Do highways help post-communist transition? Evidence from Hungary

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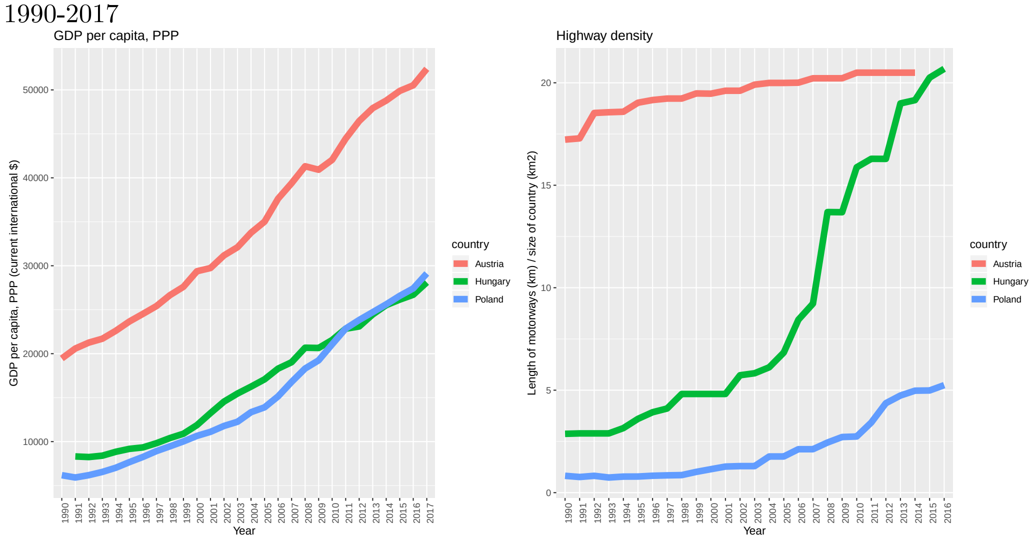
1. Research Question

After the fall of communism, the economy of every Eastern European state was in ruins. The transition from a planned economy - where the state owned almost all the means of production - was painful. Mass layoffs quickly turned full employment in 1989 to high levels of unemployment - 9.3% in Hungary and 14% in Poland by 1992 (International Monetary Fund, 2018). Industries which had been shielded faced intense competition from foreign corporations and emerging new firms. The fall of communism also affected economic geography - Central European countries lost custom-free access to their primary trading partner, the Soviet Union. Their goal was fast integration to the Western European economy. Most of the Central European countries integrated successfully, Hungary and Poland increased their purchasing-power adjusted GDP per capita threefold between 1992 and 2016 (World Bank (2019), see Figure 1). However, their path of transition was different in many aspects, including their spending on highway infrastructure.

Hungary increased its highway network from 269 km in 1992 to 1924 km in 2016 (Eurostat, 2019). Figure 1 shows this expansion relative to the size of the country. Starting from a low level which was close to Poland it increased to the level of Austria, a much wealthier and more productive country. This paper is interested in how much of the GDP growth can be attributed to highways in Hungary between 1992 and 2016. We are interested in whether the post-socialist transition led to a massive spatial redistribution of economic activity and whether regions close to Western-European markets benefitted from their location. Besides, we estimate agglomeration elasticities for Hungary which have not been done before in an Eastern European setting even though it is essential for urban and transportation project appraisal.

Figure 1: GDP per capita and highway density figures for Austria, Hungary and Poland, 1990-2017

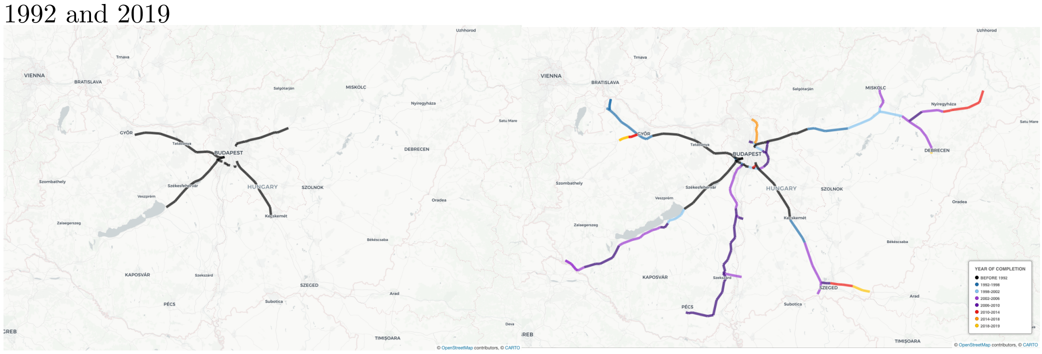


2. Data & Methodology

The research uses the firm level Cegtar database (Opten, 2019), which accounts for almost 99% of economic activity in Hungary between 1992 and 2016. The database provides the balance sheets and income statements of every company submitted to the Hungarian Tax and Customs Administration in Hungary. Full address level for every reporting unit is provided for every year which makes it possible to analyse the data using small geographical areas.

This highly disaggregate, full-address level database enables sophisticated panel and instrumental variables methodologies. First, we estimate firm productivity for every major industry and level of conurbation separately using the semiparametric methods of Olley and Pakes (1996) and Levinsohn and Petrin (2003). Second, we estimate the causal impact of new highways on aggregate firm productivity for a certain small geographic area. This enables us to estimate the causal local economic impact of the highway system on Hungarian GDP.

Figure 2: The geographical scope of the major highway expansion in Hungary between 1992 and 2019



Graham and Gibbons (2017) explain how an increased provision of transportation determines agglomeration via increased access to economic mass. Increased access changes the effective scale of access to economic activity for firms which makes them more productive. Access to economic mass is calculated using an effective density (ρ) measure:

$$\rho_i = \sum_{j=1}^{n} m_j f(D_{ij}), \tag{1}$$

where m_j is economic mass (employment in our case) at area j, D_{ij} is measures the cost of travel between areas i and j (both geographic distance and driving times in our case), and $f()$ is a decreasing function of D_{ij}. This captures the effects of both scale and spatial proximity, and through the decreasing function of the cost of travel it incorporates an implicit transport dimension.

Transportation investments change access to economic mass (ρ) and thus change overall productivity (Ω_i) for the area:

$$\Omega_i = f(\rho_i, Z_i), \tag{2}$$

where Z_i is a vector of variables representing all other variables which have an impact on productivity, and rho_i is taken as a productivity shifter. We are interested in $\sigma = \partial \log \omega_i / \partial \rho_i$: the shift in productivity which is caused by increasing the level of access to economic mass.

Following the structural work of Redding and Turner (2015), our reduced form framework is a simple taxonomy which is interested in explaining small geographical area-level firm productivity with a change in transportation possibilities taken as a productivity shifter. A similar approach is taken by Pogonyi et al. (2018), Ahlfeldt and Feddersen (2018), Gibbons et al. (2017):

$$\Omega_{it} = \alpha + \beta HW_{it} + \gamma adjacent_{it} + \kappa X_{it} + \delta_i + \theta_t + \epsilon_{it}, \tag{3}$$

where Ω_{it} denotes the natural logarithm of aggregate productivity for area i and time t. HW_{it} denotes a measure of transportation infrastructure for unit i, and in this study, this will be a dummy variable which takes the value of one if i is treated by a new highway. β shows the overall net impact of the highway on productivity. We consider every area as treated which is within a certain distance from the nearest highway access point. This distance will be estimated non-parametrically using spatial dummy variables. $adjacent_{it}$ denotes the area directly surrounding the treated area, and it is not significantly different from zero if HW_{it} controls for the complete geographical scope of the impact. X_{it} denotes a vector of location- and time-varying covariates, δ_i denotes location specific time-invariant unobservables, θ_t is a time effect and ϵ_{it} is a time and location-specific residual. The coefficient of interest is β, which in our case will show the impact of highways on aggregate firm productivity.

3. Identification strategy

This paper addresses potential reverse causality concerns. The state wanted to increase economic output and productivity with the alignment of the highways, and this may result in overestimating the actual impact.

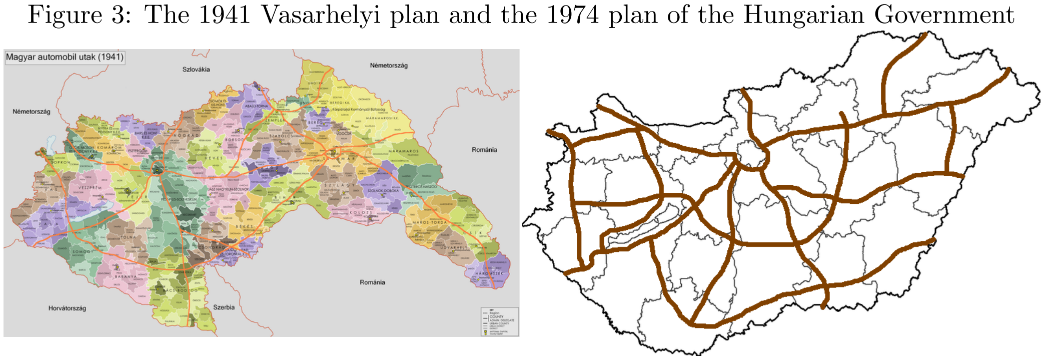
The identification strategy replicates the following experimental setting. Consider a set of small geographical areas which are identical in every respect before a new highway access is opened: they have the same aggregate productivity, employment size, economic density, transportation accessibility, and other covariates. The highway is taken as an experiment with highway access opening randomly in Hungary, changing transportation possibilities for some areas, but leaving others unchanged. The observed change between these two set of areas in 2016 is the causal impact of highways on firm productivity.

We control for omitted variable bias by using year and area fixed effects and some important variables. Year fixed effects (θ_t in Equation 3) control for time-specific confounding (like a Hungary-wide economic depression), whereas area fixed effects (δ_t in Equation 3) control for area-specific confounding (the impact of geography or historical variables). We control for previous access to highways, sectoral employment shares and proximity to the nearest country border or Budapest.

The use of an economic density variable is twofold: it controls for time- and location-specific confounding (like amenities or real estate prices) and it estimates agglomeration elasticity.

We use a two-stage planned-route Instrumental Variables approach to treat reverse causality concerns. There have been several plans developed for the optimal allocation of highways in Hungary (for a detailed history, see Fleischer (1994)). The first alignment was the doctoral dissertation of Boldizsar Vasarhelyi in 1941. This 2000 km was planned for a larger Hungary, and its aim was to integrate the outer regions of the country to its core. Another influential plan was the 1974 plan of the Hungarian Government which corresponds closely to the actually built alignment and they still aim to change the radial structure of the transport network which developed around the capita, Budapest. Similar planned route IV was used by Pogonyi et al. (2018), Baum-Snow (2007) or Donaldson (2018).

Figure 3: The 1941 Vasarhelyi plan and the 1974 plan of the Hungarian Government



4. Expected results

We expect to find that new highways had a significant impact on the spatial distribution of economic activity. The net impact of highways is positive, but there is a high level of heterogeneity in the impact. Larger cities, especially Budapest benefit both from induced growth and from displacement from other areas. Smaller cities likely lose on value added as their most productive firms decide to move to bigger cities in order to enjoy higher levels of access to economic mass. The marginal utility of highways is concave: the impact of one additional km of a highway is smaller as the overall length of the network grows. We expect to find sizeable sectoral heterogeneity: manufacturing, construction and logistics are expected to benefit the most, whereas business services and retail either benefit less or even lose. We expect the agglomeration elasticity to be slightly higher than the literature average of 0.04-0.06 as Hungary did not have a fully developed economy during the period of interest.

As a conclusion, we expect to see that even though highways have a significant impact on the economy, they redistribute the spatial distribution of economic activity most of all. This spatial redistribution was also driven by increased returns to access to Western markets, and we observe a large move of activity moving from the Eastern regions of the country to Western regions.

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