Factors Determining Plant Locations and Plant Survival*

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Abstract

We examine the decisions of firms where to locate a new plant when choosing among finalists. Firms favor states with low corporate taxes, right-to-work laws, low unionization, and (most surprisingly) small incentives. Some of these factors also affect the survival of the plants.

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1 Introduction

Governments in the United States spend approximately $100 billion each year to encourage economic development in a particular geographic area (Kline and Moretti 2014). In studying where firms locate a new facility, it is important to consider the alternatives the firm considered. Did it consider all possible cities in the country, or only some? We make use of the data set collected by Greenstone, Hornbeck, and Moretti (2010), which considered finalists. One may conjecture that if a firm is choosing only between cities A and B, having ruled out other locations, then few variables may matter. We shall see that even among finalists some state policies influence a firm's decision. We look at effects with matched cities. If city A is union friendly, but city B is union unfriendly, but nevertheless city A is a finalist, then it must be that city A has some good features for a firm. And then, if union friendliness still matters, that must be a really important factor. Moreover, the study of matched cities controls for the number of cities that have that same characteristic. For example, the benefit to a city of locating in a right-to-work state can depend on how many competing cities are also in right-to-work states. The study below effectively controls for that.

2 Literature

2.1 Effects of new plants

Consistent with our finding, a comparison of neighboring states with and without right-to-work laws finds that the pro-business right-to-work law is associated with a one-third increase in manufacturing activity (Holmes 1998).

Greenstone et al. (2010) also study large plant openings in the United States, but focus on the effects on local productivity. They compare "winning" counties (those attracting a plant) and "losing" counties (those left as runners-up in the choice process), finding that the opening of a large plant increases the productivity of incumbent plants in the winning county relative to that of plants in the losing county. In line with our study, Hooker and Knetter (2001) and Poppert and Herzog (2003) estimate the local employment effects of closures, but focus on U.S. military bases as opposed to manufacturing plants. They report that net employment effects are very similar to the number of jobs directly destroyed by the closure. Patrick (2016)

compares outcomes in counties that won new plants to counties that sought the same plants but didn't get them. She finds modest increases in new economic activity, that does not generate a fiscal surplus for winning counties. An increase in a state government's ability to aid private enterprise reduces employment over the medium-term in rural counties, but otherwise does not affect employment or growth (Patrick 2014).

Comparing establishments receiving incentives to a control group finds that the incentives create few new jobs, but that incentives given to smaller establishments generate more jobs than incentives given to very large establishments, where incentives reduce employment (Lester and Lowe 2018). Similarly, Bartik (2018) finds that incentives produce stronger economic and employment returns when channeled toward smaller establishments.

2.2 Firms' location decisions

Location decisions in the United Kingdom show a small effect of grants in attracting plants to specific geographic areas; but firms are less responsive to government subsidies in areas with fewer existing plants in their industry (Devereux, Griffith, and Simpson 2007). The U.S. Urban Empowerment Zone program increased employment in zone neighborhoods (Busso, Gregory, and Kline 2013). State tax policies (state investment tax credits and state corporate tax rates) that reduce the cost of capital in a state increase capital formation in that state, and slightly increase the number of manufacturing establishments (Chirinko and Wilson 2008). A city with low corporate tax rates is more likely to attract a relocated headquarter (Strauss-Kahn and Vives 2009).

A review of thirty studies concludes that typical incentives tip between 2 percent and 25 percent of firms receiving incentives toward making a decision favoring the location giving the incentive (Bartik 2018). Reviews of the literature find ambiguous effects of incentives on firm location.[1]

3 Data

We collected data on 82 location choices for new plants, for the years 1982 to 1993. The data originally came from the periodical *Site Selection*. In-

[1] Wasylenko (1999), Buss (2001), and Arauzo-Carod, Liviano-Solis, and Manjon-Antolin (2010).

formation on each firm included the year the firm decided to invest in the new plant or factory, and the counties that were finalists for the facility. For example, General Electric built a new plant in Lowndes, Alabama, beating out Posey, Indiana, which also applied for General Electric's new plant in 1982. This dataset is unique in providing lists of the winner and the runner ups for each plant, as opposed to identifying only the winner.

We consider several variables, with particular interest in state policies and politics. These variables included a state's policies on tax incentives, taxes paid to the state, political party of the governor, whether a state had a right-to-work law, state unionization rate, and the state unemployment rate.

Data on state policies regarding incentives are from Bartik (2017). Two examples of business incentives are property tax abatements, which reduce property taxes below normal property tax rates; and job creation tax credits, which provide tax benefits tied to jobs or payroll created. We lack annual data on incentives, so data from 1990 was used for every year a plant opened from 1982 to 1993.[2] The incentives are at a state level, whereas the plants are usually located in small counties, which on their own are unlikely to determine state policy. So endogeneity is unlikely a serious problem.

The Tax Foundation provides measures of income tax for each state from 1982 to 1993. Their database includes a column labeled "Taxes Paid to Own State Per Capita," with data in real dollars for every year starting from 1977.

Data on the political party of each state governor from 1982-1993 comes from the National Governors Association.

Data for whether a state has a right-to-work law (allowing workers represented by a union to avoid union dues) was collected from various news articles and websites, all compiled into a complete list on Wikipedia. This is a binary variable, with 1 coded for a right-to-work state and 0 otherwise.

The state education variable comes from the United States Department of Agriculture Economic Research Service. These data include the percentage of adults 25 and older who completed college for every state and year starting from 1970. Data was recorded every decade, so values were averaged to estimate for years between decades.

Unionization rates come from unionstats.com. The *Statistical Abstract of the United States* provides data on unemployment rates of every state for all necessary years. The annual unemployment rate considers the civilian non-

[2]The data source for state incentives had missing data for a few states, such as Oklahoma and Arkansas.

institutional population aged 16 or older, and was the average of monthly unemployment rates from the respective year.

State corporate tax rates were collected by examining documents from each state.

4 Plant location decisions

Let locality i have observable characteristics $X_{i1}..X_{in}$, so that its attracriveness as a plant location is $Q_i = \alpha + \beta_1 X_{i1} + ... + \beta_n X_{in} + \epsilon_i$, where ϵ is a random variable. Then the probability that locality i wins in getting a new plant over locality j is assumed to increase with $Q_i - Q_j$.

A question is whether examining finalists overestimates or underestimates the effect of a particular variable. For concreteness, consider a Right to Work Law. Let a firm's utility when locating in a state with a Right To Work Law (RTW) be $k + \epsilon$, where ϵ is a random variable. Utility at a state without a Right to Work Law (NRTW) is $0 + \epsilon$. If we look at the maximum from a sample of each type of state, the difference in means is k. But, if a locality in a NRTW is one of two finalists, then as a necessary condition, the value of $0 + \epsilon$ is greater than the second highest value of both $k + \epsilon$ and $0 + \epsilon$ at other localities. Note that a NRTW locality that is a finalist must have a high value of ϵ to beat out a RTW locality, whereas a NRTW locality can generate high utility even with a small value of ϵ. And so among finalists the difference between localities with and without Right To Work laws must be less than k. So our estimation based on finalists underestimates the importance of Right to Work laws.

A Monte Carlo simulation illustrates the size of the effect. Suppose that the profits at RTW sites is normally distributed with a mean of 10 and a standard devision of 0.1. The profits at NRTW sites are also normally distributed, with a standard deviation of 0.1, but with a slightly smaller mean, namely 9.95. A firm chooses as finalists the two sites with the highest profitability, choosing among 25 RTW sites and 25 NRTW sites.

Running the simulation 100,000 times, we examine all cases where among the two finalists, one is a RTW site, and the other is a NRTW site. The difference across these pairs is 0.005, which is one-tenth the size of the average difference of 0.05 between all RTW and NRTW sites.

Because different counties competed for the same plant, for the explanatory variables we took the difference of the winner and loser(s) between all

counties competing for a firm. For example, in 1982 the education level of Ohio 13.7 and the education level of Virginia was 19.1. Counties in these two states competed for Timken's new plant; Stark County, Ohio was the winner over Montgomery County, Virgina. Using the levels of education (as opposed to taking the difference between the two) would ignore the competition between the counties for the same plant. Thus, these two counties were replaced with two new observations: Stark-Montgomery and Montgomery-Stark. For education, the respective difference was taken, so the education level for Stark-Montgomery is -5.4 and for Montgomery-Stark is 5.4. This method controls for the differences among the 80 firms and their respective competition; it was used for all variables, not just education. For binary variables, such as the political party of the governor, new binary variables, $Republican - Democrat$ and $Democrat - Republican$, were created to account for the differences between competing counties. If one state's governor is a Republican and its competing state's governor is a Democrat, we would code a 1 for $Republican - Democrat$ and a 0 for $Democrat - Republican$. For example, the governor of Ohio in 1982 was a Democrat, while the governor of Virginia was a Republican. Thus, the observation Stark-Montgomery was labeled with a 0 for $Republican - Democrat$ and a 1 for $Democrat - Republican$; and the observation Montgomery-Stark was a 1 for $Republican - Democrat$ and a 0 for $Democrat - Republican$. The same method was used for right-to-work variables.

If a firm considered more than two competing sites, and thus had two or more losers, four or more new observations were created by taking differences. For example, Broward County, Dade County and Pasco County were three counties in Florida that competed for Racal-Milgo's new plant. Broward County won the plant, so the observations from taking differences were Broward-Dade, Broward-Pasco, Dade-Broward, and Pasco-Broward.

In total, taking the differences between all winners and losers competing for the same firm resulted in 249 observations. Because the error terms could be correlated for locations competing for the same plant, standard errors were clustered for each plant. Because the dependent variable is binary (a county either was the location of the new plant or was not), estimation was by logit. The regression coefficients are shown below.

Table 1: Probability city wins plant

Variable	Coefficient	Standard error
Republican-Democrat	0.439	0.425
Democrat-Republican	0.582	0.419
RightToWork-Not RightToWork	1.057	0.811
Not RightToWork-RightToWork	1.272	0.894
Taxes	0.000	0.39
Education	0.034	0.116
Unionization	0.078	0.074
Unemployment	0.057	0.175
Incentives	-1.296^{**}	0.567
Corporate tax	-32.37^{***}	12.50
Constant	-0.005	

At the 5 percent level, incentives and the corporate tax rate are the only statistically significant variables. Other effcts appear small. For example, if we start with a 50% chance of a county winning, then having a Democratic governor in one state and a Republican in the other, rather than the other way around, increases the chance of getting the plant by 3%. A similar calculation shows that a reduction in the corporate tax rate from 5% to zero increases the chance of winning the plant by 33%. But recall that the estimates are based on finalists. As indicated above, the effect among all localities could be ten times as large.

The results suggest that a plant is more likely established in a state with lower corporate taxes. It is puzzling, however, that the coefficient on incentives is negative. This negative coefficient suggests that the greater a state's tax incentives, the less likely it will be selected. It is possible that the losing states attempted to compensate for poor performance in other categories.

To examine our model's accuracy we compare the probabilities of competing counties to the realized outcome. For example, Stark County, Ohio beat out Montgomery County, Virginia for Timken's new plant. Thus, if our model is correct, the probability of Stark County winning should exceed the probability of Montgomery County. A location was considered the winner of the plant if it had an estimated probability greater than 50 percent of winning. Our model correctly predicted 69 winners. Thirty two winning

counties had the same probability as their respective competing counties, and 22 counties were incorrectly predicted as winners.

5 Survival of plants

Because the plants in the dataset were established several decades ago, we could examine whether a plant was still in operation years after it opened. After researching all the plants that were established from 1982-1993, by 2010 52 plants remained in operation; 24 plants closed.[3] As opposed to differences used in the previous regression, the regression reported below uses levels, and it is unnecessary to cluster the standard errors. Similar to the previous regression, a logit model was estimated, since the dependent variable is binary (a plant either currently exists or does not).

Table 2: Probability plant survives

Variable	Coefficient	Standard error
Corporate tax rate	6.197	14.08
State incentives	-0.182	0.91
Governor Democrat	-0.423	0.641
Right to work	0.250	1.087
Taxes paid to state	- 0.001	0.001
Education	0.017	0.11
Unionization	0.008	0.009
Unemployment	-0.046	0.184
Constant	2.521	

None of the coefficients is statistically significant, suggesting that the factors that affected the plant's selection do not affect the plant's chances of survival. For example, if a state has low corporate tax rates, it is more likely to be the new plant's location, but locating in a state with low corporate taxes does not make the plant more likely to succeed. These results are surprising,

[3]It was unclear whether some plants still exist or not. A difficulty is that the absence of a news item about a plant does not necessarily mean the plant had closed. For us to claim a plant has not survived, we required definitive evidence of a plant closing. However, for only five plants is data missing on survival, so it is unlikely this missing data would bias the coefficients, but may increase the standard errors.

because it is expected that plants would be built where they would most likely succeed. It is unclear why these results arose.

The political variable, whether the governor is a Democrat, is statistically insignificant. But the estimated effect can be large. Of all plants, 66% survived over the seventeen years. Having a Democratic governor at the time the plant is established instead of a Republican one would, given the estimate, reduce that probability to 56%. But recall that the coefficient is poorly estimated.

We further investigated survival by collecting data on how many years (censored at 17) a plant survived. A Poisson regression was estimated using the same variables as the previous regression, with the exception of the dependent variable.

Table 3: Survival time

Variable	Coefficient	Standard error
Corporate tax	0.938	1.289
State incentives (in 1990)	0.007	0.080
Total state taxes	0.000	0.000
Right to work	0.252^{**}	0.097
Governor Democrat	0.067	0.057
Education	-0.030^{**}	0.015
Unionization	0.020^{**}	0.008
Unemployment	0.003	0.016
Constant	3.124	0.282

This regression shows that plants survive longer in right-to-work states. Furthermore, lower education at the state level is associated with longer plant survival. Lastly, states with a higher unionization rate are also associated with longer plant survival. Other variables, such as a governor's party and state incentives, do not significantly affect survival. These results are interesting, as the variables that determined where a plant was located (state incentives and corporate tax rates) do not determine how long plants survive. Though one might expect plants to locate where they would most likely survive, we find that once a plant was built, the variables that made the location appealing are irrelevant, and a new set of variables determines how long a plant remains in operation.

Another regression estimates whether a plant located in a county estimated to have a high probability of attracting that plant is associated with longer plant survival, measured by the number of years. The regression is the following:

Table 4: Survival time as function of probability won

Variable	Coefficient	Standard error
Probability wins	-0.596	5.212
Constant	23.956	2.697

The probability that a location will get a new plant does not significantly affect how long that plant survived. For example, a plant built in a location that barely beat out its competitor does not survive for a shorter amount of time than a plant built in a location which had a high probability of winning (i.e., it easily beat out its competitor).

6 Conclusion

Even among closely matched locations, firms prefer to establish a plant in a state with business-friendly policies. The surprising exception is tax incentives—that reduces a state's attractiveness. The same factors that make a location attractive do not, however, increase a plant's survival rate.

One possibility is that a state that is otherwise unattractive must offer favorable policies. Another possibility is that tax incentives induce political opposition to the firm. For example, many voters in Seattle see Amazon as largely responsible for its homeless problem, and the city council in 2018 proposed to impose a $275-per-employee tax on large firms. In August of 2018 Disneyland said it would not take tax incentives from the city of Anaheim, perhaps to thwart a ballot initiative that would raise the minimum wage on firms that get tax incentives. As Disneyland Resort President Josh D'Amaro wrote, the incentive agreements became "a flash point for controversy and dissension in our community."

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