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INDUSTRIAL DEVELOPMENT AND CAPITAL GRANTS POLICY: EUROPEAN EXAMPLE

by

Kingsley E. Haynes
The Institute of public Policy
George Mason University
Fairfax, VA 22020-4444

and

Tony Dignan
Kent Regional Development
Kent, Ireland

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A. INTRODUCTION

Uneven development of regions within a national state has, as one of its dimensions, an imbalance in the distribution of employment opportunities. Countries such as Italy, Ireland, the United Kingdom, and Belgium, among others, provide examples of this phenomenon. In each of these countries there exists a locational problem - some region (or set of regions) experiences difficulty in attracting new industry and the employment opportunities associated with new industry activity. Recognizing this locational problem, a variety of national governments (including the four cited above) have attempted to modify the relative attractiveness of regions to firms by offering inducements to firms to locate in relatively disadvantaged regions. Typically, the inducement takes the form of a locational cost reduction mechanism. In Smith's (1966) terminology, the national government seeks to expand the spatial margins to profitability so as to include disadvantaged regions. Examples of such inducements are direct capital grants (utilized in Ireland), interest rate subsidies (utilized in Belgium), and employment premiums (utilized in the United Kingdom).

The policies cited above have in common a regional-level spatial orientation. Obviously, such policies should be effective to some degree if they significantly affect a firm's cost structure and are perceived to do so by the firms at which the policies are targeted. In this paper, we argue that an additional factor to be considered in determining the effectiveness of such regional-level policies is the structure of the decision-making process of the firm. Specifically, we utilize a probabilistic model for the locational choice behavior of individual firms which allows us to infer the nature of the decision-making process based on the revealed preferences of firms for particular locations. The relationship between the structure of the decision-making process and the level of effectiveness and/or applicability of a regionally-based subsidy mechanism are explored from a policy perspective.

2. A HYPOTHETICAL SCENARIO

Suppose that a particular country can be divided into two regions, A and B. Region A is underdeveloped relative to Region B. The national government of this hypothetical country is actively engaged in attempting to induce foreign-based firms to locate within its national boundaries. The policy instrument underlying this effort consists of direct grants paid to new industry projects in proportion to the amount of investment made. Cognizant of the relation between A and B, and concerned to enhance the ability of Region A to attract investment, the proportion of the amount invested which is payable as a direct grant is higher in region A than in Region B. Let G_{ij} be the amount payable to firm i if it locates in j. Given the scenario described above, there is a regional grant differential, $G_{iA} - G_{iB}$, where $G_{iA} > G_{iB}$

3. A PROBABILISTIC CHOICE MODEL AND ALTERNATIVE DECISION STRUCTURES

Suppose that a firm, i, has decided to locate a plant somehwere in the hypothetical country. Ostensibly, the firm must make at least two decisions: it must choose a region (A or B) and a specific urban center within the chosen region.

Assume that the firm is an optimizer and employs a utility function in choosing a location and that this function can be specified as:

(1) $U_{ijk_j} = Z_{ij}'\beta + X_{kj}'\alpha + \varepsilon_{ijk}$

where,

U_{ijk_j}, is the utility accruing to firm i from a choice of region j and urban center k within region j;

Z_{ij}, is a vector of variables operating at the regional level;

X_{k_j}, is a vector of variables operating at the urban level;

ε_{ijk_j}, is the stochastic component of utility and is a function of uncertainty and (unmeasureable) firm-specific idiosyncrasies;

β, α are parameter vectors;

j subscripts regions, j = A,B;

k_j subscripts urban centers in j, $k_j = 1, S_j$

Since utility contains a random component firm i's locational preference can be predicted only up to a probability.

Assuming that ε_{ijk_j} is distributed i.i.d. Weibull, then the selection probabilities corresponding to utility-maximizing behavior can be specified as (McFadden, 1974; 1975):

$$(2) \qquad P_{ijk_j} = \frac{\exp \quad (Z_{ij}'\beta + X_{kj}'\alpha)}{\exp(Z_{i\ell} \quad + I_\ell)}$$

where,

$$I_j = \ln \left(\sum_{k_j=1}^{S_j} \exp(X_{k_j}'\alpha) \right)$$

The inclusive value, I_j, can be interpreted as a measure of the urban content of region j (Anas, 1982).

A problem with the specification (2) is that it assumes the independence of irrelevant alternatives (IIA), ie that the unobserved attributes of urban centers are uncorrelated. McFadden (1978) reparameterizes (2) in order to take account of possible violations of the IIA assumption. Thus (2) is respecified as:

$$(3) \qquad P_{ijk_j} = \frac{\exp\ (Z_{ij}'\beta + X_{kj}'\alpha - \lambda I_j)}{\sum_\ell \exp\ (Z_{i\ell}\beta + (1-\lambda) I_\ell)}$$

where,

λ is a parameter, $0 < \lambda < 1$.

The advantages of the specification (3) in statistical terms are discussed in detail in McFadden (1978) and Anas (1982), among others. Of concern here is the variety of decision-making structures implied by various values of λ. In order to explore these decision structures, note that (3) can be decomposed as:

(4) $P_{ijk_j} = P_{ij} \times P_{ik_j|j}$

where,

$P_{ik_j|j}$ is the conditional probability of k_j being chosen, given that j has been chosen;

$P_{ij} = \sum_{k_j} P_{ik|j}$, is the marginal probability of region j being chosen.

Fig. 1 shows the decomposition of eq. (3) implied by eq. (4), as well as the probability specifications resulting from the extreme values, $\lambda=0$ and $\lambda=1$. Fig. 2 illustrates the decision structures corresponding to these extreme values.

The case of $\lambda=0$ suggests a single-stage decision process whereby the firm simultaneously chooses both an urban center and a region (see Fig. 2). Examination of the appropriate row of Fig. 1 shows that the marginal probabilities are a function of the inclusive value, I_j. That is, the regional choice depends on the characteristics of each set of urban centers within the competing regions, as well as the regional-level characteristics. It should also be noted that, when $\lambda=0$, eq. (3) reduces to eq. (2), suggesting independence of errors across urban centers.

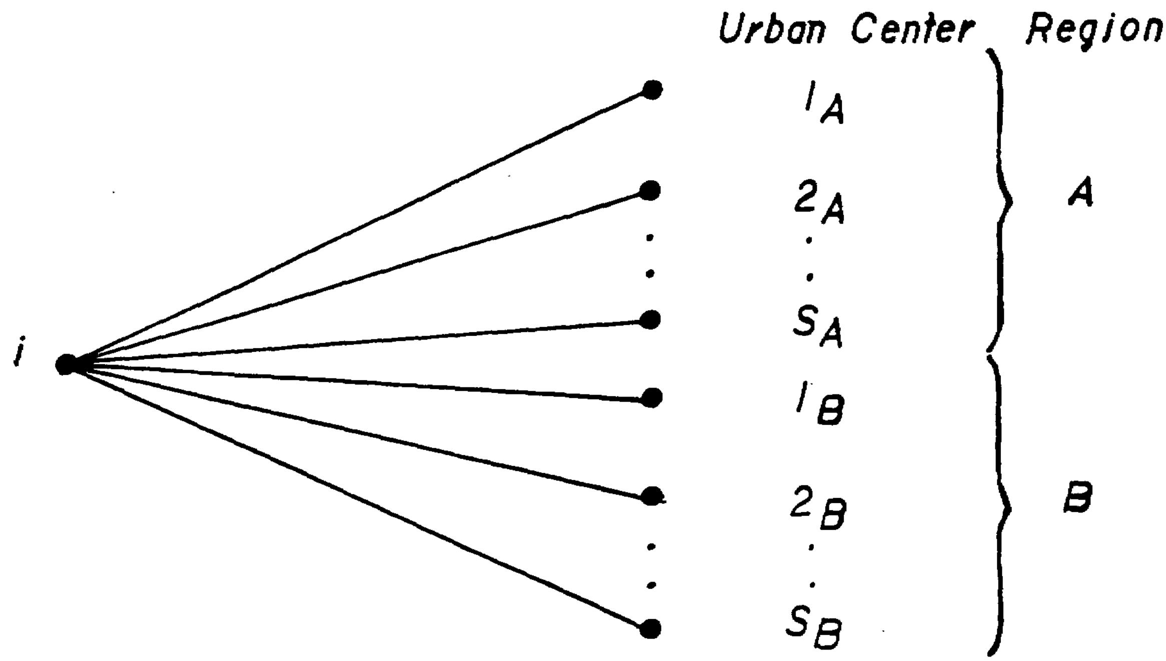
For $\lambda=1$, a hierarchical two-stage decision process is inferred. As can be seen from Fig. 2 and the final row of Fig. 1, the firm first chooses a region without regard to the characteristics of urban centers. Note the absence of the inclusive value from the regional probability when $\lambda=1$. At

FIG. 1 Selection Probabilities Implied By Alternative Values of λ

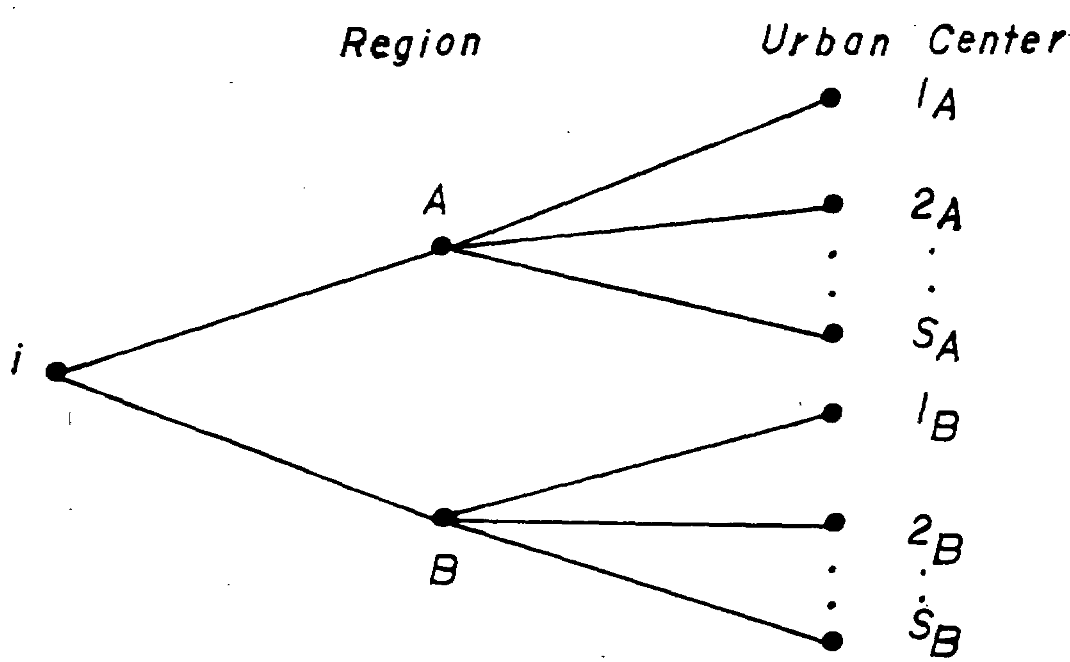
	Selection Probability		
	(a) Regional	(b) Urban	(c) Joint
	P_{ij}	$P_{ik_j\mid j}$	P_{ijk_j}
$0<\lambda<1$	$\dfrac{\exp(Z_{ij}'\beta+(1-\lambda)I_j)}{\sum_l \exp(Z_{il}'\beta+(1-\lambda)I_l)}$ $\times$	$\dfrac{\exp(X_{k_j}'\alpha)}{\exp(I_j)}$ $=$	$\dfrac{\exp(Z_{ij}'\beta+X_{k_j}'\alpha-\lambda I_j)}{\sum_l \exp(Z_{il}'\beta+(1-\lambda)I_l)}$
$\lambda=0$	$\dfrac{\exp(Z_{ij}'\beta+I_j)}{\sum_l \exp(Z_{il}'\beta+I_l)}$ $\times$	$\dfrac{\exp(X_{k_j}'\alpha)}{\exp(I_j)}$ $=$	$\dfrac{\exp(Z_{ij}'\beta+X_{k_j}'\alpha)}{\sum_l \exp(Z_{il}'\beta+I_l)}$
$\lambda=1$	$\dfrac{\exp(Z_{ij}'\beta)}{\sum_l \exp(Z_{il}'\beta)}$ $\times$	$\dfrac{\exp(X_{k_j}'\alpha)}{\exp(I_j)}$ $=$	$\dfrac{\exp(Z_{ij}'\beta+X_{k_j}'\alpha-I_j)}{\sum_l \exp(Z_{il}'\beta)}$

FIG. 2 Alternative Decision Structures Implied By The Extreme Values of λ

(a) $\lambda = 0$: Single Stage Decision Process



(b) $\lambda = 1$: Two Stage Decision Process



the second stage, the firm chooses between the urban centers within the chosen region.

4. IMPLICATIONS OF ALTERNATIVE DECISION STRUCTURES FOR REGIONAL LEVEL POLICIES

To examine the implications of alternative decision structures for regional level policies, assume that the probability model described by eq. (3), given that the linear predictor $Z_{ij}'\beta + X_{k_j}'\alpha$ is properly specified, adequately describes the decision-making process for a typical firm i. Second, assume that the parameters can be estimated.

Now, suppose that, for the hypothetical country, the only factor varying significantly at the urban level is the amount of the direct grant which a firm receives. Further, suppose that, in terms of urban content or structure, region B's attractiveness significantly outweighs region A's. This second supposition is not unrealistic: it is intuitively plausible that uneven development of regions will be reflected in diverging urban structures. This second supposition implies that:

$$(5) \quad I_B > I_A$$

Finally, in order to evaluate the degree of effectiveness of a regionally based subsidy mechanism, it is necessary to define 'degree of effectiveness' operationally.

The purpose of a regionally based grant subsidy mechanism is obviously the diversion of investment into relatively underdeveloped and/or disadvantaged regions. A policy is effective only insofar as firms are responsive to that mechanism in their locational choice behavior, ie that firms give the subsidy a non-zero weight in their location choice utility function. This suggests that we measure the effectiveness of a regionally based subsidy by its quantitative impact on the probability of a firm choosing to locate in a targeted region.

Given the above assumptions and the suppositions concerning our hypothetical country, the probability of a location in Region A can be written as:

$$(6) \qquad P_{iA} = \frac{1}{1 + \exp\,[(G_{iB} - G_{iA}) \quad + (1 - \lambda)(I_B - I_A)]}$$

Obviously, if $\beta=0$ then, regardless of the firm's decision-making process, the policy instrument should be re-evaluated. However, λ can be seen to affect the value of P_{iA} which the policy-maker is trying to enhance. If $\lambda = 1$, a two stage decision-making process is inferred in which regions are first compared with respect to their characteristics, and then urban centers are evaluated. If the firm is employing a two-stage process then its regional location behavior should be susceptible to a regional level policy instrument. Conversely, if $\lambda=1$, then the firm is inferred to employ a single-stage decision process and to be basing its regional location decision, at least in part, on a comparison of the urban content of alternative regions. A finding of $\lambda=0$ and $\beta=0$ would therefore suggest that the spatial scale of the policy instrument be re-oriented to the urban level, ie that it is deficiencies in A's urban infrastructure which must be rectified in order for the region's attractiveness to be optimally enhanced.

If $\beta>0$ holds then the policy can be construed to be effective insofar as firms are responsive to the policy instrument. However, note that, for fixed β,

$$(7) \qquad (P_{iA|\lambda=1} - P_{iA|\lambda=0})$$
$$= (P_{iA|\lambda=1} \times P_{iA|\lambda=0}) \times \exp\,[(G_{iA} - G_{iB})]\,(\exp[I_B - I_A] - 1)$$

From (5) above, $I_B > I_A$. Therefore, $\exp\,[I_B - I_A] > 1$ and,

$$(8) \qquad P_{iA|\lambda=1} > P_{iA|\lambda=0}$$

Thus, for fixed β, the probability of choosing A is higher for $\lambda=1$ than for $\lambda=0$. This suggests that the effectiveness of a regionally based subsidy, in terms of its ability to divert firms to the target region, will be highest when firms employ a two stage process. A finding of $\beta>0$ and $\lambda=0$ would suggest that the policy is having some impact at the regional level but also that there is scope for some urban-oriented policy measures.

The above discussion is summarized in Fig. 3.

FIGURE 3. ALTERNATIVE COMBINATIONS OF THE POLICY VARIABLE AND INCLUSIVE VALUE COEFFICIENTS AND IMPLICATIONS

(a)	$\beta=0$, $\lambda=1$	Two-stage decision process, policy instrument ineffective, but there is scope for a regional level instrument.
(b)	$\beta=0$, $\lambda=0$	Single-stage decision process, policy instrument ineffective, policy should be re-oriented to urban level.
(c)	$\beta>0$, $\lambda=0$	Two-stage decision process, policy instrument operating effectively.
(d)	$\beta>0$, $\lambda=0$	Single-stage decision process, policy instrument not fully effective at regional level, potential scope for urban-based policies.

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5. AN EMPIRICAL EXAMPLE

Since the mid-1950s, the Republic of Ireland has pursued a policy similar to that described for our hypothetical country. For policy purposes, Ireland was divided into three zones: Designated Areas (DAs), Non-Designated Areas (NDAs), and Dublin (DUB), the capital city. The grant scheme operated by the government and administered by the Industrial Development Authority (IDA) can be described as follows:

(10) $\quad \text{MAX} \quad G_{ij} = t_j \; EFA_i$

where,

MAX G_{ij}, is the maximum grant payable to firm i for locating in region j;

EFA_i, is the expected fixed asset investment of firm i;

t_j, is the maximum proportion of EFA_i payable as a grant for a location in j;

j = DA, NDA, DUB.

Under the scheme, up until 1977, $t_{DA} > t_{NDA} > t_{DUB}$. From 1977 on, the rates were such that $t_{DA} > (t_{NDA} = t_{DUB})$.

If EFA_i can be assumed constant across regions, then (10) can be solved to give:

(11) $G_{ik} = (t_k/t_j) \; G_{ij} \qquad ,i \neq k$

Utilizing (11), the observed grant approved for a firm locating in region j can be used to compute an expected grant approval if the firm had located in region k rather than region j.

Using a data set culled from the annual reports of the IDA, a model of the form of (3) above was estimated by means of maximum likelihood using the Powell (1970) algorithm. The linear predictor utilized was:

(12) $\beta_1 G_{ij} + \beta_{2j} U_i + \beta_{3j} UK_i + \alpha_1 \ln Pop_{k_j} + \alpha_2 \ln Acc_{k_j} - \lambda I_j$

where,

U_i, is the national unemployment rate at the year of i's observed location decision;

UK_i, = 1 if i originated in the UK;
= 0 otherwise.

Pop_{k_j}, is the population of town k in region j;

Acc_{k_j}, is the accessibility of town k to the major ports of Ireland;

$\beta_{2,DA} = \beta_{3,DA} = 0$

The results are presented in Table 1. As can be seen, $\hat{\beta}_1 = 0$. Also is significantly different from both 0 and 1. However, $\hat{\lambda}$ is closer to 0 than to 1. The results suggest an ineffective policy measure and a decision process which is closer to a single-stage than a two-stage process. In short, the results suggest a re-orientation of policy toward the urban level. The estimate of $\hat{\beta}_1$ is, however, surprising since the country is small in scale and the IDA seems quite confident that the policy is effective in terms of diverting firms to the DAs (O'Farrell, 1978).

To explore the issue further, the grant variable was respecified as:

$$(13)\ f(G_{ij}) = G_{ij}^{\phi} \qquad , 0 < \phi < 1.$$

This formulation suggests that, as the scale of investment increases, the marginal effect of the grant declines. The choice model was re-estimated for various values of ϕ. For $\phi = 0.25$, we obtained $\hat{\beta} = 0.2922$ ($t = 2.115$). Interestingly, though all other parameter estimates were quite stable, the estimate for almost doubled, to 0.6836 ($t = 2.985$). This value is also significantly different from zero and unity, but is much closer to a two-stage decision process than a one-stage process.

These results are obviously ambiguous. Additional data would seem to be needed in order to clarify the matter. In particular, note that, in generating the grant variable, G_{ij}, it was necessary to assume no regional variation in EFA_i. Since data on EFA_i was unavailable, this assumption could not be tested. Further, no data was available with respect to the level of employment each firm expected to generate. Thus, the implicit assumptions thatthis level did not vary across locations and was not a factor considered by firms could not be tested and it is possible that (12) is mis-specified so that the results may be quite misleading

5. CONCLUDING REMARKS

This paper has addressed the issue of evaluating the effectiveness of a regionally-based subsidy mechanism in terms of the policy's ability to divert firms to disadvantaged regions. The criterion of effectiveness employed was the quantitative impact of the policy on the probability of a firm locating in a disadvantaged region. The level of effectiveness, by this criterion, was suggested to vary according to the decision-making process employed by the firm. In short, it was argued that regionally-based subsidies will have maximum effect in terms of investment diversion if firms employ a two-stage decision process whereby regions and urban centers are evaluated separately. In the case of a single stage decision process it was argued that regionally-based policies need to be supplemented by urban-oriented policies.

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