# Transportation Costs and Firm Performance Evidence from a Natural Experiment

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# This Paper

Research Question: What is the impact of an increase in transportation costs on firm level outcomes? Identification Strategy: Natural experiment taking advantage of a switch from free to charged highway provision in Portugal

- Unexpected: part of a fiscal adjustment program
- Rich firm-level data for all Portuguese private firms
- Diff-in-Diff strategy from Audretsch et al. (2020, JoEG)

Results: Significant decreases in turnover, expenses, value added, employment, and labor productivity

### Our contribution Challanges

- Not straightforward to study the causal effect of transport infrastructure on economic outcomes
- Transport Infrastructure is usually not assigned at random
- Endogeneity Problem

# Our contribution

Literature

According to Redding and Turner (2015), there are three main approaches in the literature to tackle this problem:

#### 1. 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).

#### 2. Historical Route IV

Duranton and Turner (2012), Duranton and Turner (2011), Duranton et al. (2014), Baum-Snow et al. (2017), García López et al. (2013), Hsu and Zhang (2014), Martincus et al. (2017).

#### 3. Inconsequential Place Approach

Chandra and Thompson (2000), Banerjee et al. (2012), Datta (2012), Faber (2014), Ghani, Goswami and Kerr (2016), Fretz et al. (2017).

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A less common alternative: a Natural Experiment

# Our contribution

- "The emphasis has traditionally been on macro-economic studies (...), but recently the focus is shifting to micro-economic analyses." (Holl, 2016)
- "While these approaches remain open to criticism and refinement, they are about as good as can be hoped for in an environment where experiments seem implausible" (Redding and Turner, 2015)

### Institutional Background The SCUT Highway System

- Built during the period 1990-2008
- New and modern highway system
- ▶ 1/3 of total Portuguese highway network
- Free of charge

"Sem Custo para o Utilizador" or "Without Cost for the User"

### The Natural Experiment

Switch to Charged Highway Provision

- Introduction of tolls on SCUT highways:
  - 1. October 15, 2010
  - 2. December 8, 2011
- "To help keep Portugal's 78 bn bailout on track, the government has been forced to introduce charges on more than 900 km of roads where there was previous none, triggering angry protests and increasing business costs."



High toll charges leave Portugal's drivers on road to nowhere



Peter Wise in Lisbon AUGUST 25, 2013

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# The Natural Experiment

Treatment and Comparison Groups

- Treated Municipalities: have a segment of the SCUT highway (59)
- Comparison Municipalities: have no segment of the SCUT highway (219)
- Pre-treatment Balance tests



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# Empirical Strategy

#### Difference-in-Differences Event Study:

 $\ln(\mathbf{y})_{fmnt} = \beta_0 + \alpha_f + \lambda_{nt} + \sum_{t=2006}^{2009} \delta_t \operatorname{Treated}_f \cdot \operatorname{Year}_t + \sum_{t=2011}^{2016} \delta_t \operatorname{Treated}_f \cdot \operatorname{Year}_t + X'_{mnt}\beta + \epsilon_{fmnt}$ 

where:

- In(y)<sub>fmnt</sub>: firm-level outcome variable of interest
- α<sub>f</sub> : municipality fixed effects
- λ<sub>nt</sub>: Nuts2 year fixed effects
- X<sub>mnt</sub>: Municipal-level controls
- Robust standard errors clustered by municipality

### Data

#### Firm Level Data

Banco de Portugal (Central Balance Sheet): turnover, number of workers, exports, sales, average wage, inventories, labor productivity, location and status.

#### Municipal Level Data

- Instituto Nacional de Estatística: population density and age dependency ratio
- Direção Geral de Energia e Geologia: electricity consumption per capita
- Direção Geral das Autarquias Locais: municipal expenses per capita

### Turnover



Notes: N= 3680060. Graph computed with firm and Nuts 2-year FE. 90% confidence intervals calculated using clustered standard errors at the municipal level.

### Turnover Destination

	(1)	(2)	(3)	(4)
	Internal	Exports	EU	Extra EU
Treated $ imes$ PostPeriod	-0.0721*	-0.0505*	-0.0646**	0.0207
	(0.0406)	(0.0275)	(0.0255)	(0.0175)
R-squared	0.036	0.003	0.003	0.005
Ν	3680060	3680060	3680060	3680060
Firm FE	Yes	Yes	Yes	Yes
Nuts 2 $ imes$ Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

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

### Expenses



Notes: N= 3680060. Graph computed with firm and Nuts 2-year FE. 90% confidence intervals calculated using clustered standard errors at the municipal level.

### Purchases Origin

	(1)	(2)	(3)	(4)
	Internal	Imports	EU	Extra EU
Treated $ imes$ PostPeriod	-0.0615*	-0.0530*	-0.0403*	-0.0126
	(0.0336)	(0.0277)	(0.0215)	(0.0092)
R-squared	0.046	0.003	0.003	0.001
Ν	3680060	3680060	3680060	3680060
Firm FE	Yes	Yes	Yes	Yes
Nuts 2 $ imes$ Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

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

### Value Added



Notes: N= 3062711. Graph computed with firm and Nuts 2-year FE. 90% confidence intervals calculated using clustered standard errors at the municipal level.

### Employment



Notes: N= 3680060. Graph computed with firm and Nuts 2-year FE. 90% confidence intervals calculated using clustered standard errors at the municipal level.

### Employment Full or Part time?

	(1)	(2)		(3)	(4)
	Log Employment		F	ull-Time	Part-Time
Treated $ imes$ PostPeriod	-0.0110*	-0.0111*	- 0	0.0132**	0.0012
	(0.0058)	(0.0058)	(	0.0058)	(0.0028)
R-squared	0.026	0.026		0.024	0.007
Ν	3667385	3667385	3	345267	2215656
Firm FE	Yes	Yes		Yes	Yes
Nuts 2 $ imes$ Year FE	Yes	Yes		Yes	Yes
Controls		Yes		Yes	Yes

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

### Average Wages



Notes: N= 3680060. Graph computed with firm and Nuts 2-year FE. 90% confidence intervals calculated using clustered standard errors at the municipal level.

# Labor Productivity



Notes: N= 3680060. Graph computed with firm and Nuts 2-year FE. 90% confidence intervals calculated using clustered standard errors at the municipal level.

Changes in the level of economic activity vs. a reorganization of existing activity

"While much effort has been directed to unraveling the problem of non-random assignment of infrastructure to places, much less has been directed to distinguishing between growth and reorganization. This distinction is clearly central to any understanding of the role of infrastructure and transportation costs in an economy." (Redding and Turner, 2015)

# Probability of Moving

	(1)	(2)
	Prob Change	
Treated $ imes$ PostPeriod	0.0008	0.0005
	(0.0027)	(0.0026)
R-squared	0,023	0,023
Ν	3.677.473	3.677.473
Municipality FE	Yes	Yes
Nuts 2 $ imes$ Year FE	Yes	Yes
Controls		Yes

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

### Next steps

- 1. Intensity measures using Market Access?
- 2. Heterogeneity:
  - sectors of activity
  - tradables vs non-tradable sectors
- 3. Robustness:
  - Removing Metropolitan Areas
  - Removing District Capitals
- 4. More productivity measures?
- 5. Probability of Enter and Exit
- 6. Probability of Exporting and Importing

# Conclusion

- 1. Sizable decrease in firms' turnover, expenses, and value added
  - Exports to EU partner countries and sales to internal market
  - Purchases from EU partner countries and from the internal market
- 2. Significant decrease in number of employees and labor productivity.
- 3. No changes on the probability of moving.

# Thank you for your attention! joao.santos@novasbe.pt