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THE DETERMINANTS OF URBAN MANUFACTURING LOCATION - A SIMPLE MODEL

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THE DETERMINANTS OF URBAN MANUFACTURING LOCATION
- A SIMPLE MODEL

Introduction

The objective of this working paper is to describe and evaluate some preliminary results from the testing of a simple model of urban manufacturing location in the Clydeside Conurbation. Its starting point is a brief theoretical exposition of the underlying determinants of the existing location pattern on Clydeside and of the factors which are causing this pattern to change. In particular the persistent tendency for manufacturing to decentralise away from the core will be touched upon. Thereafter we present the findings of a much-quoted study by Moses and Williamson (1967) on decentralisation in post-war Chicago and use this as a benchmark against which to evaluate some comparable investigations from the Clydeside study. The core of our paper is concerned with a Moses-Williamson type model of destination choice in the Clydeside context and we conclude our discussion with a brief description of the next steps in our programme of intra-urban location research.

It is crucial to stress in this paper that choices of destination are a large part but not the totality of urban location decisions. Thus, like Moses and Williamson, we include both the decisions made by companies which close their premises at one location and re-open elsewhere (relocations or transfers) and the spatially distinct expansions by conurbation companies which involves opening new branches whilst retaining their current plants. However, the current study goes further by also including the decisions made by entirely new companies and by non-conurbation companies which established manufacturing plants within the conurbation for the first time, via new branches and divisions. Finally, the current study also includes a measure of *in situ* employment expansion by companies which do not change their location.[1]

Whilst this set is a more comprehensive reflection of location decisions than was the case with the Chicago study, it does not include relocations and expansions by conurbation companies outside of the conurbation. However, given the geographical boundaries of the study area (see Appendix 1) there are very few 'external' relocations or expansions.

A Simple Theory of Intra-Urban Location

We assume that each firm seeks a 'satisfactory' location which permits it to derive a 'reasonable' rate of return on capital invested.[2] In making an urban location decision the firm faces a rent gradient which peaks at or close to the historical core of the city and falls with increased distance from the core. This rent gradient has some smaller peaks in non-core nodes. Any individual firm is incapable of affecting the level of rent at any given point on the rent gradient. It must also assume that the cost of borrowing capital, for a given project risk, is spatially invariant. Though industrial plants are widely distributed over intra-urban space there is a dense concentration of activity surrounding the historical core of the city. This concentration occurs because of the desirable access characteristics of the core. Thus certain plants with a production technology in which the land to output ratio is low seek a central location because their

a) costs of production are minimised there as a result of external economies and urbanisation economies.[3]

b) revenue is maximised there due to cluster economies.[4]

Such plants bid against other uses with a strong preference for a central location and the highest bidder succeeds in obtaining space. The strength of such bids and therefore the position of the plant on the rent gradient, reflects both the profitability of the plant and the extent to which increasing distance from the core increases costs and/or reduces revenue.

Over time this dense cluster of manufacturing activity tends to disintegrate as plants decentralise. This may occur because[5]

a) of a fall in the demand for centrality due to improvements in transport and communications technology

b) there is a shift in the demand for the products of central-located manufacturers to peripheral-located manufacturers.

c) the attachment to the central area by non-manufacturing activities increases

d) centrally located non-manufacturing users expand their output and space requirements relative to centrally located manufacturing users,

e) large-scale urban renewal sterilises large tracts of industrial land use for long periods.

Whatever the reasons, some existing plants are freed, or are forced, to search for different locations and new activities enter the urban land market for the first time. The factors which shape these location choices are the subject of the remainder of this paper and we start by scrutinising the findings of Moses and Williamson.

Moses and Williamson

In the empirical part of the paper, the authors analysed the location decisions of 2,000 Chicago firms which, sometime between 1950 and 1964, had 'either relocated or expanded capacity at a site different from their existing one.'[6] The authors documented three critical parts of the location process -- the distribution of origins, the direction and distance of movement and the patterns of destinations. On the first point they discovered the number of origins did fall off sharply as distance from the core of the city increased. However, when allowance was made for the varying number of firms in each of the 582 zones within the metropolitan area, there was no tendency for firms closest to the core to have a higher propensity to move. In the author's words

> ...since this percentage of firms being set loose is relatively constant, the shifting pattern of industrial location must result from the spatial pattern of destinations -- the percentage which set down in each zone.[7]

Given this spatial invariance of origins, the authors then concentrated their analysis upon the distance of movement and the pattern of destinations. The discussion of distance moved generated some interesting findings. As might be expected, the relationship

> ...resembled that of a gravity model in which the number of inter-connections between zones diminishes as the distance between them increases.[8]

Even more interesting was the finding that the larger the firm,[9] the longer the distance moved. This the authors ascribed to the costs of establishing contacts with new suppliers of raw materials and services and with new customers. They contended that distance moved was a proxy for the costs of relocation and since the small firm was much more dependent upon particular sellers and particular buyers than the large firm it tended to move as short a distance as possible from the familiar locale.[10]

Rather more surprising was the finding that the distance moved was not affected either by the distance of the origin zone to the centre nor by industrial category.

Though work is still proceeding on the Glasgow data, it appears the similar results to those of Moses and Williamson's are not likely to emerge. When origins were regressed against distance of zone from the core and number of plants in the zone, the former consistently explained more than the latter.[11] Thus it appears that firms close to the core do have a higher propensity to move.

The distance moved of relocating firms appears to follow that of the pattern in Chicago. Indeed over one third of all movers remained within one of the sixty zones used for the Glasgow analysis, and the bulk of all moves was over very short distances.[12] However, there is no evidence to support the Chicago finding that distance moved was affected by size of firm. In this respect small firms tended to move as far as large firms. Indeed the most significant factor tended to be the distance of the origin zone from the centre -- the nearer the centre the longer the move. Whether this is caused by relocating central firms having to 'leap-frog' over the inner areas of housing or because of the nature of the slope in the rent gradient, is to be the subject of further enquiry.[13]

As yet we have not run regressions for length of move and industrial category but our initial impression is that the finding of Moses and Williamson will be confirmed on Clydeside.

The Glasgow Destinations Model

The central part of Moses and Williamson's paper is an analysis of destinations using a simple model and regressions. The model has the form:

$$D = a + bL + bW + bT = bH + bV + bM + bC + U$$

where a is the constant term and u the error term. D, the dependent variable is the number of destinations per unit area using the 582 Chicago zones as observations.

The independent variables were all selected as factors which might affect the location decision. L is a proxy for the rent gradient and measures the distance of the zone from the core. W is also a proxy for the wage gradient. A surrogate for this is the availability of labour in a given zone, and in the above model the data used were population density in a given zone. A measure of access to transport modes other than highways (e.g. rail and water), T, is given by the percentage of transportation land in a zone minus highway land. Accessibility to limited entry freeways was measured by H, a dummy variable of one if such a highway was in a given zone or adjacent to it; with a zero otherwise. Land availability, V, is the percentage of vacant industrial and commercial zoned land, and M, the percentage of land in manufacturing use. C is a dummy variable indicating whether any zone lies mainly within the City of Chicago.

Using data for 1950-1959, the regression for relocations explained one fifth of the variance in the dependent variable ($r^2 = .2152$), and one quarter of the variance ($r^2 = .2472$) in expansions. Significantly, better results were obtained when the Chicago zones were grouped into three separate areas, though the authors could find no obvious reason why the zone with the largest amount of land zoned for manufacturing should attract the smallest number of firms.

In the Glasgow case data on all types of location decisions are available for the period 1958 to 1968. The Glasgow University Register of Industrial Establishments (hereafter G.U.R.I.E.) pinpoints these location decisions to areas of 100 square metres. However for the purposes of defining zones with given land use and accessibility characteristics we have used the 742 zones in the Greater Glasgow Transportation Study (G.G.T.S.) and by inspection aggregated these into 60 basic zones, with a broad division between city of Glasgow zones and periphery zones (i.e., outside of the city of Glasgow).

Three forms of dependent variables were used -- destinations using plant numbers, destinations using employment 'entering' a zone and 'in situ' employment expansion. For total plant destinations entering or moving within each zone the number of inter-zonal and intra-zonal relocations were summed with the total of new plants setting up,[15] and the grand sum was divided by an index of zone size (acreage).

Zonal employment destination densities were constructed in a similar way with initial employment in the relocations and new plants being used. For new plants, closures which occurred prior to the end of 1968 were ignored. Finally, the in situ expansion figure was calculated from the net growth in new plants, interzonal relocations and in plants which remained within the zone throughout the entire period. Table 1 summarises the number of destinations under the heading of interzone moves, intrazone moves and new plants.

The multiple regression model run for the Glasgow conurbation had a similar structure to that of Moses and Williamson but several of the independent variables were re-specified. The model has the form:

$$Z = a + bD + bI + bS + bN + bC + bK + bB + bF + U$$

Table 1

Destinations by Type of Decision

Total Destinations	Number of Plants
(1) Interzone Moves	
First move	354
Second move	31
Third move	6
Total	391
(2) Intrazone Moves	
First move	196
Second move	17
Third move	2
Fourth move	1
Total	216
(3) New Plants	
Single Plant Companies	351
Branch or HQ of U.K. or Scottish Company	118
Branch or HQ of Conurbation Company	57
Total	526

Total Destinations = (1) + (2) + (3) = 1,133

Total Stock of Establishments 1963 = 2,489

Z represents the dependent variable which can be total destinations by plants or employment or in situ employment expansion. Separate runs were tried for destinations in the City of Glasgow and in the periphery and destinations were further broken down into new plant decisions and interzonal moves. 'a' and 'u' represent, respectively, the constant and error term. Unlike Moses and Williamson we do not use distance from the city core to the zone centre as a measure of the rent gradient. Instead we hypothesise that 'D', the log of centre-core distance, is a measure of access to the external economies of the core. In the Glasgow model the rent gradient is assumed to be reflected in 'I' -- zonal employment densities. The logic used here is that the more expensive the land at any given location, then the higher the labour to land ratio.

These variables, 'D' and 'I' should be seen in conjunction. If plants are 'centre-loving' then there will be a negative relationship between destinations and increased distance from the core and a positive relationship between destinations and high rent zones. If plants are decentralisers then there should be a positive relationship between destinations and increased distance from the core with a negative relationship to rent levels.

In Glasgow we do not have a precise measure of land and property vacant and available for industrial use. Instead we divided the total industrial acreage (1964) in each zone by the average stock of plants and multiplied the resulting figure by the number of plants which left the zone, or died within the zone over the period 1958-1968. This measure has obvious deficiencies. It assumes that property vacated is suitable for different users and also assumes that vacated space is automatically available for other manufacturers. In inner city urban renewal areas this last assumption may be false.

The other two land use variables, were 'N' and 'C'. 'N' is the proportion of land not in manufacturing and this is used both as an indicator of the degree to which manufacturing is likely to be unsuitable, perhaps on planning grounds (i.e. a non-conforming use) and as an indication of the lack of possible manufacturing linkages and highly localised external economies. The hypothesis therefore is, the higher the proportion of land in non-manufacturing use, the lower the number of destinations. 'C' which measures the proportion of zone land committed to communications uses, is similar to the Chicago 'T', but highway land uses are also included within 'C'. We do not include a dummy variable for the presence or absence of a motorway in the zone since the period of analysis predates the development of an extensive motorway system in the city and conurbation.

The variables 'K' and 'B' replace 'W' of the Moses and Williamson model but they are intended only as indicators of the zonal potential accessibility to labour and are not intended to imply a wage gradient. 'K' measures potential zonal access to labour using private transport whilst 'B' is a similar measure for public transport. The indices, 'K' and 'B', were derived in the following way. For each of the 60 G.U.R.I.E. zones the small scale G.G.T.S. zone central to the G.U.R.I.E. zone was plotted. Time distances between the G.G.T.S. zones central to each pair of G.U.R.I.E. zones were taken as a proxy for time distance between the centres of each pair of G.U.R.I.E. zones. Trip end-decay functions, which implicitly contained both a gravity model and intervening opportunities element, were available for the Glasgow conurbation for public and private transport. To simplify the analysis it was necessary to assume that the trip decay functions for both methods of movement remain constant regardless of zone location or the direction of travel. Thus for each pair of G.U.R.I.E. zones we could estimate the proportion of travellers, for each mode of travel, who would be willing to travel the time distance between the pair of zones. This proportion was then weighted by the number of residents in each zone who were also members of the labour force. Unfortunately we were not able to separately identify male and female residents in the labour force. For each G.U.R.I.E. zone, and for both modes of transport, we calculated the potential number of workers that could be attracted to a particular zone from all other zones. We hypothesise that higher labour accessibility, particularly by public transport, will be positively related to the density of zonal destinations.

Finally, 'F' is an index of zonal access to freight flows derived from G.G.T.S. estimates and hence acts as a proxy of zonal connectivity with the total urban manufacturing system.

Before we interpret the results one important fact must be established. The problem of non-independence of the so-called independent variables (i.e. multicollinearity) is likely to be crucial in a distance ordered city. Correlations run amongst all the independent variables used in the model suggested that land uses and accessibility patterns are strictly ordered by distance from the core. This means that particular care must be taken in interpreting the derived partial regression co-efficients.

The results for total plant destinations and total employment destinations in the Conurbation show respectively that 75% and 50% of the variance is explained by the model. Moreover, apart from 'C' which has the wrong sign and the unexpected though weak negative relationship between plant destinations and labour and freight flows accessibility

(K,B,F), which is not repeated in the employment destinations regression, the postulated associations between destinations and zonal characteristics appear to hold good. Thus an increase in access to the core, in vacant land/built space for manufacturing, in the proportion of land-use in manufacturing, in accessibility by public transport to labour and in connectivity to the urban system as a whole, is associated with an increase in destinations. However, the model has a far higher explanatory power in the city than in the periphery for both plant and employment destinations, and the signs for some of the variables are different for each of these broad areas.

For city plants the crucial consideration appears to be a desire to minimise distance from the core, which in turn is associated with a willingness to pay high rentals as indicated by the results for I. This preference for centrality is most marked for relocating firms, as the results for interzonal moves show quite clearly. The only other factor of significance for relocators appears to be access to freight flows, though this again, in a core-dominated city, may be another way of expressing distance from the core. This suggests that the preference for the familiar locale is very marked, even though this means paying high rents.

For new city locating plants, log distance is not significant at the 5% level, but high rental areas and zones with vacant space do appear to be attractive. All the accessibility variables -- communications, private and public, labour accessibility and accessibility to freight flows -- have the wrong signs, though apart from private labour accessibility, none of the relationships are significant.

For destinations in the periphery, log distance from the core is once again important for interzonal movers, and this once again reflects the preference for firms leaving city locations to stay as close to the core as possible. This apart, only access to labour by private transport (K) is significant at the 5% level (employment destinations only).

For new plants locating on the periphery, the model explains a low proportion of the zonal variance in destinations (.3660 and .2454) and neither the plant destination nor the employment destination equation is significant at the 5% level. Indeed only 'N' -- the proportion of land in non-manufacturing use -- appears to affect destinations to any extent, and in the plant regression many of the signs are contrary to the relationship postulated. The most obvious example of this is the negative sign on space available for manufacturing 'S'.

The final dependent variable, in-situ expansion, gives markedly different results in the city and the periphery, with distance from the core being the only significant variable in the city. I,S,N,C are all significant in the periphery, though both S and N have an unexpected sign.

Though a definitive summary of results must await further runs using re-specified variables, the different factors at work shaping the location choices of relocating city firms and of new firms suggest that further study must be based on the nature of the forces initiating a decision as much as on the characteristics of the zone attracting incoming plants. The results also suggest that the factors attracting plants to peripheral zones may be different in kind from those attracting plants to city zones.

Conclusions

At the aggregate level, the model discussed above explains a high proportion of the variance in zonal destinations whether these are measured in terms of plants or employment. More specifically, the model appears to have considerably greater explanatory power than that used in Chicago.

However when the Glasgow model is run for individual parts of the total set of destination decisions, some of the results are not so convincing. Thus for new plant destinations and new employment destinations in the periphery the regression is not significant at the 5% level. The same holds for inter zonal flows to peripheral zones.

We can interpret this result in a number of ways. It could be argued that decisions about peripheral locations are likely to be influenced by factors which are not easy to specify for regression purposes. For example, a peripheral location decision may be influenced by top managements' desire to minimise home-to-factory travel time or the wish to maximise access to the motorway which links the conurbation with other major industrial centres. Of even greater significance than missing variables may be the fact that peripheral land uses and patterns of accessibility tend to change relatively dramatically. For example, in a conurbation which is always chronically short of employment opportunities, local authorities may tend to re-zone peripheral land for industrial purposes whenever an attractive industrial development is in view. This can mean that a zone which, at any given date, has a low proportion of land allocated for industrial use, may nonetheless receive many 'destinations.' This highlights the peculiar difficulties of trying to associate a flow over time of plant destinations with a snap-shot of land-use and accessibility characteristics at one point in time. One obvious next step then is to use the plant flows for 1964 to 1968 and relate this to the zonal land use and accessibility data averaged out from 1964 and 1968.[16]

We are also acutely aware that the definition of our sixty zones may have been unnecessarily arbitrary, and especially on the periphery where the zones tend to be large. In essence we are trying to show that zones with a given land use configuration and given accessibility characteristics do or do not attract plants. However there is an obvious danger that absolutely small inflows of plants may not appear to be related to what are, in effect, heavily averaged land-use characteristics. This may be especially true of large zones. The obvious next step is to generate zones in which intra-zonal variance in land use and accessibility is minimised and inter-zonal variance maximised. We propose to use factor analysis on the 742 G.G.T.S. zones specifically using the population land-use and accessibility variables for this purpose.

Apart from these major changes in the specification of the zonal units we anticipate that improvements can be made to some of our independent variables. In early runs of the model a dummy variable was used for the presence or absence in each of the 60 zones of an industrial estate. The disadvantages of this approach are obvious and, accordingly, we are experimenting with a variable which measures the proportion of zonal land in industrial estate use. The other possibility is that our labour accessibility variables do not allow for variations, industry-by-industry, in the male/female employment ratio. We propose to separate our location decisions into predominantly male-employing or female-employing industries and to provide measures of male and female accessibility to each zone.

Finally, we intend to disaggregate location decisions on an industry-by-industry basis both as a means of scrutinising internal changes in production functions which may throw light upon the reasons for decentralisation and in order to specify destination choice more accurately.

NOTES

1. We are aware that employment expansion in situ may or may not be associated with a change in the physical area or configuration of the factory and it could be argued that location choice only arises when such a change is undertaken. We have a less narrow concept of choice in that we assume a decision about location is also made when companies decide to expand their employment in situ. However, we do recognise that the nature of this type of decision is different from decisions on relocation expansion or new plant locations. For this reason all our analysis separates out the different types of location decisions.

2. See H. W. Richardson, Regional Economics, Weidenfield and Nicholson, (1969), chapters 3 and 4.

3. See E. M. Hoover, An Introduction to Regional Economics, A. Knopf, (1971), chapter 4.

4. Hoover (1971), op. cit.

5. See G. C. Cameron and A. W. Evans, "The British Conurbation Centres," Regional Studies, Vol. 7 (1973) pp. 47-55.

6. Leon Moses and H. F. Williamson, "The Location of Economic Activity in Cities," American Economic Review, Vol. LVII, No. 2 (May 1967). Moses and Williamson refer to economic activity throughout their paper but all their examples seem to be drawn from manufacturing activity. We shall assume that they are primarily concerned with manufacturing.

7. Ibid., p. 216.

8. Ibid., p. 217.

9. Size was measured by "the cost of land and construction associated with relocation or expansion at a new site."

10. There are two possible explanations here. One is that the large company can attract sellers wherever it is located within the urban area because of the scale of its purchasing power. The other explanation is that the large firm itself produces (internalises) many of the purchases which the small firm has to make.

11. r^2 for distance = .69167 (1)

r^2 for stock = .25697

r^2 for log distance = .84949 (2)

r^2 for stock = .09931

r^2 for distance = .69167 (3)

r^2 for log of stock = .13539

12. The median distance moved was 1.5 kilometres.

13. If the rent gradient has a steep gradient close to the centre but then is uniformly flat beyond a certain distance from the core, then centralised plants may have to relocate over a threshold distance to escape high rentals.

14. Moses and Williamson suggested that the ethnic composition of the biggest zone (a large proportion of blacks) might explain the small number of destinations.

15. This total includes plants which ultimately died within the zone.

16. If there are sufficient numbers of destinations in 1964 and 1968 a cross sectional approach will be tried with a modified number of zones.

APPENDIX 1

The Clydeside conurbation is in West Central Scotland. It has a population of 1.7 million (1971) and a manufacturing labour force of over 300,000. The Census of Population defines it as Glasgow County of City, Dunbarton County (part), Clydebank L.B., Bearsden S.B., Kirkintilloch S.B., Milngavie S.B., Lanark County (part), Airdrie L.B., Coatbridge L.B., Hamilton L.B., Motherwell and Wishaw L.B., Rutherglen L.B., Bishopbriggs S.B., East Kilbride S.B., No. 6 D.C., No. 8 D.C., No. 9 D.C., Renfrew County (part), Paisley L.B., Barrhead S.B., Johnstone S.B., Renfrew S.B., First D.C., Second D.C.

We have included the new town of Cumbernauld in the area of the conurbation.

Type of Analysis	1	2	3	4	5	6	7	8	9	10	11
	R^2	a (Intercept)	Values of the Coefficients for the Variables D	I	S	N	C	K	B	F	F statistic
Total Plant Destinations											
Conurbation	.7477	+71.9754	-19.4439 (3.4546) **	+0.0577 (0.0127) **	+0.6240 (0.3007) **	-0.1808 (0.1894)	-0.4461 (0.3511)	-0.0013 (0.0004) **	-0.0000 (0.0004)	-0.0016 (0.0036)	18.8961 **
City	.8859	+79.7166	-15.4549 (14.0734) **	+0.0775 (0.0316)	+1.8981 (1.3824)	-0.1809 (0.4174)	-0.8240 (1.1762)	-0.0023 (0.0011)	-0.0001 (0.0002)	+0.0013 (0.0114)	11.6476 **
Periphery	.4182	+17.1275	-1.2593 (1.3298)	+0.0023 (0.0036)	-0.1006 (0.0799)	-0.1379 (0.0624) **	+0.1273 (0.0941)	-0.0001 (0.0001)	-0.0001 (0.0000)	+0.0011 (0.0008)	2.6957 *
Total Employment Destinations											
Conurbation	.5018	+3365.1797	-726.2021 (207.5701) **	+1.0817 (0.7617)	+12.2368 (18.0666)	-12.8323 (11.3796)	-19.5081 (21.0955)	-0.0655 (0.0225) **	0.0080 (0.0076)	+0.1768 (0.2137)	6.4209 **
City	.7979	+5145.3926	-1685.9825 (701.6571) **	+2.1090 (1.5761)	-45.3870 (68.9228)	-25.8682 (20.8121)	24.4147 (58.6439)	-0.1239 (0.0555) **	-0.0045 (0.0120)	+1.3465 (0.5682) **	5.9225 **
Periphery	.4163	+2748.1949	-173.1917 (269.3285)	-0.1632 (0.7357)	-23.0112 (16.1885)	-20.8627 (12.6389) *	-38.4777 (19.0619) **	-0.0349 (0.0197) *	+0.0333 (0.0092) **	+0.1700 (0.1683)	2.6749 *

Type of Analysis	1	2	3	4	5	6	7	8	9	10	11
			Values of the Coefficients for the Variables								
	R^2	a (Intercept)	D	I	S	N	C	K	B	F	F statistic
Interzonal Plant Destinations											
Conurbation	.6251	+16.6436	-5.4558 (1.2725) **	+0.0100 (0.0047) **	+0.1707 (0.1108) *	-0.0439 (0.0698)	+0.0501 (0.1293)	-0.0002 (0.0001) *	-0.0001 (0.0000)	+0.0009 (0.0013)	10.6295 **
City	.7879	+23.5526	-11.7811 (5.3850) **	+0.0133 (0.0121)	-0.0445 (0.5290)	-0.1297 (0.1597)	+0.1228 (0.4501)	-0.0004 (0.0004)	-0.0001 (0.0001)	+0.0085 (0.0044) *	5.5731 **
Periphery	.2679	+4.6670	-0.7544 (0.6505)	+0.0009 (0.0016)	-0.0244 (0.0364)	-0.0244 (0.0284)	+0.0591 (0.0428)	-0.0001 (0.0000)	-0.0000 (0.0000)	+0.0003 (0.0004)	1.3723
Interzonal Employment Destinations											
Conurbation	.3776	+303.7705	-145.0191 (63.1200) **	+0.1625 (0.2316)	+4.6587 (5.4939)	-0.2490 (3.4604)	+5.0143 (6.4149)	-0.0047 (0.0068)	-0.0017 (0.0023)	+0.0636 (0.0650)	3.8671 **
City	.6128	+641.4047	-463.2649 (292.0657)	+0.2839 (0.6560)	-17.9516 (28.6892)	-4.5679 (8.6631)	+17.7922 (24.4106)	-0.0139 (0.0231)	-0.0036 (0.0050)	+0.4758 (0.2365) **	2.3742
Periphery	.2168	+254.0407	-43.8320 (23.3786) **	+0.0478 (0.0639)	-0.9978 (1.4052)	-1.2109 (1.0971)	+0.1108 (1.6546)	-0.0031 (0.0017) *	+0.0004 (0.0008)	+0.0047 (0.0146)	1.0379

Type of Analysis	1	2	3	4	5	6	7	8	9	10	11
	R^2	a (Intercept)	Values of the Coefficients for the Variables								F statistic
			D	I	S	N	C	K	B	F	
New Plant Destinations											
Conurbation	.6958	+29.5460	-6.7312 (1.4250) **	+0.0222 (0.0052) **	+0.1994 (0.1240) *	-0.0988 (0.0781)	-0.2013 (0.1448)	-0.0005 (0.0001) **	-0.0000 (0.0000)	-0.0007 (0.0014)	14.5813 **
City	.8762	+26.4690	-2.5597 (5.5966)	+0.0269 (0.0126) **	+0.9936 (0.5497) *	-0.0382 (0.1660)	-0.4304 (0.4678)	-0.0008 (0.0004) *	-0.0000 (0.0001)	-0.0016 (0.0045)	10.6157 **
Periphery	.3660	+11.4311	-0.6806 (0.8032)	+0.0017 (0.0022)	-0.0624 (0.0483)	-0.0951 (0.0377) **	+0.0355 (0.0568)	-0.0000 (0.0000)	-0.0000 (0.0000)	+0.0005 (0.0005)	2.1651
New Employment Destinations											
Conurbation	.4873	+1034.8331	-196.1001 (74.3835) **	+1.0126 (0.2729) **	+8.3803 (6.4742)	-4.3982 (4.0779)	-6.4127 (7.5597)	-0.0182 (0.0080) **	-0.0030 (0.0027)	+0.0252 (0.0766)	6.0591 **
City	.7938	+ 870.4201	-323.8266 (238.3000)	+1.1701 (0.5353) **	+17.4179 (23.4079)	+0.0599 (7.0683)	-4.2531 (19.9169)	-0.0324 (0.0188) *	-0.0069 (0.0041)	+0.1829 (0.1930)	5.7762 **
Periphery	.2454	+1402.0342	-106.7815 (139.1630)	+0.6664 (0.3802) *	-3.3172 (8.3646)	-11.0924 (6.5306) *	-12.1827 (9.8494)	-0.0108 (0.0102)	+0.0046 (0.0048)	+0.0562 (0.0870)	1.2199

Type of Analysis	1	2	3	4	5	6	7	8	9	10	11
	R^2	a (Intercept)	Values of the Coefficients for the Variables								F statistic
			D	I	S	N	C	K	B	F	
In-situ Employment Change											
Conurbation	.2450	+916.6398	-306.5566 (101.4295) **	-0.1714 (0.3722)	+2.3832 (8.8283)	+0.1185 (5.5607)	-24.3841 (10.3084) **	-0.0221 (0.0110) **	+0.0025 (0.0037)	+0.0750 (0.1044)	2.0680
City	.4198	+1075.6240	-797.8907 (365.9125) **	-0.1622 (0.8219)	-4.9348 (35.9431)	+5.6796 (10.8535)	-32.1581 (30.5827)	-0.0368 (0.0289)	-0.0006 (0.0063)	+0.3149 (0.2963)	1.0857
Periphery	.4604	+884.4465	+175.6118 (158.5735)	-0.8901 (0.4332) **	-20.7888 (9.5314) **	-12.0072 (7.4415) *	-28.2236 (11.2232) **	-0.0011 (0.0116)	+0.0019 (0.0054)	+0.1360 (0.0991)	3.1995 **

** Significant at 1%
* Significant at 5%