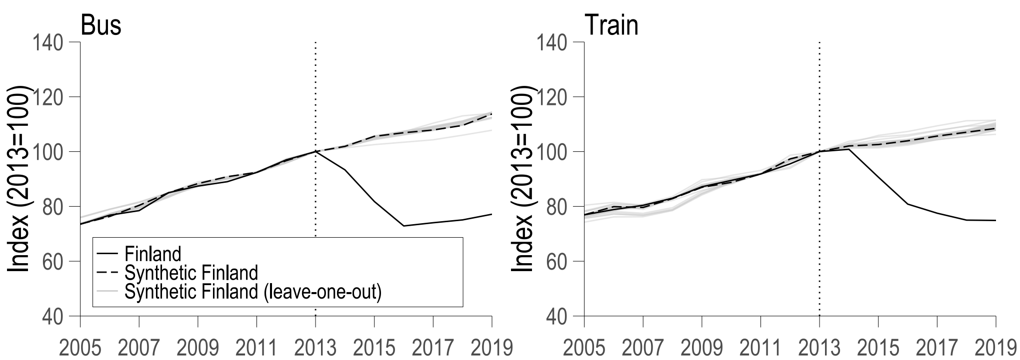

Figure 22: Leave-one-out: Distribution of the synthetic controls for Finland

Third, in Figure 23, we show the results when we use the entire sample of the 27 European countries to construct our synthetic controls. We find that this does not affect our results. The countries and their weights also do not change much. In the synthetic control for the bus prices, all of the countries that we had previously excluded receive a weight smaller than 0.05. The countries with the largest weight are now the Netherlands (0.26), Belgium (0.25), Luxembourg (0.09), Bulgaria (0.05), the UK (0.04), and Denmark (0.04). For train prices, of the previously excluded countries, only Germany gets a significant weight (0.26). Other countries with a large weight are now Belgium (0.34), Luxembourg (0.13), and Greece (0.13).

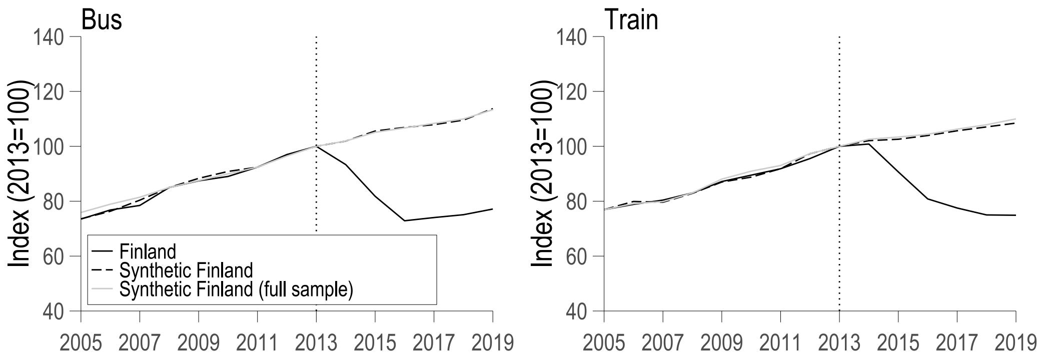

Figure 23: Path plot of prices: Main results versus full sample

A9 Evidence from a national survey

In this section, we report results from a repeated consumer survey, commissioned by the Finnish Transport and Communications Agency. The survey has been conducted every second year since 2011, with approximately 5,000 respondents. Respondents are asked to rate their satisfaction with the quality of transport services. The questionnaire covers the entire passenger transport sector. We focus on results with respect to satisfaction with long-distance (over 100 km) bus services. There was a change in the survey methodology between 2017 and 2019, when postal questionnaires were replaced by telephone surveys.

In the left panel of Figure 24, we report the results for the suitability of timetables for years 2011-2019. The results are reported separately based on the population of the respondent's home municipality. We use three categories that were formed by taking the average of corresponding categories in the survey. We did not observe a clear time trend in customer satisfaction in any of the three population categories. The change in the survey methodology in the year 2019 is reported to have resulted in a modest upward bias in the results, which might also explain the small increase in 2019. In the right panel of Figure 24, we report the results for the availability of services. Again, we observe no time trend in customer satisfaction in any of the three categories. We interpret this as suggestive evidence that the reform had no major effect on the availability of long-distance bus services.

The left panel of Figure 25 reports customer satisfaction with the punctuality of long-

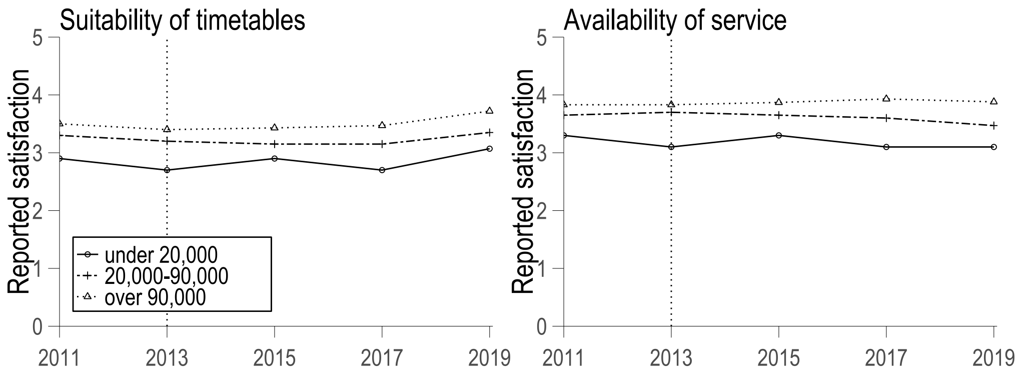

Figure 24: Customer satisfaction with suitability of timetables and availability of long-distance bus services in municipalities of different population sizes

distance bus operators. We find no significant changes post-reform in any of the three categories. We have also evaluated the development of punctuality in long-distance train services using a data set collected by the Finnish Transport Infrastructure Agency. Between January 2010 and December 2013, on average, 81.8% of trains were on time. After the reform, between January 2014 and December 2019, on average 83.5% of trains were on time. We interpret these findings as suggestive evidence that the reform did not have a significant impact on the punctuality of operators.

Finally, the right panel of Figure 25 presents the evolution of customer satisfaction with the prices of long-distance bus services.[44] Customer satisfaction increases steadily for respondents who live in large or mid-sized cities, which is consistent with our findings of significant price decreases on routes connecting large and mid-sized cities. In particular, the reported satisfaction has increased regardless of the population of the respondents' home municipality. This finding suggests that even though prices have not decreased on routes connecting smaller municipalities, their residents have benefited from lower prices on the routes connecting larger cities.

[44]This question entered the survey in 2013.

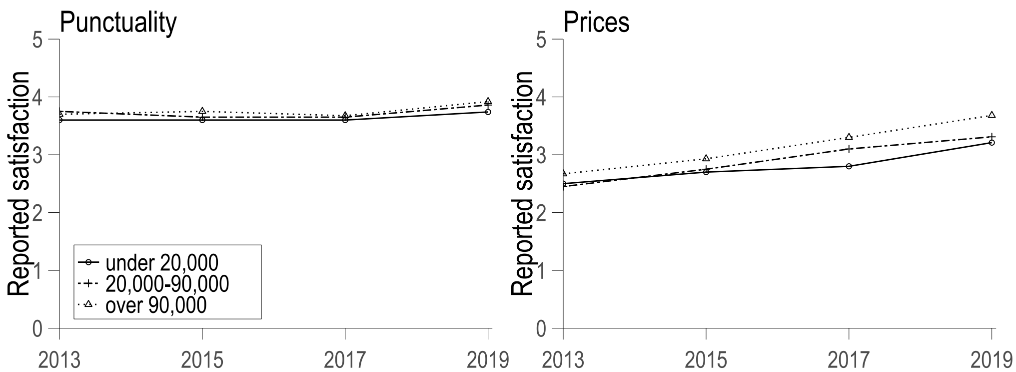

Figure 25: Customer satisfaction with the punctuality and price of long-distance bus services in municipalities of different population sizes

A10 The construction of consumer welfare bounds

In this section, we discuss in more detail how the upper- and lower-bound estimates of the change in consumer welfare are constructed. First, we introduce some notation. Consider an industry with n active firms and a downward-sloping demand curve $q(p)$. The equilibrium price is denoted by p. The consumer surplus can be expressed as a function of prices and the number of firms: $CS(p, n)$. Now consider that k new firms enter the market and the equilibrium price drops by δ. The change in consumer surplus can be divided into two parts as follows:

$$CS(p-\delta, n+k) - CS(p, n) = \underbrace{\delta q(p)}_{+} + \underbrace{\int_{p-\delta}^{p} [q(x) - q(p)]dx}_{+} \tag{7}$$

Both terms are positive. The first term represents the consumer savings that result from the drop in the market price. By dividing and multiplying it by the pre-entry price p, the first term can be expressed as a product of the pre-reform turnover and the percentage change in the price after entry. The second term represents the change in consumer surplus resulting from additional demand.

The first term is directly observable using our data and our estimate of the price change. In the last six pre-reform years, the aggregate turnovers of the long-distance train and bus industries were 326.3 and 83.3 million euros, respectively. We estimate that the reform led to 28.5% lower prices in the bus market and 21.7% lower prices in the train market. Given these numbers, the consumer savings from the reform are around 95 million euros.

The second part of equation (7) depends on the curvature and slope of the demand curve. To obtain the bounds for the entire term, including the second part, we follow Kang and Vasserman (2022). They provide closed-form formulas to compute the welfare change resulting from a change in price under different families of demand curves. To construct the bounds, the researcher is required to observe two points (p_0, q_0) and (p_1, q_1). In our setting, (p_0, q_0) denotes the pre-reform price and quantity, and (p_1, q_1) denotes the post-reform price and quantity. We calculate these points separately for the long-distance bus and train markets. We collect the pre-reform figures from the Finnish Public Transport Statistics. To construct the post-reform prices and quantities, we use our main estimates from the synthetic control method. For example, based on the Finnish Public Transport statistics, the average ticket price before reform in the long-distance bus market is 12.12 euros, and the post-reform price is constructed as follows: $12.12 - 12.12 * 0.285 = 8.66$ euros.

After we have constructed (p_0, q_0) and (p_1, q_1), we simply plug them into the closed-form formulas provided in Kang and Vasserman (2022). The formulas and the results are shown in Table 8. The first column shows the family of demand curves under which the upper and lower bounds hold. The second and third columns give the closed-form formulas for calculating the upper and lower bounds. The fourth column reports the upper- and lower-bound estimates of the effect of the reform on consumer welfare. Note that the formulas in Kang and Vasserman (2022) are used to evaluate a price increase. Because we study the welfare effects of a price decrease, we have reversed the formulas.

Table 8: Welfare bounds for ΔCS

Demand family	Lower bound formula	Upper bound formula	Results (MEUR)
Marshall's second law	$\frac{(p_0 q_0 - p_1 q_1) log(p_0/p_1)}{log(q_0/q_1) + log(p_0/p_1)}$	$q_1(p_0 - p_1)$	97.25-100.34
decreasing MR	$\frac{(p_0 - p_1) q_0 q_1 log(q_1/q_0)}{q_1 - q_0}$	$q_1(p_0 - p_1)$	97.35-100.34
log-concave demand	$\frac{(p_0 - p_1)(q_1 - q_0)}{log(q_1/q_0)}$	$q_1(p_0 - p_1)$	97.40-100.34
concave demand	$\frac{(p_0 - p_1)(q_0 + q_1)}{2}$	$q_1(p_0 - p_1)$	97.45-100.34
convex demand	$q_0(p_0 - p_1)$	$\frac{(p_0 - p_1)(q_0 + q_1)}{2}$	94.56-97.45
log-convex demand	$q_0(p_0 - p_1)$	$\frac{(p_0 - p_1)(q_1 - q_0)}{log(q_1/q_0)}$	94.56-97.40