The Location of New Foreign-Owned Manufacturing Plants in the United States and Seventh Federal Reserve District

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Introduction

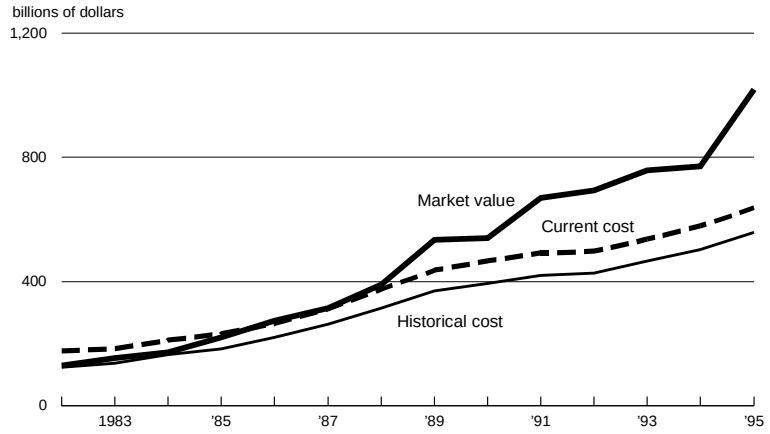
Foreign direct investment in the United States (FDIUS) increased rapidly during the 1980s with double-digit growth being the norm and, after slowing during the early 1990s, has accelerated its pace recently. As figure 1 shows, such a conclusion can be reached regardless of which measure of the stock of FDIUS one chooses. This growth resulted in a stock of FDIUS in 1995 that was $560.1 billion using historical cost, $638.5 billion using current cost, and $1,019.2 billion using market value.[1]

One way to provide perspective on the size of FDIUS is to compare the levels of foreign direct investment held by U.S. firms to FDIUS. Regardless of the measure, foreign direct investment held by U.S. firms exceeds FDIUS. For example, the stock of foreign direct investment held by U.S. firms in 1995 was $711.6 billion using historical cost, $880.1 billion using current cost, and $1,301.1 billion using market value. Thus, foreign direct investment held by U.S. firms exceeded FDIUS by $151.5 billion using historical cost, $241.6 billion using current cost, and $281.9 billion using market value.

A second way to provide perspective is to examine the share of U.S. output produced by foreign-owned firms. The share of gross domestic product attributable to foreign-owned firms rose from 2.3% in 1977 to 6.2% in 1994.[2] Coinciding with the rise in relative output share has been a rise in the percentage of U.S. workers employed by foreign-owned firms. Between 1977 and 1994 employment at nonbank foreign-affiliated firms rose from 1.7 to 5.0% of all U.S. nonbank employment.

With respect to industries, the largest share of FDIUS is in manufacturing. In 1995 the stock of manufacturing FDIUS was $210.3 billion or 38% of total FDIUS.[3] The leading source country for manufacturing FDIUS is the United Kingdom with $56.9 billion or 27% of manufacturing FDIUS. Other leading source countries are Germany with 12%, Japan with 10%, France with 10%, and Canada with 9%.

Figure 1 Foreign Direct Investment in the United States



Most analyses of the spatial distribution of FDIUS focus on the manufacturing sector. In 1994 foreign-owned manufacturing establishments employed 2.1 million workers or 11.4% of all manufacturing employees in the United States.[4] California is the leading state in terms of the number of manufacturing workers employed by foreign-owned establishments with 195,700. Employment in the states located in the Seventh Federal Reserve District, which is served by the Federal Reserve Bank of Chicago, is substantial. For example, foreign-owned establishments employed 118,000 workers in Illinois, which makes Illinois the fourth leading state in the number of manufacturing workers employed by foreign-owned businesses. The number in other Seventh District states and the rank of these states are as follows: Indiana-88,600 (8); Michigan-82,400 (11); Wisconsin-43,800 (18); and Iowa-20,400 (27/28). Thus, manufacturing employment in foreign-owned establishments in Seventh District states is 353,200 or one-sixth of the U.S. total.

Another perspective on foreign-owned manufacturing is provided by examining the preceding employment numbers relative to the manufacturing employment of the individual states. Manufacturing employment in foreign-owned establishments relative to total manufacturing employment is highest in Delaware (27.4%) and West Virginia (24.3%). For the states in the Seventh District, foreign-owned establishments employ 13.3% of manufacturing employees in Indiana, 12.3% in Illinois, 8.6% in Michigan, 8.3% in Iowa, and 7.5% in Wisconsin.

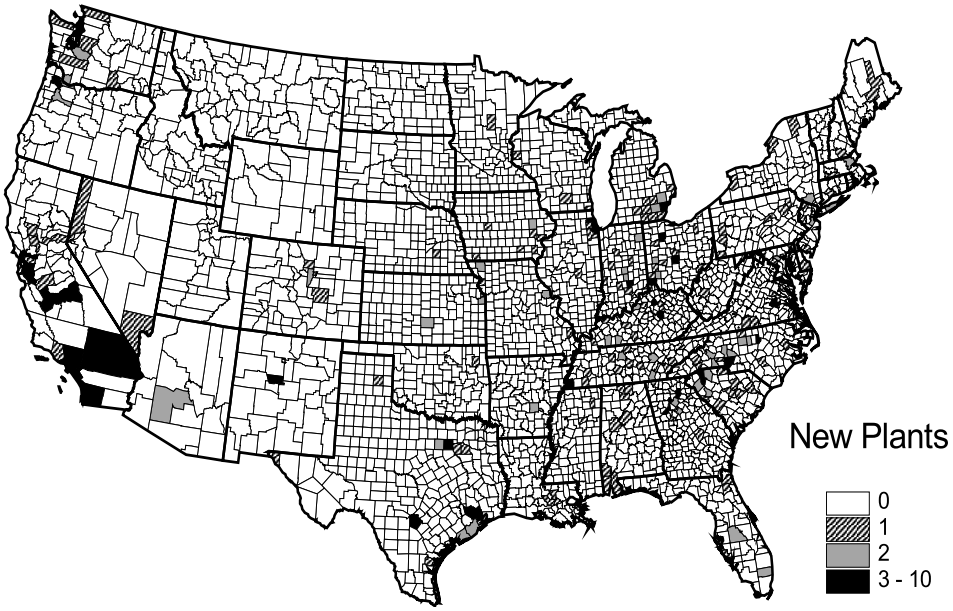
This paper focuses on one aspect of manufacturing FDIUS, the spatial distribution of foreign direct investment in new plants throughout, first, the contiguous United States and, second, the states in the Seventh Federal Reserve District. The location of new plants is of special interest for many reasons, but especially because of the new employment associated with these plants and the efforts by state and local governments to affect the location of these plants. The data for our analysis were provided by the International Trade Administration, which collected data on the number of new plants foreign investors planned to build each year, and cover 1989 through 1994. During this period foreign investors made plans to build 380 new manufacturing (excluding SIC 29 - petroleum and related industries) plants throughout the United States. The planned locations of these plants in individual counties are summarized in figure 2. Our fundamental goal is to generate an economically sound, statistical model that explains the pattern of location. Prior to presenting results, we review our modeling approach and the potential location determinants of new foreign-owned manufacturing plants.

Poisson and Negative Binomial Models

Various modeling approaches and levels of aggregation have been used for analyzing industrial location. For example, ordinary least squares, logit-conditional and nested, Tobit, Poisson, and negative binomial estimation procedures have been used. These procedures have been applied to foreign direct investment aggregated to the state level and, more frequently in recent years, to the county level.[5]

We estimate Poisson and negative binomial models, which are closely related. A Poisson distribution is frequently used to characterize processes that generate non-negative integer outcomes, such as the number of accidents that occur at a particular intersection. The number of new plants located in a specific region, especially since

Figure 2 The Spatial Distribution of FDIUS



the count is zero in many counties, is a reasonable candidate for a Poisson distribution with mean and variance equal to λ. The density function of n_j, or the likelihood of observing a count of new plants n_j, is

1) $$f(n_j) = \frac{e^{-\lambda j}\,\lambda_j^{\,nj}}{n_j!},\ n_j = 0, 1, 2,....$$

The expectation of n_j, λ_j, is assumed to be characterized by a log-linear function

2) $$\ln\lambda_j = ß' x_j,$$

where ß is a parameter vector to be estimated and x_j is a vector of observable county characteristics that influences firms' profits. The log likelihood function for this model is then

3) $$lnL = -\Sigma_j\ \lambda_j + \Sigma_j\, n_j\ ß' x_j - \Sigma_j\ \ln(n_j!).$$

The Poisson model, however, imposes the restriction that the dependent variable's mean and variance are equal to λ_j. Such a proposition can be tested and, given our national results, leads us to use a negative binomial distribution, specifying that $\ln(\lambda_j) = ß' x_j + \varepsilon$, where ε is gamma distributed with mean 1.0 and variance alpha. This allows the variance to exceed the mean.

Independent Variables

The probability of selecting a specific region for a foreign direct investment transaction depends on the levels of its characteristics that affect profits relative to the levels of these characteristics in other regions. The existing literature has examined numerous variables that can be classified as those affecting revenues and those affecting costs. The particular variables we utilize are summarized in table 1.

Since the regions under consideration are of difference sizes, in terms of both geographic and economic size, any model must incorporate a variable (or variables) to control for this feature of regions. One way to control for size is to use, following Bartik (1985), a region's land area, excluding federal land, as a proxy for the number of potential sites. Of course, existing economic activity may already occupy many of the "potential" sites, thus raising doubts about the usefulness of this proxy. Nonetheless, a region with twice as many potential sites as another region should have a probability of selection twice as large, ceteris paribus. While Coughlin et al. (1990) did find that more foreign direct investment transactions occur in larger states, the relationship was less than equiproportionate.

Another way to control for size, in this case economic size, is to use a measure of market demand that may be related to a firm's revenues. One possibility is to use the region's total personal income, but such a measure might not capture the size of the market relevant to a foreign investor's location decision. An alternative proxy is to use a gravity-adjusted measure of personal income that accounts for both the size of a region's market and its position relative to other markets. Friedman et al. (1992) and Woodward (1992) found such a measure to be a statistically significant determinant of FDIUS and Japanese FDIUS, respectively. Head et al. (1994), using a slightly different measure, also found a similar result for Japanese FDIUS.

We tried one measure of income, the total personal income of the Bureau of Economic Analysis's economic area in which the county is located (EATPI).[6] Figure 3 shows the location of these economic areas. A fundamental issue is the appropriate market area for a firm. The orientation of a specific firm need not be confined to a specific economic area and might not even be primarily focused on the region in which it locates.[7] Nonetheless, the variable is capturing the economic size of the region that is likely to have some positive effect on the number of new plants in a specific county.

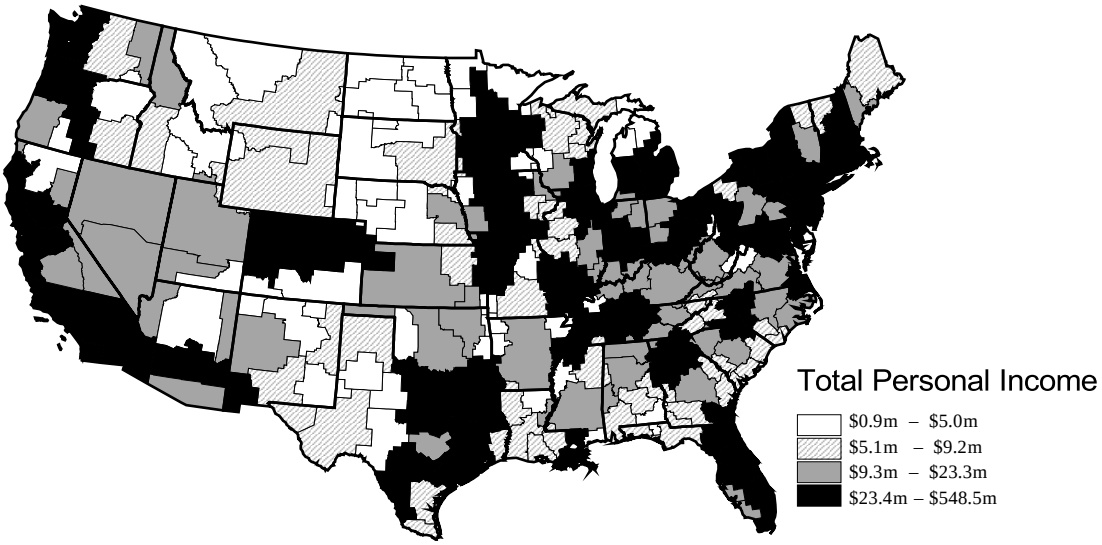
On the cost side, numerous variables have been used to explain the pattern of FDIUS, with agglomeration economies and wage rates drawing the most attention. The empirical results, using various proxies for agglomeration economies, are very strong. Luger and Shetty (1985), Coughlin et al. (1990 and 1991), Ondrich and Wasylenko (1993), and Head et al. (1994 and 1995) find support for the importance of agglomeration economies, both generally and for specific industries. For studies at the state level, higher wage rates have been found to deter foreign direct investment by Luger and Shetty (1985), Coughlin et al. (1990 and 1991), and Friedman et al. (1992); however, Ondrich and Wasylenko (1993) did not find a statistically significant relationship.[8]

Other labor-related variables have been included in relatively few studies and have generated some conflicting results. First, in both Coughlin et al. studies (1990 and 1991) and in Friedman et al. (1992) (for all countries but not Europe or Japan separately), higher unemployment rates were positively associated with the distribution

Table 1 Regression Data Summary

	Mean	Expected Sign	Source
NPFDI Foreign Direct Investment in new plants (n=366)	0.16		Foreign Direct Investment in the United States, 1989-94 Transactions
EATPI Economic area total personal income (Bill $)	49.23	+	1989 U.S. Bureau of Economic Analysis
PROD Manufacturing value added divided by manufacturing employment (CNTY)	5.18	+	U.S. Bureau of the Census - 1987 Census of Manufacturers
HRW Production worker's average hourly wage ($/hrs)(CNTY)	8.70	-	U.S. Bureau of the Census - 1987 Census of Manufacturers
EDU Percent of population 25 and over with at least a H.S. diploma (CNTY)	69.66	+	U.S. Bureau of the Census - 1990 Census
POPDEN Population per square km of land (100s per sq km)(CNTY)	10.53	+	U.S. Bureau of the Census - 1990 Census
MANDEN Manufacturing employees as a percent of labor force (CNTY)	19.59	+	U.S. Bureau of the Census - 1990 Census
HIWAY Interstate dummy equal to one if county has an interstate highway (CNTY)	0.48	+	ArcView
TAXEXP Tax expenditure ratio (STATE)	1.74	-	Testa and Oakland
CITAX 1=state has corporate income tax; 0=otherwise; 1990 (STATE)	0.92	-	Tannenwald
SLIPTAX S&L corp income and property taxes paid by businesses per $1000 of PI, 1990 (STATE)	18.17	-	Tannenwald
UNION Percentage of manufacturing work force belonging to unions, 1989 (STATE)	19.79	-	U.S. Bureau of Labor Statistics
RTW 1=state has right-to-work law; 0=otherwise, 1989 (STATE)	0.50	+	U.S. Bureau of Labor Statistics
PBLK Percentage of population that is black (CNTY)	9.96	?	U.S. Bureau of the Census - 1990 Census
NEW ENGLAND CT, ME, MA, NH, RI, VT = 1; other states = 0			U.S. Bureau of Economic Analysis
MIDEAST DE, MD, NJ, NY, PA = 1; other states = 0			U.S. Bureau of Economic Analysis
GREAT LAKES IL, IN, MI, OH, WI = 1; other states = 0			U.S. Bureau of Economic Analysis
PLAINS IA, KS, MN, MO, NE, ND, SD = 1; other states = 0			U.S. Bureau of Economic Analysis
SOUTHWEST AZ, NM, OK, TX = 1; other states = 0			U.S. Bureau of Economic Analysis
ROCKY MT. CO, ID, MT, UT, WY = 1; other states = 0			U.S. Bureau of Economic Analysis
FAR WEST CA, NV, OR, WA = 1; other states = 0			U.S. Bureau of Economic Analysis
SOUTHEAST - base AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, WV			U. S. Bureau of Economic Analysis

Figure 3 BEA Economic Areas



of FDIUS. Second, unionization rates, which might be associated positively with wage costs and negatively with managerial flexibility, were found to be positively associated with the distribution of FDIUS in Coughlin et al. (1991) and in Friedman et al. (1992). The Coughlin et al. (1991) result might be partially due to the fact that they do not separate greenfield investments from mergers and acquisitions. Friedman et al. (1992), however, restrict their focus to new plants and also find a statistically significant positive association between unionization and the distribution of FDIUS generally as well as Japanese FDIUS. On the other hand, Woodward (1992) found that higher unionization rates were associated with lower Japanese FDIUS, in direct contrast to Friedman et al. (1992).

A final labor-related variable that has been included in a few studies, generally pertaining to the location of Japanese FDIUS, is the percentage of the population that is a minority. Woodward (1992) found that Japanese manufacturing establishments tend to avoid areas with high population densities of African-Americans. On the other hand, Smith and Florida (1994) found that higher concentrations of minorities were positively associated with Japanese automotive-related FDIUS.

Generally speaking, no other input cost variables have been found to consistently affect the distribution of FDIUS. For example, skill levels were not found to be statistically significant by Luger and Shetty (1985), energy costs were not found to be statistically significant by Ondrich and Wasylenko (1993), and pollution abatement expenses were not found to be statistically significant by Friedman et al. (1992).

We incorporate a number of variables related to the labor market. The first is the average hourly wage rate of production workers (HRW). Ceteris paribus, we expect higher wage rates to be negatively related to the number of new plants. Since

higher wages may reflect higher productivity, assessing the impact of wages requires that one control for productivity. Higher productivity in manufacturing (PROD) should make an area more attractive as a location for a new plant. We also explore the importance of a skilled labor force, which could also be a proxy for productivity, using the percentage of the population 25 or older with a high school diploma (EDU). We expect that this measure of basic skills will be related positively to the number of new plants in a county.

We also examine the effects of right-to-work legislation (RTW) and the extent of unionization (UNION). States with right-to-work legislation are likely to be more attractive to foreign investors, while higher rates of unionization, which might inhibit managerial flexibility, are expected to deter foreign direct investment. In addition, we explore the possibility that investors might have racial preferences by including the percentage of the population in the country that is black (PBLK). Given the mixed results with respect to Japanese FDIUS and the lack of other information, the expected impact of this variable is uncertain.

To explore the possible effects of agglomeration economies, we include the percentage of the labor force employed in manufacturing (MANDEN). A final measure that might capture urbanization economies or might also be viewed as a proxy for land costs is the population density of the county (POPDEN). If the measure is capturing urbanization economies, this variable will be related positively to the number of new plants; however, higher land costs will likely deter firms from locating a new plant in a specific county.

With respect to the fiscal variables, the majority of the evidence suggests that higher taxes deter FDIUS. Luger and Shetty (1985), however, found no statistically significant relationship between taxes and the distribution of FDIUS. Coughlin et al. (1991) also did not find general support for the deterrent effects of taxes; however, they did find that those states with unitary taxation did have less foreign direct investment, all other things equal. Woodward (1992) generated similar findings with respect to Japanese FDIUS as higher state corporate profit taxes did not deter Japanese FDIUS, while unitary taxation did. Most other studies have found that taxes deter foreign direct investment. For example, Coughlin et al. (1990) and Friedman et al. (1992) found a statistically significant relationship between general measures of taxes and FDIUS. More important, studies examining this relationship more rigorously have also found an inverse relationship. Ondrich and Wasylenko (1993), who enter their fiscal variables through a budget constraint, found an increase of corporate taxes to fund increased welfare expenditures deterred foreign direct investment. Hines (1996) found that state taxes in combination with the tax system of the source country affected the distribution of FDIUS. In contrast to Woodward (1992), Head et al. (1994) found higher state corporate tax rates deferred Japanese investors.

Results for other fiscal variables are limited because different studies have used different variables. With respect to state attempts to attract foreign firms, most studies show a positive relationship between promotion and foreign direct investment. Luger and Shetty (1985), using a general measure of state attempts to attract foreign plants, found a weak relationship. Meanwhile, measures of promotional expenditures, used in both Coughlin et al. studies (1990 and 1991) and in Friedman et al. (1992), were found to be statistically significant determinants of FDIUS. Woodward (1992) found that states with promotional offices in Japan attracted more Japanese foreign direct investment, but Head et al. (1994) did not find such a relationship. Using

specific government-provided incentives, Coughlin et al. (1990) found no statistically significant relationships, but their measures of tax, financial, and employment assistance did not control for the magnitudes of the assistance. Head et al. (1994), however, found labor subsidies affected the pattern of Japanese FDIUS. They also found that foreign trade zones were a statistically significant determinant of Japanese FDIUS.

With respect to the effects of fiscal policy, we use a recent measure developed by Oakland and Testa (1996). Using the benefits principle, they generate a measure comparing taxes directly affecting business to government expenditures providing services to the business community. Across states the higher the ratio of business taxes to expenditures (TAXEXP) the less attractive the state is expected to be as a site for a new plant by a foreign investor. In addition, we also examine two measures focused solely on taxation. One is a dummy variable to identify whether the state had a corporate income tax (CORP). Second, we use Tannenwald's (1996) measure of state and local income and property tax as a share of state personal income (SLIPTAX). In both cases we expect taxes to deter foreign direct investment.

Governments might also make their states more attractive to investors by expenditures to facilitate transportation. Coughlin et al. (1991) found that transportation infrastructure was a positive, statistically significant determinant of the location of FDIUS, while Friedman et al. (1992) found that states with a major container port attracted relatively more foreign direct investment. We have included a dummy variable to identify whether an interstate highway is located in the county (HIWAY) and expect this variable to be related positively to the number of new plants.

Finally, we have included dummy variables for eight regions, defined by the Bureau of Economic Analysis, based on groupings of states in which the counties are located. The goal is to capture the influence of variables that we have not explicitly included and that might differ systematically across regions.

Negative Binomial Regression Results - United States

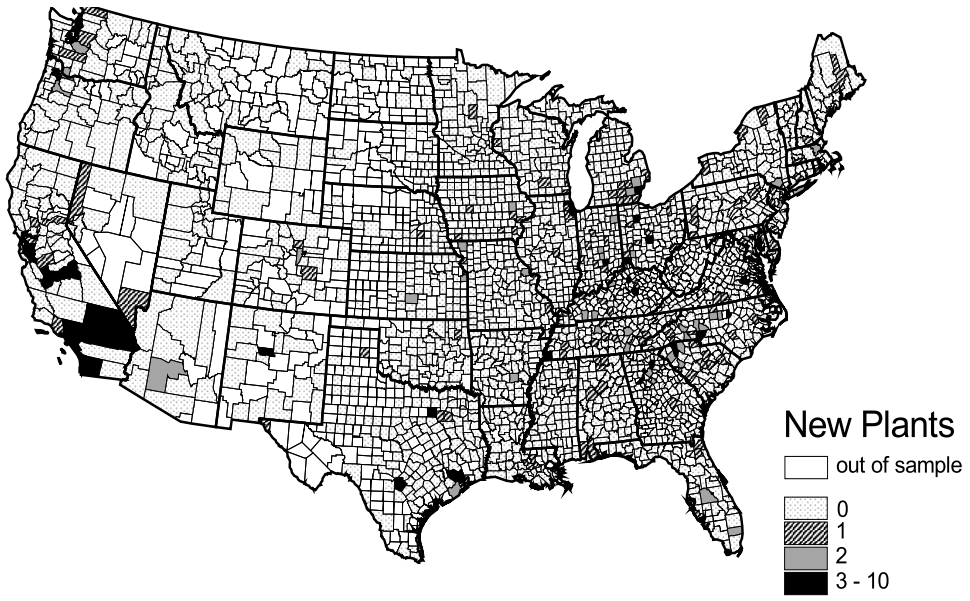
Due to data limitations, we were not able to use all the counties shown in figure 2. Primarily because of an absence of manufacturing wage data, the number of counties examined was reduced from 3111 to 2316. Generally speaking, these counties had no new plants as the number of new plants was only reduced from 380 to 366 with the elimination of these nearly 800 counties. Figure 4 shows the pattern of new plant location that our regression model attempts to explain.

The key empirical results are listed in table 2. Given the large number of potential independent variables, the coefficients estimated in six regressions are presented. The statistical significance of sigma indicates that the use of the negative binomial is superior to the Poisson distribution. In general, the majority of variables are signed as expected and are statistically significant. We begin our discussion of individual variables by discussing those that appear in each regression.

In each case, our measure of economic size—the total personal income of the economic area in which the county is located (EATPI)—is positive and statistically significant at the 0.05 level. In other words, counties located in economic areas with larger levels of total personal income tended to be the location for more new plants.

Contrary to expectations, a higher average hourly wage of production workers (HRW) in a county was not found to deter the location of new plants. In fact, a higher average hourly wage was a statistically significant, positive determinant of new plant

Figure 4 FDIUS—Model Sample



location. Such a result holds even after attempting to control for worker productivity (PROD), which was consistently positive but not statistically significant.

Two labor-related characteristics performed as expected. For example, the percentage of the population in a county 25 or older with a high school diploma (EDU) was found to be a statistically significant positive determinant. In addition, a rough proxy for agglomeration economies, manufacturing employment as a share of the labor force (MANDEN), performed as expected as higher values were associated with higher values of new plants.

The results for the population density of the county (POPDEN) suggests that urbanization economies exist. Higher levels of population density are associated with higher levels of new plants. The result is statistically significant.

One result suggests the importance of public spending on infrastructure. The existence of an interstate highway serving the county (HIWAY) has a positive, statistically significant effect on the location of new plants.

The Southeast, the area with the highest levels of new plant activity, was used as the base for the regional dummy variables. Thus, the negative signs for each of the regional dummies reflect their lower values relative to the Southeast. For virtually every region, the variable is statistically significant.

Turning to those variables reported in only one regression, models 1-3 in table 2 show results with respect to fiscal policy that reveal an absence of statistical significance. For example, in model 1 the ratio of business taxes to expenditures (TAXEXP) has the anticipated negative sign, but the variable is not statistically significant. The inclusion of a dummy variable to identify whether (0) or not (1) a state had a corporate income tax in model 2 generated similar results. Model 3 shows the results for

Table 2 Negative Binomial Regression Results — United States

Variable	MODEL 1 Coefficient	t-ratio	MODEL 2 Coefficient	t-ratio	MODEL 3 Coefficient	t-ratio	MODEL 4 Coefficient	t-ratio	MODEL 5 Coefficient	t-ratio	MODEL 6 Coefficient	t-ratio
CONSTANT	-10.359*	-9.14	-10.377*	-8.72	-10.552*	-9.31	-10.372*	-8.69	-10.411*	-9.51	-11.439*	-10.80
EATPI	0.002*	2.34	0.002*	2.34	0.002*	2.25	0.002*	2.31	0.002*	2.33	0.002*	2.43
PROD	0.039	1.05	0.038	1.04	0.038	1.02	0.038	1.04	0.039	1.05	0.037	1.04
HRW	0.191*	3.69	0.190*	3.67	0.189*	3.56	0.192*	3.67	0.190*	3.68	0.170*	3.12
EDU	0.074*	5.63	0.074*	5.65	0.074*	5.63	0.073*	5.25	0.074*	5.51	0.083*	6.50
POPDEN	0.005*	4.15	0.005*	4.16	0.005*	4.17	0.005*	4.13	0.005*	4.15	0.003*	2.59
MANDEN	0.045*	3.24	0.045*	3.27	0.045*	3.27	0.044*	3.17	0.045*	3.25	0.051*	3.84
HIWAY	1.165*	5.39	1.165*	5.39	1.165*	5.38	1.163*	5.37	1.164*	5.39	1.149*	5.56
TAXEXP	-0.035	-0.15										
CITAX			-0.038	-0.08								
SLIPTAX					0.007	0.40						
UNION							-0.002	-0.14				
RTW									-0.011	-0.05		
PBLK											0.023*	2.96
N. ENGLAND	-2.262*	-3.60	-2.280*	-3.66	-2.282*	-3.67	-2.271*	-3.62	-2.289*	-3.44	-1.906*	-3.10
MIDEAST	-1.724*	-4.25	-1.733*	-4.36	-1.747*	-4.36	-1.688*	-3.37	-1.743*	-3.88	-1.409*	-3.47
GR. LAKES	-1.426*	-5.19	-1.436*	-5.39	-1.465*	-5.44	-1.389*	-3.03	-1.446*	-4.13	-1.126*	-4.12
PLAINS	-1.536*	-4.84	-1.536*	-4.85	-1.545*	-4.85	-1.524*	-4.39	-1.539*	-4.64	-1.187*	-3.54
SOUTHWEST	-0.605	-1.82	-0.647	-1.29	-0.639*	-2.20	-0.620*	-2.18	-0.623*	-2.20	-0.311	-1.06
ROCKY MT.	-2.569*	-3.74	-2.590*	-3.80	-2.673*	-3.96	-2.584*	-3.78	-2.591*	-3.58	-2.182*	-3.19
FAR WEST	-0.410	-1.31	-0.425	-1.36	-0.424	-1.35	-0.398	-1.20	-0.425	-1.16	-0.035	-0.11
sigma	3.182*	6.79	3.181*	6.80	3.177*	6.71	3.175*	6.79	3.184*	6.80	2.830*	6.26
-L. L.	832.400		832.400		832.300		832.4		832.400		827.000	
-R. L. L.	943.600		943.400		942.6		943.1		943.100		919.900	
L. Ratio	222.400		222.000		220.6		221.4		221.400		185.800	
Sig. Lev.	0.000		0.000		0.000		0.000		0.000		0.000	

* Statistically significant at the .05 level (two-sided)

one other tax variable, state and local income and property tax as a share of state personal income (SLIPTAX). Once again, the variable is not statistically significant. In this case, the estimate of the coefficient is positive rather than negative.

Models 4 and 5 include two standard labor-related characteristics—the extent of unionization (UNION) in the state and whether or not the state in which the county was located was governed by right-to-work legislation (RTW). The sign of the unionization coefficient, negative, is as expected, but the sign of the right-to-work coefficient is negative rather than positive. Neither variable, however, was found to be statistically significant.

In model 6 we explored the possibility that the racial composition of the county affected foreign investors systematically. Rather than avoid locating in counties with relatively large black populations, foreign investors were found to locate new plants in areas where higher percentages of the population were black. This variable is a statistically significant determinant of new plant location.

Poisson Regression Results - States in the Seventh Federal Reserve District

Table 3 contains selected Poisson regression results for states in the Seventh Federal Reserve District—Illinois, Indiana, Iowa, Michigan, and Wisconsin. Regression results based on the negative binomial revealed that sigma was not statistically significant, so there was no statistical justification for estimating this model. Generally speaking, the same variables included for the entire sample were included for this smaller sample. One complication arising from reducing the sample was that because certain variables are measured at the state level, there is little variation when using only five states. The use of dummy variables for the individual states is effectively capturing the net effects of these as well as other state-level variables.

Turning to the results for individual variables measured at the county level, one finds similar as well as dissimilar results when comparing the five states in the Seventh District with the nation. Contrary to the national results, the measure of economic size (EATPI) is not statistically significant and in some regressions is negative rather than positive.

Similar to the national results, but contrary to expectations, a higher average hourly wage of production workers (HRW) was a statistically significant positive determinant of new plant location. The preceding result holds even after attempting to control for worker productivity (PROD), which was consistently positive and occasionally, in contrast to the national results, statistically significant. Two other labor-related variables performed as expected and were identical to the national results. Both the percentage of the population in a county 25 or older with a high school diploma (EDU) and manufacturing employment as a share of the labor force (MANDEN) were statistically significant positive determinants of new plant location.

The results using the population density of the county (POPDEN) suggest that urbanization economies exist for states in the Seventh District as they do nationally. Higher levels of population density are associated with higher levels of new plants and this result is statistically significant.

The final variable appearing in all the models is whether the county is served by an interstate highway (HIWAY). In the Seventh District a positive association exists between having an interstate highway in the county and new plants. Contrary to the national results, however, this relationship is not statistically significant.

Table 3 Possion Regression Results—Chicago Fed States

Variable	MODEL 1 Coefficient	t-ratio	MODEL 2 Coefficient	t-ratio	MODEL 3 Coefficient	t-ratio	MODEL 4 Coefficient	t-ratio	MODEL 5 Coefficient	t-ratio	MODEL 6 Coefficient	t-ratio
CONSTANT	-12.799*	-4.64	-11.418*	-5.18	-11.816*	-5.32	-10.205*	-4.57	-12.311*	-5.14	-12.073*	-5.21
EATPI	-0.2E-03	-0.08	0.7E-05	0.00	-0.3E-03	-0.14	-0.001	0.63	0.002	0.79	0.002	0.76
PROD	0.091	1.49	0.133*	2.14	0.143*	2.26	0.086	1.41	0.102	1.62	0.099	1.58
HRW	0.276*	4.57	0.224*	3.45	0.211*	3.24	0.276*	4.56	0.161*	2.07	0.175*	2.51
EDU	0.066*	2.26	0.057*	2.08	0.062*	2.26	0.048	1.69	0.074*	2.30	0.069*	2.34
POPDEN	0.021*	8.13	0.020*	8.18	0.021*	8.15	0.019*	8.29	0.023*	4.80	0.025*	7.89
HIWAY	0.527	1.24	0.649	1.54	0.605	1.43	0.724	1.67	0.634	1.42	0.668	1.53
TAXEXP	0.776	1.45										
SLIPTAX			0.049*	1.96								
UNION					0.032*	2.40						
RTW							0.353	0.77				
PBLK									0.011	0.42		
IA									1.465*	2.06	1.545*	2.23
WI									0.229	0.33	0.240	0.34
IN									1.781*	3.04	1.837*	3.16
MI									1.532*	2.64	1.619*	2.95
-L. L.	117.800		117.000		116.000		118.600		109.200		109.300	
-R. L. L.	188.900		188.900		188.900		188.900		188.900		188.900	
L. Ratio	142.200		143.800		145.800		140.700		159.400		159.200	
Sig. Lev.	0.000		0.000		0.000		0.000		0.000		0.000	

*Statistically significant at the .05 level.

Turning to the variables that are measured at the state level, one finds some puzzling results. The variables reflecting fiscal variables generate some results contrary to expectations. For example, in model 1 the ratio of business taxes to expenditures (TAXEXP) is positively related to the number of new plants, but it is not statistically significant. In model 2, state and local income and property taxes as a share of personal income (SLIPTAX) is not only related positively to the number of new plants but is also statistically significant. Another tax variable, the existence of a corporate income tax in the state, could not be used because all states in the Seventh District have a corporate income tax.

Another puzzling result, shown in model 3, involves the extent of unionization in the state (UNION). This variable is a positive, statistically significant determinant of the number of new plants. A final labor market variable, whether a state has a right-to-work law, was not found to be statistically significant. This result is shown in model 4. It must be stressed, however, that only one state, Iowa, had such legislation in 1989.

Model 5 shows the results of our racial composition variable (PBLK). Similar to the national results, counties with larger percentages of blacks attracted more new plants; however, contrary to the national results, this variable was not statistically significant.

Finally, in models 5 and 6 dummy variables for the individual states are included. These states are identified by their standard two-letter abbreviation. With Illinois as the base, after controlling for numerous factors, each of the other states is a relatively more attractive location for new plants. In some cases, however, the results are not statistically significant.

Conclusion

Generally speaking, the location of new plants throughout the United States tends to respond to many of the variables thought to affect the profitability of locating in a particular county. For example, proxies measuring economic size, labor force quality, agglomeration economies, urbanization economies, and transportation infrastructure were all found to be positive, statistically significant determinants of location. Contrary to expectations, higher wages were associated with larger numbers of new plants. Another result, possibly surprising to some, is that, ceteris paribus, foreign investors tended to locate more new plants in counties that had a larger percentage of blacks in the population.

Two sets of variables that have been important in other location studies were not found to be statistically significant. First, proxies for the fiscal environment showed no statistically significant relationship with the location of new plants. Second, proxies for the labor-management environment also had no statistically significant relationship with the location of new plants.

Even after controlling for the effects of numerous variables, the results for the regional dummies revealed the Southeast was preferred to other U.S. regions. One can only speculate on the reasons at this point. Growth prospects, climate, and promotional activities are some possible explanations.

Comparing the results for the counties in the states served by the Seventh Federal Reserve District with the national results, one finds both similarities and differences. One difference is that the economic size of the area in which the county was located did not affect new plant location in the Seventh District. Generally

speaking, the labor-related variables performed the same. Average hourly wage was a statistically significant positive determinant in both samples. Worker productivity was associated positively with new plant location and, contrary to the national results, was statistically significant at times. The variables for the quality of the work force and agglomeration economies were both associated with higher levels of new plants and were statistically significant.

The only other variable that is related to the labor market is the share of the population that is black. While this variable is a statistically significant positive determinant at the national level, it is not statistically significant for the Seventh District. There is, however, a positive association.

Whether the county is served by an interstate highway is another variable whose results differ from the national results. For the counties in the Seventh District a positive association exists, but the variable is not statistically significant. At the national level this variable is a statistically significant positive determinant.

Obviously, the present study leaves unanswered a number of important questions about the location of new plants nationally as well as in the Seventh District. For example, the effect of promotional expenditures was not examined. Clearly, the level of aggregation in the present study does not allow for an examination of many issues relative to the possible differential behavior across source countries and industries. Future research will examine the location patterns existing in specific industries, especially those characterized as high technology. Such an examination will, we hope, yield more insights on agglomeration economies. In addition, disaggregating by source country will, we hope, generate some insights concerning the geographic preference of individual countries.

Notes

[1]See Lowe and Bargas (1996).

[2]See Fahim-Nader and Zeile (1996) for details.

[3]See Lowe and Bargas (1996) for details.

[4]See Fahim-Nader and Zeile (1996), table 15.

[5]Aggregation, however, takes place on many other dimensions as well, such as industry, source country, and mode of foreign direct investment. Much research attention has been focused on the geography of the automobile industry. For example, see Klier (1995) for evidence on the geographic structure of supplier plants and Smith and Florida (1994) for an econometric study of the location of Japanese automotive-related manufacturing establishments.

[6]See Johnson (1995) for additional details on the construction of these 172 areas that cover the United States.

[7]An alternative used by Friedman et al. (1992) and Woodward (1992) is a gravity-adjusted measure of personal income that accounts for both the size of a region's market and its position relative to other markets.

[8]In theory, wage rates should be examined after controlling for labor productivity. Upon doing so, Friedman et al. (1992) find that higher wage rates deter foreign direct investment.

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