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# On the effects of highway investment on the regional concentration of economic activity in the USA[*]

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**Abstract**

The empirical results in this note are based on state-level VAR estimates using private output, employment, and investment, as well as different measures of highway investment to capture, for each state, both the direct effects of highway investment in the state itself and spillover effects of highway investment in other states. Empirical results suggest that the largest states tend to also be the biggest beneficiaries of highway investments which means that highway investment has not only contributed to regional concentration of economic activity in the country but has done so in many of the largest states thereby contributing to regional asymmetries in the country.

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## I. Introduction

The identification of the effects of highway investments on economic performance has long been an area of great interest [see Evans and Karras (1994), Garcia-Mila et al. (1996) and Haughwout (1998) for overviews of the earlier literature]. Pereira and Andraz (2004), in the framework of a state-specific vector auto regressive (VAR) analysis, show that accounting for regional spillover effects is critical if one is to replicate the aggregate effects estimated for the nation as a whole using state models. Building upon this idea, Pereira and Andraz (2010) address the issue of the regional incidence of highways investments to show that almost all of the states benefit either from highway investment in the state itself or from the spillovers from highway investments elsewhere. It also shows that spillovers are very important and that the effects of highway investments for each state depend heavily on the regional network of highways and implicitly on investments in highways in the other states.

Here we follow up on this line of inquiry to address the issue of which states benefit the most from highway investments and ultimately on the effects of highways investments on the concentration of economic activity. To the extent that the marginal product of highway investments for any given state is greater than the state share of output we can ascertain that highway investments contribute to the concentration of economic activity in the state.

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Following Pereira (2000) and Pereira and Andraz (2010), we develop VAR models for each of the forty-eight contiguous states, which relate highway investment and output, employment, and private investment. In these state models, in addition to highway investment in the state itself, we consider highway investment elsewhere in the country. This allows us to measure the effects for each region of highway investment in the region itself as well as elsewhere in the country and, therefore, the total effects for each state of overall highway investment in the country.

## II. Data and Preliminary Empirical Results

The data covers the years 1977 to 1999. Output, employment and aggregate private investment came from Bureau of Economic Analysis sources [see http://www.bea.doc.gov/]. State private investment was obtained as the sum across twelve industries of aggregate private investment in that industry times the fraction of the output in that industry located in the state using data from the same site. Highway investment, including federal, state, and local spending, came from the State Government Finance issues published by the U.S. Census Bureau, partially available at http://www.landview.census.gov/govs/www/state.html.

We used standard ADF test techniques to test the null hypothesis of a unit root in the rates of growth of the variables and found that stationarity in growth rates cannot be rejected for any variable. We tested for co-integration using the standard Engle-Granger approach and found no evidence of co-integration. In terms of the VAR specifications, and due to the relatively small sample size, we confine our search to first order specifications and use the BIC test to choose the deterministic components. For the overwhelming majority of the models the best specifications includes a constant and a trend.

To obtain the effects of innovations in highway investment we used the impulse-response functions associated with the estimated VAR models. The central issue here is the identification of innovations in highway investment, which are not contemporaneously correlated with innovations in the other variables. We estimated policy functions relating the rate of growth of highway investment to the information relevant for the policy makers. The residuals from these functions reflect the unexpected component of highway investment. The information set includes past but not current values of the private-sector variables, which is equivalent in the context of the Choleski decomposition to assuming that innovations in highway investment affect private-sector variables contemporaneously.

Our discussion is based on our estimates of the state marginal products as reported in the first column of Table 1 which measure the long-term accumulated change in output per dollar of long-term accumulated change in highway investment. The state marginal products are weighted

by the average share of state highway investment in aggregate highway investment to allow us to interpret the sum across states as the combined effect of one dollar in aggregate highway investment in the US. By definition, these figures included both the direct effect of highway investment in the state and the spillover effect for the state of highway investment elsewhere.

## III. On the Effects on the Regional Concentration of Economic Activity

There are two facts that become apparent when considering the marginal product figures. First, the top fifteen states in terms of the magnitude of the effects of highway investments capture 86.7% of the effects but represent only 62.8% of the national output. These states capture the effects of highway investments in a disproportionate manner and, therefore, highway investment has contributed to the concentration of economic activity in these states. Second, the states that benefit the most from highway investments tend to be the largest states in the country. Of the top fifteen states in terms of the effects of highway investment only four are not also one of the top fifteen largest in the country. This suggests that highway investment not only has contributed to the concentration of economic activity but it has done so in the largest states.

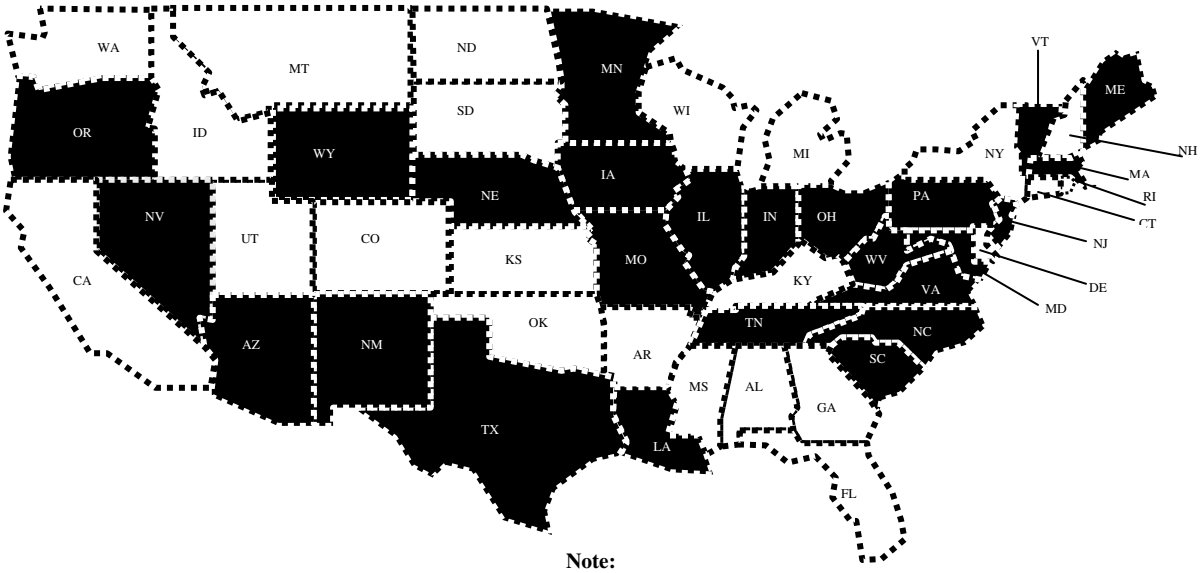
To consider this issue in more detail, we identify which states benefit more than proportionally to their size, as measure by their output share, the twenty five states in black in Map 1: AZ, IL, IN, IA, LA, ME, MD, MA, MN, MO, NE, NV, NJ, NM, NC, OH, OR, PA, SC, TN, TX, VT, VA, WV and WY. Geographically, these states fall into three clusters. The first goes from LA to OR and provides a link between the South to the Northwest. A second encompasses the states extending from the northern central part of the country, the region of Great Lakes, to the Atlantic coast states. The third includes several of the New England states. These states include thirteen of the top fifteen states in terms of the importance of the effects of highway investment. The exceptions are CA and NY. They included ten of the largest fifteen states in the country. The exceptions are CA, FL, GA, MI, and NY.

Clearly not only many of the states that benefit from highway investment tend to do so in excess to their size but many of the larger states are among the ones that benefit the most. The question is why there is such a pattern. Although a full answer is outside the scope of this note, one obvious conjecture is that this just a result of disproportionately large highway investment taking place in these states. A closer look at the results suggests that this conjecture does not seem to be valid. Indeed, the overwhelming majority of the twenty five states that benefit in excess

**Table 1: Data and Basic Results**

| | Marginal Products | State Output (% of total) | % of State Effects / % of State Output | State Highway Investment (% of total) | % of State Effects / % of State Highway Investment |
|---|---|---|---|---|---|
| **Alabama** | $0.04 | 1.25 | 0.15 | 1.74 | 0.11 |
| **Arizona** | $0.63 | 1.24 | 2.07 | 1.97 | 1.31 |
| **Arkansas** | -$0.11 | 0.73 | -0.60 | 1.21 | -0.36 |
| **California** | $2.14 | 12.97 | 0.67 | 7.04 | 1.24 |
| **Colorado** | -$0.48 | 1.41 | -1.40 | 1.45 | -1.37 |
| **Connecticut** | $0.12 | 1.69 | 0.29 | 1.40 | 0.36 |
| **Delaware** | -$0.14 | 0.35 | -1.62 | 0.42 | -1.35 |
| **Florida** | $0.35 | 4.32 | 0.33 | 4.33 | 0.33 |
| **Georgia** | $0.18 | 2.47 | 0.29 | 2.39 | 0.30 |
| **Idaho** | $0.02 | 0.34 | 0.26 | 0.63 | 0.14 |
| **Illinois** | $1.82 | 5.27 | 1.41 | 4.97 | 1.49 |
| **Indiana** | $0.70 | 2.13 | 1.33 | 2.46 | 1.15 |
| **Iowa** | $0.52 | 1.09 | 1.94 | 1.91 | 1.11 |
| **Kansas** | $0.14 | 0.95 | 0.61 | 1.38 | 0.42 |
| **Kentucky** | $0.13 | 1.27 | 0.41 | 2.25 | 0.23 |
| **Louisiana** | $0.55 | 1.88 | 1.20 | 2.03 | 1.11 |
| **Maine** | $0.12 | 0.38 | 1.25 | 0.58 | 0.82 |
| **Maryland** | $0.90 | 1.77 | 2.08 | 2.48 | 1.48 |
| **Massachusetts** | $1.27 | 2.82 | 1.84 | 2.17 | 2.39 |
| **Michigan** | -$0.66 | 3.73 | -0.72 | 3.47 | -0.78 |
| **Minnesota** | $0.87 | 1.86 | 1.90 | 2.18 | 1.62 |
| **Mississippi** | $0.04 | 0.73 | 0.22 | 1.25 | 0.13 |
| **Missouri** | $0.55 | 1.98 | 1.15 | 2.04 | 1.12 |
| **Montana** | -$0.01 | 0.26 | -0.09 | 0.65 | -0.04 |
| **Nebraska** | $0.24 | 0.61 | 1.61 | 1.01 | 0.97 |
| **Nevada** | $0.44 | 0.55 | 3.31 | 0.61 | 2.98 |
| **New Hampshire** | $0.04 | 0.43 | 0.39 | 0.49 | 0.34 |
| **New Jersey** | $1.75 | 3.72 | 1.92 | 2.83 | 2.53 |
| **New Mexico** | $0.17 | 0.52 | 1.34 | 1.07 | 0.65 |
| **New York** | $1.29 | 8.86 | 0.59 | 4.88 | 1.08 |
| **North Carolina** | $1.19 | 2.46 | 1.99 | 2.82 | 1.73 |
| **North Dakota** | -$0.07 | 0.23 | -1.25 | 0.51 | -0.56 |
| **Ohio** | $2.28 | 4.37 | 2.14 | 4.22 | 2.21 |
| **Oklahoma** | -$0.13 | 1.12 | -0.47 | 1.54 | -0.35 |
| **Oregon** | $0.34 | 1.08 | 1.27 | 1.54 | 0.89 |
| **Pennsylvania** | $2.56 | 4.64 | 2.25 | 4.87 | 2.15 |
| **Rhode Island** | $0.05 | 0.37 | 0.60 | 0.33 | 0.67 |
| **South Carolina** | $0.59 | 1.07 | 2.25 | 1.13 | 2.13 |
| **South Dakota** | $0.03 | 0.24 | 0.39 | 0.49 | 0.19 |
| **Tennessee** | $0.62 | 1.76 | 1.43 | 2.23 | 1.13 |
| **Texas** | $2.32 | 7.37 | 1.29 | 6.00 | 1.58 |
| **Utah** | $0.01 | 0.57 | 0.06 | 0.83 | 0.04 |
| **Vermont** | $0.20 | 0.19 | 4.30 | 0.34 | 2.40 |
| **Virginia** | $0.90 | 2.27 | 1.62 | 3.43 | 1.07 |
| **Washington** | -$0.32 | 1.94 | -0.68 | 2.41 | -0.55 |
| **West Virginia** | $0.16 | 0.57 | 1.16 | 1.43 | 0.46 |
| **Wisconsin** | -$0.02 | 1.91 | -0.06 | 1.95 | -0.06 |
| **Wyoming** | $0.15 | 0.28 | 2.27 | 0.63 | 1.01 |

**Map 1: On the relative importance of the effects of highway investment**




**Note:**
**States in black** – States which benefit relatively more from highway investment (effects greater than 1.0).
**States in white** – States which benefit relatively less from from highway investment (effects lower than 1.0).

to their economic size also benefit in excess to their share of highway investment. The exceptions are ME, NE, NM, OR, WV and WY. In addition, each of the fifteen largest states, with the exception of MI, benefit more than proportionally to its share of highway investment.

## IV. Conclusion

We find that most of the largest states in the country are the ones that benefit the most from highway investment and do so in excess of their economic size. This suggests that highway investment has contributed to the increased concentration of economic activity in the country in particular in the largest states. It is also clear that it is not just the magnitude of the highway investment that matters but the economic structure of these states and/or their connections to other states which may be critical in their ability to benefit relatively more from highway investment in the country.

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