Measuring policy leakage of Beijing’s car ownership restriction in neighboring cities

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Motivations
In response to severe traffic congestion and air pollution, Beijing introduced a car ownership restriction policy to curb vehicle growth in 2011. However, Beijing residents can still purchase and register their cars in neighboring cities and this noncompliant behavior could result in leakage which may substantially reduce the policy’s effectiveness. Previous studies estimating the impact of the policy on Beijing’s car stock often fail to account for this effect.

Background
Beijing, China has experienced rapid motorization over the past decades. Driven by urbanization and extraordinary economic growth (with GDP growth of about 13% a year from 2000-2010), the stock of Beijing’s private motor vehicles increased from 0.93 million in 2000 to 3.37 million in 2010. This motorization has also given rise to problems such as urban air pollution and traffic congestion. In response to these issues, Beijing adopted a car ownership restriction policy in January 2011, which limits the number of new vehicle licenses that are allocated to be registered in the city through a lottery allocation mechanism. Given that the win rate for the license plate lottery is very low (~1.5% at the end of 2012), many Beijing residents bypass the policy by purchasing and registering vehicles in neighboring cities rather than participating in the lottery. These noncompliant behaviors, understood respectively (1) to (3) through surveys (3), can therefore greatly undermine the policy’s effectiveness.

Objectives
- Quantitatively identify the causal effect of the implementation of Beijing’s car ownership restriction policy on the growth of private vehicle in neighboring cities
- Estimate the actual reduction of total private vehicle number in Beijing accounting for the policy leakage effect

Data
- Urbanization and motorization indicators for 287 Chinese cities from 2006–2013
- CEIC China Premium Database
- China’s City Statistical Yearbooks
- Study period:
  - 2006–2010: pre-treatment period
  - 2011: post-treatment period

Methods
Treatment group cities that are within 500 km driving distance from Beijing, which are likely more affected by Beijing’s car ownership restriction policy compared with other cities (Figure 1).
- A donor pool of non-treated cities is identified from which to synthesize our control cities.
- A synthetic control city is constructed as a weighted combination of non-treated cities for each treated city
  - Identify weights that minimize the gap between the treated cities and their synthetic city counterparts in terms of the pre-intervention outcome and other predictors of the post-intervention outcome
  - Objective functions:
    - $w^0 = rac{1}{w_{j}}$, $j \neq i$
    - $w_{i} = \frac{1}{\sigma_{i}^{2} - \sum_{j \neq i} w_{j}}$
- Difference-in-differences models:
  - Model with spatial decay of treatment effect
  - Model with non-spatial decay of treatment effect

Results
Average treatment effect (with different treatment boundaries)
- For a boundary of 500 km driving distance from Beijing, the number of vehicles in treated cities grew at an average of 5% more than in their control city counterparts after Beijing’s policy was implemented (3).
- Expanding the treatment boundary to 500 km, the estimated treatment effect is slightly lower, but still statistically significant (3 and 6).

Discussion
- Policy leakage occurs because the jurisdictional boundary of the policy (Beijing city) does not match the metropolitan scale of personal car ownership restriction.
- We discuss two potential ways to address this policy leakage: 1) regional cooperation and 2) additional use restrictions on non-local vehicles

Regional cooperation
This would require cities neighboring Beijing to either join in implementing or at least enforcing Beijing’s car ownership restriction policy. However, three forces may potentially inhibit enforcing Beijing’s policy in neighboring cities:
- Positive fiscal gains generated for Beijing’s neighboring jurisdictions
- Speculative activities stimulated by the non-local license registration, which includes many car dealers and traders providing agent services
- Loss of public faith in the ability of local government to enforce this type of regulation

Additional use restrictions on non-local vehicles
An alternative is for Beijing policymakers to enact additional policies within their limited jurisdiction that make non-local license less attractive. However, these restrictions (now being implemented) come with costs:
- May curtail the free flow of labor and materials between Beijing and its neighboring cities
- May unintentionally prevent people who occasionally err in Beijing from entering the city, which raises new equity concerns
- Raise debate about regional discrimination, since Beijing cars can drive in other cities without restrictions but not vice versa

Conclusions
- Using a difference-in-differences approach, we find that the implementation of Beijing’s car ownership restriction policy caused a 5% average increase in the number of private vehicles in neighboring cities
- We find that the magnitude of the policy leakage declines by 0.04% every 1 km of driving distance from Beijing
- This translates to an additional 465,000 non-local private vehicles being introduced into neighboring cities.
- So, as much as 80% of the growth in private vehicle ownership that could have been reduced by the policy simply leaked to neighboring cities.
- This evidence of policy leakage raises concerns about non-compliance, suggesting that policymakers and researchers should consider Beijing’s vehicle ownership and use policies in their regional context.

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Select references