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Do Fixed Links Affect Settlement Patterns: A Synthetic Control Approach

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ABSTRACT

This paper evaluates the extent to which transportation projects affect settlement patterns. We consider fixed link projects because they provide a large and swift change in accessibility. We use the synthetic control method and estimate the impacts on settlement patterns for 11 fixed links projects constructed in the period from 1989 to 2008. The synthetic controls are weighted averages of control municipalities with weights chosen to replicate population trends in the pre-fixed link periods. We find clear impacts on settlement patterns for fixed links connecting islands to urban areas and on islands utilizing natural resources, although there are exceptions. In the other cases, the impacts are negligible.

1. Introduction

During the last three decades, the Norwegian government has invested substantial resources in projects that replaces ferry connections with fixed links. The direct impact for road users are reduced travel costs, with a resulting increase in traffic. After this initial impact, further impacts could be induced because of changes in location decisions, commuting pattern or travel behavior. These decisions made by firms and households could have a wide range of regional impacts, such as improved market access, entry of firms, access to a wider range of goods and services, and changes in settlement patterns. Several contributions in the literature evaluate the direct impacts (some examples are Anguera, 2006; Bråthen & Hervik, 1997; Skamris & Flyvbjerg, 1997). A growing literature investigates wider impacts related to productivity externalities that represent additional benefits (see Melo, Graham, & Brage-Ardao, 2013; Melo, Graham, & Noland, 2009 for a meta-analysis of this literature). But, impacts on the population growth on islands (hereafter settlement patterns) with a fixed link are—in contrast—rarely evaluated using an econometric framework.

Impacts on settlement patterns, which are the focus of this paper, are relevant for two reasons. First, settlement patterns can be a separate policy objective. The impacts on settlements are therefore interesting when evaluating this policy. Second, settlement patterns affect traffic flows and thereby the benefits of a project. This effect is, however, neglected by Norwegian road planners, which implies that population trends and settlement patterns are assumed unaffected by the fixed link. Ironically, this assumption is at odds with the policy objective of supporting regional development. Additionally, this assumption could lead to systematic error in traffic forecasts and thereby an underestimation of the benefits of the project.

Such impact can be explained by three different mechanisms. We refer to the first mechanism as *the urban model* explanation, which originates from the works of Alonso (1964), Muth (1969, pp. 114–123) and Mills (1981). The key idea in this model is readily explained. Because of the fixed amount of land in cities, houses will be built around the city. Since the distance to the city induces commuting costs, housing prices will fall as distance to the city

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center increasessupported. At the edge of the city, the commuting cost when moving further away from the city will equal the decrease in housing prices. If a transport project decreases commuting costs, it could therefore increase the size of the functional city. The area at the edge of the city is therefore more attractive, with a resulting increase in settlements (houses). The second mechanism is the *local amenities* explanation. The mechanism is that travel time changes could enable access to goods and services, such as specialized products or a greater variety of products, which are only found in large markets. This mechanism is analogous to the sharing mechanisms, which is suggested as one of the mechanisms to explain agglomeration economies by Duranton and Puga (2004). This idea is pursued in Glaeser, Kolko, and Saiz (2001), which finds that high amenity cities have grown faster than low amenity cities. A similar finding from the Swedish context is Haugen and Vilhelmson (2013). The third mechanism is what we refer to as the *resource* explanation. Inspired by the framework in Krugman (1991), this explains why economic activity tends to be concentrated in areas that initially have some natural advantage in producing the goods. The argument for such effects centers on improvements in market access for final goods (forward linkage) or better access to inputs in the production process (backward linkage).

It is, however, not obvious that improved access through better roads will benefit a specific region. In some cases, the result may be the opposite. Following the pioneering work by Krugman (1991), the UK Standing Advisory Committee on Trunk Road Assessment (SACTRA) (1999) defined the so-called two-way road effect as one where improved transport connections may change the economic balance between two regions. As transport may lead to a concentration of economic activity to the core, the impact may be the opposite of what policy makers originally intended. With improved accessibility, it may become easier to serve a remote area from outside, and increased competition may lead to smaller rural businesses to go bankrupt. Whether this also applies to population levels is less clear, as it may be possible for the population to increase due to urban sprawl and opening new areas for housing without resulting in increased economic activity. Despite being theoretically appealing, the two-way road argument remains to be proven empirically, and Vickerman (2017) has argued that this is not a universal outcome and that a fall in transport costs could overcome the cost disadvantage of peripheral regions.

The main challenge in the analysis of past infrastructure projects is the counterfactual (potential) outcome: What would have been the outcome had the fixed link not been established? By definition, this outcome is never observed and poses one of the most difficult challenges in empirical research. How the researcher manages to address this problem in a world where randomized experiments are not available has also become the most crucial element in empirical economics (Angrist & Pischke, 2010). Moreover, for aggregated effects, such as impacts on settlement patterns, there might be no deep structural parameter effect to discover, since projects vary in both changes in accessibility and the nature of the communities that get connected. It is therefore important to consider several fixed links, which differs in both these dimensions.

In our view, the scant existing literature addressing impacts on settlement patterns do not properly address the counterfactual outcome. To the best of our knowledge, only two studies have investigated the impacts on settlement patterns from fixed links: Royle (2007, pp. 203–218) and Gutiérrez, Andersen, Nilsen, and Tørset (2015). Royle (2007, pp. 203–218) considered islands off the coast of Ireland and demonstrated a significant population impact on fixed link islands compared to the unlinked islands. Although an interesting study, the impact attributed to the fixed links could be exaggerated, since the study did not address the fact that the fixed links could be an outcome of strong regional development—rather than a cause. Gutiérrez et al. (2015) studied the effect of connecting two Norwegian islands to the mainland and reported increased population growth for both islands. An objection against this method is that it fails to account for overall changes in population growth in the period.

This paper uses the synthetic control method to address the counterfactual. We implement the method following five steps: (1) Select the treated and potential control units. Treated units are island-municipalities with fixed links, while potential controls are the set of municipalities (hereafter donor pool) that could be used to construct the synthetic control. We limit the donor pools to municipalities with roughly similar population size and no major infrastructure or other change in the period. (2) Select the analysis period. We use a 15-year period before the fixed links were constructed and an as long as possible after-period (last available year was 2015). (3) Select the predictors. We use past population growth, population size in the opening year, employment and the share of employment in the two most important industries. (4) Construct the synthetic control. Using the algorithm presented in Abadie, Diamond, and Hainmueller (2010), we find the weighting of controls (the synthetic control) that minimizes the difference between the treated and the synthetic control using only pre-fixed link period. (5) If we are successful at constructing the synthetic control, the difference between the treated and the synthetic control in the post-fixed link period is the causal effect of the fixed link on the population size.

There are several advantages of synthetic control method compared to other available methods. First, the method allows for the use of several municipalities as controls—which is an advantage since a single control unit is usually only a poor comparison. This is an advantage compared to using a difference-in-difference approach with only one control group. Second, the selection of controls (weights) follows an automatized procedure. Hence, it is more difficult for the researcher to manipulate the results. Third, the method is more transparent than the usual regression approach since the representation of the synthetic control as a weighted average of controls enables a qualitative investigation, for example, by asking the question: Does it make sense that municipality X is used in the construction of the synthetic control for municipality Y? Such questions are difficult to answer (or ask) when validating results from regression models.

We estimate the impacts on settlement patterns using 11 fixed links that improved accessibility for the 15 municipalities in our analysis. Our results show that some of the fixed links have a strong effect on settlement pattern and represent a non-negligible effect. The average effect on the population size amounts to 2 percent after five years and 6 percent after 15 years. The variation, however, is considerable: the effects are between 10 and 30 percent for five municipalities, but in other cases the effect is negligible or even negative. A placebo study used to evaluate the statistical significance shows that the most clear-cut impacts are the cases that fit the urban model explanation. For the cases where the amenity or the resource explanation applies, the impacts are lower and more uncertain. For the remainder of the links, the impacts are negligible or even negative.

The rest of the paper proceeds as follows. The next section presents the synthetic control method. Section 3 describes the fixed links used in the study together with a description of the data. Section 4 presents the estimation results. Finally, Section 5 concludes the paper.

2. The Synthetic Control Method

The synthetic control method from Abadie and Gardeazabal (2003) and later refined in Abadie et al. (2010) provides a