Does Job Creation Tax Credit Program in Maryland Induce Spatial Employment Growth or Redistribution?

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Abstract

The Job Creation Tax Credit (JCTC) program is one of the five major Smart Growth Programs initiated by the State of Maryland in 1996 and amended in 1997. Like other tax credit programs it is intended to create jobs, but it is also a place-based policy in the sense that eligibility is limited to jobs created in Priority Funding Areas (PFAs). This paper examines whether the JCTC program has furthered the goals of smart growth by concentrating job growth within well defined regions of the state. Towards this end, both the number and the relative share of employment inside and outside of the PFAs are compared using three econometric models. The empirical analysis examines employment in five economic sectors ((1) primary, (2) manufacturing, (3) transportation, communication and utilities (T.C.U.), (4) finance, insurance and real estate (F.I.R.E.) and (5) services) over the years (1994 to 1998) using ZIP Code data. The result shows that jobs in the T.C.U. and services industries have responded to the state incentive program while three other sectors have not; the distribution of jobs in the primary sector have grown counter to the state incentive policy and jobs in manufacturing and F.I.R.E. have been unaffected by the program.

Keywords: Job Creation Tax Credit (JCTC) Program, Priority Funding Area (PFA), Maryland, employment growth, employment redistribution.

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1. Introduction

Maryland is well known as a leader in the movement called Smart Growth, a term used to describe policies designed to control urban sprawl. In Maryland, smart growth refers to a bundle of growth management programs passed by the Maryland State Legislature in 1997. Maryland's Smart Growth Legislation includes five policy measures: (1) 1997 Smart Growth Area (or Priority Funding Area (PFA)) Act, (2) 1997 Rural Legacy Act, (3) Brownfields Voluntary Cleanup and Revitalization Incentive Program, (4) Job Creation Tax Credit (JCTC) Program, and (5) Live Near Your Work Program (Cohen, 2002). Perhaps the most distinguishing feature of Maryland approach to managing urban growth is its reliance on spatially designated incentives, rather than (land use) regulations.

The JCTC program, as originally passed in 1996, required a participating business to create 60 new, full-time jobs paying salaries at least 1.5 times the federal minimum wage. In 1997, the state reduced the minimum to 25 qualified full-time new jobs in a 24-month period and increased the basic credit of $1,000 per employee to $1,500 inside PFAs, as a result of establishing or expanding a business facility in a single location in the state (Cohen, 2002, p. 16). Credit granted is the lesser of $1,000 or 2.5% of a year's wages for each new, full-time job calculated on an aggregate basis. If the new or expanded facility is located in a state enterprise zone, a federal empowerment zone or a Department of Housing and Community Development designated neighborhood, then the credit is increased to the lesser of $1,500 or 5% of a year's wages for each new, full-time job. The maximum credit allowed during any credit year for a single facility is $1 million. [1] Eligible industries for these tax credits include manufacturing, mining, transportation, communications, agriculture, forestry, fishing, a public utility or warehousing, research, development, testing, biotechnology, computer programming, data processing or other computer related services, central financial, real estate, insurance services, the operation of central administrative offices or a company headquarters, business services (PFA only), entertainment, recreation, cultural or tourism related

[1] For more information, refer to the Maryland state government website (http://www.choosemaryland.org/datacenter/taxesincentives/incentives/creation.asp).

activities in a multi-use facility (revitalization area only with the minimum of 1,000 new full-time equivalent filled positions in a 2-year period). It is not only an employment-based economic development policy, but also a place-based policy in the sense that preference is given to jobs created inside PFAs (Cohen, 2002, p.17). The program itself, however, does not have any regulatory tools to restrict development outside of PFAs, which differentiates incentive programs from regulations. In the sense that the program does not explicitly limit economic development and employment growth outside the area,[2] it may not work for the exclusive employment growth of the PFA (with employment decline outside), but work for employment redistribution in relative terms between in- and outside of the PFA (possibly with employment growth both in and outside the PFA).

According to Cohen (2002, p.17), as of June 30, 1999, the Department of Business and Economic Development had received 123 applications from qualified firms proposing to generate 28,062 jobs. The positive effect, however, could be even greater if the program has spillover effects. For example, even if some new firms are not qualified to obtain the tax credit under the program at the start of their businesses (due to, for example, the small size of their employment), they might still want to locate inside a PFA for the potential benefit they can get in the future once they are qualified. Further, nonparticipating firms might choose to locate near participating firms due to agglomeration effects. In this respect, just counting employment growth reported under this program might not capture direct, indirect, and potential impacts. A more comprehensive model is needed to capture overall employment change in- and outside PFAs before and after the initiation of the JCTC program.

The purpose of this paper is to examine empirically if the JCTC program in Maryland has been an effective policy tool for preventing urban sprawl and encouraging smart growth. For this purpose, both the number and the relative share of employment inside and outside PFA zones are analyzed using three econometric models. The next section summarizes previous research on the influence of tax incentive programs. Section

[2] The state also provides the tax credit of $1,000 per employee to businesses who create 60 new full-time qualified jobs outside PFAs.

3 presents the analysis framework and findings are discussed in section 4. Section 5 presents the conclusions.

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2. Tax incentive policies and their economic and spatial implications

Job-Creation tax credits are intended to lower the cost of labor and encourage job creation. While the logic behind these policies is straightforward, whether or not tax-related incentive policies are effective at creating jobs or reviving local economies has been the subject of considerable debate. Gabe and Kraybill (1998) surveyed firms that announced major expansion projects in Ohio between 1993 and 1995, all of which were eligible for Ohio's job creation tax credits. They concluded that the tax credit program had a positive impact on job creation and capital expansion in the state between 1993 and 1995. Mofidi and Stone (1990) examined whether variations in the treatment of expenditures by states and local governments explain the inconsistent results of tax studies. Using a regression model on the net investment and employment in manufacturing between 1962 and 1982 in the 50 states, they found that the impact of state and local taxes were negative when revenues were devoted to the transfer-payment program and the impact of increases in expenditures on health, education and public infrastructure were positive. Pope and Kuhle (1996) showed, in the research that examined the impact of a wages-paid tax credit in California, that such credits have been effective in increasing employment at firms especially those with the fewest resources.

Some researchers have found a positive relationship between tax incentives and economic growth. Wasylenko (1991) conducted a comprehensive review of studies on the impact of fiscal incentives on economic development and interregional business location decisions. He concluded that the impact was not clear because research results depended on the data used (disaggregate or aggregate) and because the methodologies adopted might not be able to consider all the complexities of state or local tax system. In an extensive examination of published research, Bartik (1991) concluded that tax policy can have an effect on employment and wages, but that the effect is small. Bishop and Montgomery (1993) also showed that the effect of tax credits is not clear. Using a regression model, they surveyed more than 3,500 private employers and tested if the

Targeted Jobs Tax Credit (TJTC) altered the level of firms' employment. They reported that each subsidized hire generated between .13 and .3 new jobs, but 70% of the tax credits granted to employers are the payments for workers who would have been hired even without the subsidy.

There is also yet no consensus of now best to examine the effects tax policies. Fisher and Peters (1997) noted that there has been no agreement on how tax and other incentives should be measured. Claiming that there are serious problems with the widely used summary measures of tax burdens and incentive program activities, they suggested a hypothetical firm approach. Buss (2001) mentioned that, even with increasingly sophisticated methods, the results of analyses have been conflicting; he argued that little attention has been paid to whether public monies could have been better spent or whether tax incentives are economically justified, so that tax studies have given little guidance to policy makers concerned about the best policy as economic development tools.

The spatial distribution or geographic effects of job tax credits has been one of the important, if not the most popular, research topics among tax impact related research. Newman and Sullivan (1988) provided a comprehensive review of empirical works to test tax impacts on industrial location. According to the authors, tax related effects should be statistically significant with an appropriate specification of an econometric model with more detailed data sets. With data from Nebraska, Goss and Phillips (1999 and 2001) revealed that tax incentives have a positive impact on economic growth for low-unemployment counties and higher income areas, reinforcing the pre-existing economic inequalities across areas.

The spatial implications of tax related incentives have been more explicitly treated by research focused on enterprise zones (EZ). Since EZs are spatially defined, tax incentive effects can be measured in a spatial context and compared across the boundaries of the zone. From an analysis of the Indiana EZ program, Papke (1994) showed that unemployment claims fell 19% in the year after an area was designated as an EZ. In a similar way, Potter and Moore (2000) concluded that incentive policies in the UK attracted investors and were an important driver of the local economy in distressed areas. Boarnet and Bogart (1995), on the other hand, found no positive effects in an analysis of the New Jersey EZ program. Lambert and Coomes (2001), using a quasiexperimental approach, also found that Louisville's EZ has not been effective. Funkhouser and Lorenz (1987) showed that the Maryland EZ was not effective, even if they also noted that the findings were possibly attributed to newness of the program and usual lags in application for credits and reporting. Reviewing more detailed sets of tax incentive policies, Ladd (1994) concluded that place-based strategies have not been effective, implying that more comprehensive approaches are required. After an extensive review of the studies on EZ programs, Wilder and Rubin (1996) concluded that EZs have been effective in generating new employment and investment in certain areas, but they had important limitations to be examined in order to minimize costs and maximize benefits to depressed communities in an efficient way. In an analysis of manufacturing firms, Greenbaum and Engberg (1998) found positive employment effects on firms entering EZ, but negative effects on firms outside the zones. With data from Bridgeport, CT, between 1980 and 1984, Jones (1985), found no significant differences in employment growth in the EZ after its designation; instead he found higher levels of development activity outside than inside the zone.

3. Assessment framework

Our empirical analysis examines both the number and the relative share of employment in five economic sectors eligible for the JCTC program in Maryland: primary (agriculture, forestry, fishery, and mineral industries), manufacturing, T.C.U. (transportation, communication, and utilities), F.I.R.E. (finance, insurance and real estate) and services. The analysis adopts a time frame of five years (1994 to 1998) based on ZIP Code data. There are 452 ZIP Codes in Maryland included in the analysis.

ZIP Code-based employment data are obtained from the ZIP Code Business Pattern from 1994 and 1998. Other socioeconomic data are extracted from the 1990 U.S. Census. Both of the data sets are published by the Bureau of Census. An individual observation to be explained in the econometric model used in this analysis is the number (or proportion) of employment of a certain ZIP Code area in a certain sector in a certain year.

The first regression model is the simplest of the three models and is defined by equation (1).

$$EMP_{it}^{j} = a + b\, PFA_{it} + e_{it}^{j} \qquad (1)$$

where

EMP_{it}^{j} = employment of sector j in ZIP Code zone i in year t

PFA_{it} = areal ratio of PFA in ZIP Code zone i at year t

The basic idea of this equation is that if the JCTC program has been effective and, as a result, a higher level of employment growth has been achieved inside PFAs, the gap in terms of employment in- and outside of PFAs will increase, so that the coefficient of the PFA variable will be positive and statistically significant. It should be noted that since the spatial entity of the PFA in Maryland is very complex (see figure 1) and the boundaries of the PFAs and ZIP Code areas do not exactly match, areal ratio of the PFA in each of the ZIP Code area is calculated and used in the model as *PFA*. It is expected that a ZIP Code area with higher *PFA* has a stronger PFA influence.[3]

While it is very simple to estimate the model and to interpret the result, it has two critical problems; it considers neither location-specific nor year-specific effects. Some locations might have different levels of employment and/or employment growth due to more or less favorable locational factors (such as infrastructure capacity, for example) than others. In this respect, employment and/or employment growth in a certain location can be explained more adequately by including location- and year-specific effects. The latter include, for example, the effects of economic cycle, unanticipated economic shocks, or changing economic climates. None of those effects can be handled in equation (1). If these are not handled explicitly in the model, the coefficient of the PFA variable might be estimated imprecisely and capture the influence of unspecified variables. For example, a significant *ß* may not really mean the significance of PFA, but reflect some other unspecified structural differences between PFA and non-PFA locations or between PFA and non-PFA years.

[3] In the sense that the model has a variable similar to a dummy (values from 0 to 1) and the treatment is spatial (i.e. subgroups are chosen from the data set based on spatial criteria), it might be considered to be an extension of "spatial" ANOVA (Anselin, 1995, 34-1).

The second model addresses the limitations in equation (1) and incorporates such limitations explicitly in the equation. This model is called the random growth rate approach (Bondonio and Engberg, 2000), an extension based on the fixed effects model. It was first introduced by Heckman and Holtz (1989) and later applied to state EZ program assessments by Papke (1994), Boarnet and Bogart (1996), Bondonio and Engberg (2000), and Boarnet (2001). The model is represented in equation (2).[4]

$$EMP_{it}^{j} = a + b\,PFA_{it} + c_i + d_i t + \sum_{t=1994}^{1998} f_t YEAR_t + e_{it}^{j} \qquad (2)$$

where

c_i = ZIP Code zone specific fixed effects

d_i = ZIP Code zone specific growth rates

t = year

f_t = year specific effects

$YEAR_t$ = 1 if the year is t and 0 otherwise

The model in equation (2) eliminates location- and year-specific effects by allowing specific locations to have a different level of employment and the rate of employment growth and by allowing specific years to have different levels of employment.[5] For estimation, two location specific effects ($?_i$ and d_i) are removed through the following steps. First, equation (2) is first-differenced to eliminate ZIP Code specific employment effects, $?_i$, as in equation (3).

$$\Delta EMP_{it}^{j} = b\Delta PFA_{it} + d_i + \sum_{t=1995}^{1998} f_t\,\Delta YEAR_t + \Delta e_{it}^{j} \qquad (3)$$

The location-specific employment growth rate, d_i, can be removed if equation (3) is rewritten in such a way that each variable is represented as a deviation from the mean, as in equation (4).

[4] Equations (2) to (4) are derived from Boarnet (2001).

[5] A more detailed discussion on each of the variables in the equation can be found in Boarnet (2001).

$$\Delta EMP_{it}^{j} - \overline{\Delta EMP_{i\bullet}^{j}} = b(\Delta PFA_{it} - \overline{\Delta PFA_{i\bullet}}) + \sum_{t=1995}^{1998} f_t(\Delta YEAR_t - \overline{\Delta YEAR_{\bullet}}) + \Delta e_{it}^{j} - \overline{\Delta e_{i\bullet}^{j}} \quad (4)$$

where

$$\overline{\Delta EMP_{i\bullet}^{j}} = \frac{\sum_{t=1995}^{1998} \Delta EMP_{it}^{j}}{4}$$

One of the strengths of this specification is that it only requires a minimal amount of information (annual employment change and the PFA areal ratio at each ZIP Code). Limited information, however, may be a weakness rather than a strength, however, especially when other economic and/or socioeconomic variables are considered to be significant in explaining economic and locational behaviors.

The third model is an extension of the second. Rather than using location specific effect variables, $?_i$ and d_i, the model explicitly incorporates several explanatory variables that might explain zonal variation in employment and employment growth in detail. The model also has a PFA areal share variable (*PFA*) for the years, 1997 and 1998, in order to examine the effects of the JCTC program inside the PFA. *LEPFA* is the same variable as *PFA*, but for all years. For example, *PFA* is zero for all ZIP Code zones between 1994 and 1996 during which the JCTC program associated with PFA designation was not yet initiated. *LEPFA* has, however, a PFA areal ratio (instead of zero) even for the years between 1994 and 1996. It captures the potential effects of location within a PFA even without the tax credit program. With this variable, the model is able to show if a higher level of employment at a certain ZIP Code zone is due to the tax credit combined with PFA or just simply due to locational effect of the PFA; for instance, regardless of the tax credits, do ZIP Codes largely captured within PFAs have a higher level of employment even before 1997? The model is defined in equation (3).[6]

[6] Another type of extension can be found in Bondonio and Engberg (2000) in which propensity scores for individual ZIP Code zone characteristics are estimated through a probit model and included in the equation for the random growth rate approach similar to equation (2).

$$EMP_{it}^{j} = a + \sum_{t=1997}^{1998} b_t PFA_{it} + g\, LEPFA_i + \sum_{k=1}^{7} j_k ZIP_{ik} + \sum_{t=1994}^{1998} f_t YEAR_t + e_{it}^{j} \qquad (5)$$

where

$LEPFA_i$ = areal ratio of PFA in ZIP Code zone i

ZIP_{ik} = location specific explanatory variables in zone i

The explanatory variables included in the model are listed in table 1. There are three groups of variables: labor market characteristics, transportation infrastructure, and locational effects. The labor market group has four variables. *POP* is population size, a general indicator to measure the size of labor and product markets. *HS* is the share of high school graduates and represents a proxy for the quality of the local labor force. *UNEMP* is the rate of unemployment and is a measure of local labor availability. *PCI* is per capita income and implicitly represents labor cost. Transportation infrastructure is examined in two ways. *HWY* is a dummy variable with 1 if an interstate highway passes through the zone of interest and 0 otherwise. *AIR* is the average distance to the three major airports in the region (Reagan Washington National (DCA), Baltimore-Washington International (BWI), and Washington Dulles International (IAD)). Locational effects include one variable. *EMPDEN* measures employment density and is included to capture agglomeration and disagglomeration effects. If agglomeration benefits derived from employment density are more important considerations then this variable will have a positive coefficient. If, on the other hand, agglomeration diseconomies, such as congestion and pollution as a more serious cost factor, the variable will have a negative sign.

<<Insert table 1 here>>

Because a single ZIP Code may be too small to represent an entire labor market, all the explanatory variables except *AIR* and *LEPFA* are adjusted to reflect the variation in adjacent ZIP Codes as well. Equations (6) and (7) show the adjustments of the variables. Note that the spatially extensive variable in the model, *POP*, is adjusted using equation (6) and spatially intensive variables such as *HS*, *UNEMP*, *PCI* and *EMPDEN* are transformed by equation (7). Also note that the highway dummy variable, *HWY*, is adjusted by equation (7) so that its range is constrained between zero and one.

$$ZIP_{ik} = X_{ik} + \sum_{l=1}^{452} w_{il} X_{lk} \qquad (6)$$

$$ZIP_{ik} = \frac{X_{ik} + \sum_{l=1}^{452} w_{il} X_{lk}}{1 + \sum_{l=1}^{452} w_{il}} \qquad (7)$$

where

X_{ik} = explanatory variable k in zone i before adjustment

w_{il} = element of row standardized spatial weight matrix

$\sum_{l=1}^{452} w_{il} = 1$ when the spatial weight matrix is row standardized

Equation (7) may be considered to be a spatially weighted average in that values are multiplied by the corresponding spatial weights, summed, then divided by all the spatial weights included. Three equations in this section (equations (1), (4) and (5)) are estimated and an interpretation of the result is provided in the next section, focusing on the estimation result of equation (5). As mentioned earlier, two sets of data, the number and the relative share of employment, are examined to see if there is any difference in the pattern of employment growth and redistribution in the region, associated with the JCTC program.

4. Efficacy of the JCTC Program in PFA

PFAs in Maryland encompass (1) municipalities, (2) areas designed by the Department of Housing and Community Development (DHCD) for revitalization, (3) enterprise zones as designated by the state or federal government, and (4) areas located between Interstate 495 and D.C., or between Interstate 695 and Baltimore City (Cohen, 2002, p. 8).[7] Figure 1 presents the PFA in Maryland along with county boundaries.

[7] County governments can also designate PFA not included in the list defined by the state. Cohen (2002, p. 8) summarized a number of qualifying areas for county PFA designation.

<<Insert figure 1 here>>

The first and the second equations (equations (1) and (4)) are estimated and the results are summarized in appendix 1 and 2. A lower R^2 (between .000 and .151) suggests that *PFA* by itself is not meaningful enough to explain much of the variation in economic activities and the models should incorporate more relevant explanatory variables. Such low level of explanation precludes any kind of interpretation on the sign of the *PFA* coefficients. Table 2 and 3, on the other hand, summarize the estimation results of equation (5) for the growth model and the redistribution model.

<<Insert table 2 and 3 here>>

Note that the model explains a much larger portion of variation than the first two models. All the sectors show much higher R^2 for both growth and redistribution models, ranging from .075 (primary sector in redistribution model) to .569 (F.I.R.E. in both models). Estimated coefficients of *PFA*s also show some interesting patterns. None of the PFA coefficients for the year 1997 is significant, implying that there is no tax incentive effect detected during the year. Considering that the JCTC program became associated with PFA designation in 1997, it may be too early for any positive or negative effects to appear. A few sectors, however, show significant signs for $ß_{1998}$, implying that those sectors might have started responding to the incentive program in different ways in 1998. Note that the *PFA* coefficient is negative and significant for the primary sector (growth and redistribution model) and positive and significant for T.C.U. and services (growth model), showing that ZIP Codes with a larger areal portion within PFAs have more T.C.U. and service employment and less primary activities in 1998.

It is not surprising to observe that the primary sector is more prevalent in non-PFA zones in the sense that a majority of them might be less dependent on urban infrastructure that a large portion of PFA provides and might require large empty land area or natural resources that are not easily obtained inside most of the urbanized PFAs. Tax incentives do not seem to override this tendency of primary sector. It should also be noted that other policies in Smart Growth initiatives, such as Rural Legacy Act, might have encouraged the development of the primary sector outside PFAs. In contrast, T.C.U. and services tend to grow more within PFA intensive areas, reflecting that these sectors may have responded to the state incentive program relatively well compared to the other sectors during 1998. The model, however, is not able to determine if those significant results are specific to the year 1998 or are the beginning of successful program effect for the years to come until a longer time series of information is available. The coefficient is not significant in manufacturing and F.I.R.E. sectors. For the same reason as in primary, T.C.U. and service sectors, a longer time series of information is required to determine if those two sectors are not influenced by the tax incentive policy or they are influenced, but with some time lag.

The estimation result of *LEPFA*s reveals that primary and manufacturing sectors have negative and significant coefficients in both growth and redistribution models. It suggests that both of the sectors prefer to stay outside the PFAs throughout the years analyzed. The result also shows that service sector has a positive and significant coefficient in the redistribution model. It implies that the pure location effect of PFA without the JCTC program is captured in redistribution pattern, but not in growth pattern of service employment. In all other cases, there is no sign of significance, reflecting that there has not been any potential effect of location on those sectors within a PFA without the JCTC program.

Seven independent variables are also interpreted accordingly. *POP* (f_1) is positive and significant in all five sectors, which suggests that accessibility to labor and products market is a significant consideration in job growth. *HS* (f_2) is not significant except for manufacturing (negative and significant). This suggests that closeness to high quality labor is not an important factor for employment growth--at least in an intrametropolitan context. On the other hand, there is also a possibility that an aggregation of different sectors with different characteristics into the five macro sectors obscures prominent trends of some disaggregated sectors, masking potentially significant effects. A better understanding can perhaps be achieved by an examination with a more disaggregate sector classification. Unemployment (*UNEMP* (f_3)) is negative and significant in all sectors, reflecting that the mere availability of labor is not an important location consideration. They rather seek a more competitive labor force or economic environment and avoid areas with higher rates of unemployment. *PCI* (f_4) shows a sector-specific pattern. T.C.U. does not show any kind of obvious relationship. Primary, F.I.R.E. and service sectors yield positive coefficients. While the primary sector is considered exceptional, employment growth in F.I.R.E. and services might show a preference for a highly skilled and specialized labor force with a higher income. Manufacturing yields negative and significant coefficients, reflecting that job growth in this sector has occurred at lower income zones and, as a result, areas with lower labor cost. Highway access (f_5) is positive and significant in manufacturing and T.C.U. perhaps because those two sectors are more involved in physical movement of goods and materials than F.I.R.E. and services in which a large number of transactions can be done using an advanced information technology. *AIR* (f_6) shows a positive and significant sign in all sectors, indicating that jobs tend to stay away from the three giant airports in or near the state. This suggests that access to airports is not an important consideration at an intrametropolitan scale even if it may be at an intermetropolitan scale.[8] With the exception of the primary sector, all sectors show a positive and significant coefficient for *EMPDEN* (f_7), reflecting that their activities are strongly center-oriented. Overall, year-specific effects ($?_{1995}$, $?_{1996}$, $?_{1997}$ and $?_{1998}$) are not significant.

Comparing the growth and the redistribution models, it is hard to conclude which model performs better. Both yield similar R^2 as well as the sign and the significance of the coefficients, implying that both growth and redistribution patterns have developed in a similar way. Note, however, that no incentive effect is observed in redistribution pattern except the primary sector in 1998 while T.C.U. and services show a positive influence from the incentive program in 1998 in growth pattern. Among the sectors, F.I.R.E. and services are explained relatively well by the model whereas the primary sector shows the lowest R^2.

As for the JCTC incentive inside PFAs, four economic sectors are most important from a policy perspective: manufacturing, T.C.U., F.I.R.E. and services.[9] Among those

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[8] The geographic scale of interest is intrametropolitan in the sense that most portion of Maryland belongs to the Washington-Baltimore CMSA.

[9] Since Maryland is a highly urbanized state and has a very small portion of primary sector (less than 1% of total employment throughout the years), primary sector may not be of its biggest concern.

sectors, the most prominent effect of the incentive seems to be observed in services followed by T.C.U. Manufacturing and F.I.R.E. do not seem very responsive to the incentive policy in the years examined. As mentioned earlier, however, long term trends of job growth need to be examined to determine if the impact shown in 1998 on some sectors is the year-specific effect or the start of substantial transition in location patterns.

5. Conclusion

This paper analyzed whether the JCTC program in association with PFAs in Maryland has induced either employment growth or redistribution as intended. For this purpose, the number as well as the relative shares of employment inside and outside the PFA were examined using different econometric models. The empirical analysis tested employment in five economic sectors (primary, manufacturing, T.C.U., F.I.R.E. and services) eligible for the incentive program for the years 1994 to 1998 using 452 ZIP Code data.

The results show that incentive impact has been mild and sector-specific. More specifically, there was no evidence of an incentive effect in 1997 while a few sectors appear responsive to the state incentive policy in 1998. T.C.U. and services have responded to the state incentive in a favorable way while the primary sector, manufacturing and F.I.R.E. have not; employment in the primary sector inside PFAs diminished while employment in the other two sectors did not change, holding other things constant. While both the growth and redistribution models were similar in terms of explanatory power and the pattern and the sign of coefficients, the JCTC program effect associated with PFAs was only detected in growth pattern of a few sectors, but not in redistribution pattern (with the exception of primary sector in 1998). Among sectors, F.I.R.E. and services were relatively better explained by the model than the others.

The results do not provide enough information to determine if the influence shown in some sectors in 1998 is a one-year effect or the start of substantial transition in employment location patterns. It will be worth revisiting this model later when more time-series data is available. Disaggregation of economic sectors in the model might also help understand the sensitivity of business location and distribution patterns to economic incentives at a more detailed level.

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Table 1. Explanatory variables in equation (5)

Group	Variable	Description
Labor market	*POP*	Population in 1990
	HS	Percentage of high school graduates in 1990
	UNEMP	Unemployment rate in 1990
	PCI	Per capita income in 1990
Transportation infrastructure	*HWY*	Highway dummy
	AIR	Average distance to the three major airports (DCA, BWI and IAD)
Locational effect	*EMPDEN*	Employment density in 1994

Table 2. Estimation result of growth model

	Primary	Manufacturing	T.C.U.	F.I.R.E.	Services
Constant	-21.146 (-1.76)	292.019 (2.28)*	-.129.063 (-1.79)	-862.173 (-8.09)**	-3113.255 (-7.21)**
PFA_{1997}	-4.184 (-.422)	-17.412 (-.16)	7.107 (.12)	-12.701 (-.14)	320.307 (.90)
PFA_{1998}	-26.866 (-2.71)**	-84.516 (-.80)	139.262 (2.33)*	-34.297 (-.39)	1356.798 (3.80)**
LEPFA	-24.860 (-3.95)**	-154.399 (-2.30)*	-47.226 (-1.25)	13.818 (.25)	203.606 (.90)
POP	.002 (14.10)**	.017 (13.01)**	.009 (12.39)**	.007 (6.99)**	.080 (18.72)**
HS	-.293 (-1.58)	-4.527 (-2.28)*	.379 (.34)	-1.456 (-.88)	-8.299 (-1.24)
UNEMP	-3.933 (-5.62)**	-17.699 (-2.37)*	-14.692 (-3.48)**	-47.529 (-7.64)**	-148.367 (-5.89)**
PCI	.003 (5.49)**	-.012 (-2.02)*	-.002 (-.72)	.040 (7.86)**	.135 (6.54)**
HWY	-2.983 (-.44)	463.925 (6.39)**	167.666 (4.09)**	-8.669 (-.15)	-236.911 (-.97)
AIR	.221 (4.24)**	1.881 (3.37)**	1.097 (3.48)**	4.665 (10.04)**	15.049 (8.00)**
EMPDEN	.001 (.34)	.271 (8.04)**	.354 (18.61)**	1.165 (41.491)**	2.531 (22.25)**
$YEAR_{1995}$	4.246 (.91)	8.071 (.16)	10.812 (.38)	2.060 (.05)	62.467 (.37)
$YEAR_{1996}$	7.873 (1.68)	.107 (.00)	13.705 (.49)	-7.315 (-.18)	105.304 (.62)
$YEAR_{1997}$	10.984 (1.84)	15.743 (.25)	11.169 (.31)	10.953 (.21)	95.327 (.44)
$YEAR_{1998}$	-18.363 (-3.08)**	22.393 (.35)	6.987 (.19)	17.479 (.33)	221.831 (1.03)
R^2	.179	.254	.385	.569	.514

t-value in parenthesis (**: significant at 99% and *: significant at 95%)
F_{1994} not included in the table and the year specific effect in 1994 can be calculated assuming the other year dummies (from 1995 to 1998) are zero.

Table 3. Estimation result of redistribution model

	Primary	Manufacturing	T.C.U.	F.I.R.E.	Services
Constant	-.00218 (-2.05)*	.00177 (2.30)*	-.00114 (-1.62)	-.00579 (-8.10)**	-.00394 (-7.13)**
PFA_{1997}	-.00035 (-.40)	-.00018 (-.28)	-.00008 (-.14)	-.00022 (-.38)	-.00011 (-.24)
PFA_{1998}	-.00244 (-2.77)**	.00040 (-.63)	.00015 (.25)	-.00034 (-.58)	-.00035 (-.76)
LEPFA	-.00163 (-2.92)**	-.00093 (-2.31)*	-.00022 (-.60)	.00014 (.38)	.00078 (2.70)**
POP	.0000001 (10.26)**	.0000001 (13.02)**	.0000001 (12.57)**	.0000001 (6.98)**	.0000001 (18.87)**
HS	-.00001 (-.55)	-.00003 (-2.28)*	.000004 (.38)	-.00001 (-.88)	-.00001 (-1.22)
UNEMP	-.00026 (-4.18)**	-.00011 (-2.37)*	-.00014 (-3.48)**	-.00032 (-7.63)**	-.00019 (-5.87)**
PCI	.0000002 (3.31)**	-.0000001 (-2.02)*	-.00000003 (-.86)	.0000003 (7.86)**	.0000002 (6.56)**
HWY	-.00029 (-.48)	.00279 (6.40)**	.00166 (4.15)**	-.00006 (-.15)	-.00032 (-1.02)
AIR	.00002 (4.42)**	.00001 (3.37)**	.00001 (3.49)**	.00003 (10.04)**	.00002 (8.06)**
EMPDEN	.0000002 (.85)	.000002 (8.03)**	.000003 (18.71)**	.00001 (41.49)**	.000003 (22.49)**
$YEAR_{1995}$	.0000000 (.00)	-.0000000 (.00)	-.0000001 (.00)	.0000000 (.00)	-.0000000 (.00)
$YEAR_{1996}$	-.0000002 (-.00)	-.0000000 (.00)	-.000001 (-.00)	-.0000001 (.00)	-.0000004 (-.00)
$YEAR_{1997}$	-.00013 (.24)	.00006 (.16)	.00002 (.06)	.00008 (.23)	.00004 (.14)
$YEAR_{1998}$	.00091 (1.72)	.00014 (.38)	-.00007 (-.20)	.00013 (.36)	.00012 (.45)
R^2	.075	.254	.387	.569	.514

t-value in parenthesis (**: significant at 99% and *: significant at 95%)
F_{1994} not included in the table and the year specific effect in 1994 can be calculated assuming the other year dummies (from 1995 to 1998) are zero.

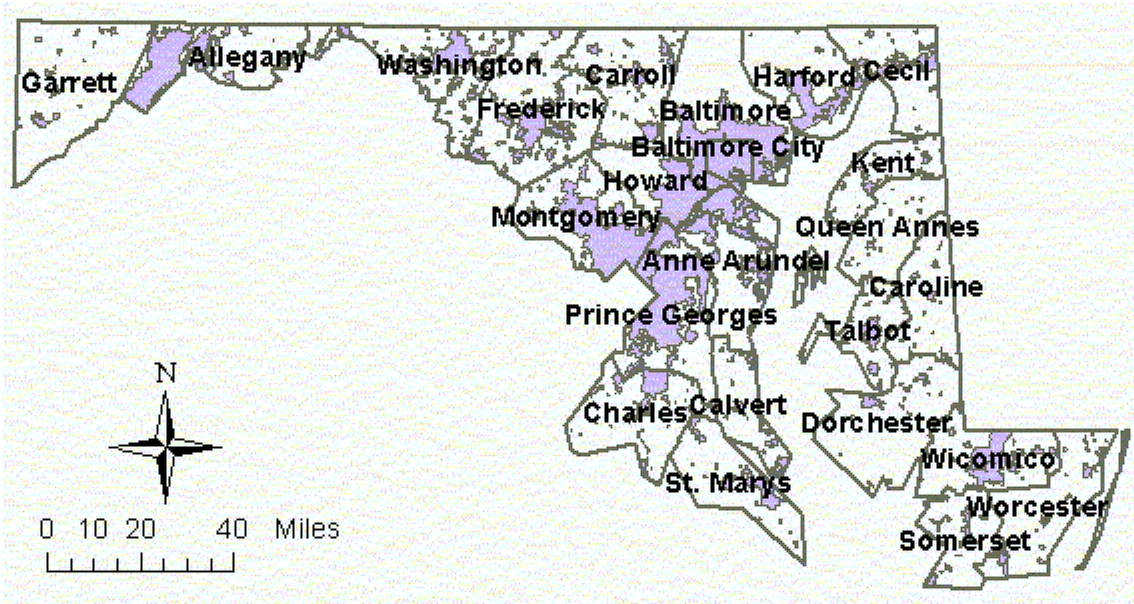

Figure 1. PFA in Maryland

Appendix 1. Estimation result of equation (1)

	Primary		Manufacturing		T.C.U.		F.I.R.E.		Services	
	G	R	G	R	G	R	G	R	G	R
a	37.053 (20.54)**	.0022 (14.81)**	310.398 (15.49)**	.0019 (15.48)**	166.843 (13.60)**	.0017 (14.25)**	248.568 (11.40)**	.0017 (11.48)**	1209.371 (14.95)**	.0017 (16.14)**
ß	-8.987 (-1.70)	-.0001 (-.31)	387.341 (6.58)**	.0023 (6.63)**	392.531 (10.89)**	.0033 (9.35)**	546.143 (8.52)**	.0036 (8.29)**	3418.754 (14.38)**	.0034 (10.97)**
R^2	.001	.000	.019	.019	.050	.037	.031	.030	.084	.051

G: Growth model and R: Redistribution model
t-value in parenthesis (***: significant at 99% and **: significant at 95%)

Appendix 2. Estimation result of equation (4)

	Primary		Manufacturing		T.C.U.		F.I.R.E.		Services	
	G	R	G	R	G	R	G	R	G	R
ß	9.044 (1.52)	.0008 (1.33)	21.969 (1.28)	-.00003 (-.27)	-60.791 (-3.03)**	-.0002 (-.91)	48.500 (2.31)*	.00004 (.31)	-130.820 (-2.05)*	.0001 (1.64)
F_{1995}	6.027 (1.68)	.0003 (.83)	6.507 (.63)	-.00001 (-.16)	-13.003 (-1.07)	-.0001 (-.56)	6.684 (.53)	.00002 (.20)	-97.220 (-2.52)*	.00004 (1.01)
F_{1996}	5.418 (1.51)	.0003 (.83)	-9.386 (-.91)	-.00001 (-.16)	-20.739 (-1.71)	-.0001 (-.56)	-4.641 (-.37)	.00002 (.20)	-116.410 (-3.02)**	.00004 (1.01)
F_{1998}	-35.684 (-9.93)**	.0003 (.83)	-19.397 (-1.87)	-.00001 (-.16)	21.539 (1.78)	-.0001 (-.56)	3.202 (.25)	.00002 (.20)	352.176 (9.12)**	.00004 (1.01)
R^2	.147	.001	.007	.000	.018	.000	.004	.000	.151	.001

G: Growth model and R: Redistribution model
t-value in parenthesis (**: significant at 99% and **: significant at 95%)
F_{1997} not included in the table and the year specific effect in 1997 (more specifically, the change between 1996 and 1997) can be calculated assuming the other year dummies (1995, 1996 and 1998) are zero.