Gabinete de Estratégia e Estudos

REPÚBLICA PORTUGUESA
ECONOMIA E MAR

GEE Paper

167

Setembro de 2022

The impact of a rise in transportation costs on firm performance and behaviour

Catarina Branco | Dirk C. Dohse | João Pereira dos Santos | José Tavares

Gabinete de Estratégia e Estudos da Economia e do Mar
Office for Strategy and Studies of Economy and Maritime Affairs
Avenida da República, n.º 79 - 1069-218 Lisboa, Portugal
www.gee.gov.pt
ISSN (online): 1647-6212

The impact of a rise in transportation costs on firm performance and behaviour [1] [2]

Catarina Branco[3], Dirk C. Dohse[4], João Pereira dos Santos[5], José Tavares[6]

Abstract

This paper uses micro-level data encompassing the universe of Portuguese private firms for the period 2006-2016 to analyse the effect of the introduction of tolls on previously toll-free highways. To establish causality, we rely on a natural experiment which resulted from Portuguese authorities being forced to in- crease these transportation costs in some highways during the sovereign debt crisis. Difference-in-differences results show a 10.7% decrease of turnover in firms located in affected municipalities vis-à-vis firms in the remaining areas, on average. Firm profits were also severely hit and reduced by more than 15%. Both sales and purchases to/from the internal market and abroad (especially to/from EU countries) were affected. Furthermore, employment reduced 2% in treated areas. Importantly, our findings do not uncover induced inter-regional firm migration, suggesting that the tolls have induced a substantial net loss to the Portuguese economy.

JEL Classification: R48, L25, R12

Keywords: Road tolls, Turnover, Expenses, Value Added, Exports, Imports, Competitiveness, Portugal

Note: This article is sole responsibility of the authors and do not necessarily reflect the positions of GEE or the Portuguese Ministry of Economy and Maritime Affairs.

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[1] Award-winning work by the Call for Papers on "Internationalization of the Portuguese Economy in post-Covid-19: Opportunities and Challenges", a partnership between the Office for Strategy and Studies of the Ministry of Economy and Maritime Affairs (GEE) and the Portuguese Investment and Foreign Trade Agency (AICEP).

[2] The authors are grateful to Pedro Bação, Pedro Pita Barros, Samira Barzin, Mário Centeno, Dave Donovan, Luisa Doerr, Ed Glaeser, Nezih Guner, Julian Hinz, Adelheid Holl, Gabriel Kreindler, Xiang Li, Susana Peralta, Alfredo M Pereira, Miguel Portela, Pedro Portugal, Francisco Queiró, Lasare Samartzidis, Rok Spruk, and seminar participants at Nova SBE, the DUP meeting (Harvard University), the 3rd CompNet ProdTalks, SAEe2020, the 9th PhD Student Workshop on Industrial and Public Economics (ECO-SOS), the 10th European Meeting of the Urban Economic Association, COMPIE 2021, the 14th Annual Meeting of the PEJ, the European Association for Research in Industrial Economics (EARIE) Annual Conference 2021, Jornadas de Economia Industrial of the Spanish Economic Association, 11th ifo Dresden Workshop on Regional Economics, and CAED 2021 (Coimbra) for useful comments and suggestions. We would also like to thank BPLim – Banco de Portugal for providing the necessary data for this study. This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER- 007722 and Social Sciences Data- Lab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209) and the research project PTDC/EGE- ECO/31213/2017. All errors are our own.

[3] Nova School of Business and Economics, Universidade Nova de Lisboa, Campus de Carcavelos, Rua da Holanda 1, 2775-405 Carcavelos, Portugal. E-mail: catarinalebrebranco@gmail.com.

[4] Kiel Institute for the World Economy, Kiellinie 66, 24105 Kiel, Germany. E-mail: dirk.dohse@ifw-kiel.de.

[5] RWI – Leibniz Institute for Economic Research, Hohenzollernstr. 1-3, 45128 Essen, Germany; Nova School of Business and Economics, Universidade Nova de Lisboa, Campus de Carcavelos, Rua da Holanda 1, 2775-405 Carcavelos, Portugal; REM/ UECE, Portugal . João Pereira dos Santos gratefully acknowledges financial support by FCT – Fundação para a Ciência e Tecnologia - PD/BD/128121/2016 and PTDC/GES- GCE/4046/2021. Corresponding author. E-mail: joao.santos@novasbe.pt.

[6] Nova School of Business and Economics and Centre for Economic Policy Research (CEPR), London, U.K. E-mail: jtavares@novasbe.pt.

1 Introduction

Transport infrastructure is key for economic development. Not only does it allow for circulation of people, it is a fundamental piece in the exchange of goods. At the same time, transport infrastructure is rather expensive. Thus, it is essential to understand the relationship between transport infrastructure and economic outcomes in order to adequately design transport policy. Given the importance of this topic, studies on the effect of transport infrastructure on aggregate economic outcomes are quite abundant (Redding and Turner, 2015). However, micro level studies on the effect of transport infrastructure on firms performance are rather limited (Holl, 2016).[1] This paper contributes to this still-growing literature by studying the impact of an exogenous increase in transportation costs on a series of financial indicators of firm performance using micro-level data. It provides a deep and comprehensive analysis of how introducing tolled highways affects various dimensions of firm performance and how firms react to the increased transportation costs.

Estimating the causal effect of transport infrastructure on economic outcomes is not straightforward, as this kind of infrastructure is usually not randomly assigned. Therefore, it would not be clear if firm-level outcomes are varying due to a change in transportation costs caused by this infrastructure or due to other unobserved characteristics. A common solution in the literature for this endogeneity problem is to use an Instrumental Variable (IV) or the inconsequential places approach (Redding and Turner, 2015). Although less common, some papers alternatively rely on a natural experiment.[2] The latter is exactly what we do in this paper.

The SCUT highway system started being built in 1990 and came into completion in 2008 in Portugal. Portuguese authorities made this network toll free for its users, hence the name SCUT ("**S**em **C**usto para o **Ut**ilizador" or "Without Cost for the User"). One of the main motivations behind its conception was to create an alternative network to the old and deteriorated (municipal) roads. This new and more modern system sought to make travelling safer and a lot faster. By the end of 2008, SCUTs accounted for almost 1000km which was nearly a third of the Portuguese highway grid at that time (Statistics Portugal, 2008).

All of this changed in 2010. On the onset of the European sovereign debt crisis, the Portuguese government was forced to consolidate its financial position, cutting spending and increasing revenues (Financial Times, 2013). Thus, the national budget could no longer sustain the provision of a toll free network. Tolls were then introduced in two waves, first by the end of 2010 and, then, by the end of 2011.

This event provides a unique setting for a natural experiment, which allows one to study the impact of an exogenous variation of transportation costs on firm related outcomes.[3] This is only possible because tolls were introduced purely out

[1] Some studies explore the effect of transport infrastructure on micro-level outcomes, such as: firms' exports (Martincus et al., 2012; Martincus and Blyde, 2013; Martincus et al., 2014; 2017), inventories (Datta, 2012; Li and Li, 2013; Shirley and Winston, 2004), and productivity (Lall et al., 2004; Gibbons et al., 2019; Holl, 2012; 2016; Martin-Barroso et al., 2015; Graham, 2007b,a; Fiorini et al., 2021).

[2] For some examples of papers which also use a natural experiment as source of exogenous variation in infrastructure see Martincus et al. (2014) and Martincus and Blyde (2013). Pereira et al. (2021) and Audretsch et al. (2020) study the same natural experiment that we do in this paper, but rely on macro data aggregated at the municipal-level.

[3] In Portugal, the transportation of goods is mainly done through road transports. According to Statistics Portugal (2015), in 2010, 76% of goods were delivered via road transportation. Moreover, there were no changes in the provision or in the capacity of railroads in this period. Municipal roads were also constant in our sample period.

of the necessity to regulate government budget. In other words, this decision was made without special consideration for the firms (or municipalities) in those regions. Two earlier studies have used the same natural experiment in their analyses to assess the impact of the unexpected introduction of road tolls on other economic outcomes. Pereira et al. (2021) show that the introduction of tolls resulted in the increase of the number of (light) accidents and road injuries, whereas Audretsch et al. (2020) find that it had a significant negative impact on macroeconomic outcomes (firm numbers and employment) in the affected municipalities. The current paper goes far beyond previous research, making use of a new firm-level micro dataset, encompassing more than 300 000 firms per year. This allows us to investigate the medium-run impact of tolls on a wide array of firm-level performance indicators (including turnover, value-added, productivity, imports, and exports), to analyse firms' adaptation strategies in response to the tolls and to critically assess whether the tolls have induced inter-regional firm migration.

The paper contributes to the literature in four different ways. First, it provides an in-depth analysis of the impact of interurban road tolls on a wide array of firm-level performance measures that helps us better understand how transportation costs affect different dimensions of firm performance and firm behavior Second, it analyses how the tolls affect labour productivity and how firms pass on the burden of the tolls to their employees (employment cuts or wage cuts). Third, it covers a relatively long time period after the introduction of tolls, which allows us to disentangle short-run and longer- run effects. And fourth, the rich firm-level dataset allows us to analyse whether the firms respond to the tolls by migration to other (less or non-affected) regions in Portugal. This is an important pre-condition for the assessment of the overall welfare effects of the tolls, as losses in the (most) affected municipalities might be compensated by benefits in the remaining regions.

Using difference-in-differences and event study specifications, our findings show that the introduction of tolls caused a 10.7% decrease of turnover in firms located in affected municipalities *vis-à-vis* firms in the remaining areas. Other measures of firm performance, such as profits and value added, reduced by more than 16.3% and 12.2% in these areas, respectively.

We also analyse measures of firm behaviour to examine how firms adjust to the shock. Focusing on the effects of the tolls on the labour market, we find that paid employment fell, on average, 2% in the treatment areas. Full-time employees suffer more (in terms of employment losses) than part-time employees. The majority of effects are long term, i.e. still persistent six years after the introduction of tolls. Average wages go down as well, but the effect is not statistically significant. In addition, we show that total expenses are also negatively affected by the shock (around 10%, on average). This reduction was common for employee expenses and for the costs associated with goods and materials consumed and supplies of external services.

We also investigate whether these effects are related to economic deterioration of the overall economic activity or re-location. To shed light on this issue, we analyse how firm numbers, entry, exit, and inter-regional firm migration reacted. We confirm that firm numbers were negatively influenced by the shock Entry of new start-ups and firm movement have not seemed to play a major role in response to the introduction of tolls. This is a particularly important insight as it

allows to suggest that we observe a real deterioration of overall economic activity – and not just a relocation of firms from treated to non-treated municipalities.

Finally, both sales and purchases to/from the domestic market and abroad (especially to/from partners in the European Union) were significantly hit. The extensive margin, ie., the probability that firms enter international trade, by exporting or importing, does not seem to be influenced by the sharp rise in transportation costs.

The rest of the paper is structured as follows. Section 2 presents a brief literature review. Section 3 details the institutional background, whereas Section 4 presents the data and discusses the methodology and possible identification threats. Section 5 highlights the results related to firm-level performance and labour-market outcomes. Section 6 discusses if the previous results represent a relocation of economic activity from treated to comparison areas or an overall deterioration of the economic conditions. Section 7 concludes.

2 Literature Review

The majority of research on the economic impact of infrastructure provision and pricing focuses on the macro (country or region) level and looks at macroeconomic variables. Some of the most prominent papers study the impact of transport infrastructure on: population growth (Baum-Snow, 2007; Baum-Snow et al., 2017; Michaels et al., 2012; Garcia-López et al., 2015), aggregate trade (Duranton et al., 2014; Storeygard, 2016; Donaldson, 2018), and GDP (Banerjee et al., 2012; Faber, 2014).

However, studies carried out at aggregate levels of analysis provide little insights in the actual mechanisms by which improvements or deterioration of infrastructure affect firm performance (Haughwout, 2002) Moreover, these studies ignore mobility of firms and responses to local price changes caused by modifications in infrastructure provision and pricing (Holl, 2006). Therefore, researchers have begun to analyse the effects of transportation infrastructure on firm level performance variables.

Holl (2012) investigates the influence of transportation infrastructure on firm-level productivity through its effects on market potential in Spain, finding that growth of market access has a positive impact on firm-level output growth. Holl and Mariotti (2018) use detailed geo-referenced data to study the effects of highway development on firm level performance in the Spanish logistics sector. They find that highways have significant implications for logistics' firm performance, although with important spatial heterogeneity. While improved highway access increases the productivity performance of urban logistics firms, the impact on productivity growth of rural logistics firms that remain outside of highway corridors is found to be negative. Gibbons et al. (2019) estimate the impact of new road infrastructure on employment and labour productivity using firm level longitudinal data for Britain. They measure exposure to transport improvements through changes in accessibility and find that improved accessibility increases output per worker, wages, and use of intermediate inputs for existing establishments. Several (recent) studies suggest that infrastructure provision positively affects firm performance in a developing country context. Chauvet and Ferry (2020) investigate the relationship between

taxation and firm performance in developing countries, finding that taxation benefits firm growth in developing countries, especially in lower-income countries, through the financing of public infrastructure. Barzin et al. (2018) estimate the effect of roads on firms' output growth in Colombia, finding elasticities of output with respect to road infrastructure ranging from 0.13 to 0.15%, which is clearly larger than what is found in comparable work for developed countries.

While the recent literature has made substantial progress in addressing the possibility that infrastructure and transportation costs are not assigned to regions randomly,[4] the majority of research is unable to distinguish between growth (or decline) and reorganization of economic activity. As Gibbons et al. (2019) put it, "In common with all empirical work that estimates causal effects from statistical comparisons across time and place, it is impossible to know for sure whether these employment increases are additional to the economy as a whole" (Gibbons et al. (2019), p. 45).

However, as is well-known since the seminal paper by Fogel (1964), the assessment of the economic impact of infrastructure depends critically on whether transport cost changes the level of economic activity or just leads to a reorganization (or relocation) of existing activity. Quite obviously, the welfare implications of a new road that creates new firms and employment are quite different than those that just lead to a re-location of pre-existing economic activity (Redding and Turner, 2015). The same is true for the economic effects of road tolls. If the tolls lead to a deterioration of economic activities (losses in value added, employment etc.) this is – from an overall economic point of view – quite different from a mere relocation of economic activities to other (less or non-affected) regions.

We know from the pertinent literature that such relocation effects can be quite substantial. Duranton et al. (2014), who investigate the effects of within-city motorways on intercity trade within the US, find that the main effect of within-city highways is to relocate economic activity, and not to create it. Besides Chandra and Thompson (2000), who study the effects of access to the US interstate highways system in rural counties, find that access to these highways increases firm earnings in treated counties mainly at the expense of their untreated neighbour counties. It is thus important to not only tackle the endogeneity problem, but also to check whether the observed effect is a real growth or decline in economic activity or just the consequence of relocation of economic activity. Our experimental design and our rich firm-level data base that contains information about movement of firms allows us to do both: the natural experiment creates quasi-exogeneity of the introduction of tolls and the rich firm level dataset allows us to examine whether the firms respond to the tolls by migration to other (less or non-affected) regions in Portugal. This is most important for the assessment of the overall welfare effects of the tolls, as losses in the (most) affected municipalities might be compensated by benefits in the less or non-affected) regions.

[4]The most recurrent strategy found in the literature to solve this problem is the use of an instrumental variable. According to Redding and Turner (2015) the use of instrumental variables in this literature can be categorized into three main strategies: planned route IV (Baum-Snow 2007, Michaels 2008, Michaels et al. 2012, Hornung 2015, Jedwab and Moradi 2016, Mayer and Trevien 2017, Möller and Zierer 2018), historical route IV (Duranton and Turner 2011, 2012, Duranton et al. 2014, Hsu and Zhang 2014, Garcia-López et al. 2015, Percoco 2016, Baum-Snow et al. 2017, Martincus et al. 2017), and the inconsequential place approach (Chandra and Thompson 2000, Banerjee et al. 2012, Datta 2012, Faber 2014, Ghani et al. 2016, Fretz et al. 2017, Ahlfeldt and Feddersen 2018). An attractive alternative to these standard approaches is the use of natural experiments (Bröcker et al., 2019).

3 Institutional Background

Since 1986, Portugal invested substantial resources to close the gap with the core of Europe in terms of road infrastructure (Fernandes and Viegas, 1999). During the 1990s, however, these investments became a heavy financial burden. The need to guarantee the necessary funds without breaching the EU rules on member state budget deficits spurred the cooperation with private enterprises through public private partnerships (PPPs) to expand and operate road infrastructures (Fernandes et al., 2005). In 1997, a new kind of PPP scheme was introduced: a system of modern, toll-free highways, the so-called SCUTs (acronym for "Sem Custos para o Utilizador"/without costs for the users).[5] Private investors were ensured, based on the traffic volume and operation standards, a long-term rent paid by the central government budget (Sarmento, 2010).[6]

The SCUT highways were constructed between 1998 and 2002 at a cost of about 3 billion Euro, and cover nearly 1000 km, i.e., about one-third of the total Portuguese highway system. This new PPP scheme allowed for a swift expansion of the highway system in Portugal at low initial costs for the public sector, and helped cut average travel time between Lisbon and the Spanish border (as well as between the capital and some areas) by more than 40%. However, these large investments also generated a severe pressure for the country's budget over the next 25-30 years (Sarmento, 2010; Santos and Santos, 2012). Many industrial parks were built in the proximity of these infrastructures to take advantage of the improved transportation connection.

In the course of the European sovereign debt crisis, the financial strain on the central budget became so tough that the Portuguese authorities had no choice but to enforce sizeable tolls on the formerly toll-free SCUT highways. As the Financial Times wrote, "To help keep Portugal's 78bn bailout on track, the government has been forced to introduce charges on more than 900 km of roads where there was previously none" (Financial Times of 25 August 2013). When the tolls were established in 2011, the price was 9 cents/km, which was significantly higher than for the other highways (Audretsch et al., 2020). In many situations, this implied a shift from SCUT highways to slower alternative options (e.g., municipal roads), and thus negatively affected businesses' competitiveness. These toll prices were so high that they also had a substantial adverse impact on traffic. According to a study by the Institute for Road Infrastructures, traffic along the SCUT highways decreased substantially between the first quarter of 2011 and the first quarter of 2012. There were no noteworthy congestion cases on the SCUTs highways when they were introduced (INIR 2011). This shock was driven by purely financial reasons and did not consider local conditions. The mayors of the SCUTs regions were against the introduction of tolls (even those who belonged to the same party as the national government), and there were massive protests from the local populations.[7]

With the improvement of the financial conditions, and in reaction to the decrease in traffic and the widespread criticism

[5] According to the Court of Accounts, these projects were financed essentially through loans from commercial banks (45%), the European Investment Bank (40%), and equity (12%). Fernandes et al. (2016) compute that the financing costs of SCUT highways are, on average, 370 basis points above the cost of raising public debt. Moreover, they argue that the transaction costs (which include banking fees and diligence costs and the impact of all cash distribution traps, such as reserve accounts or minimum-level of debt ratios) account for around 40% of that financial premium.

[6] The same rationale can be found, for example, in the UK, Spain, and Australia.

[7] See, for instance, https://www.jornaldenegocios.pt/empresas/transportes/detalhe/parlamento-rejeita-fim-das-portager

in the public, the new Portuguese Socialist government decided to cut back the tolls on SCUT highways by 15% from 1 August 2016 onwards. This decision was supported by a report from the public entity responsible for managing the road infrastructure that estimated that decreasing the tolls by 15% would increase public revenues.[8]

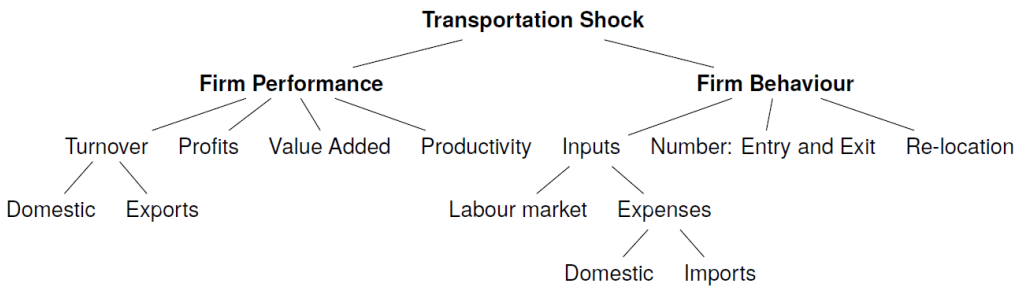
4 Data and Empirical Approach

4.1 Data

We combine administrative firm with municipality-level data. The firm-level information comes from the *Central Balance Sheet* database provided and harmonised by *Banco de Portugal*.[9] It consists of economic and financial information on virtually all private firms (such as financial balance sheet indicators, location, number of employees, size, among other indicators). This is quite an extensive dataset comprising 554,497 firms during the period of 2006-2016, amounting to a total of firm-year 3,680,060 observations.[10] Note that it is an unbalanced dataset, as not all firms have observations for all the years in this period. Additionally, only firms in Portugal mainland were considered, hence firms from Madeira and Azores are not part of the analysis.

This unique dataset allows us to investigate a variety of firm-level performance and behaviour variables. In a nutshell, Figure 1 briefly summarises how we evaluate the impact of the increase in transportation costs in firm performance and behaviour.

Figure 1



We consider four indicators of firm performance. These are turnover (the amount of sales of goods and services after any allowances, discounts, and returns are considered); a measure of profitability – EBT (earnings before taxes, but after interest payments, depreciation, and amortisation); value added (the value of output minus the value of intermediate consumption); and labour productivity (value added divided by the number of employees).

[8] See, for instance, https://www.tsf.pt/economia/descer-portagens-nas-antigas-scut-e-bom-negocio.html.

[9] The data in this database is collected through *Simplified Business Information (IES - Informação Estatística Simplificada)* since 2006. *IES* is an annual report that must be filled online by firms. This report is mandatory and non-compliants are penalized. The quality of this data is then monitored by Statistics Portugal who check with respondents on a regular basis.

[10] This corresponds to the total number of observations after dropping firms with no municipality reported, non positive levels of turnover, and non positive number of employees. This last drop is meant to eliminate cases of self-employment from the sample.

Regarding firm behaviour, we start by studying what happened to inputs of production, highlighting the incidence for the labour market and examining how expenses changed after the shock. For the labour market, we study how yearly average wages and the number of total, full-time, and part-time employees reacted. Total firm expenses are also considered, dividing them between wage-related expenses (considering not only transfers to the workforce, but also social security and insurance payments) and expenses directed to other stakeholders, including suppliers and the state. We analyse the costs associated with goods sold and material consumed, with supplies and external services, and with the corporate income tax.

We then consider the behaviour of firms according to other margins of adjustment. We investigate how firm numbers changed with the shock, separating firm entry entrepreneurship from firm exit. Moreover, this rich dataset further allows us to follow the location of firms across time. Hence, we are able to observe if firms tried to mitigate or circumvent the effects of the treatment by moving to municipalities less affected by the rapid transport cost increases.[11]

Finally, we assess whether internal or international trade were most affected by the increase in highway tolls. For both turnover and purchases, we can distinguish between those to/from the domestic market and exports/imports, from the European Union (EU) and the rest of the world. We further consider the extensive (probability of exporting or importing) and the intensive margins.

We complement the firm-level data with administrative municipal information which allows us to control for time-variant municipal-level covariates. Municipal socio-demographic characteristics, such as the population density and the age dependency ratio, were gathered from Statistics Portugal. Moreover, information on per capita electricity consumption was retrieved from *Direção Geral de Energia e Geologia* (DGEG) and data on municipal expenditures was acquired from *Direção Geral das Autarquias Locais* (DGAL) to proxy for the wealth of the region.

Table 1 presents the descriptive statistics on the firm- and municipal-level variables used in this study.

4.2 Empirical Strategy

The validity of our strategy relies on the fact that the introduction of tolls on SCUT highways was forced by an exogenous shock (the sovereign debt crisis) upon the Portuguese political authorities. Being a national matter, municipal authorities played no role in this decision nor were they able to directly intervene.[12] At the same time, there was no discrimination nor favoritism towards these municipalities.[13]

The effect of an increase in transportation costs on outcome y is estimated using the following difference-in-differences specification for unit of analysis firm f, in municipality m, NUTS 2 or NUTS 3 region n, and year t, during the period 2006-2016, according to:

[11] An important limitation of this strategy is that we are not able to observe if the *same* entrepreneur decides to close a firm in a given municipality and open a *different* firm in another area.

[12] Even though, there were huge protests made by SCUT highway users and local mayors, they had no saying in this decision. (See https://www.jornaldenegocios.pt/empresas/transportes/detalhe/municipios_e_utentes_perdem_accoes_contra_portagens)

[13] Audretsch et al. (2020) show that there was no political attempt to favor municipalities of the same political party.

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Treated	0.244	0.430	0	1
Firm Performance				
Turnover	885.095	21389.33	0	9628761
Profits	40.128	6361.093	-2360387	5966117
Value Added	202.454	4266.332	-2257171	118161.700
Labour Productivity	18.241	1352.733	-2257171	118161.7
Firm Behaviour				
Average Wage	9.812	8.926	0	2280.594
Paid Employment	7.351	81.992	0	2468
Full-Time Paid Employment	7.602	73.104	0	19441
Part-Time Paid Employment	0.690	27.800	0	7592
Total Expenses	936.675	22542.990	-222670.300	9746508
Employee Expenses	126.232	1747.205	-9.184	474102.100
Costs of goods and materials consumed	478.686	17409.970	0	8719599
Supplies and external services	215.037	4711.432	0	1823159
Income Tax	10.135	517.381	-320944.300	262133.200
Moved	0.018	0.134	0	1
Domestic vs. international trade				
Turnover – Domestic	721.677	17516.630	-9.184	474102.100
Prob of Export	0.143	0.350	0	1
Exports	163.418	7191.246	0	3693663
Exports – EU	112.061	4667.122	0	1948067
Exports – extra EU	51.356	3685.152	0	2065586
Purchases – Domestic	330.613	10959.950	0	5016564
Prob of Import	0.157	0.363	0	1
Imports	153.669	10916.240	0	7318419
Imports – EU	124.281	9344.458	0	7318419
Imports – extra EU	29.388	5357.542	0	6841137
Controls				
Population density	1717.197	2131.935	4.2	7492.4
Age dependency ratio	0.534	0.095	0.371	1.108
Electricity consumption pc	4.880	3.421	1.527	83.860
Expenses pc	0.507	0.235	0.089	2.630

Notes: All variables are measured in ln. The exceptions are Treated and Moved (dummy variables) and the vector of controls.

$$y_{fmnt} = \alpha_f + \delta_m + \lambda_{nt} + \gamma Treated_m \times PostPeriod_{mt} + X'_{mt}\beta_1 + \epsilon_{fmnt} \quad (1)$$

where α_f denotes firm fixed effects, δ_m municipality fixed effects, and λ_{nt} represents NUTS 2 (or NUTS 3) $\times$ year fixed effects. The coefficient of interest is γ as it gives us the treatment effect. $Treated \times PostPeriod$ represents the interaction between the $Treated$ dummy and the $PostPeriod$ dummy.

We define treatment as the introduction of tolls in the SCUT highways.[14] As such, municipalities are divided into a treatment group and a comparison group. All municipalities that have a segment of the SCUT highway network belong

[14] Audretsch et al. (2020) and Pereira et al. (2021) use a similar identification strategy.

to the treatment group. These amount to 59 municipalities in the treatment group and 219 in the comparison group.[15] Note that municipalities in the comparison group can have other (non-SCUT) highways. However, it is important to point out that these other highways were already subject to charges a long time before the European sovereign debt crisis and that these charges remain unchanged by the shock. $Treated$ variable thus takes the value one for municipalities in the treatment group and zero otherwise.[16]

Regarding the treatment period, note that in some treated municipalities, tolls were introduced on the 15^{th} of October 2010 and in others, this happened on the 8^{th} of December 2011. However, there were important anticipation effects suggesting that these areas would be eventually treated.[17] Accordingly, we define $PostPeriod$ as a binary indicator that equals one from 2011 onwards. Recent developments in the difference-in-differences literature highlight challenges in designs that exploit staggered treatments (Goodman-Bacon, 2021). In this paper, we do not face these problems. In fact, both Callaway and Sant'Anna (2020) and Borusyak et al. (2021) discuss the importance of properly considering possible anticipatory effects.

For robustness, we substitute the NUTS 2 by NUTS 3 $\times$ year fixed effects and a vector of time-variant municipal-level controls X'_{mt} in some specifications. To control for socio-demographic characteristics, we include the age dependency ratio, population density, and electricity consumption per capita and municipal expenses per capita to control for municipal income.[18]

Robust standard errors are clustered at the municipal level municipality to correct for heteroskedasticity and autocorrelation, since treatment varies at this level (Bertrand et al., 2004). However, a few firms change municipality during the period under study. Therefore, the municipality at the time of the treatment was used to cluster the standard errors, i.e., the location of the firm in the year 2009 just before the treatment. For firms that do not have an observation for this year (since this is an unbalanced panel), the location of the firm at the time it first appears in the sample was used.

Outcome variables y can either be integers, shares, or binary indicators. In the case of integers, we use the inverse hyperbolic sine transformation. This technique approximates the natural logarithm of that variable, but presents and important advantage as it allows retaining zero or negative-valued observations (Bellemare and Wichman, 2020).[19]

When the outcome variable is a binary variable, as when we address the growth versus re-organization issue, we compute a linear probability model as in the following equation for firm f, in municipality m, and year t:

$$Moved_{fmnt} = \delta_m + \lambda_{nt} + \gamma Treated_m \times PostPeriod_{mt} + X'_{mt}\beta + \epsilon_{fmnt} \quad (2)$$

where $Moved$ takes the value of one if firm relocates to another municipality, and zero otherwise. The remaining

[15] In Table A.1, there's a list with the municipalities which were affected by this shock and in Figure A.1, there's a geographical display of these municipalities.

[16] We relax this assumption by constructing a continuous distance decay function of treatment in a robustness test.

[17] See, for example, https://www.publico.pt/2010/06/30/politica/noticia/governo-propoe-portagens-nas-outras-scuts-a-

[18] We acknowledge that controlling for municipal level covariates could also be problematic, as they can also respond to the treatment. Nevertheless, the results are remarkably similar with and without these controls.

[19] A previous version of this paper was written using the log(y+1) to deal with zero-values. All the results using that method are remarkably similar to those we present in this paper and are available from the authors upon request.

variables are defined as before.[20]

Finally, in some specifications, we aggregate firm-level data into municipal-level outcomes to better deal with questions related to the number of incumbent firms, entry or exit. In those cases, we estimate a regression as follows:

$$y_{mnt} = \delta_m + \lambda_{nt} + \gamma Treated_m \times PostPeriod_{mt} + X'_{mt}\beta + \epsilon_{mnt} \quad (3)$$

where all variables are defined as before.

4.3 Identification threats

The internal validity of a difference-in-differences estimation model relies on the parallel trends assumption (Angrist and Pischke, 2008). This assumption states that in absence of treatment, the average outcome of the treatment group would have changed in a similar trend as the average outcome of the comparison group. For a careful test on the validity of the parallel trends assumption, we rely on event study designs for the main outcome variables. An event study has two main advantages. First, it allows us to observe whether the strength of the treatment varies with time. Second, it provides a more rigorous test on whether the common trend assumption holds in the pre-treatment periods (i.e., 2006-2009 in our sample). The estimating equation for the event study of firm f, in municipality m, NUTS 2 region n, and year t is:

$$y_{fmnt} = \alpha_f + \delta_m + \lambda_{nt} + \sum_{t=2006}^{2009} \delta_t Treated_m \cdot Year_t + \sum_{t=2011}^{2016} \delta_t Treated_i \cdot Year_t + \epsilon_{fmnt} \quad (4)$$

and all variables are defined as before. The coefficients of interest are δ, capturing the dynamic effects of the treatment, before and after the introduction of tolls in SCUT highways. Notice that, in Equation (4), the interaction terms for all pre- and post-treatment years are included, except for 2010. This way, all the coefficients are estimated relative to the last pre-treatment year.

Another key threat to our identification strategy arises if there are any other contemporaneous shocks than the treatment occurring during the time period under analysis. In this study, our time period includes one of the greatest recessions in recent history, forcing the Portuguese government to request an international bailout. Given that this crisis might have affected municipalities differently, region-year fixed effects, either at the NUTS 2 or NUTS 3 levels, are used to mitigate this problem.[21] On top of this, we also include a rich vector of municipal-level yearly controls, in some specifications, to take into consideration the socio-demographic and the economic context of these regions.

As mentioned, we also discuss if our results indicate a drastic net-reduction of economic activity in Portugal as a whole, or if they are driven by differential entry and exit patterns or a re-location of firms from the most affected to the least affected municipalities in Portugal. In any case, even in the presence of non-negligible negative effects of the introduction of tolls that spillover to comparison municipalities, we argue that our estimates constitute a lower-bound of the causal impact.

[20] Results are very similar if we add firm fixed effects.

[21] Moreover, Tavares and Pereira dos Santos (2018) show that the allocation of European funds is important for business firms dynamics in Portugal. Since this allocation is done at the NUTS2-level, using regional-year fixed effects can help accounting for this effect.

Lastly, to further mitigate all these possible identification threats, we show that our results are robust to several exercises that we describe below.

4.4 Robustness and Heterogeneity

We perform a battery of robustness checks and exploit the heterogeneity in our sample to shed light on the mechanisms driving our results. Regarding the robustness tests, we show whether our findings hold if we exclude *i)* firms in the municipalities of the Lisbon metropolitan area; *ii)* firms in the 18 district capitals.[22] In the first exercise, we remove from our sample firms that are located in the more urban comparison areas. The second exercise is inspired by the inconsequential place approach, described in Section 2, where we drop from our sample the most important cities in each area (district capitals). For the remaining (minor) cities located close to a major transportation infrastructure, it can be argued that they happen to be "accidentally" located between two important agglomeration local centres. These specifications present the additional advantage that they exclude most of the outliers (e.g., bigger firms) that are located in more urban regions. In two additional exercises, we focus *iii)* on single establishment firms (which account for more than 95% of firm numbers), and *iv)* we relax the assumption that all municipalities are either treated or non-treated. We do it by considering a distance decay function from the address of the town hall of each of the 278 municipalities to the closest SCUT highways computed using geographical information system techniques. Therefore, we rely on a more continuous treatment assignment where some municipalities, because they are closer to these highways, are relatively more affected by the shock.

Regarding heterogeneity, we divide the universe of Portuguese private firms between tradable and non-tradable, and between manufacturing and service sectors.

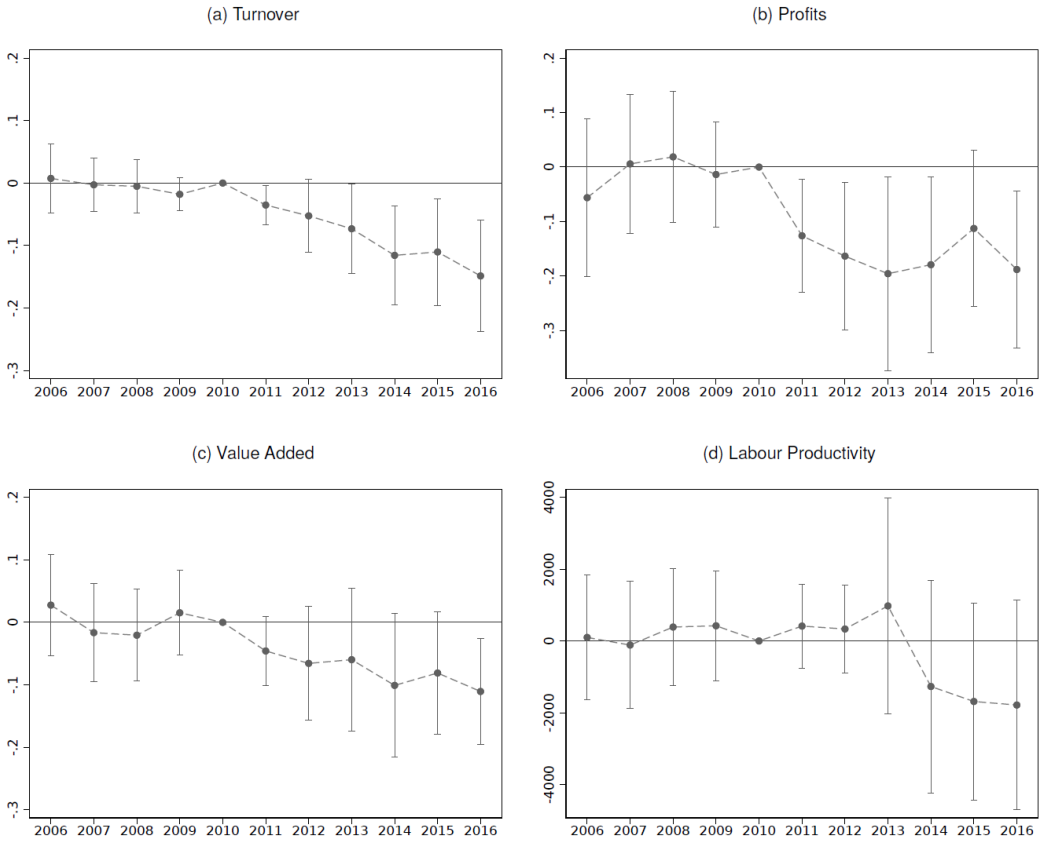
5 Firm performance

We start by analysing the impact of the introduction of tolls on previously toll-free highways on four important indicators of firm performance. We present the event study estimates, computed as in Equation (4), in Figure 2 for firm turnover (in panel a), profits (in panel b), value added (in panel c), and labour productivity (in panel d). For all these outcomes, our results corroborate the parallel trend assumption, i.e., that there are no significant differences between the treatment and the comparison group in the years 2006-2009 before the treatment set in. We find that firms in treated municipalities experienced a significant reduction in their turnover and profits. Furthermore, value added and labour productivity decreased in treated areas after the transportation shock, but results are only significant, for value added, in 2016.

The event study results are confirmed in the difference-in-differences specifications, estimated using Equation (1), and presented in Table 2. On top of showing the results with Nuts 2 $\times$ year fixed effects, we underline that they are robust

[22] In 2003, the Portuguese municipalities were allowed to organize themselves into inter-municipal communities and the two metropolitan areas of Lisbon and Porto. Since then, administrative, financial, and political competencies have been transferred to these entities. Districts in mainland Portugal still serve as a basis for electoral constituencies.

Figure 2: Event Studies – Firm Performance



Notes: The first three variables are measured using the inverse hyperbolic sine transformation. Graphs were computed with Firm, Municipality, and NUTS 2 × Year fixed effects. The 90% confidence levels are calculated using clustered standard errors at the municipal level.

(and more precise) when we consider a more demanding specification with Nuts 3 × year fixed effects and a vector of time-variant municipal controls. We find that firms located in treated municipalities experienced, on average, a decrease of 7.9% in turnover *vis-à-vis* firms located in comparison regions when we consider the specification in column (1) and 10.7% when we consider the specification in column (2). Importantly, profits decreased between 15.3% (in column 3) and 16.3% (in column 4). Moreover, value added deteriorated by around 12%. Finally, we observe a reduction in labour productivity, although non-statistically significant.

The results for the four outcomes are robust to removing firms in municipalities in the Lisbon metropolitan area and in district capitals from the sample, as shown by Table AR.1 in the Appendix. These results also hold if we only consider single establishment firms and an alternative continuous measure using a distance decay function from the town hall address to the closest SCUT highway, as displayed in Table AR.2. Moreover, results seem to be heterogeneous across

Table 2: Firm performance deteriorated with the introduction of tolls

	Turnover		Profits		Value added		Labour Productivity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Treated \times Post$	-0.079*	-0.107***	-0.153*	-0.163**	-0.075	-0.122**	-512.689	-380.933
	(0.043)	(0.037)	(0.082)	(0.083)	(0.054)	(0.059)	(1,155.294)	(1,858.985)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 $\times$ Year FE	Yes	No	Yes	No	Yes	No	Yes	No
NUTS 3 $\times$ Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.607	0.607	0.451	0.451	0.547	0.54 7	0.214	0.215
Observations	3,635,121		3,635,021		3,635,110		2,826,431	

Notes: Standard errors in parenthesis are clustered at the municipal level. The first three variables are measured using the inverse hyperbolic sine transformation. The vector of socio-demographic and economic controls includes electricity consumption per capita, age dependency ratio, population density and expenses per capita. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

firms since the shock affects more tradable than nontradable sectors (see Table AH.1 in the Appendix) and the profits in the manufacturing sector more than in the services sector (see Table AH.2 in the Appendix).

6 Firm behaviour

In this section, we investigate two possible margins of adjustment in response to the increase in transportation costs. First, we zoom in on the inputs that firms use for production. Second, we shed light on whether entrepreneurs decide to open, close, or relocate their businesses.

6.1 Inputs

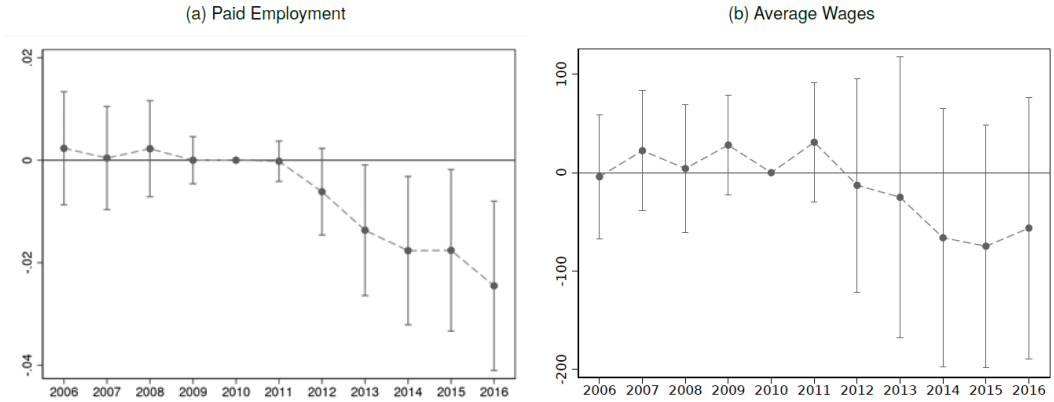
For the inputs, we examine if workers were affected by the shock and separately explore several types of expenses that firms can adjust to respond to the shock. In the end of this subsection, we present a plethora of robustness checks and look into possible heterogeneous effects.

6.1.1 Labour market

We first focus on the labour market impacts of the tolls. We distinguish between the extensive margin (i.e., if the shock caused a reduction in employment) and the intensive margin (i.e., if those who stayed employed experienced a wage cut). We present the event study results, estimated using Equation (4), for labour related outcomes in Figure 3. One can observe that the introduction of tolls had a significantly negative effect on (paid) employment numbers (in panel a) and these effects seem to deteriorate further between 2013 and 2016.

And what happened to the wages of those who managed to keep their job in these firms? To answer this question, we provide the event study specifications of averages wages (in panel b). We find a non significant negative impact caused by the introduction of tolls in treated SCUT highways. This can be explained by the fact that there is a strong downward nominal labour rigidity in Portugal (Dias et al., 2013). Legal restrictions on nominal wage cuts and periods of close-to-zero inflation leave employers with limited margin to adjust real wages. As a consequence, in periods of crisis, employment becomes the main margin of adjustment (Carneiro et al., 2014).[23] In any case, results are substantially noisier than in the pre-treatment years.

Figure 3: Event Studies – Labour market



Notes: The first variable is measured using the inverse hyperbolic sine transformation. Graphs were computed with Firm, Municipality, and NUTS 2 × Year fixed effects. The 90% confidence levels are calculated using clustered standard errors at the municipal level.

The difference-in-differences results, computed as in Equation (1), are presented in Table 3 and confirm the event study insights. We find a negative, although non-statistically significant, decrease for averages wages (in columns 1 and 2). However, we would like to point out that the point estimate of the average yearly decrease is below 40 euros. This constitutes a small effect, even if we consider that, during this period, the minimum monthly wage was below 550 euros (Alexandre et al., 2022).

At the same time, we find a significant reduction of paid employment (in columns 3 and 4) of close to 2% on average, for firms in affected municipalities *vis-à-vis* firms in the comparison group.[24] In addition, our dataset allows us to distinguish between full-time (shown in column 5) and part-time employment (in column 6). Our findings highlight that the effects are concentrated on full-time workers with an estimated decrease of 1.5% in treated areas.

[23] The minimum wage was frozen between 2011 and 2014 at 485 euros.

[24] These results are consistent with the findings of Audretsch et al. (2020), who documented a significantly negative impact on employment at the municipal-level.

Table 3: Employment decreased with the introduction of tolls

	Average Wage		Paid Employment		Full-Time	Part-Time
	(1)	(2)	(3)	(4)	(5)	(6)
$Treated \times Post$	-37.880	-36.804	-0.013*	-0.023***	-0.015**	0.002
	(69.547)	(63.798)	(0.008)	(0.007)	(0.007)	(0.004)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	No	Yes	No	Yes	Yes
NUTS 3 × Year FE	No	Yes	No	Yes	No	No
Controls	No	Yes	No	Yes	No	No
R2	0.702	0.702	0.844	0.844	0.854	0.709
Observations	2,826,431		3,621,415		3,291,641	2,140,383

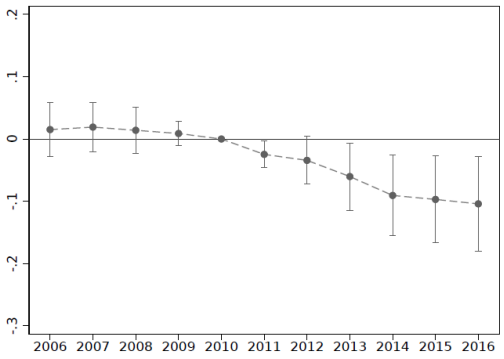
Notes: Standard errors in parenthesis are clustered at the municipal level. The employment variables are measured using the inverse hyperbolic sine transformation. The vector of socio-demographic and economic controls includes electricity consumption per capita, age dependency ratio, population density and expenses per capita. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

6.1.2 Expenses

We investigate whether firm expenses adjusted in reaction to this shock using the event study strategy described in Equation (4). The results are presented in Figure 4. Once again, we find evidence suggesting that the parallel trends assumption holds in this setting. In addition, we observe an increasing deterioration of expenses after the introduction of tolls.

Figure 4: Event Studies – Expenses

(a) Total Expenses



Notes: The variable is measured using the inverse hyperbolic sine transformation. Graphs were computed with Firm, Municipality, and NUTS 2 × Year fixed effects. The 90% confidence levels are calculated using clustered standard errors at the municipal level.

The difference-in-differences results, displayed in Table 4, confirm that total expenses decreased by, on average, between 7.5% (in column 1) and 9.9% (in column 2). Importantly, the level of detail in the dataset allows us to divide

expenses in several categories: employee expenses (in column 3), costs of goods sold and material consumed (in column 4), costs associated with supplies and external services provided to the firm (in column 5), and corporate income tax payments (in column 6). Employee expenses includes wages, social security expenses, and insurance schemes for accidents at work and occupational diseases. These distinctions are important to understand how firm managers reacted to the increase in transportation costs. Our findings suggest the adjustment from the expenditure side impacted labour-related costs with a similar magnitude (about 7%, on average) as the remaining expenses, with the exception of income tax payments that displayment a negative, although non-significant, coefficient.

Table 4: Firm expenses adjusted after the introduction of tolls

	Total Expenses		Employee	Costs of goods	Supplies Ext serv	Income Tax
	(1)	(2)	(3)	(4)	(5)	(6)
$Treated \times Post$	-0.075**	-0.099***	-0.068*	-0.070*	-0.074**	-0.075
	(0.035)	(0.029)	(0.038)	(0.039)	(0.036)	(0.051)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	No	Yes	Yes	Yes	Yes
NUTS 3 × Year FE	No	Yes	No	No	No	No
Controls	No	Yes	No	No	No	No
R-squared	0.639	0.639	0.730	0.816	0.654	0.578
Observations	3,635,118		3,635,121	3,635,121	3,635,121	3,635,110

Notes: Standard errors in parenthesis are clustered at the municipal level. The vector of socio-demographic and economic controls includes electricity consumption per capita, age dependency ratio, population density and expenses per capita. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

In Section 6.1 we provide evidence suggesting that inputs decreased in response to the transportation shock. The results for the three main outcomes in this and in the previous subsection are robust to several exercises. First, removing firms in municipalities in the Lisbon metropolitan area and in district capitals from the sample, as shown in Table AR.3 in the Appendix, do not seem to change our baseline results. Second, results are virtually similar if we focus on single establishment firms or if we consider a balanced sample, as displayed in Table AR.4 in the Appendix. In all cases, we estimate that paid employment falls, on average, 1% to 2%. Although negative, we do not find statistical evidence that average wages were affected. Furthermore, negative impacts seem to be, once again, concentrated in tradable sectors, as can be seen in Table AH.3 in the Appendix. labour-related impact differences between manufacturing and service sectors are more pronounced as can be seen in Table AH.4 in the Appendix.

6.2 Economic deterioration or just re-location?

In this subsection, we shed light on a key public policy question: do these results really indicate a drastic net-reduction of economic activity in Portugal as a whole, or are they just driven by differential regional entry and exit patterns or by the re-location of firms from the most affected to the least affected municipalities in Portugal? While, in the second scenario,

this would imply a zero-sum game for regions, the first case would imply that the Portuguese economy as a whole is negatively affected.

We start by aggregating data at the municipality-level to scrutinise what happened to the number of firms in the affected areas. In Figure 5, we show that firms in treated areas, when compared with non-SCUT regions, are significantly reduced (panel a).

We then analyse whether entry and exit of firms explains the previous pattern. For entry (in panel b), we do not find any statistically significant difference between treatment and comparison groups. This is not true, however, for exit (in panel c). For this outcome, our results do not corroborate the parallel trend assumption. Therefore, difference-in-differences results for firm death should be interpreted with a grain of salt.

Our unique data and setting also allows us to also analyse whether the tolls had a significant effect on inter-municipal firm migration. In order to test this issue, we resort, once again, to firm-level data. Our dependent variable is now an indicator variable that takes value one if a firm decides to change to another municipality and zero otherwise. Deviating from the analysis so far, we do not include firm-fixed effects in this subsection due to the nature of the explanatory variable, which by definition has a very low variability. All remaining specifications will nevertheless continue to include municipal- and year-fixed effects.[25]

We show the event study results in Figure 5 (panel d). We can observe that all point estimates are very close to zero. If anything, these zeros are even more precise after the implementation of tolls in SCUT highways indicating that re-location did not seem to take place.

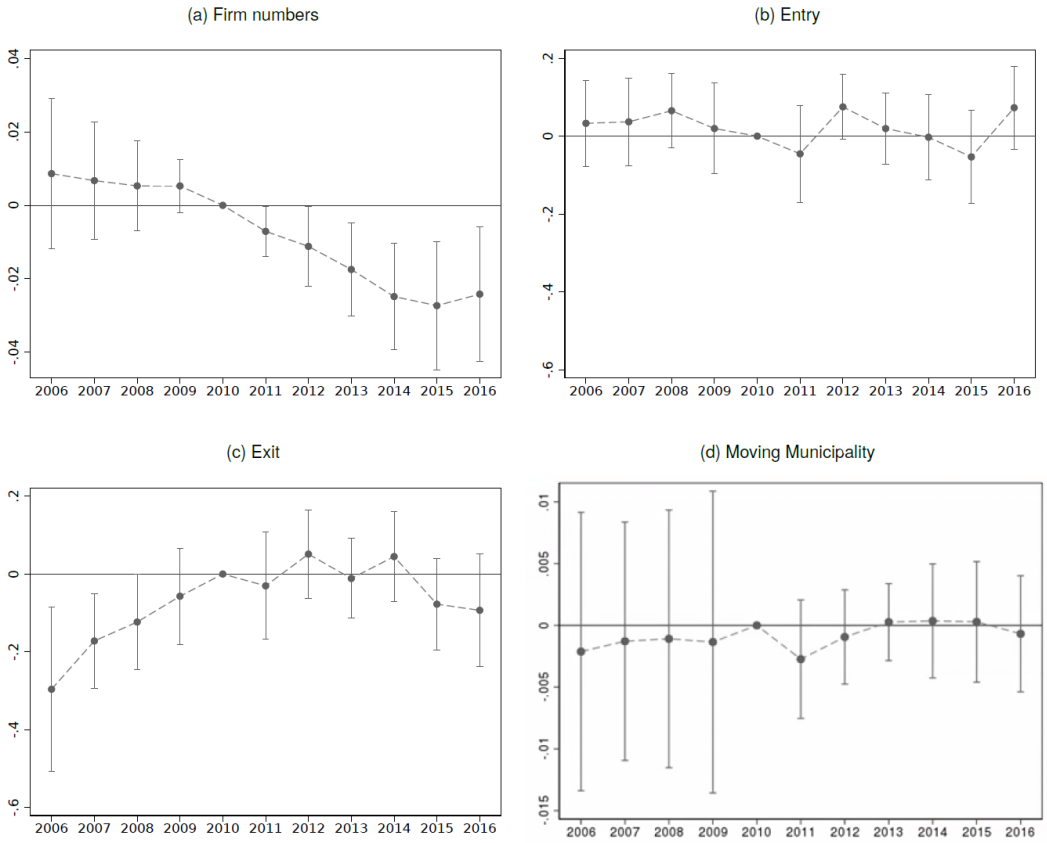
We use the empirical strategy described in Equation (3) to estimate the effects for number of firms, entry, and exit. We present the obtained difference-in-differences results in Table 5. We find that the number of firms reduced significantly in SCUT areas, *vis-à-vis* firms in the remaining municipalities, by 2.4% (in column 1) and by 1.9% (in column 2) when we also control for municipal-level observables. Results for the number of start-ups (in columns 3 and 4) do not seem to react to the introduction of tolls.

We also confirm previous results examining the difference-in-differences obtained from estimating Equation (2) for the probability of firms changing municipality. We find that all estimated coefficients are extremely small and not statistically significant. These precisely estimated zeros corroborate the idea that displacement effects played no significant role and that the tolls on SCUT highways led to a severe deterioration of economic activity in Portugal as a whole. The results are consistent with earlier findings suggesting that Portuguese entrepreneurs tend to have a strong home-bias in deciding the municipality where to locate their firms (Figueiredo et al., 2002).

Finally, these results are unchanged when we exclude all firms located in *i)* the Lisbon metropolitan area, *ii)* in the 18 district capitals, and *iii)* restrict our attention to single establishment firms. This is also the case when we rely on a balanced panel covering the firms that remain in our sample throughout the period of analysis. All these results can

[25] That is, their values vary utmost once from 0 to 1 when a firm changes municipality or exits the market. As such, these variables have very low individual within variation. Therefore, adding firm fixed effects might not be appropriate in Equation (2) as it would condition the results for firms where we necessarily observe transition. Nevertheless, the results are very similar if we include firm fixed-effects.

Figure 5: Event Studies – Firm numbers: Entry and exit



Notes: The first three variables, aggregated at the municipal level, are measured using the inverse hyperbolic sine transformation. The last is a binary indicator measured at the firm-level. Graphs were computed with Municipality and Year (for the first three outcomes) and NUTS 2 × Year fixed effects (for the last). The 90% confidence levels are calculated using clustered standard errors at the municipal level.

be seen in Table AR.5 in the Appendix. Exploring heteregoneity regarding firms in tradable and non-tradable sectors of activity or between those in manufacturing industries and services sectors does not change these conclusions. The results for these exercises are presented in Table AH.5 in the Appendix.

7 Domestic or international trade?

So far, we documented a strong impact of this transportation shock on firm performance and behaviour. We now analyse how the rise in transportation costs impacted the destination of goods and services and the origin of purchases. In both cases, we exploit the extensive and the intensive margins of exporting and importing, as well as the division between the EU or extra EU destination/ origin.

Table 5: Firm numbers deteriorated with the introduction of tolls

	Firm Numbers		Entry		Exit	
	(1)	(2)	(3)	(4)	(5)	(6)
$Treated \times Post$	-0.024**	-0.019*	-0.020	-0.015	0.110**	0.091*
	(0.011)	(0.010)	(0.032)	(0.033)	(0.049)	(0.047)
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No
Controls	No	Yes	No	Yes	No	Yes
R-squared	0.998	0.998	0.944	0.944	0.925	0.926
Observations	3,058		3,058		3,058	

Notes: Standard errors in parenthesis are clustered at the municipal level. Outcome variables are measured using the inverse hyperbolic sine transformation. The vector of socio-demographic and economic controls includes electricity consumption per capita, age dependency ratio, population density and expenses per capita. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table 6: Firms did not change their municipality in reaction to the shock

	Prob Change	
	(1)	(2)
$Treated \times PostPeriod$	0.001	0.002
	(0.003)	(0.004)
Municipality FE	Yes	Yes
NUTS 2 $\times$ Year FE	Yes	No
NUTS 3 $\times$ Year FE	Yes	Yes
Controls	No	Yes
R-squared	0,004	0,005
Observations	3,680,060	

Notes: Standard errors in parenthesis are clustered at the municipal level. The vector of socio-demographic and economic controls includes electricity consumption per capita, age dependency ratio, population density and expenses per capita. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

7.1 Destination of turnover

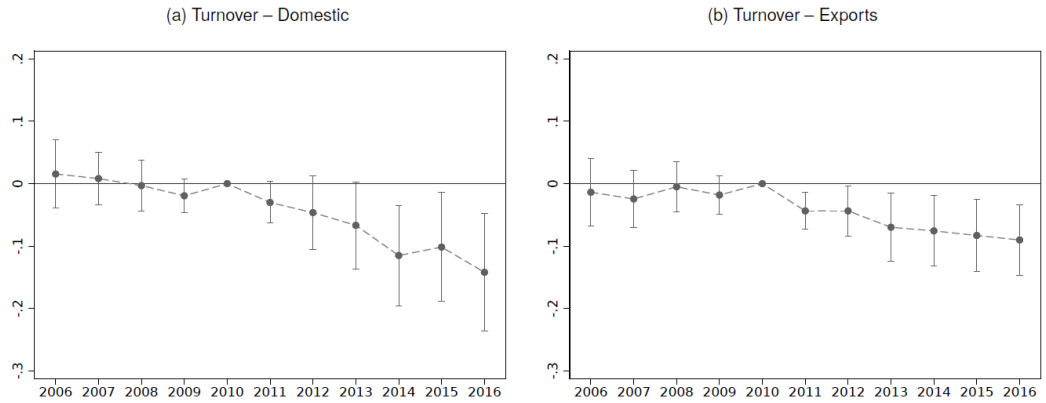
Theoretically, it is not clear if sales to domestic buyers should be more or less affected than sales to foreign buyers by the transportation costs in Portugal. On the one hand, SCUT highways connect several locations in Portugal. On the other hand, some of these highways are the most important roads to Spain. Moreover, it is a well-known stylised fact that exporting firms usually constitute a small share in their own industry. They also tend to be larger and more productive than their domestic counterparts (Melitz, 2003). Hence, they may be more robust to adverse shocks.[26]

This question is tested using Equation (4) and the results are presented in Figure 6 for domestic turnover (in panel

[26]In Portugal, Bastos and Silva (2010) demonstrate that, controlling for distance, exporters in 2005 charged higher prices for goods sold to richer destination markets within narrow product categories. Moreover, Bastos et al. (2018) show that exporting to richer countries leads Portuguese firms to pay higher prices for inputs, raising the average quality of goods they produce.

a) and exports (in panel b). For both outcomes, we find evidence suggesting that the parallel trend assumption holds. Importantly, our results show an increasing deterioration with persistent effects, in the treatment period, for firms in SCUT regions. The decrease in exports sets in directly after the introduction of tolls, whereas the decrease in domestic turnover comes with a time lag of three years. However, the longer run decrease in domestic turnover is stronger than the decrease in exports.

Figure 6: Event Studies – Turnover by destination



Notes: Outcome variables are measured using the inverse hyperbolic sine transformation. Graph computed with Firm, Municipality, and NUTS 2 × Year fixed effects. The 90% confidence levels are calculated using clustered standard errors at the municipal level.

We further decompose these effects computing difference-in-differences regressions as in Equation (1). Our findings are displayed in Table 7. Recall that, in Table 2, we showed that total turnover decreased by 10.7%.

First, we analyse the impact on turnover that is destined to the domestic market. We find that firms subject to this shock experienced a decrease in turnover from internal market by 7.7% (in column 1) and by 10.6% (in column 2) when we consider a more demanding set of fixed effects and a vector of time-variant municipal-level controls.

Second, we focus on the extensive and intensive margins of selling abroad. Our results clearly suggest that the introduction of tolls did not impact the probability of firms to enter export (in column 3). However, the same is not true for the intensive margin. We look into exports and observe that the exports of treated firms decreased by 5.4% (in column 4) more than in the comparison group. The results are, however, non-significant in a more demanding specification when we include Nuts 3 × year fixed effects and municipal controls.

Finally, we go one step further to separately analyse the exports that were going to the EU market and the ones going to the rest of the world. One can see that exports to the EU area (in column 6) were significantly hit while no significant effect was found for the ones directed to the non-EU market (in column 7). More precisely, exports to the EU decreased by 6.7% for firms in treated areas. Note that this decrease in exports coincides with the hypothesis previously made in regards to how the manufacturing sector, as well as firms in the tradable sectors were affected by the shock.

Then it is only natural that these firms were more vulnerable to this shock, given that exports were heavily affected. The results obtained for the sales to the EU and the internal market can be explained by the heavy dependence of these two markets on road transportation.

Table 7: Sales to domestic and foreign EU consumers were affected

	Domestic		Prob of Export	Exports		EU	extra EU
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Treated \times Post$	-0.077*	-0.106***	-0.004	-0.054*	0.005	-0.067**	0.022
	(0.044)	(0.035)	(0.003)	(0.031)	(0.027)	(0.030)	(0.018)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	No	Yes	Yes	No	Yes	Yes
NUTS 3 × Year FE	No	Yes	No	No	Yes	No	No
Controls	No	Yes	No	No	Yes	No	No
R-squared	0.615	0.615	0.654	0.721	0.721	0.718	0.664
Observations	3,635,121		3,635,121		3,635,121		

Notes: Standard errors in parenthesis are clustered at the municipal level. The vector of socio-demographic and economic controls includes electricity consumption per capita, age dependency ratio, population density and expenses per capita. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Regarding the EU market, it is important to highlight that Spain is one of the main trading partners of Portugal[27] and Portugal's gate to the rest of the EU. As mentioned, some of the affected highways are the most important roads to Spain, and Spain's proximity to Portugal makes trade between these two countries particularly dependent on road transportation. By contrast, large part of Portugal's exports to the "rest of the world" is transferred by ship and thus relatively less dependent on road transport than Portugalâs trade with the EU. This could possibly explain the decrease in exports to the EU market.

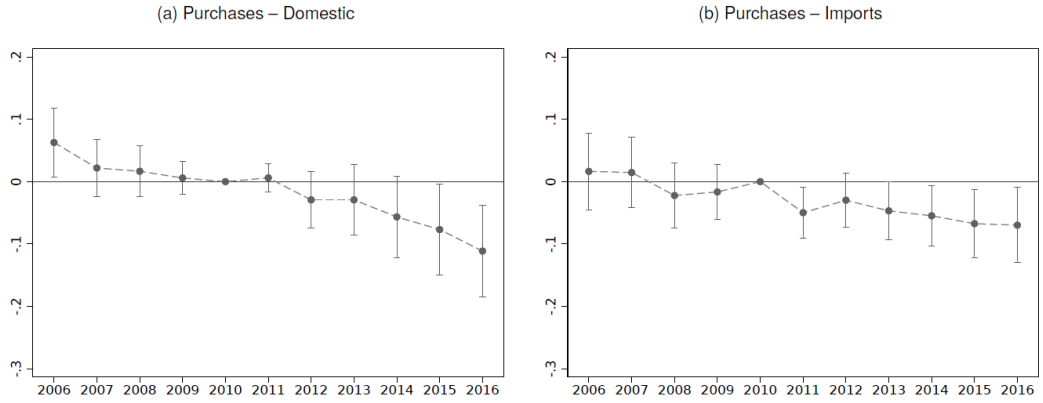
7.2 Origin of purchases

We next investigate whether purchases of raw and intermediate materials were affected by the transportation shock. The event study graphs, estimated using Equation (4), are displayed in Figure 7: domestic purchases (in panel a) and imports (in panel b). Our results show that estimates for domestic purchases should be interpreted with a grain of salt as the parallel trend assumption shows some statistically significant differences between treatment and comparison areas in the first year of our sample, 2006. Nevertheless, the estimated coefficients are very close to zero in the remaining years of the pre-treatment period. The results are very similar to those regarding the destination of turnover as both domestic purchases and imports were negatively influenced by the shock.

We also analyse the effect of an increase in transportation costs on the origin of firm's purchases using difference-in-differences regressions in Table 8. We investigate the following outcome variables: purchases from the internal market (in columns 1 and 2), the probability of importing (in column 3) and the amount of imports (in columns 4 and 5). We find

[27] In 2010, Portugal's exports to Spain accounted for 32% of the total exports made to the EU area.

Figure 7: Event Studies – Purchases by origin



Notes: Outcome variables are measured using the inverse hyperbolic sine transformation. Graphs were computed with Firm, Municipality, and NUTS 2 × Year fixed effects. The 90% confidence levels are calculated using clustered standard errors at the municipal level.

that, whereas the probability of import is not affected, both purchases from the domestic and the international market were impacted: purchases from domestic products were reduced by 6.2% to 9.9%, on average, while total imports were reduced by 4.6% in treated areas. The result is not statistically significant in our most demanding specification. However, if we distinguish between imports from within the EU (in column 6) and Extra EU imports (in column 7), only imports from the EU seem to be affected (4%), although this is not statistically significant, as imports from outside the EU are less dependent on transportation by road.

Table 8: Purchases from domestic and foreign EU consumers were affected

	Domestic		Prob of Import	Imports		EU	extra EU
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Treated \times Post$	-0.062	-0.099***	-0.004	-0.049*	-0.000	-0.042	-0.013
	(0.038)	(0.029)	(0.003)	(0.0267)	(0.022)	(0.026)	(0.011)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	No	Yes	Yes	No	Yes	Yes
NUTS 3 × Year FE	No	Yes	No	No	Yes	No	No
Controls	No	Yes	No	No	Yes	No	No
R-squared	0.812	0.812	0.659	0.734	0.733	0.731	0.679
Observations	3,635,121		3,635,121		3,635,121		

Notes: Standard errors in parenthesis are clustered at the municipal level. The vector of socio-demographic and economic controls includes electricity consumption per capita, age dependency ratio, population density and expenses per capita. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

The results for the main outcome variables in this section are robust to excluding all firms in the Lisbon metropolitan area, in district capitals, in a restricted sample of single establishment firms, and replacing the binary indicator for

treatment for a distance decay function. These results can be seen in Table AR.6 and in Table AR.7 in the Appendix. However, trade-related results on exports and imports are less precisely estimated and are not statistically different from zero in these specifications. Finally, heterogeneity results highlight that negative effects are concentrated in the tradable sectors (in Table AH.6 in the Appendix) and in manufacturing firms (in Table AH.7 in the Appendix). Overall, we find that economic exchange within Portugal and with partners in the EU decreases, whereas overseas trade is not much affected by the tolls.

8 Conclusion

Politicians in several countries argue that new highways are worth large amounts of public money because they stimulate, among other effects, private business sector activity and lead to economic development. In fact, however, it is very difficult to assert the efficacy of these efforts in a causal manner as roads are not assigned to locations randomly. We deal with this fundamental endogeneity problem examining the impact of a substantial reduction in transportation costs on the performance of private firms. In our setting, the provision of transportation infrastructure remains constant throughout the period.

Interurban road tolls can affect firm performance in several ways, which are not well understood. While earlier work has focused on municipality-level firm numbers and employment, the current paper allows deeper insights by analysing the effect of the introduction of road tolls on a broad variety of firm-level performance measures, using a rich administrative micro dataset covering the universe of private firms in a country. Theoretically, both demand and supply factors can play a role.

Our findings show that the tolls had a significant negative effect on firm turnover (especially serving the domestic market, but also on exports) and purchases (especially those from the domestic market, but also, to a lesser extent, on imports). The impact is more pronounced for turnover than for total expenses, and therefore, firm profits are negatively hit. Firm value-added and (paid) employment numbers also decrease more for firms located in affected areas impacted by this shock in transportation costs. In addition, average wages and labour productivity decline, but the effect is not statistically significant. Full-time employees suffer more (in terms of employment losses) than part-time employees. The majority of effects for all these outcomes are medium-term, i.e., still persistent six years after the introduction of tolls.

Critically, we find that inter-regional firm migration has not played a major role in response to the introduction of tolls. In other words, we observe a real deterioration of economic activity and not just a relocation of economic activity. This is extremely important for the assessment of the overall welfare effects of these tolls, as losses in the (most) affected municipalities were not compensated by benefits in the less or non-affected regions. All our results are robust to a plethora of exercises restricting both the treatment and the comparison group. In this regard, the exercise where we exclude all firms in the major cities of the country is especially interesting as it resembles the inconsequential places approach that is also common in the urban and trade literature.

Our results thus provide compelling evidence that affordable road infrastructure has a key impact on private firm performance and that an unduly high increase in the user cost of road infrastructure can cause a net loss to individual firms as well as to the economy as a whole. Future research can further disentangle the impact of this natural experiment on the financial conditions of firms, depending on their pre-shock level of debt and their relations with the banking system.

Acnowledgments

The authors are grateful to Pedro Bação, Pedro Pita Barros, Samira Barzin, Mário Centeno, Dave Donovan, Luisa Doerr, Ed Glaeser, Nezih Guner, Julian Hinz, Adelheid Holl, Gabriel Kreindler, Xiang Li, Susana Peralta, Alfredo M Pereira, Miguel Portela, Pedro Portugal, Francisco Queiró, Lasare Samartzidis, Rok Spruk, and seminar participants at Nova SBE, the DUP meeting (Harvard University), the 3rd CompNet ProdTalks, SAEe2020, the 9^{th} PhD Student Workshop on Industrial and Public Economics (ECO-SOS), the 10^{th} European Meeting of the Urban Economic Association, COMPIE 2021, the 14^{th} Annual Meeting of the PEJ, the European Association for Research in Industrial Economics (EARIE) Annual Conference 2021, Jornadas de Economia Industrial of the Spanish Economic Association, 11^{th} ifo Dresden Workshop on Regional Economics, and CAED 2021 (Coimbra) for useful comments and suggestions. We would also like to thank *BPLim – Banco de Portugal* for providing the necessary data for this study. This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209) and the research project PTDC/EGE-ECO/31213/2017. All errors are our own.

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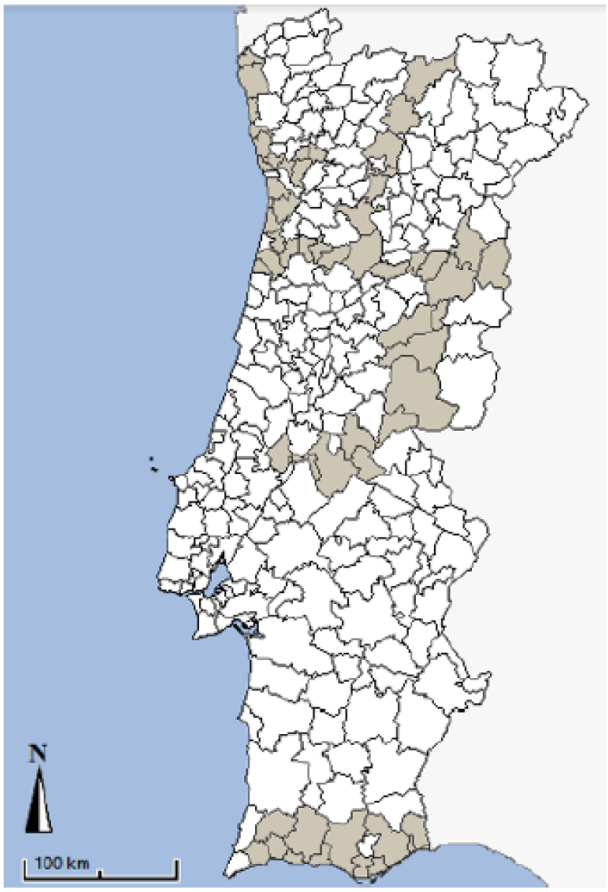
Figures

Figure A.1: Geographical Distribution of Affected Municipalities



Note: Darkened regions represent treated municipalities whereas light regions depict municipalities in the comparison group.

Tables

Table A.1: Municipalities Affected by the Introduction of Tolls in the SCUT Highways

SCUT Highway	Municipalities Affected
Tolls introduced on the 15^{th} October 2010	
SCUT Grande Porto - 79 Km	
A4: AE Transmontana	Matosinhos, Maia.
A41: CREP - Circular Regional Exterior do Porto	Matosinhos, Valongo, Santa Maria da Feira, Espinho.
A42: AE Douro Litoral	Valongo, Paços de Ferreira, Paredes, Lousada.
SCUT Litoral Norte -113 Km	
A28	Matosinhos, Vila do Conde, Póvoa de Varzim, Esposende, Viana do Castelo, Caminha.
SCUT Costa da Prata – 110 Km	
A29	Estarreja, Ovar, Espinho, Vila Nova de Gaia.
Tolls introduced on the 8^{th} December 2011	
SCUT Algarve – 133 Km	
A22	Lagos, Monchique, Portimão, Lagoa, Silves, Albufeira, Loulé, Faro, Olhão, Tavira, Castro Marim, Vila Real de Sto. António.
SCUT Beira Interior – 217 Km	
A23	Torres Novas, Entroncamento, Constancia, Abrantes, Marvão, Gavião, Vila Velha de Rodão, Vila Nova da Barquinha,Castelo Branco, Fundão, Belmonte, Covilha, Guarda.
SCUT Interior Norte – 162 Km	
A24	Viseu, Castro Daire, Lamego, Peso da Régua, Vila Real, Vila Pouca de Aguiar, Chaves.
SCUT Beiras Litoral e Alta – 173 Km	
A25	Íhavo, Aveiro, Albergaria-a-Velha, Sever do Vouga, Oliveira de Frades, Vouzela, Viseu, Mangualde, Fornos de Algodres, Celorico da Beira, Guarda, Pinhel, Almeida.

Robustness Tests

Table AR.1: Firm performance Robustness: excluding i) the Lisbon metropolitan area and ii) district capitals

	Turnover		Profits		Value Added		Labour Productivity	
	no Lisbon	no Capitals	no Lisbon	no Capitals	no Lisbon	no Capitals	no Lisbon	no Capitals
$Treated \times Post$	-0.079*	-0.134***	-0.154*	-0.206**	-0.074	-0.139**	-524.569	138.618
	(0.043)	(0.049)	(0.082)	(0.104)	(0.054)	(0.063)	(1,158.388)	(1,112.071)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.610	0.611	0.456	0.450	0.551	0.546	0.213	0.211
Observations	2,431,368	2,555,134	2,431,341	2,555,086	2,431,365	2,555,130	1,931,176	2,023,946

Notes: Standard errors in parenthesis are clustered at the municipal level. The first three variables are measured using the inverse hyperbolic sine transformation. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AR.2: Firm performance Robustness: i) only single establishments and ii) continuous treatment

	Turnover		Profits		Value Added		Labour Productivity	
	Single	Continuous	Single	Continuous	Single	Continuous	Single	Continuous
$Treated \times Post$	-0.078*		-0.158*		-0.068		-169.329	
	(0.045)		(0.084)		(0.057)		(1,181.832)	
$Distdecay \times Post$		-0.043*		-0.231*		-0.092*		885.160
		(0.023)		(0.135)		(0.048)		(807.530)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.603	0.607	0.451	0.451	0.546	0.547	0.559	0.214
Observations	3,519,597	3,635,121	3,519,514	3,635,021	3,519,588	3,635,110	2,715,722	2,826,431

Notes: Standard errors in parenthesis are clustered at the municipal level. The first three variables are measured using the inverse hyperbolic sine transformation. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AR.3: Inputs Robustness: excluding i) the Lisbon metropolitan area and ii) district capitals

	Average Wage		Paid Employment		Total Expenses	
Exclude	no Lisbon	no Capitals	no Lisbon	no Capitals	no Lisbon	no Capitals
$Treated \times Post$	-38.640	-137.544**	-0.013*	-0.018**	-0.074**	-0.103**
	(68.903)	(67.329)	(0.008)	(0.009)	(0.035)	(0.040)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.685	0.688	0.843	0.844	0.643	0.644
Observations	1,931,176	2,023,946	2,422,977	2,545,863	2,431,368	2,555,132

Notes: Standard errors in parenthesis are clustered at the municipal level. The last two variables are measured using the inverse hyperbolic sine transformation. The vector of socio-demographic and economic controls includes electricity consumption per capita, age dependency ratio, population density and expenses per capita. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AR.4: Inputs Robustness: i) only single establishments and ii) continuous treatment

	Paid Employment		Average Wage		Labour Productivity	
	Single	Continuous	Single	Continuous	Single	Continuous
$Treated \times Post$	-40.635		-0.013*		-0.075**	
	(71.821)		(0.008)		(0.036)	
$Distdecay \times Post$		-45.637		0.002		-0.011
		(62.406)	(0.005)	(0.017)		
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.027	0.051	0.006	0.007	0.000	0.000
Observations	3,553,977	1,667,255	2,775,850	1,484,934	2,775,850	1,484,934

Notes: Standard errors in parenthesis are clustered at the municipal level. The vector of socio-demographic and economic controls includes electricity consumption per capita, age dependency ratio, population density and expenses per capita. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AR.5: Moved Robustness: i) excluding the Lisbon metropolitan area, ii) excluding district capitals, iii) single establishment firms, and iv) balanced sample

	Moved			
	no Lisbon	no Capitals	Single	Balanced
$Treated \times Post$	0.002	0.003	0.002	0.002
	(0.004)	(0.002)	(0.005)	(0.003)
Firm FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
NUTS 3 × Year FE	Yes	Yes	Yes	Yes
Controls × Year FE	Yes	Yes	Yes	Yes
Observations	2,461,358	2,592,200	3,356,784	1,668,469
R-squared	0.004	0.005	0.005	0.005

Notes: Standard errors in parenthesis are clustered at the municipal level. The vector of socio-demographic and economic controls includes electricity consumption per capita, age dependency ratio, population density and expenses per capita. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AR.6: Trade Robustness: excluding i) the Lisbon metropolitan area and ii) district capitals

	Domestic Turnover		Exports		Domestic Purchases		Imports	
Exclude	no Lisbon	no Capitals	no Lisbon	no Capitals	no Lisbon	no Capitals	no Lisbon	no Capitals
$Treated \times Post$	-0.076*	-0.077*	-0.053*	-0.054*	-0.060	-0.062	-0.048*	-0.049*
	(0.044)	(0.044)	(0.031)	(0.031)	(0.038)	(0.038)	(0.027)	(0.027)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.035	0.039	0.004	0.003	0.047	0.050	0.004	0.003
Observations	2,431,368	3,635,121	2,431,368	3,635,121	2,431,368	3,635,121	2,431,368	3,635,121

Notes: Standard errors in parenthesis are clustered at the municipal level. All variables are measured using the inverse hyperbolic sine transformation. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AR.7: Trade Robustness: i) only single establishments and ii) balanced sample

	Domestic Turnover		Exports		Domestic Purchases		Imports	
	Single	Continuous	Single	Continuous	Single	Continuous	Single	Continuous
$Treated \times Post$	-0.076		-0.053*		-0.063		-0.048*	
	(0.046)		(0.031)		(0.039)		(0.026)	
$Distdecay \times Post$		-0.041*		-0.026		-0.020		-0.005
		(0.024)		(0.029)		(0.026)		(0.024)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.037	0.056	0.003	0.007	0.047	0.053	0.003	0.003
Observations	3,556,604	1,668,469	3,556,604	1,668,469	3,556,604	1,668,469	3,556,604	1,668,469

Notes: Standard errors in parenthesis are clustered at the municipal level. All variables are measured using the inverse hyperbolic sine transformation. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Heterogeneity Tests

Table AH.1: Firm performance Heterogeneity: Tradables vs non-tradables

	Turnover		Total Expenses		Value Added		Profits	
	T	NT	T	NT	T	NT	T	NT
$Treated \times Post$	-0.105**	-0.054	-0.279**	-0.045	-0.134*	-0.021	-1,614.967	570.191
	(0.045)	(0.047)	(0.122)	(0.089)	(0.075)	(0.060)	(2,825.926)	(526.795)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.613	0.609	0.443	0.463	0.549	0.548	0.214	0.472
Observations	1,608,599	2,022,832	1,608,514	2,022,817	1,608,591	2,022,829	1,290,478	1,532,650

Notes: Standard errors in parenthesis are clustered at the municipal level. The first three variables are measured using the inverse hyperbolic sine transformation. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AH.2: Firm performance Heterogeneity: Manufacturing vs Services

	Turnover		Total Expenses		Value Added		Profits	
	M	S	M	S	M	S	M	S
$Treated \times Post$	-0.084	-0.078*	-0.475***	-0.028	-0.177	-0.041	-2,143.525	164.065
	(0.070)	(0.041)	(0.149)	(0.073)	(0.112)	(0.051)	(3,999.295)	(608.336)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.609	0.612	0.422	0.466	0.537	0.550	0.673	0.394
Observations	877,193	2,646,751	877,173	2,646,672	877,189	2,646,745	717,459	2,025,939

Notes: Standard errors in parenthesis are clustered at the municipal level. The first three variables are measured using the inverse hyperbolic sine transformation. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AH.3: Inputs Heterogeneity: Tradables vs non-tradables

	Paid Employment		Average Wage		Labour Productivity	
	T	NT	T	NT	T	NT
$Treated \times Post$	-0.019**	-0.003	-16.127	-45.927	-1,614.967	570.191
	(0.007)	(0.006)	(95.829)	(63.495)	(2,825.921)	(526.794)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.017	0.039	0.005	0.007	0.000	0.001
Observations	1,626,134	2,041,251	1,318,925	1,565,595	1,190,473	1,377,044

Notes: Standard errors in parenthesis are clustered at the municipal level. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AH.4: Inputs Heterogeneity: Manufacturing vs Services

	Average Wage		Paid Employment		Total Expenses	
	M	S	M	S	M	S
$Treated \times Post$	-112.097	5.130	-0.018	-0.012*	-0.099*	-0.065**
	(80.879)	(72.217)	(0.018)	(0.007)	(0.058)	(0.031)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.671	0.711	0.850	0.838	0.650	0.639
Observations	717,459	2,025,939	874,533	2,635,937	877,193	2,646,748

Notes: Standard errors in parenthesis are clustered at the municipal level. The last two variables are measured using the inverse hyperbolic sine transformation. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AH.5: Moved Heterogeneity: Tradables vs non-tradables and Manufacturing vs Services

	Moved			
	T	NT	M	S
$Treated \times Post$	0.001	0.001	0.000	0.000
	(0.003)	(0.003)	(0.002)	(0.003)
Firm FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes
Observations	1,631,134	2,048,926	887,783	2,682,601
R-squared	0.005	0.004	0.005	0.005

Notes: Standard errors in parenthesis are clustered at the municipal level. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AH.6: Trade Heterogeneity: Tradables vs non-tradables

	Domestic Turnover		Exports		Domestic Purchases		Imports	
	T	NT	T	NT	T	NT	T	NT
$Treated \times Post$	-0.107**	-0.050	-0.062*	-0.044	-0.066*	-0.046	-0.040	-0.051
	(0.047)	(0.047)	(0.033)	(0.033)	(0.039)	(0.047)	(0.025)	(0.035)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.619	0.619	0.744	0.691	0.853	0.775	0.748	0.726
Observations	1,608,599	2,022,832	1,608,599	2,022,832	1,608,599	2,022,832	1,608,599	2,022,832

Notes: Standard errors in parenthesis are clustered at the municipal level. All variables are measured using the inverse hyperbolic sine transformation. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

Table AH.7: Trade Heterogeneity: Manufacturing vs Services

	Domestic Turnover		Exports		Domestic Purchases		Imports	
	M	S	M	S	M	S	M	S
$Treated \times Post$	-0.079	-0.075*	-0.089	-0.027	-0.153**	-0.038	-0.062*	-0.039
	(0.065)	(0.042)	(0.057)	(0.021)	(0.077)	(0.029)	(0.035)	(0.028)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NUTS 2 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.045	0.034	0.009	0.003	0.051	0.038	0.007	0.003
Observations	439,117	2,682,601	439,117	2,682,601	439,117	2,682,601	439,117	2,682,601

Notes: Standard errors in parenthesis are clustered at the municipal level. All variables are measured using the inverse hyperbolic sine transformation. Asterisks indicate significance levels of 10% (*), 5% (**), and 1%(***), respectively.

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