ON THE REGIONAL INCIDENCE OF PUBLIC INVESTMENT IN HIGHWAYS IN THE USA

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Abstract

The objective of this paper is to investigate the regional incidence of the aggregate effects of public investment in highways in the US taking into consideration the possible existence of regional spillovers. The empirical results are based on VAR estimates at both the aggregate and state levels using private output, employment, and investment, as well as different measures of public investment. Empirical results allow us to establish several stylized facts. First, public investment in highways affects private sector variables positively at the aggregate level as well as in most states. Second, overall, the spillover effects of public investment in highways are at least 80% of the total effects for all private sector variables. Third, the spillovers have a clear geographical pattern in that they tend to be more important in western states and the corridor between the Great Lakes and the Gulf Coast. Fourth, we find that relative to their share of the US private sector variables, the biggest beneficiaries of public investment in highways tend to be the largest states in the country. This suggests that public investment in highways has contributed to concentration of private sector activity in the largest states.

JEL Classification: C32, H54, and R53.

Key words: public investment, highway investment, regional spillovers.

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1. Introduction

The impact of public investment on private sector performance has been a matter of great interest in academic and policy circles in the US in the last few decades. While there is little doubt that public investment should have a positive effect on private sector performance there is little agreement as to the magnitude or significance of such effects at the aggregate level. More importantly, the relevance of the effects of public investment at the aggregate level does not provide any information as to the regional incidence of such effects. In fact, significant positive effects at the aggregate level could be associated with balanced positive regional effects or could mask uneven regional gains. Also, even insignificant aggregate effects could hide substantial effects for certain regions.

In this paper, we first present measures of the aggregate effects of public investment. Our ultimate objective, however, is to provide a regional decomposition of such effects. By using state-specific public investment data, we attempt to identify the regional incidence of aggregate public investment taking into consideration its regional location. In doing so, we attempt to uncover the regional diversity behind the aggregate results and to identify the effects of public investment on the regional concentration of economic activity.

The evaluation of the effects of public capital formation on private output was brought to the limelight by the work of Aschauer (1989a, 1989b). Using a production function approach relating output to public capital, in addition to employment and private capital, Aschauer suggests that public capital formation has very important effects on output. Aschauer's work generated a large body of supporting literature [see, for example, Berndt and Hansson (1992), Holtz-Eakin (1988, 1989), Lynde and Richmond (1991), Nadiri and Mamuneas (1994), Seitz (1994) and Shah (1992)]. Other contributions, however, were less supportive [see, for example, Aaron (1990), Evans and Karras (1993), Jorgenson (1991), Rubin (1991), Tatom (1991) and Schultze (1990)]. In general, no clear conclusion on the importance of public capital at the aggregate level has emerged in the literature [see Gramlich (1994) and Munnell (1992) for surveys of this literature and Hulten and Schwab (1993) for a discussion of the main issues in debate].

Aschauer's work also inspired research on the impact of public capital formation with a regional focus. Earlier studies used panel data at the state level to estimate nation-wide production functions. Some provide evidence that supports Aschauer's claims on the importance of public capital [see, for example, Costa et al. (1987), Duffy-Deno and Eberts (1991), Munnell with Cook (1990), McGuire (1992) and Garcia-Milà and McGuire (1992)]. More recent studies [see, for example, Holtz-Eakin (1994), Evans and Karras (1994) and Garcia-Milà et al. (1996)], however,

find that after controlling for state-specific and unobserved characteristics, public capital variables are not significant. The main conclusion of this literature seems to be, paraphrasing Garcia-Milà et al. (1996), that no evidence of a positive linkage between public capital and private output has been found within the aggregate production function framework.

One possible explanation for the inconclusive nature of the regional literature is that it ignores spillover effects [see, for example, Boarnet (1998) and Mikelbank and Jackson (2000)]. Indeed, it could be argued that the consideration of spillovers should be an integral part of the analysis of the regional impact of public capital formation [see, for example, Haugwout (1998) and (2002)]. The positive effects of public capital formation in a region can be induced by public investment in the region itself. However, the better accessibility of a region can be generated by a greater public investment in other regions. This leads to the concept of spillover effects of public investment, i.e., to the idea that a region may benefit from public investment elsewhere.

Paradoxically, maybe because of the inconclusive nature of the results on the impact of public capital on output at the regional level, the issue of the possible existence of regional spillovers from public capital formation has received little attention. Munnell (1990) deals marginally with this issue. The point is that the elasticities of output with respect to public capital obtained with state-level data tend to be lower than those obtained with aggregate data. The conjecture is that this is due to the existence of leakages, i.e., that part of the benefits generated by public capital are not captured with just state-level data. This issue is addressed directly by Holtz-Eakin (1994). The main finding is that regional level estimates are essentially identical to those from state data, suggesting no quantitatively important spillover effects across states. The same conclusion is reached in Holtz-Eakin and Schwartz (1995), which focused on the case of state highway investment. Clearly, the empirical relevance of spillover effects across regions is largely an unresolved issue.

This paper is in the confluence of the empirical literature on the regional effects of public capital and the empirical literature on the relevance of regional spillovers. Methodologically speaking, however, we depart from the prevalent production function approach. We adopt the suggestion in Garcia-Mila et al. (1996) and Haughwout (1998) and (2002), that the stage has been set in the regional research for trying alternative methodologies and follow a multivariate time series framework as in Pereira (2000) and Pereira and Andraz (2003, 2006). In this context, we develop separate vector auto regressive (VAR) models for the US and for each of the forty-eight contiguous states, which relate public investment and private output, employment, and investment. In the state models, in addition to public investment in the state itself, we consider a measure of public investment elsewhere in the country. This is consistent with the suggestions in Haughwout (1998) and (2002) and the empirical evidence on the importance of such regional spillovers in Pereira and Andraz (2004, 2006).

The multivariate dynamic approach adopted in this paper is based on the idea that dynamic feedbacks are essential to the understanding of the relationship between public capital formation and private sector variables. Indeed, as a positive externality to private production public capital affects output directly. It also affects production indirectly via its effects on the use of private inputs. It is conceivable that a greater availability of public capital could reduce the demand for private inputs (a substitution effect). Higher availability of public capital, however, also increases the marginal productivity of private inputs thereby potentially increasing output (a scale effect). In turn, the evolution of the private sector variables can conceivably affect the evolution of public investment. Increasing output provides the government with a growing tax base and the potential for greater public investment while declining employment often leads to policies that involve increased public investment. There is, therefore, the possibility of reverse causality, i.e., the evolution of private sector variables may affect the evolution of public investment.

Finally, although our approach is exclusively empirical in nature it is not a-theoretical. Indeed, we have in the background of our analysis a dynamic model of the economy. In this model, the economy uses a production technology based on the use of private inputs, capital and labor, as well as public investment, to generate private output. For each state, output is affected by public investment located in the state itself, as well as public investment located elsewhere in the country. Given the market conditions and the availability of public investment, the private sector decides on the appropriate level of input demands. In turn, the public sector decides on the evolution of the public capital formation, using a policy rule that relates public capital to the evolution of the private sector variables. The estimated VAR models can be thought of as a reduced form for the production function, input demands and policy function.

2. Data and Preliminary Results

2.1 Data: sources and description

We consider annual data on private output, private employment, gross private investment and gross public investment in highways at the aggregate level as well as at the disaggregated state level for the forty-eight contiguous states. Private output, private investment and public investment are in billions of 1990 dollars, while private employment is in fulltime equivalent employees. The data covers the sample period from 1977 to 1999. This is because data at the state level for private output and employment is only available in a consistent manner after 1977. Furthermore, empirical evidence in Pereira and Schmidt (2007) shows that there is a structural break in public investment in highways in the US in 1976 with a 90% confidence interval that ranges from 1972 to 1977. This evidence suggests that our choice of sample period is a natural one and that we do not need to be concerned with structural breaks.

The data for private output and employment, both at the aggregate and at the state levels, as well as the data for private investment at the aggregate level were obtained from Bureau of Economic Analysis sources available on-line at http://www.bea.doc.gov/. In turn, the data for public investment was obtained from the different annual issues of the State Government Finance published by the US Census Bureau, which for the period after 1992 are available on-line at http://www.landview.census.gov/govs/www/state.html. The state public investment variable includes federal, state and local public investment spending in highways located in the state.

The choice of the scope of the public investment variable as confined to highways is a matter of both convenience and design. On one hand, public investment in highways is one of the few public investment spending categories with an unambiguously consistent definition in the data sources throughout the sample period. On the other hand, among public investment spending, highways are perceived as one of the prime potential sources of regional spillovers and have been the focus of some of the previous literature on this very issue [see, for example Boarnet (1998) and Holtz-Eakin and Schwartz (1995)].

The state disaggregation of private investment poses a particular challenge since such date is not available. To obviate this problem, we constructed a data series for private investment by state, using state data for private output by industry and data for aggregate private investment by industry. The output data came from Bureau of Economic Analysis sources while private investment by industry came from the US Department of Commerce's Fixed Reproducible Tangible Wealth in the United States publications and is also available on-line at http://www.bea.doc.gov/. Specifically, private investment figures by state were obtained as the sum, across twelve industries, of the aggregate private investment in that industry times the fraction of the output in that industry located in the state. By construction, therefore, this series captures the variations in state private investment due to the aggregate evolution of private investment, as well as changes in the sector composition of investment. It does not, however, capture the changes in investment across states within each of the twelve industries.

In Table 1, we present some summary statistics on the importance of private sector variables and public investment by state. Most states are very small economically, and a few of them concentrate most of the economic power of the country. CA, FL, GA, IL, IN, MA, MI, NJ, NY, NC, OH, PA, TX, VA, and MO, in the cases of private output and employment, or LA, in the case of private investment, make up the top fifteen states. These fifteen states concentrate 69.4% of private output in the nation, 68.8% of private investment and 67.3% of private employment. From these fifteen states, only two, MA and MO, or LA, do not belong to the top fifteen states in terms of their share of public investment. Instead, MD and WA join the fifteen most important states. Together, these fifteen states concentrate 58.6% of the nation's public investment.

2.2 Univariate and co-integration analysis

In order to determine the order of integration of the variables, we use the Augmented Dickey-Fuller (ADF) t-test to test the null hypothesis of a unit root in the rates of growth of the different variables. We use the Bayesian Information Criterion (BIC) to determine the optimal number of lagged differences to be included in the regressions, and we include deterministic components in the regressions if they are statistically significant. Details of the test results are available from the authors upon request.

The results suggest that the null hypothesis of a unit root in the rates of growth of all of the variables at the aggregate level can be rejected at the 5% significance. Also, for the overwhelming majority of the variables at the state level, the t-statistics are smaller than the 5% or, at least, the 10% critical values. For nine state-level private output variables, three private employment variables and one private investment variable, however, the ADF tests allow us to reject the null hypothesis of a unit root in the rates of growth only at the 15% significance level. We take this evidence altogether as an indication that stationarity in growth rates is a good approximation for all the variables under consideration. This evidence is consistent with the conventional wisdom in the macroeconomics literature that aggregate output, employment, and private investment are I(1). Although, most of our series are more disaggregated, the same pattern of stationarity in growth rates is not surprising.

We also test for co-integration at the aggregate level, among output, employment, private investment, and public investment. Following the standard Engle-Granger approach, we perform four tests, each one with a different endogenous variable. This is because it is possible that one of the variables enters the co-integrating relationship with a statistically insignificant coefficient. In this case a test that uses such a variable as the endogenous variable would not pick up the existence of co-integration. We apply the ADF t-test to the residuals from the regressions of each variable on the remaining variables. In all of the tests, the optimal lag structure is chosen using the BIC, and a deterministic component is included if it is statistically significant. Details of the test results are available from the authors upon request.

The results of the co-integration tests show that the values of the t-statistics are larger than the 5% critical values in all cases. Thus, the ADF tests cannot reject the null hypothesis of no co-integration at this aggregated level. This is consistent with results in the literature [see, for example, Pereira (2000) and Pereira and Andraz (2003)]. Co-integration tests were not performed at the disaggregated state level because of the large number of tests that would be required. It would be rather unlikely, however, to find co-integration at the state level when no evidence for co-integration was found at the aggregated level.

2.3 VAR specification and estimates

We now estimate VAR models for the US and for each of the forty-eight contiguous states relating private output, employment, and investment, and public investment. Given the evidence of stationarity in first differences of all variables, and following the standard procedure in the literature, all estimates are in first differences of log-levels, i.e., in growth rates. Details of the specification tests and estimation results are available from the authors upon request.

We estimate three different sets of VAR models. First, we estimate a VAR model with aggregate variables for the whole country. It includes aggregate public investment, in addition to private sector variables and is designed to give us the overall picture on the effects of public investment in the US. Second, we estimate state-specific VAR models with state-specific output, employment, private investment and public investment variables. These models are designed to determine whether or not focusing only on the effects of public investment in the state itself is enough to capture the overall aggregate effects of public investment. Third, we estimate state-specific VAR models including, in addition to the state-specific variables, a variable that reflects public investment in the rest of the country. These models are designed to take into account the possible existence of spillover effects produced by the public investment in other states, and they yield the central results in the paper. Because of the nature of the different sets of models we focus on the VAR specification for the first and third sets and adopt for the second, for the sake of easy comparability, the same specification as for the third.

We confine the search for the best VAR model to first order specifications and use the BIC test to choose the best specification in terms of the deterministic components. The focus on first order specifications is due to the relatively small sample size available. This strategy, however, is not likely to be problematic. Indeed, for the aggregate VAR model, for which a much larger data sample is available, the first order specification is consistently selected over specifications up to the fourth order using the BIC test for different time periods. This result is consistent with previous literature, which suggests that the first order VAR specification is adequate [see, for example, Pereira (2000) and Pereira and Andraz (2003)]. In addition, for our sample period test results suggest that both at the aggregate level and for the forty-eight state-specific models the best specification includes both a deterministic constant and a trend.

3. Identifying and Measuring the Effects of Innovations in Public Investment

3.1 Identifying exogenous innovations in public investment in highways

We use the impulse-response functions associated with the estimated VAR models to obtain the effects of innovations in public investment on output at both the aggregate and state levels. While the public investment variables are endogenous in the context of the VAR estimates, the

central issue for the determination of the effects of public investment on the other variables is the identification of shocks to public investment that are not contemporaneously correlated with shocks in the private sector variables. These exogenous shocks are not subject to the reverse causation problem. In dealing with this issue, we draw from the approach typically followed in the literature on the effects of monetary policy on the economy [see, for example, Christiano, Eichenbaum and Evans (1996, 1998), and Rudebusch (1998)]. This approach was adopted in Pereira (2000) and Pereira and Andraz (2003, 2004), in the context of the analysis of the effects of public investment in the US.

Ideally, the identification of shocks to public investment variables, which are not correlated with shocks in other variables, would result from knowing what fraction of the federal, state, and local appropriations in each period is due to purely non-economic reasons. The econometric counterpart to this idea is to estimate policy functions, which relate the rate of growth of public investment to the information in the information set of the relevant public policy-makers. The residuals from these policy functions reflect the unexpected component to the evolution of the corresponding public investment variables and, by definition, are not correlated with innovations in the private sector variables.

At the aggregate level we assume that the information set for the relevant public policy makers includes past values but not current values of the aggregate private sector variables. This is equivalent in the context of the standard Choleski decomposition to assuming that innovations in aggregate public investment lead innovations in aggregate private sector variables. This means that while innovations in aggregate public investment affect aggregate private sector variables contemporaneously, the reverse is not true.

We have two reasons for making this our central assumption. First, it seems reasonable to assume that the private sector reacts within a year to innovations in public investment decisions. Second, it also seems reasonable to assume that the public sector is unable to adjust public investment decisions to innovations in the private-sector variables within a year. This is due to the time lags involved in information gathering and public decision-making.

The same assumption, with the same justifications, is made at state level, i.e., we assume that innovations in state public investment affect state private sector variables contemporaneously, but the reverse is not true. This assumption, however, is even more plausible at the state level. This is because part of the public investment at the state level is financed by federal funds. We would expect innovations in federal funding to be less correlated with innovations in state private sector variables than innovations in aggregate public investment with innovations in aggregate private sector variables.

The identification of exogenous innovations in public investment has an additional difficulty at the state level in the models in which we consider both public investment in the state and public investment outside the state. Indeed, we need to consider the contemporaneous

relationship between innovations in public investment in the state and innovations in public investment outside the state. Here, our assumption is that innovations in public investment outside any given state lead innovations in public investment in the state. This means that innovations in public investment outside the state affect contemporaneously innovations of public investment in the state but the reverse is not true. This assumption is justified by the fact that the fraction of public investment undertaken in any given state is relatively small compared to the investment undertaken outside.

These arguments establish a very plausible central case for the identification of innovations in public investment variables that are not correlated with innovations in other variables. Nevertheless, to determine the robustness of our central case results we consider also all the possible alternatives in terms of the definition of which observations are included in the central administration information set. This is equivalent to considering all the possible orderings of the variables within the Choleski decomposition framework. We report the corresponding range of results in Table 2.

3.2 The policy functions for public investment in highways

Details of the estimation results for the policy functions at both the aggregate and state-level models are available from the authors upon request. For this paper, we just discuss the basic patterns of the results. The estimated policy function at the aggregate level suggests that innovations in public capital are not strongly correlated with lagged changes in private sector variables. This can be understood as a consequence of the fact that a great part of the aggregate public investment considered in this paper is financed at the local and state level.

The same reasoning would suggest that one should expect that, in general, state public investment should be more responsive to lagged changes of state private sector variables. Indeed, state public investment responds significantly to the evolution of at least one private sector variable in sixteen of the forty-eight states considered. At the state level, public investment responds strongly to changes in private output in AR, CT, FL, IL, MI, OH, SC, TX, and WI, in employment in AR, FL, KY, OH, OK, OR, VA and WV, and in private investment in CA, GA, MS, OH, and TX. In no case do the states involved concentrate more than 30% of the private sector variables in the country. Therefore, the states that show responsiveness to private sector variables are not sizable enough to induce a pattern of response of public investment to private sector variables at the aggregate level.

3.3 Measuring the effects of innovations in public investment in highways

Given the estimated VAR models and the corresponding dynamic feedbacks among private sector variables and public investment and given our assumptions about the contemporaneous

correlations among the estimated VAR residuals, and the related policy functions, we are now in position to measure the effects of exogenous innovations in the public investment variables.

We consider the effects of one-percentage point, one-time innovation in the rate of growth of public investment on private output at both the aggregate and state levels. We expect these one-time shocks to have temporary effects on the growth rates of the private-sector variables. They will, however, have permanent effects on the levels of these variables. Since the temporary effects on the growth rates of the different variables are different, the level effects will also be different. This implies changes in the long-term observed ratios between the different variables, which is consistent with the absence of evidence of co-integration.

We report the long-term accumulated elasticities of output with respect to each public investment variable considered. Long-term is defined as the time horizon over which the growth effects of innovations disappear, that is the accumulated impulse-response functions converge. In our analysis, all accumulated impulse-response functions converge within a five to ten year period. The long-term accumulated elasticities represent the total percentage point change in output for each long-term accumulated percentage-point change in public investment once all the dynamic feedback effects among the different variables have been considered.

We also report the long-term accumulated marginal products of public investment. These figures measure the long-term accumulated change in private output for every dollar of long-term accumulated change in public investment. We obtain each figure by multiplying the long-term accumulated elasticity by the corresponding output to public investment ratio. This ratio is in the original levels of the variables and is the average ratio for the last ten years of the sample. Since there is no evidence for co-integration, there is no natural choice of the output to public investment ratios. The choice of the average for the last ten years is designed to reflect the relative scarcity of public investment at the margin of the sample period without letting these ratios be overly affected by business cycle factors. This choice allows us to interpret the marginal product figures as the long-term effects of policies implemented at the end of the sample measured under the conditions observed in the last ten years of the sample period.

The marginal product figures at the state level are weighted figures. This means that the raw marginal products for each state were multiplied by the average share of state public investment in aggregate public investment for the last ten years. This allows us to interpret the sum on the state marginal products as the combined effect of one dollar in aggregate public investment given the state decomposition of public investment in the last ten years of the sample period. Therefore, the sum of the disaggregated figures obtained from the state-specific models are directly comparable to the marginal product figure obtained from the aggregate model for the whole country.

4. On the Regional Effects of Public Investment in Highways

We start by introducing the results on the impact of public investment in the US based on the VAR estimates at the aggregate level. Our ultimate objective, however, is to provide a state decomposition of such aggregate effects. To do so, we consider the results from the state-specific VAR models. These models include, in addition to the four state-specific variables, a fifth variable reflecting public investment in the other states. We, therefore, estimate for each state the effects of public investment in the state itself, as well as the effects of public investment in the other states, which measure the spillovers of public investment elsewhere captured by each state.

4.1 On the aggregate effects of public investment in highways

The empirical results at the aggregate level are reported in the top sections of Tables 2 to 5. The elasticity of private investment with respect to public investment is 0.329. This elasticity corresponds to a marginal product of $4.21. This suggests that, at the aggregate level, public investment and private investment are complements. In turn, the elasticity of private employment with respect to public investment is 0.123, which implies that one million dollars in public investment creates, in the long-term, about 313 new private-sector jobs. At the national level, public investment also crowds in private employment. Finally, the elasticity of private output with respect to public investment is 0.139. This elasticity means that one dollar invested in public capital leads to an accumulated long-term increase in private output of $16.08. The annual rate of return over a twenty-five year period implicit in this figure is 14.9%.

The comparison of these results with the evidence in the literature is not easy. This is primarily because the literature has used a variety of econometric techniques, which makes similar terms, like elasticity or marginal product, not always comparable and the definitions of public investment vary wildly. Also, most of the literature considers public investment as an exogenous variable and focuses exclusively on the effects of public investment on private output ignoring the impact on private inputs.

Although comparisons are difficult they are not impossible. The results in this paper are most directly comparable with the results in Pereira (2000), where the same methodological approach is used. For public investment in highways and streets, which is the most comparable to our measure of public investment, Pereira (2000) reports elasticities of 0.012, -0.006, and 0.006 for private investment, employment and output, respectively. The figures we obtain here are, therefore, substantially larger.

Clearly, differences in results between this paper and Pereira (2000) are to be expected, since the two papers use slightly different definitions of public investment as well as different data sources and sample period. As it turns out, however, the difference in data sources is not

particularly relevant while the difference in sample period is critical to explain the difference between the two sets of results. In this paper we consider a sample period starting in 1977 while Pereira (2000) considers a larger period starting in 1956. Replicating the results is Pereira (2000) for the sample period starting in 1977 we obtain elasticities of private investment, employment and output of 0.130, 0.126, and 0.158 respectively. For both output and employment, the values are only marginally different from the figures obtained in this paper while for private investment the values are of the same order of magnitude. For further discussion of these issues see Pereira and Schmidt (2007) and in particular on the evidence of a structural break in the late 1970s in the VAR relationship with public investment in highways.

4.2 On the effects of public investment in highways on regional private investment

As we now turn to the regional results, let us consider first, the impact of public investment on state private investment. The relevant results are reported in Tables 2 and 3. Estimation results suggest that for most states ***public investment in the state*** crowds in private investment. We find positive elasticities in twenty-nine of the forty-eight states. The elasticities range from –1.370 for OK to 0.565 for VT. In terms of the marginal products, the largest values are for IL, MA, NJ, OH and TX. In turn, ***public investment elsewhere*** affects state private investment positively in forty-two of the forty-eight states. Therefore, for most states, public investment installed elsewhere crowds in local private investment. The elasticities range from –0.608 for CO to 1.655 for WY. The largest marginal products are for CA, NJ, NY, OH and TX.

One pattern that arises is that for all states, with the exception of AR, private investment responds positively to either public investment in the state or public investment elsewhere or both. Therefore, the total effect for each state of ***public investment in the country***, i.e., the sum for each state of the direct effect and the spillover effect, are positive in thirty-six of the forty-eight states. In fact, with the exception of AR, private investment responds positively to either public investment in the state or to public investment elsewhere or both. In terms of the total marginal products, the greatest values occur in CA with $0.54, MA with $0.31, NJ with $0.38, OH with $0.40 and TX with $0.95. Other states with important benefits include IL, IN, IA, LA, MI, MN, NM, NY, NC and VA.

4.3 On the effects of public investment in highways on regional private employment

The effects of public investment on state private employment are reported in Tables 2 and 4. The estimation results suggest that for most states ***public investment in the state*** crowds in private employment. We find positive elasticities in twenty-nine of the forty-eight states. The elasticities fall in a narrow range between –0.310 for OK to 0.271 for VT. The largest marginal products, or the largest number of long-term jobs created per one million dollars in public investment, are in MA, MI, NJ, NC, and OH. In terms of the effect of ***public investment***

elsewhere, we get positive elasticities in thirty-seven of the forty-eight states. The elasticities range from –0.374 in CO to 0.476 in NV. The greatest beneficiaries from spillovers in terms of added employment are CA, IL, NY, OH, and PA.

As to the aggregate effects of ***public investment in the country***, the sum of the effects of public investment in the state and public investment elsewhere, we find that public investment and employment are complements in thirty-six of the forty-eight contiguous states. In fact, with the exceptions of AR, ND and SD, private employment responds positively to either public investment in the state or to public investment elsewhere or both. In terms of the marginal products, the states that benefit the most are CA with 43.2 new jobs, IL with 22.5, MA with 29, OH with 48.3, PA with 43.7, and TX with 26.5. Other states with large benefits in terms of employment are MD, MI, MN, MO, NJ, NY, NC, TN, and VA.

4.4 On the effects of public investment in highways on regional private output

The effects of public investment on state private output are reported in Tables 2 and 5. State output is positively affected by ***public investment in the state*** itself in thirty-three of the forty-eight states. The states with negative elasticities are AL, CA, CT, DE, ID, KT, MI, MS, NY, OK, RI, TN, WA, WI and WY. All elasticities fall within a relative small range. The state with the lowest elasticity is OK with –0.521, and the state with the largest is VT with 0.576. In terms of the marginal products, the states that exhibit the largest values are GA, MA, NJ, OH, and TX all with values above fifty cents.

In addition, estimation results show that output is affected positively by ***public investment elsewhere***, in all but six states, AR, CO, DE, GA, MT, and ND. This suggests the existence, for almost all states, of spillovers from public investment undertaken elsewhere. Again, all elasticities fall within a relative small range. The state with the lowest elasticity is ND with –0.480 and the state with the largest is WY with 0.889. In terms of the marginal products, the states that exhibit the largest values are CA, IL, NY, PA, and TX, all with marginal products above one dollar.

Finally, the total effects of ***public investment in the country***, the sum of the direct and the spillover effect, are negative in only nine states – AR, CO, DE, MI, MT, ND, OK, WA, and WI. These states represent just 11.7% of output and 13.6% of the public investment in the US. Of these states only DE does not seem to benefit either from public investment in the state or public investment elsewhere. In turn, the states with the highest total marginal products are CA with a marginal product of $2.14, IL with $1.82, OH with $2.28, PA with $2.56 and TX with $2.32. Other states with important effects include AZ, IN, MD, MA, MN, NJ, NY, NC, SC, and VA all with marginal products higher than fifty cents.

4.5 On the aggregate versus the disaggregated effects of public investment in highways

It is important to reflect at this stage on the relationship between the results from the aggregate US model and the sum of the results from the forty-eight independent state models. In general, we would expect the sum of the regional effects to be somewhat higher than the value from the aggregate model. This would be the result of general equilibrium effects that are captured by the aggregate model but not by the regional models.

Indeed, when public investment occurs, more private inputs are demanded, simultaneously, by most of the states. For each state it is as if producers face a horizontal supply schedule for private inputs. This is because no single state is large enough to substantially affect the aggregate input prices. The simultaneous increase in input demand, however, is limited by resource constraints. Therefore, at the aggregate level, producers face an upward sloping input supply schedule, and part of the increased demand for private inputs translates into higher input prices and a downward adjustment of the state-specific demands. Thus, the sum of the regional marginal products should somewhat exceed the aggregate effect. The same reasoning applies in terms of output. We would not expect the increase in output observed in any given state to reduce substantially the output market prices at the aggregate level, i.e., it is as if each state has a horizontal output demand schedule. At the aggregate level, however, we would expect a negatively slopped output demand schedule. Therefore, an increase in output in most states would lead a reduction in the aggregate output price and to a lower increase in equilibrium output than implied by the state models.

According to our empirical results, the sum across the different states of the effects of public investment represent 109.2%, 129.2% and 152.1% of the values obtained with the aggregate model for private investment, employment, and output, respectively. These figures have two corollaries. First, the general equilibrium effects seem to be relevant in the case of output, less so in the case of employment, and only marginally in the case of investment. The fact that these general equilibrium effects seem to be more important for output is not surprising. This is because according to our methodology the effects on output capture not only the direct effects of public investment on output but also the indirect effects on output through the impact on private input demand. Second, overall the results from the forty-eight independent state models are remarkably in line with the results from the aggregate model. This gives great credibility to our efforts to find the regional patterns behind the aggregate results.

5. On the Importance and the Regional Incidence of the Spillover Effects

We have established that public investment affects positively private sector variables for most states. We have also established that both the direct effects of public investment in the state itself and the spillover effects from investment in other states are important. We now want to

identify the relative importance of these two effects. We want to determine the importance of the spillover effects for the country overall as well as for each individual state.

5.1 On the overall importance of the spillover effects of public investment in highways

To identify the overall importance of the regional spillover effects in the US, we consider the sum across states of all the direct effects from public investment in the state itself as well as the sum across states of all the spillover effects from public investment undertaken elsewhere. The total effect of public investment in the US is given by the sum of these two parcels. Then, we calculate how much of the total effect of public investment in the US is due to the direct effects and how much is due to the spillover effects.

In terms of the effects of public investment on ***private investment***, of the total aggregate effect of $4.60, the direct effects correspond to $0.78 and the spillover effects to $3.82. This suggests that overall the spillover effects of public investment are very important and account for 83% of the total effects on private investment. Furthermore, the spillover effects are at least as important as the direct effects for thirty-seven of the forty-eight contiguous states. As to the effects on ***private employment***, of the overall aggregate effects, i.e., 404.78 new jobs, the direct effects correspond to 66.89 or 16.5% and the spillover effects correspond to 337.89 or 83.5%. Furthermore, spillover effects are more important than the direct effects for thirty-two of the forty-eight contiguous states.

Finally, in terms of the effects of public investment on ***private output***, our results show that while public investment undertaken in each state has an important positive effect on output in that state, these direct effects account for only about 20% of the total effects of public investment, i.e., $5.00 of a total of $24.46. In turn, the spillover effects of public investment undertaken elsewhere correspond to the remaining $19.46 or 80% of the total. Spillovers are more important in thirty-three of the forty-eight states. Accordingly, as in the case of private inputs, the spillover effects of public investment on state output are much stronger than the direct effects.

Overall our discussion of disaggregated results confirms the existence of important regional spillovers. Although this is an interesting result in itself, it may also bring some light into some of the glaring contradictions in the empirical literature with a regional focus. In fact, the identification of very large results from public capital formation at the aggregate level has not been matched by the identification of large effects at the state level. Our results provide a plausible answer to this paradox. The small effects detected with the state-specific models without spillover effects are due to the very omission of such spillover effects. When such spillover effects are considered, the large aggregate effects are fully compatible with the state level results.

The importance of spillover effects, however, raises the question of why the evidence on spillovers has been so elusive in the literature. One possible conjecture is that our VAR approach has succeeded where more conventional approaches, like the production function approach used,

for example, in Boarnet (1998) and Holtz-Eakin and Schwartz (1995), have failed. This is consistent with the suggestions in Haughwout (1998) and (2002) that the production function approach is inadequate and with the evidence in Pereira and Flores (1998) and Pereira (2000) that dynamic feedbacks are critical for the analysis of the effects of public capital. At a different level, differences in the scope of the areas under consideration may play a role in the different results we obtain compared to the literature. For example, Boarnet (1998) considers 55 counties in California while we consider forty-eight states in the US. It could be that the larger size of the regions we consider masks the negative effects found in Boarnet (1998) at a smaller regional scale.

5.2 On the regional incidence of the spillover effects

It is our purpose now to identify which states benefit more from the spillover effects than from the direct effects. To do so, we compute for each state and for each private sector variable the ratio of the spillover effect to the total effect, i.e., the sum of the direct and the spillover effects. The relevant information is reported in Table 6. In Maps 1 to 3, we gather the forty-eight states in three different groups. The first group (in black) gathers states for which the spillover effect is more important than the average for the country. In particular, the spillover effect is more than 83% of the total effect in the cases of private investment and employment, and more than 80% in the case of private output. A second group (in gray) includes the states for which the spillover effects are at least 50% of the total effects but less than the average for the country. Naturally, the last group (in white) includes states where the spillover effects are less relevant than the direct effects.

Regarding the spillover effects on ***private investment***, the three groups of states are represented in Map 1. The first group for which spillovers are particularly important (in black) includes twenty-one states: AZ, CA, CT, DE, ID, KS, ME, MD, MS, MT, NV, NH, NY, OK, OR, PA, RI, SD, WA, WI, and WY. Most of these states are located in the western part of the country as well as in the North Atlantic Coast. The second group for which spillovers are less important but still important (in gray) includes sixteen states: IN, IA, LA, MI, MN, NE, NJ, NM, NC, OH, SC, TX, UT, VT, VA and WV.

In terms of the spillover effects on ***private employment***, the three groups of states are represented in Map 2. The first group (in black) gather the sates for which the spillover effects are the most important and includes twenty-three states: AL, CA, CT, DE, IL, IN, IA, KY, ME, MS, NE, NV, NY, OK, OR, RI, SC, TN, UT, WA, WV, WI and WY. It includes states in the western part of the country, states located in the interior forming a corridor from the Great Lakes region to the south of the country and between the Great Lakes area and the western part of the country. The second group (in gray) includes nine states: KS, MD, MN, MO, NC, OH, PA, TX and VA.

Finally, the three groups in terms of the spillover effects on ***private output*** are depicted in Map 3. The first group (in black) includes twenty-one states for which spillovers are particularly

important: AL, AZ, CA, CT, FL, ID, IL, IN, KY, MI, MS, NV, NY, OK, OR, RI, SC, TN, WA, WI and WY. These states fall in two main geographical clusters: the western states and a line of states linking the Great Lakes, in the north, to the Gulf Coast, in the South. The second group (in gray) includes twelve states: IA, KS, LA, ME, MD, MN, NH, NM, NC, PA, VA and WV.

The geographical pattern of results that seems to emerge is that spillovers are generally more important for the western states, the states along the corridor from the Great Lakes to the Gulf Coast and, to a lesser extent, for some states along the Eastern Atlantic Coast. This suggests that there are intensive economic connections among the states located in each of these areas and that they depend heavily on the regional network of infrastructures, and implicitly on infrastructure investment located elsewhere. In turn, for the central states, which tend to be economically small, the direct effects of public investment undertaken in the states themselves seem generally more important. This suggests less of a connection with other areas.

6. On the Effects on the Concentration of Economic Activity

In section 4, we identified which states that benefit the most from public investment in terms of each of the private sector variable. Upon closer scrutiny there are two facts that are rather important. First, these states capture the overall effects of public investment in a disproportionate manner. Their share of the benefits of public investment clearly exceeds their share of the corresponding private variable in the country. The top fifteen states in terms of the effects of public investment on private investment, employment and output, capture 89%, 90.8% and 86.7% respectively of such effects. Nevertheless, they represent only 61.3%, 63.4%, and 62.8%, respectively of the nation's private investment, employment, and output, respectively. Clearly, public investment has contributed to the concentration of economic activity in these states. Second, the states that benefit the most from public investment tend also to be the largest in the country. In fact, of the top-fifteen states in terms of the strength of the effects of public investment only three (four in the case of output) do not belong to the top fifteen in terms of their shares of the private sector variables. This suggests that public investment not only has increased the concentration of private economic activity but it has done so mostly in the largest states.

We now consider this issue in more detail. We want to identify which states benefit the most in terms of the size of the effects of public investment, as measured by their share of the total effects, relative to the size of the state, as measured by its share of the country's private sector variable in question. The results are reported in Table 7. In Maps 4 to 6, the forty-eight states are gathered in two groups depending on the magnitude of the relative effects. The first group (in black) gathers states for which their shares of the benefits are higher than their share of the

country's private sector variable in question. The second group (in white) gathers the states for which the opposite is true.

Regarding the relative importance of the effects of public investment on ***private investment***, the first group (in black in Map 4) includes twenty-three states: IN, IA, KS, KY, LA, MA, MI, MN, MO, NE, NV, NH, NJ, NM, NC, OH, RI, SC, TX, VT, VA, WV and WY. This group includes twelve of the top fifteen states in terms of the effects on private investment (the exceptions are CA, IL, and NY) and ten of the largest fifteen states in terms of their share on the country's private investment (the exceptions are CA, FL, GA, IL, and NY).

The importance of the effects of public investment on ***private employment*** places twenty states in the first group (in black in Map 5): IL, IA, ME, MD, MA, MN, MO, NV, NH, NJ, NC, OH, PA, RI, SC, TN, UT, VT, VA and WY. This group of states includes eleven of the top fifteen states in terms of the effects of public investment on private employment (the exceptions are CA, MI, NY, and TX). It also includes seven of the most important fifteen states in terms of their share on the country's public investment.

Finally, in terms of the effects on ***private output***, the first group (in black in Map 6) includes twenty-five states: 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 group encompasses the states that extend from the northern central part of the country, the region of Great Lakes, to the Atlantic coast states. The third includes some New England states. These states includes thirteen of the top fifteen states in terms of the importance of the effects of public investment on output (the exceptions are CA and NY). Also, it includes nine of the fifteen largest states, in terms of their share of public investment (the exceptions are CA, FL, GA, MI, NY, and WA).

It seems even more clear now that, indeed, not only the states that benefit from public investment tend to do so in excess to their size but that the larger states tend to be the ones that benefit the most from public investment. The question is why is there such a pattern. Although a full answer to this question is outside the scope of this paper, one obvious conjecture is that the relatively large gains captured by some states could just be a consequence of a disproportionately large public investment in these states. In this case while the effects would be disproportionate to the state's share of the private sector variable, they would not be disproportionate to the state's share of public investment.

A closer look at the results suggests that this conjecture does not seem to be valid. Indeed, as suggested above, the overwhelming majority of the states that benefit in excess to their share of the private sector variable also benefit in excess to their share of public investment (see also Table 7). There are five exceptions for private investment (KS, KY, NH, VA, and WY), three for private employment (IA, UT and WY) and six for private output (ME, NE, NM, OR, WV and

WY). Furthermore, for all the private sector variables only two states (CA and NY) seem to benefit in excess to their share of public investment but still less than proportionally to their share of the private sector variable. This discussion suggests that the larger states tend to benefit the most and to do so in excess to their shares of either the private sector variable in question or their share of public investment. Therefore, it seems that it is not just the size of the of public investment that matters but the economic structure of these states and/or their connections to other states may be critical in their ability to benefit relatively more from public investment in the country.

7. Summary and Concluding Remarks

The objective of this paper is to investigate the state incidence of the effects of public investment in highways in the presence of spillover effects. The empirical results are based on VAR estimates at both the aggregate and state levels using private output, employment, and investment, as well as public investment in highways. This approach follows the argument that the analysis of the effects of public investment requires the consideration of dynamic feedback effects among the different variables. It allows for the identification of the state distribution of the effects of public investment in a manner that is consistent with the evaluation of the effects at the aggregate level.

Our empirical results allow us to establish some important stylized facts on the effects of public investment in highways. At the aggregate level, public investment in highways affects private sector variables positively. In particular, the long-term marginal product of public investment in highways is $16.08, which corresponds to a rate of return of 14.9%. At a disaggregated level, we find that almost all of the states benefit from either public investment in highways in the state or from the spillover effects from public investment in highways elsewhere.

An important finding is that the spillover effects of public investment in highways are very important. They correspond to at least 80% of the aggregate effects for any of the private sector variables. Accordingly, overall, the spillover effects of public investment in highways located elsewhere are much stronger than the direct effects from public investment in highways installed in each state. Naturally, different states benefit from the direct and spillover effects to different degrees. The geographical pattern of results that emerges is that spillover effects are generally more important for the western states, the states along the corridor from the Great Lakes to the Gulf Coast and, to a lesser extent, for some the states along the Eastern Atlantic Coast. This suggests that there are intensive economic connections among the states located in each of these areas and that they depend heavily on the regional network of highway and implicitly on investment in highways located in the other states.

In terms of the absolute gains from aggregate public investment in highways in the country, we find that the states that benefit the most tend to be among the largest economically speaking. Furthermore, our results suggest that most of the largest states benefit from public investment in highways in excess of their shares of either the private sector variables or aggregate public investment. This suggests that public investment in highways has contributed to increase the state concentration of private economic activity in the country in particular in the largest states. Furthermore, it suggests that it is not just the size of the public investment that matters but the economic structure of these states and/or their connections to other states may be critical in their ability to benefit relatively more from public investment in highways in the country.

In answering some important research questions this paper has opened the door to other even more crucial research issues. First, it establishes the relevance of spillover effects from public investment in highways. A fundamental question then is the determination of the optimal location of public investment projects. This paper allows us to identify which states benefit the most from spillovers but not which states generate the greatest spillover effects. Since, however, public infrastructures installed in a given state impact positively the economic performance of other states and each state benefits from public infrastructures installed in the state and elsewhere in the country, then one would want to know which locations generate the greatest effects.

At the same time, this paper allows us to identify the states that benefit relatively more from spillovers as well as the states that benefit more from public investment than suggested by their share of private sector variables or share of public investment. What we do not do is to compare for each state the effects of public investment in the state with public investment elsewhere on a dollar per dollar basis. That is, we do not answer the question of whether or not one dollar invested in the state itself is more effective in promoting economic activity in the state than one dollar invested elsewhere in the country. Our results suggest that in the presence of spillovers the answer to this question is not a foregone conclusion.

Finally, our results suggest that public investment in highways has contributed to the concentration of economic activity in the largest states. This begs the question of identifying what is it in the economic fabric of these states that allows them to benefit so disproportionately from public infrastructures. In particular, there is the intriguing possibility that these benefits may in some way be linked to their ability of these states to capture spillover effects of public investment in a disproportionate manner.

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Table 1: Regional decomposition of the basic data (%)

	Private Output	Private Investment	Private Employment	Public Investment in highways
U.S.	100.0%	100.0%	100.0%	100.0%
1. Alabama	1.25	1.30	1.44	1.74
2. Arizona	1.24	1.20	1.37	1.97
3. Arkansas	0.73	0.78	0.88	1.21
4. California	12.97	12.35	11.80	7.04
5. Colorado	1.41	1.46	1.55	1.45
6. Connecticut	1.69	1.56	1.54	1.40
7. Delaware	0.35	0.34	0.30	0.42
8. Florida	4.32	4.14	4.84	4.33
9. Georgia	2.47	2.48	2.62	2.39
10. Idaho	0.34	0.35	0.39	0.63
11. Illinois	5.27	5.08	4.94	4.97
12. Indiana	2.13	2.04	2.33	2.46
13. Iowa	1.09	1.12	1.18	1.91
14. Kansas	0.95	1.04	1.04	1.38
15. Kentucky	1.27	1.37	1.34	2.25
16. Louisiana	1.88	2.59	1.53	2.03
17. Maine	0.38	0.36	0.49	0.58
18. Maryland	1.77	1.63	1.84	2.48
19. Massachusetts	2.82	2.53	2.85	2.17
20. Michigan	3.73	3.45	3.61	3.47
21. Minnesota	1.86	1.82	1.99	2.18
22. Mississippi	0.73	0.78	0.85	1.25
23. Missouri	1.98	1.94	2.20	2.04
24. Montana	0.26	0.32	0.31	0.65
25. Nebraska	0.61	0.65	0.68	1.01
26. Nevada	0.55	0.51	0.56	0.61
27. New Hampshire	0.43	0.39	0.49	0.49
28. New Jersey	3.72	3.57	3.25	2.83
29. New Mexico	0.52	0.68	0.51	1.07
30. New York	8.86	8.48	7.35	4.88
31. North Carolina	2.46	2.40	2.79	2.82
32. North Dakota	0.23	0.29	0.25	0.51
33. Ohio	4.37	4.15	4.54	4.22
34. Oklahoma	1.12	1.37	1.21	1.54
35. Oregon	1.08	1.04	1.19	1.54
36. Pennsylvania	4.64	4.46	4.88	4.87
37. Rhode Island	0.37	0.33	0.42	0.33
38. South Carolina	1.07	1.04	1.31	1.13
39. South Dakota	0.24	0.27	0.27	0.49
40. Tennessee	1.76	1.62	2.03	2.23
41. Texas	7.37	8.87	6.89	6.00
42. Utah	0.57	0.60	0.67	0.83
43. Vermont	0.19	0.19	0.25	0.34
44. Virginia	2.27	2.21	2.42	3.43
45. Washington	1.94	1.83	1.92	2.41
46. West Virginia	0.57	0.72	0.59	1.43
47. Wisconsin	1.91	1.82	2.11	1.95
48. Wyoming	0.28	0.49	0.20	0.63

Table 2: Long-term elasticities with respect to public investment in highways

	Private Output		Private Investment		Private Employment	
	Public Investment inside	**Public Investment outside**	**Public Investment inside**	**Public Investment outside**	**Public Investment inside**	**Public Investment outside**
USA	0.139 [0.016; 0.139]		0.329 [0.088; 0.329]		0.123 [0.025; 0.123]	
1. Alabama	-0.129 [-0.81; -0.205]	0.163 [-0.094; 0.163]	0.175 [-0.194, 0.175]	0.122 [-0.135, 0.288]	-0.119 [-0.191, -0.030]	0.179 [-0.191, 0.187]
2. Arizona	0.052 [-0.113; 0.052]	0.339 [-0.594; 0.387]	-0.003 [-0.279, -0.003]	0.268 [-1.200, 0.369]	0.064 [-0.058, 0.064]	-0.022 [-0.902, 0.077]
3. Arkansas	0.023 [-0.032; 0.035]	-0.151 [-0.218; -0.101]	-0.040 [-0.119, -0.016]	-0.121 [-0.121, 0.042]	-0.001 [-0.077, 0.008]	-0.035 [-0.097, 0.084]
4. California	-0.021 [-0.023; 0.007]	0.173 [0.088; 0.252]	-0.011 [-0.017, 0.017]	0.347 [0.161, 0.351]	-0.014 [-0.032, -0.007]	0.166 [0.082, 0.169]
5. Colorado	0.079 [-0.133; 0.079]	-0.364 [-0.364; -0.124]	0.180 [-0.345, 0.180]	-0.608 [-0.608, -0.161]	0.031 [-0.119, 0.031]	-0.374 [-0.374, -0.221]
6. Connecticut	-0.032 [-0.147; 0.139]	0.095 [-0.215; 0.095]	-0.297 [-0.371, -0.031]	0.349 [-0.297, 0.349]	-0.136 [-0.137, -0.005]	0.218 [-0.036, 0.218]
7. Delaware	-0.139 [-0.279; 0.227]	-0.168 [-0.279; -0.070]	-0.778 [-0.778, 0.035]	0.264 [-0.061, 0.285]	-0.247 [-0.247, 0.076]	0.003 [-0.102, 0.013]
8. Florida	0.010 [-0.005; 0.044]	0.054 [0.054; 0.232]	0.100 [0.016, 0.160]	-0.207 [-0.207, 0.242]	0.030 [-0.017, 0.035]	-0.023 [-0.023, 0.085]
9. Georgia	0.192 [0.103; 0.239]	-0.140 [-0.470; -0.140]	0.079 [0.079, 0.234]	-0.582 [-0.895, -0.481]	0.092 [0.067, 0.144]	-0.052 [-0.226, -0.035]
10. Idaho	-0.054 [-0.174; -0.054]	0.107 [0.004; 0.139]	-0.127 [-0.384, -0.127]	0.419 [0.157, 0.450]	0.030 [-0.025, 0.032]	-0.077 [-0.134, -0.023]
11. Illinois	0.000 [-0.058; 0.000]	0.311 [0.067; 0.413]	0.198 [-0.078, 0.198]	0.067 [-0.735, 0.139]	-0.018 [-0.057, -0.011]	0.204 [0.056, 0.312]
12. Indiana	0.061 [0.007; 0.228]	0.229 [0.128; 0.303]	0.385 [0.163, 0.439]	0.521 [0.185, 0.521]	-0.064 [-0.111, 0.118]	0.133 [0.067, 0.213]
13. Iowa	0.197 [-0.007; 0.197]	0.254 [-0.108; 0.254]	0.413 [0.037, 0.413]	0.836 [0.238, 0.836]	0.033 [-0.064, 0.033]	0.205 [-0.021, 0.237]
14. Kansas	0.037 [0.003; 0.037]	0.102 [0.007; 0.102]	-0.017 [-0.127, -0.017]	0.428 [0.159, 0.428]	0.032 [0.004, 0.032]	0.090 [0.035, 0.090]
15. Kentucky	-0.052 [-0.074; -0.015]	0.143 [-0.077; 0.144]	0.251 [0.093, 0.264]	0.153 [0.011, 0.294]	-0.141 [-0.141, -0.044]	0.088 [-0.091, 0.091]
16. Louisiana	0.118 [0.022; 0.153]	0.191 [0.191; 0.394]	0.246 [0.118, 0.316]	0.350 [0.350, 0.753]	0.041 [-0.012, 0.058]	-0.064 [-0.064, -0.006]
17. Maine	0.086 [0.086; 0.387]	0.180 [-0.141; 0.180]	-0.344 [-0.344, 0.146]	0.484 [-0.018, 0.484]	0.033 [0.033, 0.238]	0.165 [-0.032, 0.165]
18. Maryland	0.209 [0.131; 0.252]	0.214 [-0.079; 0.214]	-0.074 [-0.098, 0.097]	0.330 [-0.072, 0.330]	0.144 [0.107, 0.184]	0.160 [-0.036, 0.160]
19. Massachusetts	0.324 [-0.114; 0.443]	0.027 [-0.782; 0.027]	0.478 [0.125, 0.690]	0.419 [-0.634, 0.419]	0.219 [0.063, 0.293]	0.182 [-0.201, 0.182]
20. Michigan	-0.240 [-0.914; 0.161]	0.077 [-0.074; 0.318]	0.122 [0.122, 1.586]	0.278 [0.278, 0.978]	0.134 [-1.442, 0.147]	0.011 [-0.216, 0.180]
21. Minnesota	0.198 [0.130; 0.229]	0.203 [-0.081; 0.203]	0.099 [-0.024, 0.229]	0.386 [-0.270, 0.386]	0.147 [0.072, 0.163]	0.159 [-0.038, 0.343]

Table 2 (Cont.): Long-term elasticities with respect to public investment in highways

State	Private Output		Private Investment		Private Employment	
	Public Investment inside	Public Investment outside	Public Investment inside	Public Investment outside	Public Investment inside	Public Investment outside
22. Mississippi	-0.045 [-0.074; -0.036]	0.094 [0.010; 0.094]	0.047 [-0.055, 0.047]	0.242 [0.143, 0.288]	-0.044 [-0.066, -0.026]	0.106 [0.038, 0.106]
23. Missouri	0.150 [0.037; 0.150]	0.101 [0.013; 0.103]	0.273 [0.066, 0.273]	0.108 [-0.002, 0.122]	0.092 [0.022, 0.092]	0.128 [0.068, 0.128]
24. Montana	0.043 [-0.036; 0.043]	-0.064 [-0.064; 0.093]	0.011 [-0.154, 0.011]	0.177 [0.177, 0.556]	0.018 [-0.030, 0.018]	-0.232 [-0.234, -0.094]
25. Nebraska	0.273 [0.076; 0.273]	0.081 [-0.064; 0.093]	0.544 [0.052, 0.544]	0.442 [0.157, 0.442]	0.004 [-0.100, 0.004]	0.144 [0.064, 0.144]
26. Nevada	0.054 [-0.121; 0.054]	0.513 [0.266; 0.514]	0.037 [-0.202, 0.121]	0.476 [-0.233, 0.476]	0.064 [-0.103, 0.064]	0.476 [0.208, 0.476]
27. New Hampshire	0.015 [-0.022; 0.165]	0.062 [-0.737; 0.062]	-0.013 [-0.077, 0.272]	0.354 [-0.907, 0.354]	0.088 [0.065, 0.174]	0.075 [-0.489, 0.075]
28. New Jersey	0.254 [0.153; 0.255]	0.135 [-0.521; 0.178]	0.294 [0.150, 0.315]	0.474 [-0.803, 0.474]	0.142 [0.094, 0.148]	0.113 [-0.393, 0.113]
29. New Mexico	0.132 [0.069; 0.133]	0.142 [0.111; 0.605]	0.309 [0.131, 0.309]	1.084 [1.084, 2.036]	0.018 [0.013, 0.022]	-0.191 [-0.209, -0.062]
30. New York	-0.072 [-0.072; 0.063]	0.203 [-0.109; 0.203]	-0.230 [-0.230, 0.101]	0.376 [-0.250, 0.376]	-0.052 [-0.052, 0.032]	0.140 [-0.046, 0.140]
31. North Carolina	0.185 [-0.003; 0.192]	0.208 [-0.011; 0.208	0.127 [-0.086, 0.209]	0.280 [-0.046, 0.280]	0.134 [-0.007, 0.141]	0.159 [0.030, 0.159]
32. North Dakota	0.161 [-0.137; 0.161]	-0.480 [-0.480; 0.306]	0.437 [-0.234, 0.437]	-0.382 [-0.382, 1.313]	-0.021 [-0.070, -0.021]	-0.051 [-0.051, 0.142]
33. Ohio	0.259 [-0.059; 0.259]	0.222 [0.000; 0.222]	0.399 [-0.428, 0.399]	0.392 [-0.177, 0.392]	0.162 [-0.100, 0.170]	0.269 [0.100, 0.281]
34. Oklahoma	-0.521 [-0.521; 0.366]	0.407 [0.407; 1.032]	-1.370 [-1.370, 0.717]	1.153 [1.153, 2.607]	-0.310 [-0.310, 0.175]	0.166 [0.166, 0.548]
35. Oregon	0.012 [0.012; 0.216]	0.247 [0.063; 0.247]	-0.667 [-0.667, 0.078]	0.539 [0.087, 0.539]	-0.008 [-0.020, 0.160]	0.158 [0.029, 0.158]
36. Pennsylvania	0.111 [0.111; 0.149]	0.385 [0.135; 0.385]	-0.082 [-0.119, -0.064]	0.120 [-0.154, 0.120]	0.076 [0.076, 0.110]	0.296 [0.112, 0.296]
37. Rhode Island	-0.135 [-0.211; 0.007]	0.267 [-0.501; 0.267]	-0.097 [-0.097, -0.336]	0.685 [-0.451, 0.685]	-0.097 [-0.166, -0.018]	0.313 [-0.188, 0.313]
38. South Carolina	0.040 [0.018; 0.040]	0.411 [0.145; 0.415]	0.160 [0.114, 0.160]	0.420 [0.092, 0.443]	0.043 [0.029, 0.043]	0.234 [0.100, 0.240]
39. South Dakota	0.050 [-0.027; 0.101]	0.031 [-0.051; 0.067]	-0.184 [-0.243, -0.084]	0.405 [0.168, 0.405]	-0.065 [-0.104, -0.019]	-0.008 [-0.032, 0.023]
40. Tennessee	-0.038 [-0.134; 0.056]	0.328 [0.097; 0.342]	0.051 [-0.301, 0.083]	-0.044 [-0.519, -0.044]	0.017 [-0.108, 0.096]	0.366 [0.193, 0.378]
41. Texas	0.143 [-0.123; 0.143]	0.135 [0.112; 0.253]	0.247 [-0.153, 0.247]	0.629 [0.554, 0.875]	0.050 [-0.198, 0.050]	0.098 [0.061, 0.121]
42. Utah	0.009 [-0.024; 0.009]	0.001 [0.001; 0.015]	0.092 [0.005, 0.092]	0.134 [0.134, 0.179]	-0.010 [-0.038, -0.010]	0.169 [0.169, 0.176]
43. Vermont	0.576 [0.204; 0.582]	0.295 [0.015; 0.312]	0.565 [0.138, 0.596]	0.763 [0.222, 0.763]	0.271 [0.120, 0.279]	0.237 [0.009, 0.237]
44. Virginia	0.129 [-0.079; 0.132]	0.193 [0.016; 0.193]	0.125 [-0.121, 0.125]	0.271 [0.023, 0.271]	0.133 [-0.032, 0.133]	0.200 [0.057, 0.200]

Table 2 (Cont.): Long-term elasticities with respect to public investment in highways

State	Private Output		Private Investment		Private Employment	
	Public Investment inside	**Public Investment outside**	**Public Investment inside**	**Public Investment outside**	**Public Investment inside**	**Public Investment outside**
45. Washington	-0.318 [-0.318; 0.024]	0.186 [0.006; 0.186]	-0.282 [-0.282, 0.141]	0.457 [0.019, 0.457]	-0.212 [-0.212, 0.033]	0.256 [0.080, 0.256]
46. West Virginia	0.115 [0.003; 0.115]	0.178 [-0.032; 0.178]	0.289 [-0.024, 0.289]	0.216 [-0.136, 0.216]	0.014 [-0.062, 0.038]	0.140 [-0.030, 0.144]
47. Wisconsin	-0.216 [-0.235; 0.067]	0.203 [0.087; 0.227]	-0.215 [-0.215, 0.314]	0.369 [-0.078, 0.369]	-0.187 [-0.204, 0.081]	0.108 [-0.001, 0.151]
48. Wyoming	-0.238 [-0.251; -0.083]	0.889 [0.258; 0.889]	-0.543 [-0.566, -0.236]	1.655 [0.597, 1.655]	-0.145 [-0.151, -0.077]	0.449 [0.153, 0.449]

Table 3: Regional disaggregation of the effects on investment

	Elasticities with respect to		Marginal Product with respect to(*)		
	Public Investment inside	**Public Investment outside**	**Public Investment inside (1)**	**Public Investment outside (2)**	**Total (3)=(1+2)**
U.S.	0.329		$4.21		
1. Alabama	0.175	0.122	$0.03	$0.02	$0.05
2. Arizona	-0.003	0.268	$0.00	$0.05	$0.05
3. Arkansas	-0.040	-0.121	$0.00	-$0.01	-$0.01
4. California	-0.011	0.347	-$0.03	$0.57	$0.54
5. Colorado	0.180	-0.608	$0.04	-$0.12	-$0.08
6. Connecticut	-0.297	0.349	-$0.07	$0.07	$0.00
7. Delaware	-0.778	0.264	-$0.04	$0.01	-$0.03
8. Florida	0.100	-0.207	$0.06	-$0.12	-$0.06
9. Georgia	0.079	-0.582	$0.03	-$0.21	-$0.18
10. Idaho	-0.127	0.419	-$0.01	$0.02	$0.01
11. Illinois	0.198	0.067	$0.13	$0.04	$0.17
12. Indiana	0.385	0.521	$0.10	$0.13	$0.23
13. Iowa	0.413	0.836	$0.06	$0.11	$0.17
14. Kansas	-0.017	0.428	$0.00	$0.05	$0.05
15. Kentucky	0.251	0.153	$0.04	$0.03	$0.07
16. Louisiana	0.246	0.350	$0.06	$0.09	$0.15
17. Maine	-0.344	0.484	-$0.02	$0.02	$0.00
18. Maryland	-0.074	0.330	-$0.02	$0.07	$0.05
19. Massachusetts	0.478	0.419	$0.17	$0.14	$0.31
20. Michigan	0.122	0.278	$0.05	$0.12	$0.17
21. Minnesota	0.099	0.386	$0.02	$0.09	$0.11
22. Mississippi	0.047	0.242	$0.00	$0.02	$0.02
23. Missouri	0.273	0.108	$0.07	$0.03	$0.10
24. Montana	0.011	0.177	$0.00	$0.01	$0.01
25. Nebraska	0.544	0.442	$0.04	$0.04	$0.08
26. Nevada	0.037	0.476	$0.00	$0.04	$0.04
27. New Hampshire	-0.013	0.354	$0.00	$0.02	$0.02
28. New Jersey	0.294	0.474	$0.15	$0.23	$0.38
29. New Mexico	0.309	1.084	$0.03	$0.09	$0.12
30. New York	-0.230	0.376	-$0.25	$0.40	$0.15
31. North Carolina	0.127	0.280	$0.04	$0.09	$0.13
32. North Dakota	0.437	-0.382	$0.01	-$0.01	$0.00
33. Ohio	0.399	0.392	$0.20	$0.20	$0.40
34. Oklahoma	-1.370	1.153	-$0.19	$0.16	-$0.03
35. Oregon	-0.667	0.539	-$0.09	$0.08	-$0.01
36. Pennsylvania	-0.082	0.120	-$0.05	$0.07	$0.02
37. Rhode Island	-0.097	0.685	$0.00	$0.03	$0.03
38. South Carolina	0.160	0.420	$0.02	$0.06	$0.08
39. South Dakota	-0.184	0.405	-$0.01	$0.01	$0.00
40. Tennessee	0.051	-0.044	$0.01	-$0.01	$0.00
41. Texas	0.247	0.629	$0.27	$0.68	$0.95
42. Utah	0.092	0.134	$0.01	$0.01	$0.02
43. Vermont	0.565	0.763	$0.01	$0.02	$0.03
44. Virginia	0.125	0.271	$0.04	$0.08	$0.12
45. Washington	-0.282	0.457	-$0.07	$0.12	$0.05
46. West Virginia	0.289	0.216	$0.02	$0.02	$0.04
47. Wisconsin	-0.215	0.369	-$0.05	$0.08	$0.03
48. Wyoming	-0.543	1.655	-$0.03	$0.08	$0.05
Total all states			$0.78	$3.82	$4.60
Total as % of U.S.			17.0%	83.0%	100.0%

(*) The marginal product of one dollar in aggregate public investment in the U.S. weighted according to the average regional decomposition of public investment in the sample period.

Table 4: Regional disaggregation of the effects on employment

	Elasticities with respect to		Marginal Product with respect to(*)		
	Public Investment inside	Public Investment outside	Public Investment inside (1)	Public Investment outside (2)	Total (3)=(1+2)
U.S.	0.123		313.25		
1. Alabama	-0.119	0.179	-4.45	6.65	2.20
2. Arizona	0.064	-0.022	2.63	-0.87	1.76
3. Arkansas	-0.001	-0.035	-0.02	-0.80	-0.82
4. California	-0.014	0.166	-7.44	50.61	43.17
5. Colorado	0.031	-0.374	1.30	-15.64	-14.34
6. Connecticut	-0.136	0.218	-5.21	7.92	2.71
7. Delaware	-0.247	0.003	-1.97	0.02	-1.95
8. Florida	0.030	-0.023	4.03	-3.06	0.97
9. Georgia	0.092	-0.052	6.61	-3.70	2.91
10. Idaho	0.030	-0.077	0.32	-0.82	-0.50
11. Illinois	-0.018	0.204	-2.20	24.68	22.48
12. Indiana	-0.064	0.133	-3.82	7.87	4.05
13. Iowa	0.033	0.205	0.97	6.02	6.99
14. Kansas	0.032	0.090	0.84	2.35	3.19
15. Kentucky	-0.141	0.088	-4.87	3.02	-1.85
16. Louisiana	0.041	-0.064	1.51	-2.33	-0.82
17. Maine	0.033	0.165	0.41	2.06	2.47
18. Maryland	0.144	0.160	6.93	7.59	14.52
19. Massachusetts	0.219	0.182	16.64	12.34	28.98
20. Michigan	0.134	0.011	12.21	1.00	13.21
21. Minnesota	0.147	0.159	7.66	8.24	15.90
22. Mississippi	-0.044	0.106	-0.97	2.30	1.33
23. Missouri	0.092	0.128	5.06	7.01	12.07
24. Montana	0.018	-0.232	0.14	-1.85	-1.71
25. Nebraska	0.004	0.144	0.07	2.52	2.59
26. Nevada	0.064	0.476	1.12	8.27	9.39
27. New Hampshire	0.088	0.075	1.11	0.94	2.05
28. New Jersey	0.142	0.113	11.28	8.84	20.12
29. New Mexico	0.018	-0.191	0.26	-2.64	-2.38
30. New York	-0.052	0.140	-8.95	24.01	15.06
31. North Carolina	0.134	0.159	9.92	11.76	21.68
32. North Dakota	-0.021	-0.051	-0.13	-0.32	-0.45
33. Ohio	0.162	0.269	18.20	30.10	48.30
34. Oklahoma	-0.310	0.166	-9.13	4.84	-4.29
35. Oregon	-0.008	0.158	-0.25	5.00	4.75
36. Pennsylvania	0.076	0.296	8.96	34.78	43.74
37. Rhode Island	-0.097	0.313	-0.96	3.06	2.10
38. South Carolina	0.043	0.234	1.49	8.03	9.52
39. South Dakota	-0.065	-0.008	-0.48	-0.06	-0.54
40. Tennessee	0.017	0.366	0.92	19.71	20.63
41. Texas	0.050	0.098	8.97	17.53	26.50
42. Utah	-0.010	0.169	-0.20	3.27	3.07
43. Vermont	0.271	0.237	1.73	1.50	3.23
44. Virginia	0.133	0.200	8.56	12.76	21.32
45. Washington	-0.212	0.256	-11.26	13.51	2.25
46. West Virginia	0.014	0.140	0.20	1.94	2.14
47. Wisconsin	-0.187	0.108	-10.16	5.84	-4.32
48. Wyoming	-0.145	0.449	-0.69	2.09	1.40
Total all states			66.89	337.89	404.78
Total as % of U.S.			16.5%	83.5%	100.0%

(*) The marginal product of one dollar in aggregate public investment in the U.S. weighted according to the average regional decomposition of public investment in the sample period. Marginal products measured as number of workers per one million 1990 dollars.

Table 5: Regional disaggregation of the effects on output

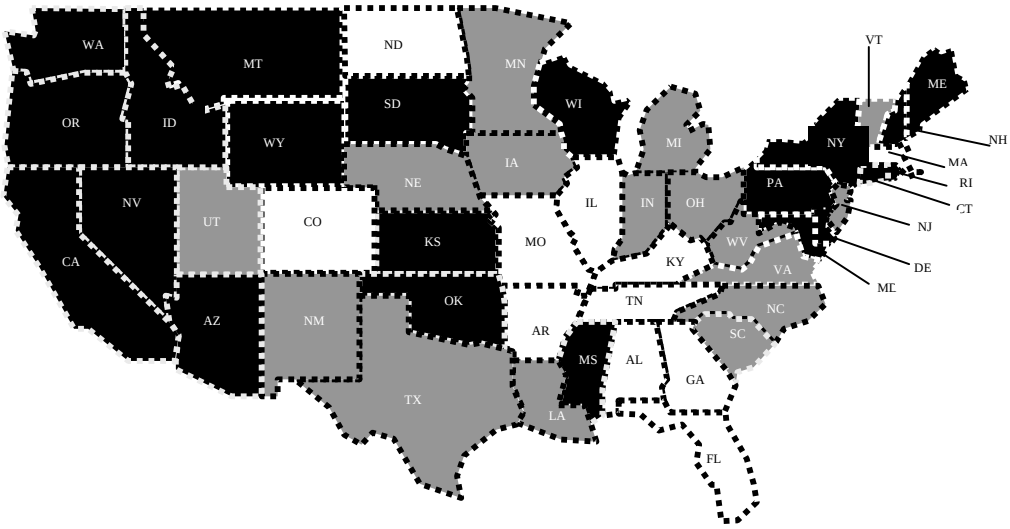
States	Elasticities with respect to		Marginal Product with respect to(*)		
	Public Investment inside	Public Investment outside	Public Investment inside (1)	Public Investment outside (2)	Total (3)=(1+2)
U.S.	0.139		$16.08		
1. Alabama	-0.129	0.163	-$0.19	$0.23	$0.04
2. Arizona	0.052	0.339	$0.09	$0.54	$0.63
3. Arkansas	0.023	-0.151	$0.02	-$0.13	-$0.11
4. California	-0.021	0.173	-$0.54	$2.68	$2.14
5. Colorado	0.079	-0.364	$0.14	-$0.62	-$0.48
6. Connecticut	-0.032	0.095	-$0.07	$0.19	$0.12
7. Delaware	-0.139	-0.168	-$0.06	-$0.08	-$0.14
8. Florida	0.010	0.054	$0.05	$0.30	$0.35
9. Georgia	0.192	-0.140	$0.62	-$0.44	$0.18
10. Idaho	-0.054	0.107	-$0.02	$0.04	$0.02
11. Illinois	0.000	0.311	$0.00	$1.82	$1.82
12. Indiana	0.061	0.229	$0.14	$0.56	$0.70
13. Iowa	0.197	0.254	$0.23	$0.29	$0.52
14. Kansas	0.037	0.102	$0.04	$0.10	$0.14
15. Kentucky	-0.052	0.143	-$0.07	$0.20	$0.13
16. Louisiana	0.118	0.191	$0.21	$0.34	$0.55
17. Maine	0.086	0.180	$0.04	$0.08	$0.12
18. Maryland	0.209	0.214	$0.45	$0.45	$0.90
19. Massachusetts	0.324	0.027	$1.18	$0.09	$1.27
20. Michigan	-0.240	0.077	-$0.97	$0.31	-$0.66
21. Minnesota	0.198	0.203	$0.43	$0.44	$0.87
22. Mississippi	-0.045	0.094	-$0.04	$0.08	$0.04
23. Missouri	0.150	0.101	$0.33	$0.22	$0.55
24. Montana	0.043	-0.064	$0.01	-$0.02	-$0.01
25. Nebraska	0.273	0.081	$0.19	$0.05	$0.24
26. Nevada	0.054	0.513	$0.04	$0.40	$0.44
27. New Hampshire	0.015	0.062	$0.01	$0.03	$0.04
28. New Jersey	0.254	0.135	$1.15	$0.60	$1.75
29. New Mexico	0.132	0.142	$0.08	$0.09	$0.17
30. New York	-0.072	0.203	-$0.72	$2.01	$1.29
31. North Carolina	0.185	0.208	$0.56	$0.63	$1.19
32. North Dakota	0.161	-0.480	$0.04	-$0.11	-$0.07
33. Ohio	0.259	0.222	$1.23	$1.05	$2.28
34. Oklahoma	-0.521	0.407	-$0.57	$0.44	-$0.13
35. Oregon	0.012	0.247	$0.02	$0.32	$0.34
36. Pennsylvania	0.111	0.385	$0.58	$1.98	$2.56
37. Rhode Island	-0.135	0.267	-$0.06	$0.11	$0.05
38. South Carolina	0.040	0.411	$0.05	$0.54	$0.59
39. South Dakota	0.050	0.031	$0.02	$0.01	$0.03
40. Tennessee	-0.038	0.328	-$0.08	$0.70	$0.62
41. Texas	0.143	0.135	$1.20	$1.12	$2.32
42. Utah	0.009	0.001	$0.01	$0.00	$0.01
43. Vermont	0.576	0.295	$0.13	$0.07	$0.20
44. Virginia	0.129	0.193	$0.36	$0.54	$0.90
45. Washington	-0.318	0.186	-$0.77	$0.45	-$0.32
46. West Virginia	0.115	0.178	$0.06	$0.10	$0.16
47. Wisconsin	-0.216	0.203	-$0.46	$0.44	-$0.02
48. Wyoming	-0.238	0.889	-$0.06	$0.21	$0.15
Total all states			$5.00	$19.46	$24.46
Total as % of U.S.			20.4%	79.6%	100.0%

(*) The marginal product of one dollar in aggregate public investment in the U.S. weighted according to the average regional decomposition of public investment in the sample period.

Table 6: On the importance of the spillover effects

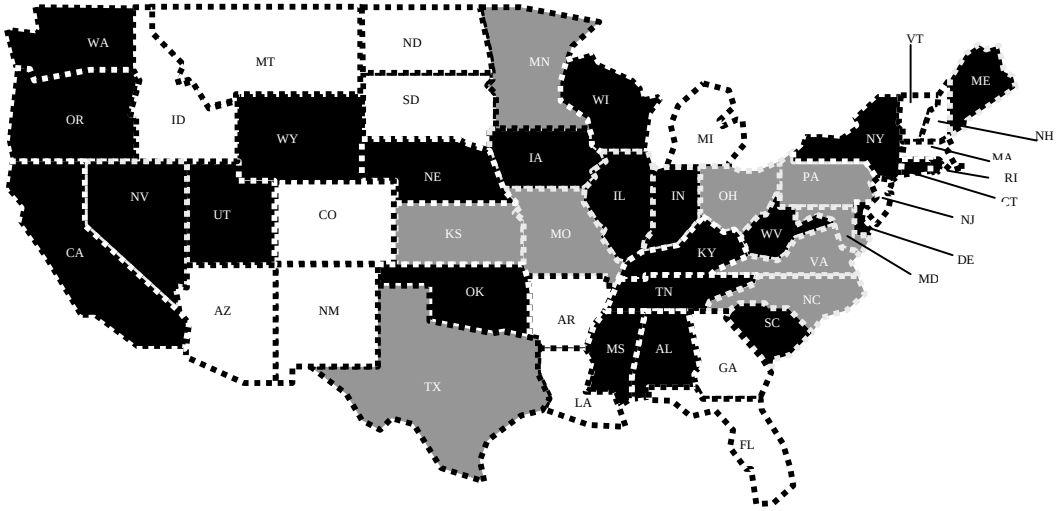
States	Private Investment	Private Employment	Private Output
1. Alabama	40%	100%	100%
2. Arizona	100%	0%	86%
3. Arkansas	0%	0%	0%
4. California	100%	100%	100%
5. Colorado	0%	0%	0%
6. Connecticut	100%	100%	100%
7. Delaware	100%	100%	0%
8. Florida	0%	0%	86%
9. Georgia	0%	0%	0%
10. Idaho	100%	0%	100%
11. Illinois	24%	100%	100%
12. Indiana	57%	100%	80%
13. Iowa	65%	86%	56%
14. Kansas	100%	74%	71%
15. Kentucky	43%	100%	100%
16. Louisiana	60%	0%	62%
17. Maine	100%	83%	67%
18. Maryland	100%	52%	50%
19. Massachusetts	45%	43%	7%
20. Michigan	71%	8%	100%
21. Minnesota	81%	52%	51%
22. Mississippi	100%	100%	100%
23. Missouri	30%	58%	40%
24. Montana	100%	0%	0%
25. Nebraska	50%	97%	21%
26. Nevada	100%	88%	91%
27. New Hampshire	100%	46%	75%
28. New Jersey	61%	44%	34%
29. New Mexico	75%	0%	53%
30. New York	100%	100%	100%
31. North Carolina	69%	54%	53%
32. North Dakota	0%	0%	0%
33. Ohio	50%	62%	46%
34. Oklahoma	100%	100%	100%
35. Oregon	100%	100%	94%
36. Pennsylvania	100%	80%	77%
37. Rhode Island	100%	100%	100%
38. South Carolina	75%	84%	92%
39. South Dakota	100%	0%	33%
40. Tennessee	0%	96%	100%
41. Texas	72%	66%	48%
42. Utah	50%	100%	0%
43. Vermont	67%	47%	35%
44. Virginia	67%	60%	60%
45. Washington	100%	100%	100%
46. West Virginia	50%	91%	63%
47. Wisconsin	100%	100%	100%
48. Wyoming	100%	100%	100%
U.S.	83%	83.5%	79.6%

Map 1: On the spillover effects of public investment in highways on investment



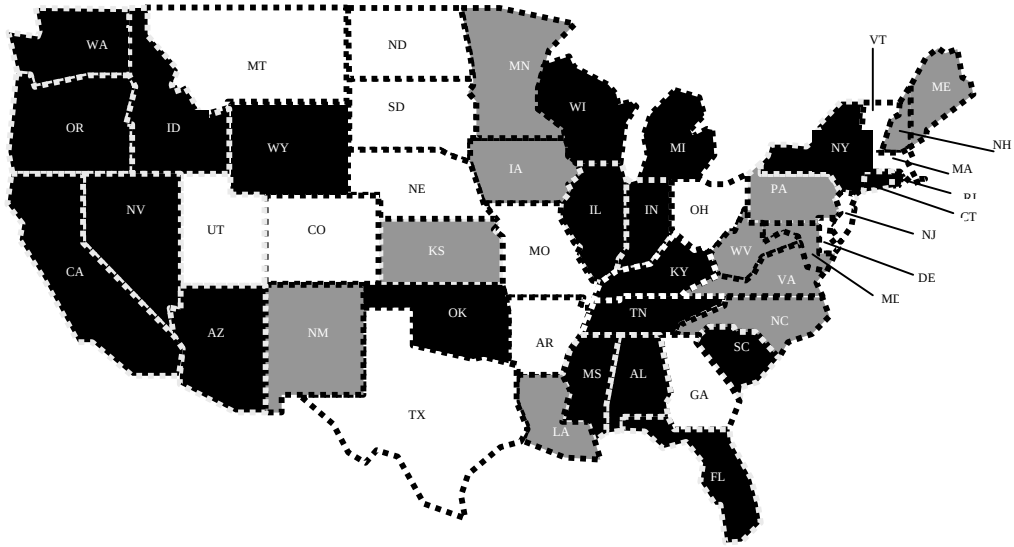
Note:
States in black – States which benefit the most from spillovers (spillovers at least 83% of the total effects).
States in gray – States which benefit moderately from spillovers (spillovers between 50% and 83% of the total effects).
States in white – States which benefit the least from spillovers (spillovers less than 50% of the total effects).

Map 2: On the spillover effects of public investment in highways on employment



Note:
States in black – States which benefit the most from spillovers (spillovers at least 83% of the total effects).
States in gray – States which benefit moderately from spillovers (spillovers between 50% and 83% of the total effects).
States in white – States which benefit the least from spillovers (spillovers less than 50% of the total effects).

Map 3: On the spillover effects of public investment in highways on output

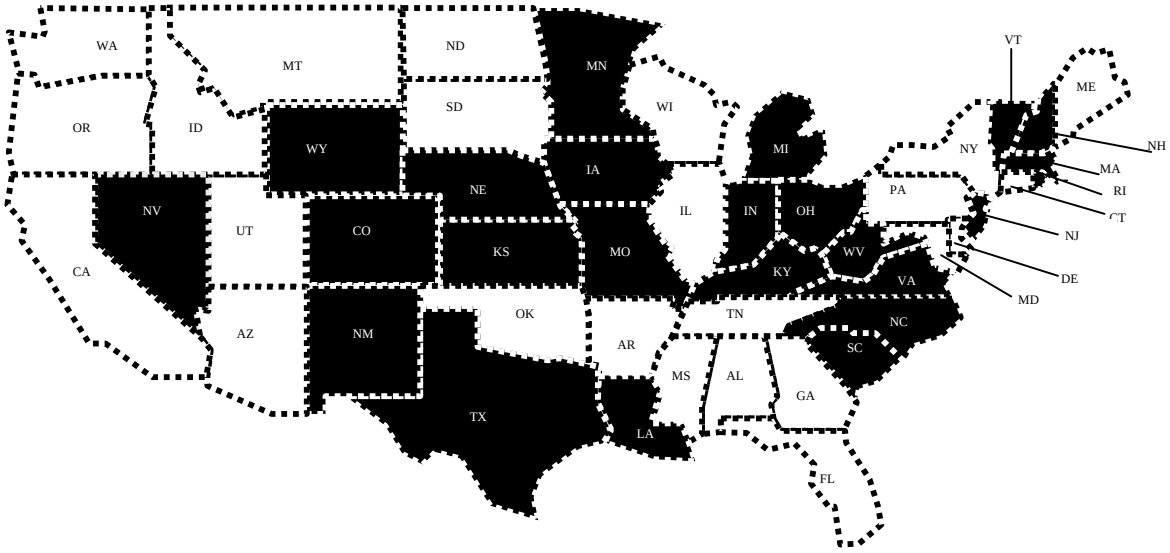


Note:
States in black – States which benefit the most from spillovers (spillovers at least 80% of the total effects).
States in gray – States which benefit moderately from spillovers (spillovers between 50% and 80% of the total effects).
States in white – States which benefit the least from spillovers (spillovers less than 50% of the total effects).

Table 7: Effects of public investment in highways relative to the state's share

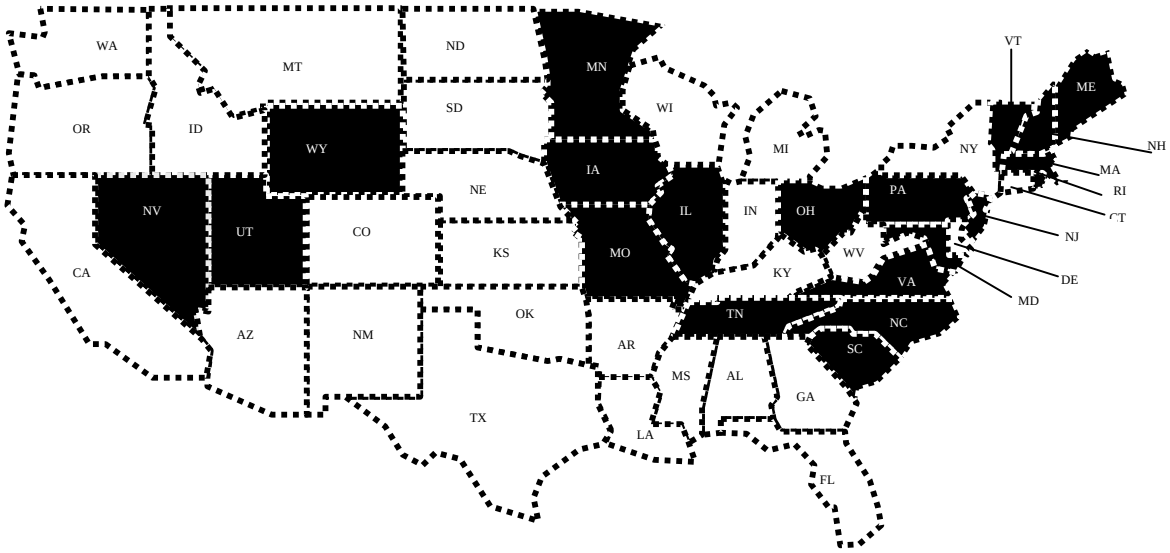
States	Private Investment		Private Employment		Private Output	
	% of effects/ % of state investment	% of effects/ % of state public investment	% of effects/ % of state employment	% of effects/ % of state public investment	% of effects/ % of state output	% of effects/ % of state public investment
1. Alabama	0.82	0.62	0.38	0.31	0.15	0.11
2. Arizona	0.83	0.50	0.32	0.22	2.07	1.31
3. Arkansas	-0.28	-0.18	-0.23	-0.17	-0.60	-0.36
4. California	0.95	1.67	0.90	1.51	0.67	1.24
5. Colorado	-1.27	-1.27	-2.28	-2.44	-1.40	-1.37
6. Connecticut	0.00	0.00	0.43	0.48	0.29	0.36
7. Delaware	-1.64	-1.32	-1.60	-1.14	-1.62	-1.35
8. Florida	-0.32	-0.31	0.05	0.06	0.33	0.33
9. Georgia	-1.61	-1.67	0.27	0.30	0.29	0.30
10. Idaho	0.83	0.47	-0.32	-0.20	0.26	0.14
11. Illinois	0.73	0.74	1.12	1.12	1.41	1.49
12. Indiana	2.48	2.06	0.43	0.41	1.33	1.15
13. Iowa	3.21	1.89	1.47	0.90	1.94	1.11
14. Kansas	1.07	0.81	0.75	0.57	0.61	0.42
15. Kentucky	1.06	0.65	-0.34	-0.20	0.41	0.23
16. Louisiana	1.27	1.62	-0.13	-0.10	1.20	1.11
17. Maine	0.00	0.00	1.24	1.05	1.25	0.82
18. Maryland	0.67	0.44	1.95	1.45	2.08	1.48
19. Massachusetts	2.70	3.14	2.51	3.30	1.84	2.39
20. Michigan	1.07	1.07	0.90	0.94	-0.72	-0.78
21. Minnesota	1.35	1.13	1.98	1.80	1.90	1.62
22. Mississippi	0.56	0.35	0.39	0.26	0.22	0.13
23. Missouri	1.12	1.07	1.36	1.46	1.15	1.12
24. Montana	0.43	0.21	-1.36	-0.65	-0.09	-0.04
25. Nebraska	2.70	1.73	0.93	0.63	1.61	0.97
26. Nevada	1.76	1.47	4.13	3.80	3.31	2.98
27. New Hampshire	1.06	0.85	1.04	1.03	0.39	0.34
28. New Jersey	2.31	2.92	1.53	1.76	1.92	2.53
29. New Mexico	3.85	2.44	-1.15	-0.55	1.34	0.65
30. New York	0.39	0.68	0.51	0.76	0.59	1.08
31. North Carolina	1.18	1.00	1.92	1.90	1.99	1.73
32. North Dakota	0.00	0.00	-0.45	-0.22	-1.25	-0.56
33. Ohio	2.11	2.07	2.63	2.83	2.14	2.21
34. Oklahoma	-0.51	-0.46	-0.88	-0.69	-0.47	-0.35
35. Oregon	-0.21	-0.14	0.99	0.76	1.27	0.89
36. Pennsylvania	0.10	0.09	2.22	2.22	2.25	2.15
37. Rhode Island	1.66	1.68	1.23	1.57	0.60	0.67
38. South Carolina	1.73	1.59	1.79	2.08	2.25	2.13
39. South Dakota	0.00	0.00	-0.49	-0.27	0.39	0.19
40. Tennessee	0.00	0.00	2.51	2.29	1.43	1.13
41. Texas	2.32	3.43	0.95	1.09	1.29	1.58
42. Utah	0.66	0.47	1.13	0.91	0.06	0.04
43. Vermont	3.84	2.10	3.24	2.35	4.30	2.40
44. Virginia	1.19	0.77	2.18	1.54	1.62	1.07
45. Washington	0.60	0.45	0.29	0.23	-0.68	-0.55
46. West Virginia	1.13	0.57	0.90	0.37	1.16	0.46
47. Wisconsin	0.36	0.33	-0.51	-0.55	-0.06	-0.06
48. Wyoming	2.23	1.73	1.75	0.55	2.27	1.01

Map 4: On the relative importance of benefits of public investment in highways on investment



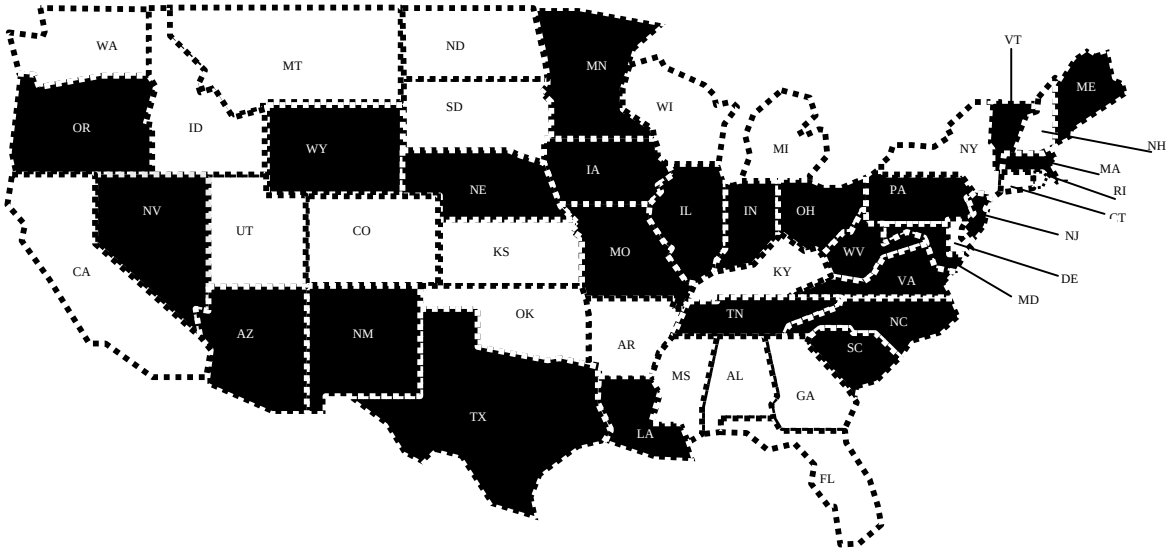
Note:
States in black – States which benefit relatively more from public investment in highways (effects greater than 1.00).
States in white – States which benefit relatively less from public investment in highways (effects lower than 1.00).

Map 5: On the relative importance of benefits of public investment in highways on employment



Note:
States in black – States which benefit relatively more from public investment in highways (effects greater than 1.00).
States in white – States which benefit relatively less from public investment in highways (effects lower than 1.00).

Map 6: On the relative importance of benefits of public investment in highways on output



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