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THE DETERMINANTS OF REGIONAL MANUFACTURING INVESTMENT: A SIMULTANEOUS EQUATIONS APPROACH

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Introduction

Because investment is crucial in regional economic growth, it is surprising that regional investment theory is a relatively neglected field of study among regional analysts. Crow (1979) notes that regional economists have devoted little attention to analyzing both interregional and intraregional investment patterns. One reason for this lack of emphasis has been a scarcity of adequate regional data. As a result, analysts either have attempted to adapt national investment equations as proxy models or have used data at the national level to drive their region-specific models. In either case, as Nadji and Harris (1984) argue, such approaches often yield little information that is region-specific. For example, interest rates determined in national markets do not vary by region; therefore, they cannot reflect differences in profitability among regions. Similarly, other determinants of national investment that reflect national market forces cannot answer the question adequately that the current study addresses: why does capital investment vary across states?

Previous Work

Much of the literature relevant to the current study emphasizes plant location. For example, using a panel data set, Plaut and Pluta (1983) analyze the relationship between business climate (a concept that the authors emphasize is difficult to quantify) and industrial growth. The study measures industrial growth with three different variables—the change in real value added, the change in employment, and the change in real capital stock—which results in three distinct estimable equations. Each equation is estimated using the same set of regressors, all of which are assumed to be exogenous. (It is argued that this assumption is justified because the regressors were measured at the beginning of the period.) Conflicting results characterize this study. For example, the study finds that business climate, taxes, and government expenditures are unrelated to overall state industrial growth. These variables are found to be significantly related to employment and capital stock

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growth, however. As is the case with most studies of this sort, the most important variables are those that account for traditional market characteristics.

Also using panel data, Helms (1985) measures economic growth with a single variable: state personal income. This results in a single equation model that reveals that taxes can have different effects on business activity depending on how tax revenues are spent. If the revenues are used simply to redistribute income, plant location as proxied by state personal income is affected negatively. If tax revenues are used to improve public capital, however, businesses may view the economic benefits of public capital as outweighing the concomitant tax cost and thus may tend to locate in high tax areas.

McHone (1986) attempts to predict plant location by modeling the supply and demand of "industrial development rights." McHone estimates a two equation model: one equation represents the supply of manufacturing employment and the other models the demand of manufacturing employment. His results reveal that the most important determinant of regional manufacturing employment is the income level of its residents, a common market indicator.

In another paper of interest to the current study and to the general problem of plant location, Wassmer (1992) uses an extensive simultaneous equation system to investigate the effect of property tax abatements on the values of various categories of property in the Detroit area. If property tax abatements are effective in attracting businesses, of course, the abatements should have a positive impact on property valuation. Wassmer's model confirms that this relationship probably exists if for some reason the profit-reducing characteristics of the land in question has not been capitalized fully into the price. In other words, communities can benefit (i.e., improve local economic development) by using property tax abatements to offset noncapitalized profit-reducing characteristics of land.

Relationship to the Current Study

The above literature review makes it clear that concern for local economic development expresses itself by emphasizing two important economic variables: employment and income. The issue, however, generally is expressed by regional economists as a plant location problem. The justification for this approach is the well-known relationship in economics between investment (plant location), employment, and income. This results in a simultaneous equation system that has been noted by many of the authors listed above. Unfortunately, most of the studies listed above (and many others) either model income or employment in a single equation framework (see Helms and Plaut and Pluta) or use multiple equations with primary interest in a single variable (see Wassmer and McHone). This study proposes to examine these three important regional variables in a simultaneous equation framework that allows for endogeneity of the relevant variables.

In addition, investment is estimated in a cross-sectional framework, an approach with some advantages over traditional time-series analysis. There are also some disadvantages with this approach. First, cross-sectional analysis allows political units (and, therefore, political attempts at economic policy making) to vary. For example, this study combines information on many controversial state-level economic policies such as issuance of industrial revenue bonds, use of corporate income taxes and various tax credits, and regulatory control of the sale of common stock. In other words, this approach provides a unique opportunity to sift through the effectiveness of various economic development programs. It also should be added that information on these programs in a time series framework may be extremely difficult, if not impossible, to obtain.

The second advantage is that cross-sectional analysis produces results more appropriate to the long run than those produced by time-series methods. Because cross-sectional observations provide information on individuals and firms operating at different locations on their planning curves (i.e., long-run cost curves), variations from these curves should be random. The resulting estimates allow inferences to be drawn about the long-run determinants of investment (Kuznets, 1966, pp. 433-436; Kuh and Meyer, 1957). Given that investment has economic impacts that stretch over long periods of time, cross-sectional estimation techniques are arguably more appropriate to investment analysis than are estimations based on time-series data.

Of course, the primary disadvantage of a cross-sectional approach is that the economist's favorite investment determinant—the interest rate—is unavailable for use. It simply is not plausible to argue that interest rates vary significantly from one geographic area of the country to another. So, a cross-sectional study does involve a tradeoff. But the gains may significantly outweigh the losses.

The Model

The proposed model consists of a system of three equations describing investment, employment, and income. The three equation system is listed below:

$$(1)\ \text{PCINVEST} = \alpha_0 + \alpha_1\text{PCINC} + \alpha_2\text{WAGE82} + \alpha_3\text{UNION\%} + \alpha_4\text{BTU} + \alpha_5\text{DENSITY} + \alpha_6\text{APW} + X_I\alpha_I + e_I$$

$$(2)\ EMPLOYMENT = \beta_0 + \beta_1 WAGE82 + \beta_2 UNION\% + \beta_3 DENSITY + \beta_4 POP82 + \beta_5 HSGRADS + X_N\beta_N + e_N$$

$$(3)\ PCINC = \gamma_0 + \gamma_1 PCINVEST + \gamma_2 EMP\% + \gamma_3 DENSITY + \gamma_4 HSGRADS + \gamma_5 UN\% + X_Y Y_Y + e_Y$$

The named variables on the right side of each equation are assumed to be endogenous. (Table 1 lists all endogenous variables and their definitions.) The system is not complete in the sense that an equation is specified for every endogenous variable. This in itself is not unusual. A complete system would require an extensive model (probably a general equilibrium model) which is beyond the intended partial equilibrium approach of this investigation. The vector X in each equation represents an array of exogenous variables. (Table 2 lists and defines all of these variables.)

Variables appearing in the investment equation are chosen because they, theoretically, should affect a firm's perceptions of the long-run profitability of an investment project. The named (endogenized) variables in equation 1, however, also could be sources of simultaneous equation bias. For example, input costs (WAGE82 and BTU) affect investment, but the level of investment probably also affects input costs. This dual causality also could be a problem with income (PCINC) and population density (DENSITY). The average number of production workers per manufacturing firm (APW) also could suffer from simultaneity problems. Because these variables are sources of possible simultaneous equation bias, the equation is estimated using both ordinary least squares and two stage least squares. (Variables utilized for creating the instrumental variables used in the two stage process include all exogenous variables appearing in the model and listed in Table 2 plus those variables listed in Table 3.)

Variables selected for the employment equation are chosen for their ability to reflect long-run, prevailing supply and demand conditions in the state's labor market. Simultaneity problems also could occur with several variables in this equation. Investment, the degree of unionization (for the advisability of endogenizing this variable see Lee, 1978), and wages exercise some influence on employment and so are treated, statistically, as endogenous. The same argument holds for the population variables such as density and total population. As a result of these possibilities, both ordinary least squares and two stage least squares also are used to estimate this equation.

Finally, variables appearing in the income equation (equation 3) are chosen for their hypothesized relationship to labor productivity (including labor leisure tradeoffs) and government transfer programs.

Possible simultaneity problems also exist with the named variables in this equation. The demographic variables—employment, unemployment, population density, and high school graduates (EMP%, DENSITY, HSGRADS, and UN%)—logically affect income. The level of investment also affects income. Consequently, ordinary least squares and instrumental variables are used to estimate this equation.

An additional concern involves possible correlation of the error terms (e) in each equation. If the random factors that cause errors in the investment equation also influence the employment and income equations (which seems highly plausible), unnecessarily large standard errors will result for the estimated coefficients. Standard econometric practice requires the use of a system estimator such as three stage least squares to correct for this problem. Iterative three stage least squares (3SLS) is chosen to estimate the system. Of course, if there is a misspecification in any single equation, a systems estimator may prove inferior by introducing that misspecification into the other equations. With this shortcoming in mind, results are provided for two single equation techniques (ordinary least squares and two stage least squares) and for the iterative three stage least squares technique. Close examination of Tables 4, 5, and 6 reveals a great deal of consistency among the three estimates, providing some support for the chosen statistical techniques. Data for the estimations consist of an observation for each state in the year 1982. The data appendix lists, defines, and provides sources for all variables used in the model.

The Investment Equation

The parameter estimates of the equation describing PCINVEST are reported in Table 4. Manufacturing investment per capita in each state is a function of expected profits; therefore, the 17 endogenous and exogenous explanatory variables reflect either expected revenue or expected costs anticipated by firms deciding whether to invest.

The magnitude, algebraic sign, and statistical significance of the estimated parameters are similar across the three estimation techniques, providing some support for the chosen specification. Referring to the 3SLS estimates, nine of the 17 estimates are statistically significant at the 10 percent level or better.

Given that manufacturing investment per capita is influenced by expected costs, factor prices such as WAGE, BTU and WGROWLAG are included in the specification. Normal procedure is to include an interest rate variable as a measure of capital costs. In a cross-sectional analysis, however, this is not possible or even desirable. At the margin, interest rates should not vary from region to region. Consequently, other cost factors must be considered. The *a priori* signs of these explanatory variables are indeterminate. Assuming the mobility of capital and the efficacy of capital markets, capital may migrate from areas of relatively high factor costs to areas with lower factor costs. If capital flight exists, more investment occurs in states with relatively lower factor prices. This effect implies that the coefficients of these three variables should be negative. In the theory of production, however, capital may substitute for relatively more expensive factors. As the prices of other inputs increase, the cost-minimizing firm will substitute capital for relatively more expensive inputs. This argument implies that per capita investment is greater in areas where the costs of other factors are relatively high. The coefficients of WAGE, BTU, and WGROWLAG will be positive if the substitution effect is greater than the capital flight effect. The 3SLS estimation results indicate the dominance of the substitution effect, as all three of the coefficients are positive (with the coefficients for WAGE and WGROWLAG significant at the 5 percent level and the coefficient for BTU significant at the 10 percent level). This result is consistent with other studies. (See Rones, 1986, pp. 9-10.)

The specification of the equation includes three binary variables indicating whether a given state has an investment tax credit (ICREDIT), a tax credit for research and development (RNDCREDIT), or a tax credit for the purchase of new machines and equipment (EQCREDIT). These variables equal 1 if a particular tax credit exists in a given state and 0 otherwise. As selective tax credits distort the mechanics of the market, per capita investment should be greater in those states that employ them, and the coefficients of ICREDIT, RNDCREDIT, and EQCREDIT are expected to be positive. The 3SLS results show that the coefficient for ICREDIT has the expected positive sign and is significant at the 5 percent level. The coefficients of RNDCREDIT and EQCREDIT are negative, but they are not significantly different from 0.

The presence of a corporate income tax increases a firm's costs and reduces the expected profitability of new investment. Therefore, the specification of the per capita manufacturing investment equation includes a binary variable, CORPTAX, that indicates whether a given state has a corporate income tax. Given that this variable is equal to 1 if a corporate income tax exists, the coefficient is expected to be negative. The 3SLS estimate of the parameter for CORPTAX is negative and significant at the 10 percent level.

The net impact of a state personal income tax is less certain than the impact of a corporate income tax. Gwartney and Stroup (1983) defend the supply side view that higher marginal tax rates on personal income reduce labor supply. Betson and Greenberg (1986), Bohanon and Van Cott (1986), and Gahvari (1986) all suggest that the effect of personal tax rates on labor supply and productivity is theoretically indeterminate. Consequently, the impact of personal income taxes on labor supply and productivity becomes an empirical issue.

While this model does not test the effects of marginal personal income tax rates on labor supply directly, it does investigate their effect on a closely related variable: per capita investment. A firm located in a high marginal personal income tax state will have to pay, all else constant, a higher wage to attract the same workers as a firm located in a low marginal income tax state. This must be the case as long as workers are mobile and workers choose employment on the basis of net (after tax) salaries. Canto, Joines, and Laffer (1983, p. 6) state that a tax on income "will unambiguously reduce the equilibrium level of labor and capital employed in the market sector, resulting in a net reduction of the level of production of market goods." To the extent that these arguments are correct, a positive coefficient would be expected for TAXRATE.

If tax revenues are used to acquire and maintain a state's stock of public capital and if this capital provides significant external economies to the firm, a positive relationship can exist between taxation and investment (Helms, p. 581). While TAXRATE does not measure tax revenues (see Helms for a good discussion of how difficult it is to formulate worthwhile tax variables), it does provide an indication of the state's willingness to levy a significant tax. Hence, a positive coefficient for TAXRATE is plausible. As reported in Table 4, the 3SLS coefficient on TAXRATE is positive and marginally significant, which casts doubt on another supply-side argument.

Unions impose two types of costs on a firm. First and foremost, the union can negotiate a higher wage successfully. A second, less commonly discussed cost is the extent to which a union can influence managerial policies and decisions. In either case, the presence of a union implies higher costs. In specifying the PCINVEST equation, two variables are used to indicate labor union strength within a given state. RTW is a binary variable indicating whether a state has a right-to-work law, while UNION% (an endogenized variable) shows the percentage of a state's work force that is unionized. If firms wish to avoid the effects of unionism, the coefficient of UNION% is expected to be negative. Analogously, if RTW is an indicator of the relative power of labor unions within a state, firms will tend to locate in states with right-to-work laws. Because RTW is 1 for states with right-to-work laws, the expected sign of its coefficient is positive. The 3SLS results indicate that the coefficient for RTW is positive, but is not statistically different from zero. The 3SLS estimate of the UNION% coefficient is negative, as expected, and significant at the 5 percent level.

Many states adopt paternalistic policies in regard to public stock issuance. The policies are referred to as *blue sky laws* and supposedly protect consumers by reducing the risk associated with stock purchases. A side effect of the policy is to make stock issuance more expensive and, therefore, the acquisition of investment funds more difficult. Thus, the specification includes the variable BLUESKY which is a published index where smaller values indicate more intensive stock regulation and larger values correspond to less restrictive regulation (Brandi, 1985, p. 704). Because a less restrictive environment reduces the cost of generating investment funds, a positive coefficient for BLUESKY is expected. In recent years, states have attempted to subsidize new investment through the sales of industrial revenue bonds. Because these monies reduce the interest costs of the firms receiving them, the use of industrial revenue bonds should result in increased per capita investment. To account for this factor, DEVBONDS—the per capita value of industrial revenue bonds sold during the year—is included in the equation, and a positive coefficient is expected. Referring again to the 3SLS estimates reported in Table 4, both DEVBONDS and BLUESKY have the expected positive sign, but neither estimate is statistically significant.

Manufacturing investment in a given state also may be influenced by the volume of research and development grants given to its universities by the federal government. To the extent that these funds encourage industrial development, they will have a positive influence on investment expenditures. Therefore, per capita investment is expected to be related directly to PCRND, the per capita amount of federal research and development funds given to universities. The estimation results indicate a positive, but insignificant coefficient.

One variable that relates to some firms' evaluation of their expected revenue is the proximity and size of the market for their products. To control for this, population per square mile (DENSITY) is included in the specification of the equation. *Ceteris paribus,* a larger population per square mile could provide a larger market for consumer products and lead to greater investment. The positive and significant coefficient for DENSITY confirms this hypothesis.

The firm's measure of expected revenue should be related directly to income in the state. For this reason, per capita income (PCINC) and lagged per capita income (PCINCLAG) are included in the model. The theoretical advisability of including income variables in a cross-sectional model of investment has been debated in regional investment literature (Crow, 1979). It seems obvious that a higher level of income leads to increased sales revenue and thus a higher level of investment spending. Also, more income implies more money to invest in new or ongoing enterprises. On the other hand, business investment in a given state is influenced by economic factors that are not state-specific. In an age of large, multinational firms with worldwide markets, investment in a given plant does not depend entirely on income in the state where the plant is located. In addition, per capita income may act as a proxy for a regional price index. States with high per capita income are likely to be states with relatively high production costs. Consequently, no expected sign can be attached to the two income variables (PCINC and PCINCLAG). Estimation results reveal the coefficient of PCINC is positive and insignificant, while the coefficient for PCINCLAG is negative and significant at the 5 percent level.

Finally, the investment equation includes the average number of production workers (APW). Increased investment is expected to occur in plants with a larger number of employees in an attempt to offset the diminishing marginal productivity of labor. As seen in Table 4, the coefficient on APW is positive as expected and is statistically significant at the 5 percent level.

The Employment Equation

Table 5 provides the estimated coefficients and standard errors produced for the employment equation. Once again, the coefficients are remarkably similar across all three regression techniques. The magnitudes of the coefficients are much the same, their signs remain constant, and their levels of significance do not change. In addition, only one variable (RTW) has an unexpected sign.

Growth in investment should lead to greater labor productivity and to increases in the aggregate demand for labor. As a result, employment will rise. The variable INVEST has the correct positive sign and is significant at the 5 percent level which provides empirical evidence for the hypothesized relationship. Over the long run, investment has a significantly positive impact on regional employment.

The coefficient for DENSITY is large and significant at the 5 percent level. This follows because the more dense a population is, the more available important services and products are to the firm. A dense population corresponds to a good variety of labor skills, an adequate supply of social capital, and well-developed transportation systems.

One variable that might be expected to affect both labor demand and labor supply, the average wage rate (Phelps, 1970), has no significant impact on employment. Theory generally holds that higher wages reduce the willingness of firms to hire labor. The long-run demand for labor is usually assumed to be more sensitive to wage changes than the short-run demand. In a cross-sectional framework, however, it usually is assumed that deviations from long-run equilibrium are random with positive deviations canceling negative ones. After adjustment to long-run equilibrium, there is no reason to suspect that a higher relative wage will reduce employment. In fact, it will be as likely to increase employment (due to supply side effects) as to reduce it. Therefore, it is not surprising that the coefficient of WAGE82 is statistically insignificant.

Three variables are included in the equation to account for differing aspects of labor supply. UNION% is included in the estimation as an indicator of union strength and the ability of unions to restrict the supply of labor. The estimated coefficient for UNION% which is negative and significant at the 5 percent level indicates a considerable degree of success on the part of unions. HSGRADS has been included as an indicator of labor force quality under the assumption that a higher quality labor force leads to more employment (Hamermesh and Rees, 1984, pp. 54-61). This hypothesis is verified by the positive and significant coefficient of HSGRADS. Finally, the absolute population level is included as a scale factor to adjust for use of the absolute employment level as the dependent variable. As a result, the coefficient for POP82 is positive and significant at the 5 percent level.

The final category of variables that are included in the employment equation represents various government policies often argued to have an effect on employment. State expenditures for job training and employment services (JOB) usually are designed to combat structural unemployment problems. The effectiveness of such programs has been debated by economists (Ehrenberg and Smith, 1982, pp. 255-256). The coefficient on JOB is positive and significant at the 5 percent level, leading to the conclusion that these programs are of measurable benefit to the employment problem. Another state government program overtly designed to encourage employment is the existence of a job creation tax credit (JOBCREDIT). Labor economists long have argued that these kinds of programs simply encourage employers to remix production techniques and employees in an effort to create the illusion of newly created jobs. Our findings confirm this notion. The coefficient of JOBCREDIT is insignificantly different from 0. Also included in the equation is total state and local general expenditures (EXPEND). While these expenditures do not represent an overt attempt on the part of the state to affect employment, they do create some jobs. The question on a regional level is whether the jobs created by such expenditures outweigh the possible loss of jobs due to collection of tax revenues to finance the expenditures (the *crowding out* effect). As might be suspected, the coefficient for EXPEND is insignificant. Finally, a binary right-to-work variable is included to indicate whether the state has adopted a right-to-work law. Because RTW accepts the value 1 when a state has a right-to-work law it is somewhat surprising that its estimated coefficient is negative and significant at the 10 percent level. Instead of concluding that passage of a right-to-work law reduces employment, a more likely explanation was sought. The existence of a right-to-work law is rare outside the South. This regionality of RTW could be acting as a regional dummy which explains the unexpected coefficient.

The Income Equation

Estimation results for the income equation are reported in Table 6. As with the other two equations, the signs and the magnitudes of the estimated coefficients are consistent across all three estimation techniques. Also, the levels of significance remain identical (5 percent level) for five of the seven slope estimates.

Two variables are included in the equation to account for productivity differences between states. Because the level of education is highly correlated with labor force productivity, a measure of the educational attainment of a state's population (HSGRADS) is included as an explanatory variable in the equation. The estimated coefficient for HSGRADS is positive and significant, providing additional evidence for the well-known relationship between educational attainment and income. The other variable chosen to account for productivity differences is the per capita level of manufacturing investment (PCINVEST). Surprisingly, the estimated coefficient for PCINVEST is negative and marginally significant. This unexpected outcome probably is due to the use of investment instead of the preferred but unavailable capital stock variable.

Because the labor-leisure choices of a state's population to a large extent determine income-earning activity within the state, two variables thought to measure this characteristic are included in the equation. The employment rate, which is the ratio of the employed population to the total population, is probably the best indicator of the diligence of a state's population. The estimated coefficient for EMP% is relatively large and significantly positive. The unemployment rate which is also included in the equation can be somewhat misleading because it relies on a number (the labor force) that involves a subjective calculation. Therefore, it is no surprise that the estimated coefficient for UN% is positive but insignificant.

Government spending and income redistribution programs also contribute to per capita income within a state. Thus state per capita general expenditures (PCEXPEND) is included. The coefficient for PCEXPEND is positive (though small) and significant. Per capita federal aid to states is included in the model. At first glance, the negative and significant coefficient for PCFEDAID might seem unreasonable, but many federal redistribution programs are triggered by a low state per capita income level.

Finally, population density is included in the specification as a measure of market gravity. In other words, economic entities such as retail, wholesale, and manufacturing firms tend to gravitate to areas of dense population. Accordingly, incomes should be greater in areas of high population density. This hypothesis is verified by the positive and significant coefficient for DENSITY.

Model Validity

To assure validity of the model, several tests are performed on the specification of the three equation system. These tests are conducted using quasi-likelihood ratio statistics (based on a chi-squared distribution) suggested by Gallant and Jorgenson (1979). First, a test is performed on the null hypothesis that the coefficient of every explanatory variable is equal to zero. This null hypothesis is strongly rejected at the 1 percent level of significance (the test statistic is 35,429).

In addition, the overall importance of state tax deductions is examined. Specifically, a test is performed on the null hypothesis that the coefficients of JOBCREDIT, ICREDIT, RNDCREDIT, and EQCREDIT are equal to zero. Given a test statistic of 6.91, the null hypothesis cannot be rejected at the 10 percent level with a critical value of 7.779. This confirms the relative unimportance of these tax credits.

A final test is performed to check the efficacy of both state and federal government expenditures. The test is done on the null hypothesis that the coefficients for PCRND, AID, EXPEND, PCFEDAID, and PCEXPEND are equal to zero. The calculated chi-squared value for this test is 60.25. As the critical value for a 1 percent significance test is 15.09, the null hypothesis is rejected. Therefore, we conclude with a relatively high level of confidence that federal, state, and local fiscal actions influence investment, employment, and income.

Conclusion

A dominant theme found in the specification of the equations is that state and local governments do influence regional investment and economic development. Evidence is produced that state corporate income taxes discourage investment. On the other hand, the provision of education and public goods—generally an accepted role of state governments—has a positive impact on investment and economic development. The continued supply of these public goods not only attracts new firms to a given location, but it facilitates the continued operation of existing firms. With the exception of the investment tax credit, overt actions by state governments such as industrial revenue bonds and equipment tax credits are ineffective. Consequently, any program designed to stimulate economic growth should emphasize the importance of public capital and education. The ineffectiveness of policies that distort the market with temporary tax-saving reductions is evident.

In conclusion, this novel cross-sectional approach to investment modeling produces new inferences not obtainable with time-series techniques. One advantage of this method is that it facilitates a study of investment based on microeconomic theory. This permits an explicit analysis of individual state policies and their impact on investment. For these reasons, further investigations of investment using cross-sectional techniques are recommended.

References

1. Betson, David M., and David Greenberg, "Labor Supply and Tax Rates: Comment," *American Economic Review*, 76 (June 1986), pp. 551-556.

2. Bohanon, Cecil E., and T. Norman Van Cott, "Labor Supply and Tax Rates: Comment," *American Economic Review*, 76 (March 1986), pp. 277-279.

3. Brandi, J.T., "Securities Practitioners and Blue Sky Laws: A Survey of Comments and a Ranking of States by Stringency of Regulation," *The Journal of Corporation Law*, 10 (Spring 1985), pp. 689-710.

4. Canto, Victor A., Douglas H. Joines, and Arthur B. Laffer, "Tax Rates, Factor Employment, Market Production, and Welfare," in *Foundations of Supply-Side Economics: Theory and Evidence* (New York: Academic Press, 1983).

5. Crow, R.T., "Output Determination and Investment Specification in Macroeconometric Models of Open Regions," *Regional Science and Urban Economics*, 9 (May/August 1979), pp. 141-158.

6. Ehrenberg, Ronald G., and Robert S. Smith, *Modern Labor Economics* (Glenview, Illinois: Scott Foresman and Company, 1982).

7. Farber, Henry S., "Right-to-Work Laws and the Extent of Unionization," *Journal of Labor Economics*, 2, no. 32 (1984), pp. 319-352.

8. Gahvari, Firouz, "Labor Supply and Tax Rates: Comment," *American Economic Review*, 76 (March 1986), pp. 280-283.

9. Gallant, A.R., and D. Jorgenson, "Statistical Inference for a System of Simultaneous Nonlinear, Implicit Equations in the Context of Instrumental Variable Estimation," *Journal of Econometrics*, 11 (October/December 1979), pp. 275-302.

10. Gwartney, James, and Richard Stroup, "Labor Supply and Tax Rates: A Correction of the Record," *American Economic Review*, 73 (June 1983), pp. 446-451.

11. Hamermesh, D.S., and A. Rees, *The Economics of Work and Pay*, 3rd edition (New York: Harper and Row, 1984).

12. Helms, L. Jay, "The Effect of State and Local Taxes on Economic Growth: A Time Series-Cross Section Approach," *The Review of Economics and Statistics*, 67 (November 1985), pp. 574-582.

13. Kuh, E., and J. Meyer, "How Extraneous are Extraneous Estimates?" *The Review of Economics and Statistics*, 39 (November 1957), pp. 380-393.

14. Kuh, E., *Capital Stock Growth: A Micro-Econometric Approach* (Amsterdam: North-Holland, 1963).

15. Kuznets, S., *Modern Economic Growth* (New Haven: Yale University Press, 1966).

16. Lee, Lung-Fei, "Unionism and Wage Rates: A Simultaneous Equations Model with Qualitative and Limited Dependent Variables," *International Economic Review*, 19 (June 1978), pp. 415-433.

17. McHone, Warren W., "Supply-Side Considerations in the Location of Industry in Suburban Communities: Empirical Evidence from the Philadelphia SMSA," *Land Economics*, 62 (February 1986), pp. 64-73.

18. Nadji, M., and C.C. Harris, Jr., "A Note on Regional Investment Functions," *Journal of Regional Science*, 24 (May 1984), pp. 271-275.

19. Plaut, T.R., and J.E. Pluta, "Business Climate, Taxes and Expenditures, and State Industrial Growth in the United Sates," *Southern Economic Journal*, 50 (July 1983), pp. 99-119.

20. Rones, Phillip, L., "An Analysis of Regional Employment Growth, 1973-85," *Monthly Labor Review*, 109 (July 1986), pp. 3-14.

21. U.S. Bureau of the Census, *1982 Census of Manufactures: Geographic Area Studies.*

22. U.S. Bureau of the Census, *Statistical Abstract of the United States*, various years.

23. Wassmer, Robert W., "Property Tax Abatement and the Simultaneous Determination of Local Fiscal Variables in a Metropolitan Area," *Land Economics*, 68 (August 1992), pp. 263-82.

Table 1—List of Endogenous Variables

PCINVEST	Per capita manufacturing investment (in $ thousand per person)
INVEST	Total manufacturing investment (in $ millions)
WAGE82	Average hourly manufacturing wages
PCINC	Per capita income (in $ thousands)
UNION%	Percentage of the labor force which is unionized
BTU	Average cost of energy per million BTUs
DENSITY	Population in thousands per square mile
APW	Average number of production workers per manufacturing firm
EMPLOYMENT	Total employment in thousands
POP82	Total population for 1982 in thousands
HSGRADS	Percentage of the population over age 25 with high school diplomas
EMP%	Employment rate
UN%	Unemployment rate

Table 2—Exogenous Variables Appearing in the Model

BLUESKY	Index of restrictions on stock issuance
DEVBONDS	Per capita dollar value of industrial development bonds
CORPTAX	Dummy: 1 = corporate income tax
PCINCIAG	Per capita income lagged one year
RTW	Dummy: 1= right-to-work law
ICREDIT	Dummy: 1 = investment tax credit
RNDCREDIT	Dummy: 1 = research and development tax credit
EQCREDIT	Dummy: 1 = industrial machinery and equipment tax credit
TAXRATE	Highest marginal personal income tax rate
PCRND	Per capita research and development funds for colleges and universities
WGROWLAG	Wage growth lagged one year
EXPEND	State and local direct general expenditures (in $ millions)
PCEXPEND	Per capita state and local direct general expenditures (in $ thousands per person)
JOB	State expenditures on training, employment, and other labor services
JOBCREDIT	Dummy: 1 = job creation tax credit
PCFEDAID	Per capita federal aid (in $ thousands per person)

Table 3—Exogenous Variables Not Appearing in the Model

AG%LAG	Percent of total income derived from agriculture lagged one year
MFG%LAG	Percent of total income derived from manufacturing lagged one year
FAILLAG	Business failures lagged one year
METRO%	Percent of the population living in metropolitan areas
POPGROWLAG	Population growth lagged one year
UN%LAG	Unemployment rate lagged one year
EMPGROWLAG	Employment growth lagged one year
STBONDS	State issued tax free student bonds
EXBONDS	State and local bonds for tax exempt institutions
WAGE81	Average wage in 1981
EMP81	Employment in 1981 (in thousands)
POP81	Population in 1981 (in thousands)
PCJOB	Per capita state expenditures on training, employment, and other labor services

Table 4—Estimated Coefficients of Per Capita Investment Equation, PCINVEST as the Dependent Variable

Independent Variables	OLS	2SLS	3SLS
INTERCEPT	91.712	93.486	141.722
	(0.512)	(0.399)	(0.788)
WAGE82[a]	88.444[e]	113.024[e]	104.016[e]
	(3.086)	(2.948)	(4.095)
BLUESKY	6.930	12.934	14.105
	(0.496)	(0.801)	(1.137)
DEVBONDS	-46.671	99.201	89.314
	(-0.206)	(0.386)	(0.455)
CORPTAX	-56.307[b]	-64.618[b]	-59.390[b]
	(-1.353)	(1.335)	(1.596)
PCINCLAG	-329.334[c]	-207.403[b]	-224.458[c]
	(-2.722)	(-1.331)	(-1.870)
PCINC[a]	270.787[c]	130.162	133.210
	(2.298)	(0.841)	(1.116)
RTW	44.111[b]	35.807	32.132
	(1.391)	(0.954)	(1.117)
UNION%[a]	-4.354[c]	-5.408[c]	-6.084[c]
	(-2.109)	(-1.945)	(-2.807)
BTU[a]	47.453[d]	48.318	48.000[d]
	(1.928)	(1.383)	(1.788)
DENSITY[a]	20.631	131.509	159.309[c]
	(0.310)	(1.150)	(1.810)
ICREDIT	28.063[b]	37.720[b]	37.010[c]
	(1.397)	(1.658)	(2.119)
RNDCREDIT	-8.813	-19.680	-19.948
	(-0.397)	(-0.777)	(-1.033)
EQCREDIT	-27.090	-32.767	-43.982
	(-0.712)	(-0.763)	(-1.338)
TAXRATE	2.948	4.156	3.865
	(1.138)	(1.341)	(1.623)
PCRND	-0.691	-0.462	0.123
	(-0.557)	(-0.341)	(0.119)
WGROWLAG	12.341[d]	16.465[d]	15.706[e]
	(1.728)	(2.036)	(2.529)
APW[a]	0.112[c]	0.130[c]	0.122[c]
	(2.340)	(2.366)	(2.893)
R^2	0.585	0.516*	* *

t-ratios are in parentheses
[a]Endogenous variable
[b]Significant at the 10 percent level
[c]Significant at the 5 percent level (one tail tests)
[d]Significant at the 10 percent level
[e]Significant at the 5 percent level (two tail tests)
* R^2 is provided for comparison purposes only. The authors are aware that it is an inappropriate statistic when instrumental variables are used in a regression
* * TSP was used to estimate the model and it provided no statistic comparable to R^2

Table 5–Estimated Coefficients of Per Capita Investment Equation, Employment as the Dependent Variable

Independent Variables	OLS	2SLS	3SLS
INTERCEPT	-351.616[d]	-454.043[e]	-472.169[e]
	(-1.997)	(-2.094)	(-2.468)
INVEST[a]	0.116[c]	0.193[c]	0.183[c]
	(2.116)	(2.773)	(2.982)
EXPEND	0.007	0.003	0.0003
	(0.190)	(0.085)	(0.009)
JOB	10.507[c]	10.3577[c]	10.184[c]
	(2.371)	(2.183)	(2.437)
RTW	-71.625[b]	-75.375[b]	-73.672[b]
	(-1.619)	(-1.541)	(-1.706)
UNION%	-10.122[c]	-10.783[c]	-10.754[c]
	(-2.783)	(-2.354)	(-2.659)
DENSITY[a]	214.538[c]	272.075[c]	265.665[c]
	(2.600)	(2.593)	(2.868)
JOBCREDIT	14.196	18.207	15.973
	(0.426)	(0.515)	(0.513)
POP82[a]	0.408[c]	0.394[c]	0.396[c]
	(36.964)	(28.807)	(32.905)
HSGRADS[a]	8.952[c]	10.642[c]	10.982[c]
	(3.362)	(2.761)	(3.232)
WAGE82[a]	-10.075	-9.619	-10.791
	(-0.253)	(-0.190)	(-0.242)
R^2	0.998	0.998*	* *

t-ratios are in parentheses
[a]Endogenous variable
[b]Significant at the 10 percent level
[c]Significant at the 5 percent level (one tail tests)
[d]Significant at the 10 percent level
[e]Significant at the 5 percent level (two tail tests)
* $R^2$is provided for comparison purposes only. The authors are aware that it is an inappropriate statistic when instrumental variables are used in a regression
* * TSP was used to estimate the model and it provided no statistic comparable to R^2

Table 6—Estimated Coefficients of the Per Capita Investment Equation With PCINC as the Dependent Variable

Independent Variables	OLS	2SLS	3SLS
INTERCEPT	-0.122	-1.460	-0.886
	(-0.104)	(-0.996)	(-0.671)
PCINVEST[a]	0.0002	-0.001	-0.002[b]
	(0.205)	(-0.786)	(-1.440)
EMP%[a]	6.686[c]	8.114[c]	6.764[c]
	(2.685)	(2.543)	(2.374)
DENSITY[a]	1.325[c]	1.411[c]	1.472[c]
	(4.600)	(3.938)	(4.507)
PCFEDAID	-4.400[c]	-4.364[c]	-4.341[c]
	(-4.945)	(-4.571)	(-5.053)
PCEXPEND	0.749[c]	0.711[c]	0.684[c]
	(6.338)	(5.602)	(5.966)
UN%[a]	-0.020	0.015	0.005
	(-0.603)	(0.383)	(0.138)
HSGRADS[a]	0.344[c]	0.044[c]	0.047[c]
	(3.254)	(3.336)	(3.960)
R^2	0.780	0.751*	* *

t-ratios are in parentheses
[a]Endogenous variable
[b]Significant at the 10 percent level
[c]Significant at the 5 percent level (one tail tests)
[d]Significant at the 10 percent level
[e]Significant at the 5 percent level (two tail tests)
* R^2 is provided for comparison purposes only. The authors are aware that it is an inappropriate statistic when instrumental variables are used in a regression
* * TSP was used to estimate the model and it provided no statistic comparable to R^2

DATA APPENDIX

Table 7—Primary Variables, Sources, and Definitions

Variable	Definition	Source
AG%LAG	Percent of total income derived from agriculture 1981	U.S. Department of Commerce, *State Personal Income Estimates for 1929-1982*
APW	Average number of production workers per manufacturing firm	*1982 Census of Manufacturers: Geographic Area Studies*
AREA	Total area of state (in square miles)	*Statistical Abstract of the United States 1982-83*
BLUESKY	Index of state restrictions on stock issuance	Brandi (1985)
BTU	Average cost of energy per million BTUs (1981)	*Census of Manufactures: Subject Studies*
COLLEGERND	Research and development funds provided to colleges by governments ($ millions)	National Science Foundation, Washington, D.C., *Academic Science Research and Development Funds Fiscal Year 1982*
CORPTAX	Dummy: 1 = existence of a state corporate income tax	*Statistical Abstract of the United States 1984*
DEVBONDS	Per capita collar value of state industrial revenue bonds 1983	*Statistics of Income Bulletin* (Summer 1984)
EMP82 EMP81 EMP80	Total employment for each state (in thousands)	U.S. Bureau of Labor Statistics, *Geographic Profile of Employment and Unemployment, 1980, 1981, and 1982*
EMP%	Civilian employment as a percent of civilian noninstitutional population	U.S. Bureau of Labor Statistics, *Geographic Profile of Employment and Unemployment, 1982*
EMPLOYMENT	Total state employment in thousands	U.S. Bureau of Labor Statistics, *Geographic Profile of Employment and Unemployment, 1982*

Table 7 (cont.)—Primary Variables, Sources, and Definitions

Variable	Definition	Source
EQCREDIT	Dummy: 1 = state industrial machinery and equipment tax credit	Congressional Budget Office, *The Federal Role in State Industrial Development Programs*
EXBONDS	Total dollar value of state and local bonds for tax exempt institutions (in $ millions)	Department of the Treasury, Internal Revenue Service, *Statistics of Income Bulletin* (Summer 1984)
EXPEND	State and local government direct general expenditures (in $ millions)	*Statistical Abstract of the United States 1985*
FAILLAG	Total business failures per state 1981	*Statistical Abstract of the United States 1985*
FEDAID	Total federal aid to each state (in $ millions)	*Statistical Abstract of the United States 1984*
HSGRADS	Percentage of state population over age 25 with high school diplomas	National Center for Education Statistics, U.S. Department of Education, *Digest of Education Statistics 1982*
ICREDOT	Dummy: 1 = state investment tax credit	Congressional Budget Office, *The Federal Role in State Industrial Development Programs*
INVEST	Total manufacturing investment (in $ millions)	*1982 Census of Manufactures: Geographic Area Series*
JOB	State expenditures on training, employment, and other labor services (in $ millions)	Congressional Budget Office, *The Federal Role in State Industrial Development Programs*
JOBCREDIT	Dummy: 1 = state creation tax credit	Congressional Budget Office, *The Federal Role in State Industrial Development Programs*
METRO%	Percent of state population living in metropolitan areas	*Statistical Abstract of the United States 1985*

Table 7 (cont.)—Primary Variables, Sources, and Definitions

Variable	Definition	Source
MFG%LAG	Percent of total income derived from manufacturing in 1981	U.S. Department of Commerce, *State Personal Income Estimates for 1929-1982*
PCINC PCINCLAG	State per capital income 1982 State per capita income 1981	U.S. Department of Commerce, *State Personal Income Estimates for 1929-1982*
POP82 POP81 POP80	Total state population in thousands 1982, 1981, and 1980	U.S. Bureau of the Census, Current Population Reports Series P-25, nos. 929 and 930
RNDCREDIT	Dummy: 1 = state research and development tax credit	Congressional Budget Office, *The Federal Role in State Industrial Development Programs*
RTW	Dummy: 1 = existence of right-to-work law	Farber (1984)
STBONDS	Total dollar value of state issued tax free student bonds (in $ millions)	Department of the Treasury, Internal Revenue Service, *Statistics of Income Bulletin* (Summer 1984)
TAXRATE	Highest marginal state personal income tax rate	Advisory Commission on Intergovernmental Relations, *Significant Features of Fiscal Federalism (1981-82)*
UN% UN%LAG	Percent unemployed of the civilian labor force	U.S. Bureau of Labor Statistics, *Geographic Profile of Employment and Unemployment, 1982*
UNION%	Percentage of the labor force that is unionized	*Statistical Abstract of the United States 1985*
WAGE82 WAGE 81	Average hourly manufacturing wages 1982, 1981, 1980	U.S. Bureau of Labor Statistics, *Employment and Earnings*

Table 8—Variables Created From Raw Data

Variable	Transformation
DENSITY	POP 82/AREA
PCINVEST	INVEST/POP82
PCRND	COLLEGERND/POP82
WGROWLAG	WAGE81-WAGE80
PCEXPEND	EXPEND/POP82
PCFEDAID	FEDAID/POP82
POPGROWLAG	POP81-POP80
EMPGROWLAG	EMP81-EMP80
PCJOB	JOB/POP82