LABOUR FORCE PARTICIPATION RATES IN THE LONDON METROPOLITAN REGION

J.S. WEE

NUMBER 2

May, 1968

This paper is circulated for discussion purposes and its contents should be considered preliminary.

The object of this paper is to determine the factors which explain the variation in participation rates between the different boroughs in the London Metropolitan Region. Previous work on participation rates has usually taken two forms. Some studies have been at highly aggregated levels, for example, seeing how the male and female participation rates have varied over time for a whole economy.[1] These studies often consider rates for different age groups and it has been possible to disaggregate and consider variations in participation rates between regions.[2] The alternative approach has involved study at the 'micro' level of the individual. Samples, usually of females, are studied to isolate the factors that explain whether or not the person is employed.[3]

This work takes an intermediate approach as comparatively small units of observation, in this case local authority areas, are taken within a large region. Over this cross section of areas male and female participation rates are observed, the data being obtained from the 1951 and 1961 Censuses of Population. An attempt is made using least squares multiple regression analysis to identify the variables which account for variations in the participation rates. The impact of these explanatory variables is measured for 1951 and 1961 and this provides an assessment of which variables are becoming more (and less) important.

---

1. C.D. Long, 'The Labour Force under Changing Income and Employment', Princeton 1958, and C.E.V. Leser, 'The Supply of Women for Gainful Work in Britain', Population Studies, November 1955.

2. P. Galambos, 'Activity Rates of the Population of Great Britain 1951-1964', Scottish Journal of Political Economy, Vol XIV, No. 1, February 1967, pp. 48-69, and G.G. Cain, 'Married Women in the Labour Force', Chicago 1966. This latter reference contains an excellent review of the literature in this field.

3. R.N. Rosett, 'Working Wives: an Econometric Study', in 'Studies in Household Economic Behaviour' by T.F. Dernberg, R.N. Rosett and H.W. Watts, New Haven, Conn. 1958, and J. Mincer, 'Labor Force Participation of Married Women' in 'Aspects of Labor Economics, A Conference of the Universities', National Bureau of Economic Research, Princeton 1962.

1. The Variables Used in the Analysis.

Data was collected from 122 boroughs surrounding central London. These boroughs, which are listed in the appendix, correspond exactly to ones used in a study of the journey to work in central London.[4] The five central boroughs of City, Finsbury, Holborn, St. Marylebone and Westminster have been omitted from the analysis because of their uniqueness in having exceptionally high concentrations of employment.

Male and female participation rates are considered separately and two definitions are considered for each sex. The four dependent variables were defined as follows :-

W_{M1} The number of economically active males resident in the borough per 1,000 of the male population aged 15 and over. The number economically active includes workers who were sick or unemployed at the time of the census. In 1951 the values of W_{M1} ranged from 940 in Dagenham to 752 in Epsom and Ewell with an average value over the 122 boroughs of 881.63. However, the most striking feature of this dependent variable was the small amount of variation it exhibited, 92 of the boroughs falling in the range 850 to 909. The standard deviation in 1951 was 31.70 giving a coefficient of variation of only 3.59%. The frequency distributions of the four dependent variables for 1951 and 1961 are given in table 1 below.

The definition of the participation rate in terms of the number economically active per 1,000 of the male population aged 15 and over is the one usually adopted, for example by the Ministry of Labour. However, this participation rate is influenced by the proportion of pensioners in the borough as well as by the proportion of persons of working age who offer themselves for employment. If one wishes to consider only the latter factor then a different deflator of the number economically active is required.

---

4. J.S. Wabe, 'Factors Influencing the Journey to Work in Central London' to be published in a forthcoming issue of the Journal of Transport Economics and Policy.

Table 1 Frequency Distributions of Dependent Variables

Value	Variable W_{M1} Frequency 1951	1961	Value	Variable W_{M2} Frequency 1951	1961
750 - 789	1	1	850 - 879	1	-
790 - 819	7	2	880 - 909	1	2
820 - 849	7	15	910 - 939	4	7
850 - 879	30	35	940 - 969	5	14
880 - 909	62	46	970 - 999	46	44
910 - 939	14	22	1000 - 1029	58	40
940 and over	1	1	1030 - 1059	7	14
			1060 and over	-	1
Total	122	122	Total	122	122
Average	881.63	881.52		996.68	993.31
Standard Deviation	31.70	30.71		26.91	29.73
Coefficient of Variation	3.59%	3.48%		2.70%	2.99%

Value	Variable W_{F1} Frequency 1951	1961	Value	Variable W_{F2} Frequency 1951	1961
240 - 279	3	1	320 - 359	2	1
280 - 319	13	3	360 - 399	14	2
320 - 359	41	17	400 - 439	25	8
360 - 399	24	27	440 - 479	26	11
400 - 439	18	30	480 - 519	19	19
440 - 479	12	20	520 - 559	12	21
480 - 519	7	14	560 - 599	11	23
520 - 559	4	6	600 - 639	4	11
560 and over	-	2	640 - 679	8	14
			680 - 719	1	10
			720 and over	-	2
Total	122	122	Total	122	122
Average	379.71	422.49		484.73	558.50
Standard Deviation	63.51	63.02		81.59	90.26
Coefficient of Variation	16.73%	14.92%		16.83%	16.16%

W_{M2} The number of economically active males resident in the borough per 1,000 of the male population aged 15 to 64. This alternative definition expresses the participation rate in terms of the population of usual working age. The most surprising result is that W_{M2} frequently exceeds the value of 1,000 indicating that the number of males who carry on working after the retirement age of 65 more than offsets the number who stay in full time education after the age of 15 plus the number who retire from employment before 65. In 1951 a total 65 boroughs had a W_{M2} value in excess of 1,000, the highest value being 1038 in Bethnal Green. The corresponding figure in 1961 had dropped to 55 but Bethnal Green still had the highest value with W_{M2} equal to 1,067.

W_{F1} The number of economically active females resident in the borough per 1,000 of the female population aged 15 and over.[5] In 1951 the values of this dependent variable ranged from 532 in both St. Pancras and Shoreditch to 268 in Coulsdon and Purley. In 1961 the highest value was 565 in Kensington and the lowest was 267 in Chorley Wood. The most important point about the frequency distribution of W_{F1} is that it exhibits much more variability than the corresponding male participation rate. In 1951 the average value was 379.71 with a standard deviation of 63.51 giving a coefficient of variation equal to 16.73%. The biggest difference in 1961 was the large increase in the average value to 422.49, an increase of almost 43 per 1,000. The standard deviation in 1961 was 63.02 giving, in comparison to 1951, a slightly lower coefficient of variation of 14.92%.

The increase in the working population for the whole of the London Metropolitan region between 1951 and 1961 was 290,700 males, an increase of 7.7%, and 267,200 females, an increase of 13.8%. During the decade the population increased by 6.9%.[6] Thus, the increase for males is slightly greater than the population increase indicating that

---

5. The number economically active includes part-time employment. Unfortunately the only information on part-time employment is for the number of married women working part-time and this information is only given for boroughs with a population in excess of 50,000. Only about two-thirds of the 122 boroughs used in this study come in this category.

6. J.S. Wabe, 'An Econometric Analysis of the Factors Affecting the Journey to Work in the London Metropolitan Region and their Significance', Oxford D.Phil thesis, 1966. Information is taken from tables 3 and 6.

there has been no significant change in the male participation rate over the decade. The average male participation rate over the 122 boroughs, admittedly an unweighted one, has in fact declined marginally over this period. The increase in female workers is exactly double the population increase. Thus, as a rough approximation, half the increase in the number of economically active females can be considered to be due to the increase in population and the other half to be a result of the increase in the participation rate. An increase in employment of some 133,000 in a decade in a region with a population of 12 million shows that extra man-power, or more correctly woman-power, can be found from an increase in the participation rates.[7] However, there is some evidence that most of the change has been a result of an increase in part-time employment.[8]

W_{F2} The number of economically active females resident in the borough per 1,000 of the female population aged 15 to 59. Again the alternative definition uses as a deflator the female population of usual working age.

The following variables were all considered as possible explanatory or independent variables :-[9]

T The average journey time in minutes for all trains, both British Railways and the tube, from the borough to the terminal station or stations in central London. If a borough is served by the tube then the journey time to the tube station nearest one of the main line termini was taken. The average journey time being calculated for all trains leaving the borough between 7.00 and 9.30 a.m. The purpose of this variable is to get an idea of the nearness, in a time sense, of each borough to the central area. It is thought that journey time to the centre will be negatively correlated with the participation rate for two reasons. The first is connected with property prices in the area and the second with the pattern of wages.

The employment pattern in the whole of the Metropolitan region is dominated by the fact that approximately 20% of all the 6 million jobs are located in the geographically small area of central

---

7. This is important from the point of view of the manpower gap envisaged in the national Plan. See 'The National Plan', Cmnd 2764 H.M.S.O., September 1965, Chapter 3.

8. See below section 4 page 24

9. Many of the independent variables are the same as ones used in a previous paper. See J.S. Wabe, 'Factors Influencing the Journey to Work in Central London'.

London. Workers living in boroughs with short journey times to the centre and hence having high rents would, on retirement, be likely to move to cheaper property areas at a distance from the centre. Thus boroughs at a distance from the centre will have a smaller proportion of both males and females working than boroughs close to the centre. Young couples with no children are likely, especially if the wife is working, to be able to afford to live close to the centre. Once children arrive the family will need more space and it is more difficult for the wife to work so the family income will be reduced. Both of these factors will tend to ensure that families with children will move away from the centre to cheaper property areas and will reinforce the tendancy for the proportion of economically active females to decrease as the journey time to the centre increases.

The high concentration of employment in central London will mean that, for any given skill, wages will tend to be the highest in the centre. Thus, because time is valuable, the shorter the journey time to the centre the greater is the opportunity cost of not being employed and the greater is the cost of retiring. The former is more likely to be appropriate for females and the latter in the case of males. This second factor will also give a negative correlation between journey time and the participation rate.

P The average price in pence for a single journey by train or tube from the borough to central London. Again the centre is taken as the main line termini or the corresponding tube station. It is expected that there will be a negative correlation between the price variable and the participation rate. Given that wages are highest in the centre then, the lower the price of travelling to the centre the greater is the money loss if a person retires and the greater is the opportunity cost of not working.

J_{M1} The number of employment opportunities in the borough which are filled by males per 1,000 of the male population aged 15 and over. This definition is used in conjunction with dependent variable W_{M1}.

J_{M2} The number of employment opportunities in the borough which are filled by males per 1,000 of the male population aged 15 to 64. This definition being used when W_{M2} is the dependent variable.

It is not possible to get information on a borough basis for such things as unemployment and unfilled vacancies, both of which would affect the level of wages locally and hence could be expected to exert

some influence on the participation rate. In this work it is hoped that J_{M1} will reflect the impact of unemployment and unfilled vacancies for male workers. It is assumed that a high concentration of male employment opportunities will be associated with a low level of unemployment within the borough and a high proportion of unfilled vacancies. Wages for a given skill will tend to be high and the male participation rate in the borough will increase.[10] The opposite effects will be true in a borough with a low proportion of male employment opportunities.

The employment variable is also likely to influence the participation rate by acting through the property market. High concentrations of employment will probably mean a greater demand for property locally. This will affect the price of property and will, presumably, decrease the number of retired males living in the borough.

J_{F1} The number of employment opportunities in the borough which are filled by females per 1,000 of the female population aged 15 and over. This definition being used with dependent variable W_{F1}.

J_{F2} The number of employment opportunities in the borough which are filled by females per 1,000 of the female population aged 15 to 59. This definition being used when W_{F2} is the dependent variable.

It is assumed that these variables will work in a similar way to J_{M1} and J_{M2}. It is considered that the female participation rate will be influenced by local variations in both the level of wages and level of rents and property prices. There seems to be one further reason for a positive correlation between the jobs variable and the female participation rate. An important factor in determining whether a woman takes up employment may be the availability of a suitable job. The only suitable job for a housewife with children at school may be one that involves working locally, say within 10 minutes walk of where she lives. The greater the concentration of female employment within the borough the greater is the likelihood of a convenient job existing for a housewife and the more likely it is that she will join the labour force.

There is a basic difficulty with the jobs variable in that the employment situation in one borough has repercussions on all the surrounding boroughs. A borough with a low level of unemployment and a high level of unfilled vacancies will almost certainly raise the

---

10. It is recofnised that some jobs filled by males can obviously be performed by females and that many of the jobs in a borough are filled by workers from other boroughs.

participation rate in adjacent boroughs. However, the difficulties in allowing for the employment situation in adjacent boroughs in any satisfactory way are immense and, in spite of the possible importance of this factor, no account was taken of it.[11] It is hoped that the spillover effects of a high concentration of employment into adjacent boroughs will, in some sense, be offset by low levels of employment in other nearby boroughs. As will be seen in section 3 below there is some evidence that this is not in fact the case.[12]

S This variable is a measure of the social character of a borough and the definition varies between 1951 and 1961. In the 1951 Census all occupied and retired males over 15 were allocated to one of five social classes and variable S was defined as the number in social classes I and II per 1,000 occupied and retired males aged 15 and over. In 1961 variable S was defined as the number in socio-economic groups 1,2,3,4 and 13 per 1,000 occupied and retired males aged 15 and over. The definition adopted in 1961 is the one that provides the greatest amount of overlap with the 1951 definition.

A negative correlation is expected between the social class variable and the participation rate. Two factors would seem to be operating to give this result. Firstly, young people over the age of 15 are more likely to stay on at school if their parents are in social classes I and II. Moser and Scott found, using the 1951 census, that there was a correlation of 0.946 between the percentage in social classes I and II and the percentage aged 15 to 24 in full time education.[13] The second factor would seem to be related to the economic necessity of working which for males tends to be reflected in the age of retirement. Male workers in the top two social classes may retire at an earlier age than workers in other social classes. In fact, it may be that some workers in social classes IV and V have to carry on working after the pension age of 65 out of sheer economic necessity. The boroughs which have a value of W_{M2} in excess of 1,000 are predominantly ones with a high proportion in social classes IV and V. As far as the female participation rate is concerned then, among social classes I and II, it is probably less important for the wife to work in order to supplement the family income. On the other hand workers in social classes IV and V will

---

11. Some of these difficulties are discussed in J.S. Wabe 'Factors influencing the Journey to Work in Central London'.

12. See below section 3 page 21.

13. Moser C.A., and Scott W., "British Towns", Table 26 Oliver and Boyd, London, 1961.

be less well paid and many of these families may find it an economic necessity for the wife to go out to work.

H_M The number of male patients in psychiatric hospitals plus prisoners in jail per 1,000 of the male population aged 15 and over. For these males the definition of economically inactive is[14]

> 'inmates of institutions returning a former occupation but not stated to be retired, who are known or assumed to be withdrawn from employment for a period of six months or more.'

The number of such institutions is not large but, for the boroughs in which they are located, the number of inmates tends to form an important part of the total population of the borough. This is especially true for the outer boroughs which contain the large psychiatric hospitals and is most noticeable in the case of Epsom and Ewell. In 1951 the male population of this borough included 3,213 patients in psychiatric hospitals. The total male population aged 15 and over was 24,846 giving an H_M value of 129. A high proportion of these patients would, presumably, be classified as economically inactive. This fact must go a long way towards explaining Epsom and Ewells exceptionally low participation rates of 752 per 1,000 males aged 15 and over and 864 per 1,000 aged 15 to 64. Approximately 75% of the boroughs have H_M equal to zero. For the remaining 25% it is expected that there will be a negative correlation between H_M and the male participation rate.[15]

H_F This variable is the female equivalent of H_M and is defined as the number of female patients in psychiatric hospitals plus prisoners in jail per 1,000 of the female population aged 15 and over.

C The number of children aged 0 to 4 per 1,000 resident population. It is thought that this variable will be negatively correlated with the female participation rate, the higher the proportion of children in the population the lower will be the proportion of females working, keeping all other factors constant. This age group has been selected because it is likely to be the pre-school age children who are the biggest handicap in preventing a married woman from taking employment.

---

14. Definition taken from 'Census 1961, Occupation, Industry, Socio-Economic Groups - County Reports', H.M.S.O., 1965.

15. In the 1961 Census it is possible to obtain the number of economically inactive institution inmates but only for boroughs with a total population in excess of 50,000. Many of the psychiatric hospitals are located in boroughs with populations less than this. No comparable information is available for the 1951 Census.

2. Results for the Male Participation Rate

The results obtained from the least squares multiple regression analysis using the two definitions of the male participation rate as the dependent variable are given in table 2. Equation 1 shows that the social class composition of the borough and the proportion of male 'inmates' in psychiatric hospitals and prisons were the two critical variables influencing the level of W_{M1} in 1951. Both these variables have the expected negative sign and between them accounted for some 72% of the total variation in the male participation rate. The coefficient of S indicates that a borough having 6 per 1,000 more in social classes I and II had, approximately, a one per 1,000 lower participation rate keeping H_M constant. The coefficient of H_M shows that a difference of 10 per 1,000 in this variable was associated with, approximately, a difference of 9 per 1,000 in the participation rate keeping S constant. Equation 2 adds the three other explanatory variables which it was thought would have been important. The addition of these three variables does not substantially change the coefficients of S and H_M found in equation 1 and makes only a marginal addition to the multiple correlation coefficient. Two of the new coefficients, those for variables time and jobs, have the opposite sign to the one expected. However, neither of these coefficients is different from zero at the 5% significance level. On the other hand the price coefficient has the correct sign and is significant at the usual 5% probability level.

The 1961 results for the variable W_{M1} follow the pattern exhibited in 1951. The two crucial variables are again S and H_M, the coefficient of the latter variable being almost identical to that found in 1951. The coefficient of S has declined to three-quarters of its 1951 value. The social class composition of the borough is defined differently in 1961, in fact for any borough the value of S in 1961 is approximately four-fifths of the 1951 value. Thus the same relationship between W_{M1} and S in 1961 would have involved a larger regression coefficient for S in comparison to its 1951 value. It appears as if given differences in the social class composition of boroughs now lead to smaller differences in the activity rate. The addition of the three extra variables in 1961 again makes very little difference to the overall fit of the regression equation. There still appears to be some evidence of a positive partial correlation between the activity rate and the journey time. However, none of the three new coefficients are different from zero at the 5% significance level.

TABLE 2 MALE PARTICIPATION RATES

Variable	1951 DATA (a)	1951 DATA Equation 1 (b)	1951 DATA Equation 2 (b)	1961 DATA (a)	1961 DATA Equation 3 (b)	1961 DATA Equation 4 (b)
$\bar{W}_{M1}$	881.63 31.70			881.52 (30.71)		
T	26.93 (12.88)		0.5289 (0.3629)	26.47 (12.96)		0.5550 (0.4561)
P	10.64 (4.44)		-2.2219 (1.0700)	20.36 (8.61)		-0.2819 (0.6917)
J_{M1}	717.98 (310.81)		-0.0003 (0.0055)	729.16 (362.41)		0.0015 (0.0066)
S	226.66 (92.67)	-0.1780 (0.0167)	-0.1657 (0.0198)	184.32 (88.46)	-0.1329 (0.0231)	-0.1455 (0.0281)
H_M	7.43 (21.41)	-0.8737 (0.0721)	-0.8551 (0.0718)	6.47 (18.35)	-0.8709 (0.1121)	-0.9009 (0.1132)
Constant Term		928.4736 (4.0371)	935.0601 (7.9708)		911.8478 (4.7026)	904.3389 (9.2892)
R^2		0.7232	0.7382		0.4747	0.4988

The column headed (a) gives the average value of the variable and the standard deviation in brackets.

The column headed (b) gives the regression coefficient and the standard error in brackets.

R^2 gives the square of the multiple correlation coefficient.

This presentation will be adopted in Table 3.

TABLE 2 CONTINUED

Variable	1951 DATA (a)	1951 DATA Equation 5 (b)	1951 DATA Equation 6 (b)	1961 DATA (a)	1961 DATA Equation 7 (b)	1961 DATA Equation 8 (b)
W_{M2}	996.68 (26.91)			993.31 (29.73)		
T	26.93 (12.88)		-0.0743 (0.2366)	26.47 (12.96)		0.2287 (0.5106)
P	10.64 (4.44)		-0.0656 (0.6975)	20.36 (8.61)		-0.1180 (0.7743)
J_{M2}	809.04 (341.62)		0.0077 (0.0032)	820.73 (403.49)		-0.0005 (0.0064)
S	226.66 (92.67)	-0.1081 (0.0109)	-0.0903 (0.0128)	184.32 (88.46)	-0.0866 (0.0253)	-0.0942 (0.0313)
H_M	7.43 (21.41)	-0.9730 (0.0472)	-0.9576 (0.0467)	6.47 (18.35)	-0.9987 (0.1229)	-1.0136 (0.1268)
Constant Term		1028.4130 (2.6422)	1020.7190 (5.1637)		1015.7302 (5.1584)	1013.9978 (10.3999)
R^2		0.8358	0.8460		0.4218	0.4254

The results obtained using W_{M2} as the definition of the male participation rate substantiate those found for W_{M1}. Only two variables appear to be important in explaining variations in the male participation rate between boroughs. Again there is evidence of a remarkable constancy in the coefficient of H_M over the decade. The coefficients for S confirm that the social class composition of the borough is becoming numerically less important through time. The only other interesting feature is that the jobs coefficient for 1951 (equation 6) is different from zero at the 5% significance level. The coefficient is numerically of little significance, a borough having 130 per 1,000 more jobs than another borough having a one per 1,000 higher participation rate, keeping other factors constant.

3. Results for the Female Participation Rate

The results obtained from the least squares multiple regression analysis using the two definitions of the female participation rate as the dependent variable are given in table 3. Equation 9 shows that all 6 explanatory variables are important. All the regression coefficients have the expected sign, they are all different from zero at the 5% significance level and together they account for some 86% of the total variation in W_{F1}. Equation 10 adds the square root of the proportion of jobs as a further explanatory variable. It was thought that jobs could have a non-linear impact on W_{F1} but, judging by the results in equation 10, there is no appreciable evidence of this.[16]

The 1961 results for variable W_{F1} follow, with one important exception, the pattern exhibited in 1951. Considering equation 11 then the big difference is that the coefficient of C, the proportion of children aged 0-4, has been considerably reduced in size and is no longer a significant explanatory variable. All the other variables in equation 11 are different from zero at the 5% significance level. Comparing equations 11 and 9, excluding C, then the price coefficient shows the biggest change, having approximately halved in value. Bearing in mind the fact that prices have generally doubled in the decade then this change in fact implies a roughly constant relationship between W_{F1} and the price of the journey to the centre. In equation 12 the square root of the proportion of jobs is added as an explanatory variable.

---

16. This factor is examined more carefully for W_{F2}.

TABLE 3 FEMALE PARTICIPATION RATES

Variable	1951 DATA (a)	1951 DATA Equation 9 (b)	1951 DATA Equation 10 (b)	1961 DATA (a)	1961 DATA Equation 11 (b)	1961 DATA Equation 12 (b)
W_{F1}	379.71 (63.51)			422.49 (63.02)		
T	26.93 (12.88)	-1.3759 (0.5291)	-1.2943 (0.5201)	26.47 (12.96)	-1.2133 (0.5538)	-1.0395 (0.5522)
P	10.64 (4.44)	-4.5602 (1.5597)	-5.1481 (1.5501)	20.36 (8.61)	-2.5177 (0.8761)	-3.0065 (0.8949)
J_{F1}	311.50 (129.51)	0.1546 (0.0187)	-0.1246 (0.1200)	349.66 (144.20)	0.1263 (0.0203)	-0.2156 (0.1171)
$J_{F1}^{\frac{1}{2}}$			11.0438 (4.6935)			13.8763 (6.4595)
S	226.66 (92.67)	-0.2169 (0.0319)	-0.2018 (0.0320)	184.32 (88.46)	-0.1863 (0.0350)	-0.1678 (0.0357)
H_F	7.71 (23.24)	-0.4694 (0.0988)	-0.4227 (0.0989)	6.19 (19.03)	-0.6235 (0.1354)	-0.5487 (0.1382)
C	83.13 (9.51)	-1.3654 (0.2865)	-1.2150 (0.2882)	73.61 (11.69)	-0.2114 (0.2531)	-0.1388 (0.2520)
Constant Term		565.4301 (29.2911)	466.7690 (57.3025)		515.5785 (20.3556)	379.3907 (68.3465)
R^2		0.8634	0.8697		0.8274	0.8391

TABLE 3 CONTINUED

Variable	1951 DATA (a)	Equation 13 (b)	Equation 14 (b)	1961 DATA (a)	Equation 15 (b)	Equation 16 (b)
W_{F2}	484.74 (81.59)			558.50 (90.26)		
T	26.93 (12.88)	-2.1369 (0.7107)	-2.0335 (0.7065)	26.47 (12.96)	-2.3909 (0.8394)	-2.1827 (0.8071)
P	10.64 (4.44)	-4.7342 (2.0922)	-5.2959 (2.0970)	20.36 (8.61)	-2.3202 (1.2743)	-3.0534 (1.3068)
J_{F2}	395.43 (165.31)	0.1663 (0.0192)	-0.0446 (0.1203)	461.67 (179.53)	0.1407 (0.0219)	-0.2025 (0.1068)
$J_{F2}^{\frac{1}{2}}$			9.3243 (5.2538)			16.1529 (7.8815)
S	226.66 (92.67)	-0.2301 (0.0424)	-0.2178 (0.0426)	184.32 (88.46)	-0.2180 (0.0506)	-0.1919 (0.0515)
H_F	7.71 (23.24)	-0.5917 (0.1322)	-0.5575 (0.1324)	6.19 (19.03)	-0.7649 (0.1967)	-0.6690 (0.1996)
C	83.13 (9.51)	-2.3100 (0.3846)	-2.1584 (0.3905)	73.61 (11.69)	-1.2174 (0.3683)	-1.0948 (0.3682)
Constant Term		752.6541 (39.2377)	664.6723 (73.6324)		724.4264 (30.1703)	550.4755 (87.3431)
R^2		0.8511	0.8551		0.8222	0.8341

In 1961 there is more evidence of a non-linear relationship between the proportion of jobs and the activity rate. The exact nature of this non-linearity will be considered when discussing the results for W_{F2}.

The results obtained using W_{F2} as the definition of the female participation rate are given in equations 13 to 16 and these will now be considered in some detail.[17] In equation 13 all six explanatory variables have regression coefficients with the expected sign, the coefficients are all different from zero at the 5% significance level and the multiple correlation coefficient is again high. The jobs variable is the only positive coefficient but it was thought that the female participation rate in any borough cannot rise continually as the proportion of jobs increases. There must be a maximum or saturation level to the proportion of women in employment and, for various reasons, this level must be less than 1,000. To see if this proposition is true the square root of the proportion of jobs is added as an explanatory variable in equation 14. The coefficients of the other five variables are substantially unchanged from those found in equation 13. However, judging by the standard errors of J_{F2} and $J_{F2}^{\frac{1}{2}}$ there is very little evidence of a non-linear impact on W_{F2}. The effect of the proportion of jobs on the female participation rate as measured in equations 13 and 14 can be seen in figure 1. The line numbered (13) plots the equation $W_{F2} = 753 + 0.17J_{F2}$ while the line numbered (14) plots the equation $W_{F2} = 665 - 0.04J_{F2} + 9.32J_{F2}^{\frac{1}{2}}$. It can be seen that over the relevant range of values of J_{F2} there is little difference between the linear and non-linear relationship. However, line (14) does show that for a low proportion of jobs a given absolute increase in the proportion of jobs tends to be associated with a bigger increase in the female participation rate than will result from the same absolute increase when the proportion of jobs is higher.

Equations 15 and 16 show that the 1961 results follow, exactly, the pattern found in 1951. In equation 16 the standard errors of J_{F2} and $J_{F2}^{\frac{1}{2}}$ show that there is slightly more evidence of a non-linear relationship between the proportion of jobs and the participation rate in 1961. The relation between these two variables as measured in

---

17. A similar amount of detail could be devoted to W_{F1} but it is considered that W_{F2} is preferable as the definition of the participation rate.

equations 15 and 16 is also shown in figure 1. The line numbered (15) plots the equation $W_{F2} = 724 + 0.14J_{F2}$ while the line numbered (16) plots the equation $W_{F2} = 550 - 0.20J_{F2} + 16.15J_{F2}^{\frac{1}{2}}$. In 1961 there is a greater divergence between the linear and non-linear relationships and there is definately more evidence of a saturation level in the female participation rate. When J_{F2} equals 1,000 the slope of (16) is almost zero, that is to say an increment in the proportion of jobs will have an almost negligible impact on the participation rate.

The evidence examined for 1951 and 1961 does seem to indicate that a maximum level to the female participation rate does exist. The evidence is more more substantive because of the parsity of high value observations of J_{F2}. The frequency distributions of J_{F2} in 1951 and 1961 are given in table 4 below. The flattening of W_{F2} seems to occur for values of J_{F2} in excess of 576 and, in 1951, only 12 of the 122 boroughs came in this category. In 1961 this number had increased to 18, and so the evidence for the flattening of the participation rate is based on a small proportion of the boroughs. The interesting corollary is that as most boroughs have 'low' values of J_{F2} there is still a considerable amount of scope to increase the labour force by increasing employment in the boroughs with a low proportion of female employment.

Table 4 Frequency Distribution of J_{F2}

Value of J_{F2}	Frequency	
	1951	1961
144-255	20	6
256-399	55	43
400-575	35	55
576-783	7	10
784-1023	4	6
1024 and over	1	2
	122	122

The regression coefficients obtained in equations 14 and 16 can be compared to see if any major changes have taken place over the decade. Bearing in mind that, in 1961, the price of the journey to the centre has doubled and that the social class variable is approximately four-fifths of its 1951 value, then the two coefficients showing the most marked change are those for C and S. The coefficient for the proportion of children aged 0-4 is almost exactly half its 1951 value. The fact that the

participation rate is less responsive to the proportion of young children seems to indicate that married women are less reluctant to let very young children deter them from taking employment. The effective decline in the social class coefficient is probably related to changes in the social background of children staying at school after the age of 15.

Consideration of the partial correlation coefficient between each independent variable and W_{F2} provides a useful assessment of the relative importance of the explanatory variables. The square of the partial correlation coefficient indicates the proportion of the variation in the dependent variable that can be accounted for by changes in one of the independent variables when the effects of all the other independent variables have been eliminated. The square of these partial correlation coefficients for equations 14 and 16 are given in Table 5.

Table 5 Square of the Partial Correlation Coefficient Between Female Participation Rate and Each Independent Variable.

Independent Variable	1951 Equation 14	1961 Equation 16
T	0.063	0.060
P	0.050	0.046
J_{F2}	0.387	0.289
S	0.183	0.108
H_F	0.112	0.080
C	0.207	0.072

In 1951 the most important explanatory variable was the proportion of jobs available for women in the Borough. After allowing for the other explanatory variables the addition of the jobs variable reduced the residual variation by almost 30%. The next most important variable were social class and the proportion of children aged 0-4. Journey time and price were the least important explanatory variables. In 1961 the proportion of jobs available in the borough is still the most important factor in determining the female participation rate. The biggest change in the decade is the decline in the partial correlation coefficients for variables S and C. This is most marked for variable C, the proportion of young children only reducing the residual variation by 7% in 1961 compared with almost 21% in 1951.

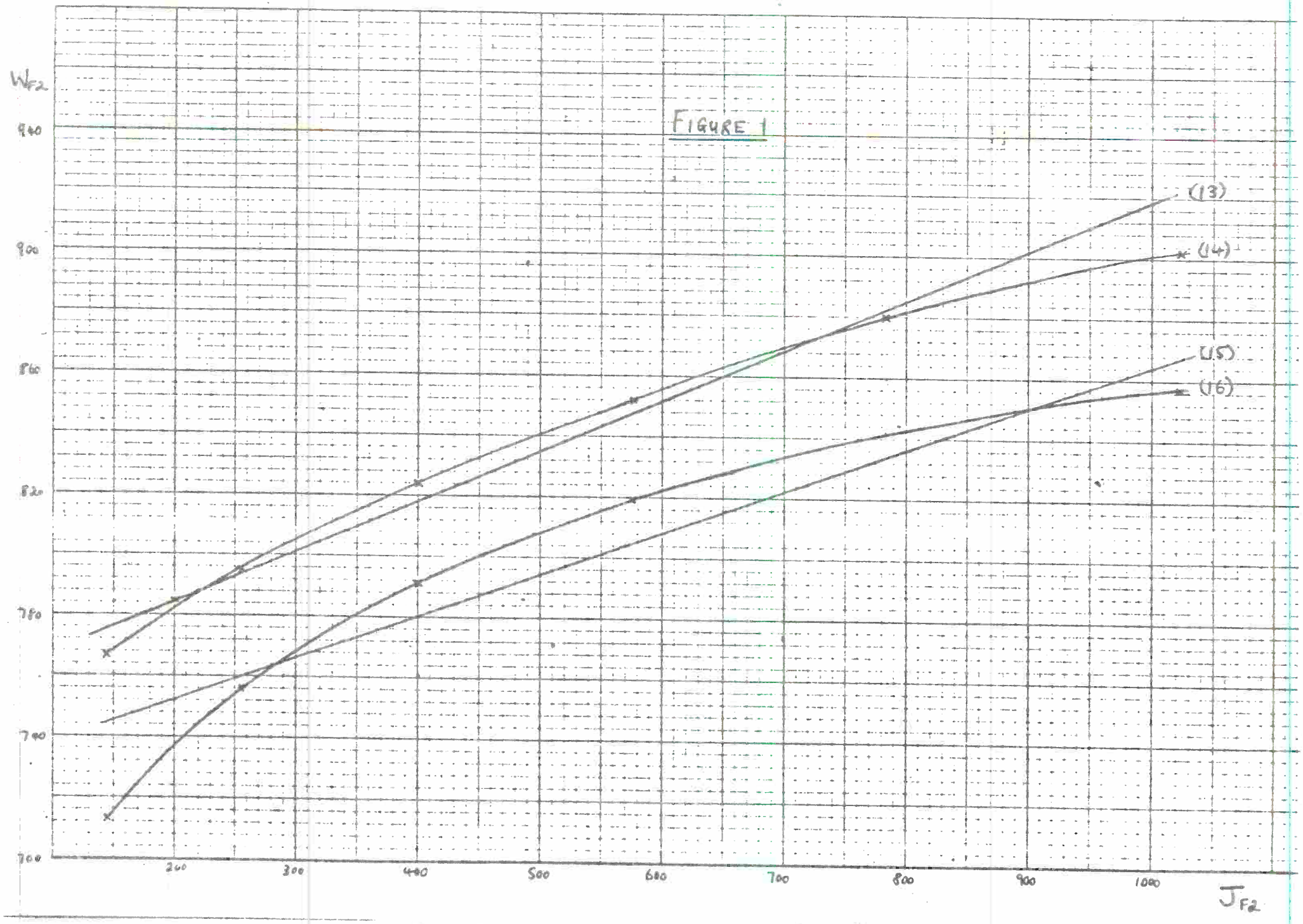
FIGURE 1
W_{F2}
940
900
860
820
780
740
700
200
300
400
500
600
700
800
900
1000
J_{F2}
(13)
(14)
(15)
(16)

One final aspect of equations 14 and 16 remains to be considered. Plotting the residuals from equation 14 on a map, the residual being the observed value minus the expected value, reveals that large geographical areas have boroughs with either all positive or all negative residuals. Repeating the exercise for equation 16 shows that in 1961 the same areas again have boroughs with predominantly positive or negative residuals. This fact is important and seems to indicate that within these areas there must be some unique feature which is resulting in a higher than expected, or less than expected, number of females in employment. The boroughs forming these areas are listed in table 6. The residual and the proportion of jobs for females are given for each of these boroughs in both 1951 and 1961. Four geographical areas have been identified and these contain 40 boroughs.

Table 6 Geographical Distribution of Residuals

Number on Map	Borough	1951 (c)	1951 (d)	1961 (e)	1961 (f)
	Outer Eastern Boroughs				
23	East Ham	-23.59	249	-4.39	302
44	Barking	-51.24	314	-90.34	407
45	Ilford	-60.58	300	-46.84	368
46	Wanstead and Woodford	-13.08	242	-20.81	298
65	Dagenham	-19.70	305	-9.75	440
66	Romford	-12.41	290	-50.92	410
84	Hornchurch	-16.68	198	-10.14	220
99	Thurrock	-24.93	324	-52.08	356
100	Brentwood	-16.57	422	-33.84	355
110	Basildon	-8.78	213	-25.87	336
	WEIGHTED AVERAGE	-29.96	281	-33.62	354
	South Eastern Boroughs				
41	Penge	-3.85	241	-0.59	292
42	Lewisham	-5.82	233	-4.35	316
43	Greenwich	-17.46	392	-28.36	437
62	Beckenham	-49.40	269	-36.57	288
63	Bromley	-24.97	356	-21.19	436
64	Woolwich	-52.51	436	-28.76	477
79	Orpington	-6.34	288	-41.27	389
80	Chislehurst and Sidcup	-14.46	282	7.95	344
81	Bexley	-30.32	153	17.00	221
82	Crayford	2.80	176	21.16	221
83	Erith	-36.24	265	-41.71	322
98	Dartford	-13.14	439	-26.44	480

Number on Map	Borough	1951 (c)	1951 (d)	1961 (e)	1961 (f)
	Inner Eastern Boroughs				
3	Bethnal Green	49.50	392	22.64	544
8	Hackney	-40.73	530	-36.82	549
16	Poplar	-4.13	530	-20.33	565
18	Shoreditch	0.60	1184	-23.27	1057
20	Stepney	-77.86	1021	-74.27	993
24	West Ham	-27.27	453	-33.44	523
25	Leyton	-35.44	363	-20.83	452
26	Walthamstow	-34.76	424	-9.88	437
27	Tottenham	-5.43	471	-17.39	584
	WEIGHTED AVERAGE	-26.23	548	-24.78	592
	Inner Western Boroughs				
1	Battersea	20.19	300	20.00	376
5	Chelsea	18.18	730	-19.55	759
7	Fulham	48.44	270	69.68	333
9	Hammersmith	11.85	614	26.11	761
10	Hampstead	81.88	396	69.48	357
13	Kensington	52.11	568	54.01	557
15	Paddington	71.20	395	30.69	471
36	Brentford and Chiswick	0.12	678	49.95	764
37	Barnes	29.23	220	57.53	259
	WEIGHTED AVERAGE	41.70	460	43.20	508

Columns (c) and (e) give the residual from equations 14 and 16.
Columns (d) and (f) give the value of J_{F2}.

The remaining 82 boroughs have residuals which form no definite pattern and can be considered as randomly distributed.[18]

In 1951 each of the ten boroughs forming the outer eastern group had a negative residual giving a weighted average residual of almost -30.

18. Consideration of the residuals for the male participation rate in a similar way did not show any clustering of boroughs with either all positive or all negative residuals.

The fact that each of these contiguous boroughs had a smaller than expected participation rate seems to be related to the general lack of employment in the area. Brentwood is the only borough which had a value for J_{F2} in excess of 395, this being the 1951 unweighted average value of J_{F2} over the 122 boroughs in the cross section. Thus, not only does each borough tend to have a low proportion of jobs but it is also adjacent to other boroughs with low proportions of jobs. It was recognised earlier that the availability of employment in adjacent boroughs would influence the participation rate within a given borough.[19] However, the general averaging out of high and low employment boroughs that was hoped for is not found in the outer eastern boroughs. The general shortage of female employment remains unchanged in 1961 and each borough again has a negative residual.

The south eastern boroughs form a similar group to the one just considered. This is another area with a deficiency of female employment and this seems to be responsible for the lower than expected participation rate.

The two remaining groups of boroughs are not as easy to deal with. The inner eastern group of boroughs form an area with a very much above average level of female employment and show a less than expected number of females in employment. This result is contrary to the one found for the outer eastern and the south eastern boroughs. Comparing the inner eastern with the inner western boroughs seems to make the situation even more confusing. The inner western boroughs have a somewhat above average level of female employment, the 1961 weighted average value of J_{F2} being 460, and large positive residuals. The puzzling feature is that this is a low level of female employment when compared to the weighted average of 548 for the inner eastern boroughs.

The explanation of this rather conflicting situation would seem to lie in two partly related factors. The first of these concerns the distribution of female employment within the central London office area. The three boroughs of City, Finsbury and Holborn form the eastern half of the central area and, in 1951, they contained only 41.6% of all female employment in the centre. The largest part of

---

19. See discussion on page 8.

female employment in central London, that is the remaining 58.4% was located in the western half in the boroughs of Westminster and St. Marylebone. The inner eastern boroughs are immediately adjacent to the part of central London which is relatively short of female employment and access to Westminster and St. Marylebone means travelling through the central area. This relative shortage of jobs might have more than offset the above average proportion of jobs in the inner eastern boroughs and, as a result, the area had a lower than expected proportion of women in employment. On the other hand the inner western boroughs are immediately adjacent to the part of central London which had a relative abundance of female employment. This fact, together with the high proportion of jobs in these boroughs, ensured that a higher than expected proportion of women were working.

The second factor is that the inner western boroughs form the 'bed-sit' area. This part of London has attracted large numbers of single girls who wish to work in central London and this inflow into the area might explain the positive residuals for these boroughs. In sharp contrast the inner eastern boroughs have probably attracted few of these girls and, for an area so close to central London, this results in negative residuals. It is not hard to think of possible explanations for the unattractiveness of the inner eastern boroughs from the point of view of developing as a 'bed-sit' area. For example, these boroughs are highly industrialised and they have a high proportion of local authority housing. It is impossible to ascertain how far this factor is a direct result of the distribution of employment within the central area. Did the inner western boroughs develop as the 'bed-sit' area because they were so conveniently located for the largest part of the female central area employment in Westminster and St. Marylebone? This might be important but so must the fact that this area contained property suitable for subdivision into flats.

In 1961 the distribution of female employment in central London became more even. The three boroughs forming the eastern part had 46.0% of this employment while the remaining 54% was located in the two boroughs forming the western part. However this equalising of the employment within the centre had little or no impact on the weighted average residual in the inner eastern and the inner western groups of boroughs. This would seem to throw more emphasis for the explanation of the residuals on the fact that the western area has developed as a 'bed-sit' area whereas the eastern area has not. As a result all the inner eastern boroughs have a lower then expected female participation rate and the opposite is true in the inner western boroughs.

4. Conclusion

The least interesting results were those obtained for the male participation rate. Variation in this factor being the result of the social class composition of the borough and the proportion of males in psychiatric hospitals plus prisons. The coefficient of the latter variable seems to be approximately constant through time. On the other hand the coefficient of the social class variable has decreased and, if this is related to changes in the social background of children staying at school after the age of 15, there is every likelihood that it will decrease still further in the future.

The results obtained for the female participation rate seem more interesting and the most important aspect of these results is the fact that the proportion of jobs available locally is the critical variable in determining the female participation rate. This confirms the conclusion reached by J. Westergaard in his written evidence to the Royal Commission on Local Government in Greater London.[20]

> This cannot change the general conclusion that differences in local employment opportunities are of major importance in explaining the striking variations in the extent of employment among married women.

In the same evidence Westergaard was very much concerned about the lack of adequate employment in some of the newer suburbs and he considered that:[21]

> The price of suburbanisation must be counted not only in terms of the cost of long journeys to work, but also in terms of a restriction of employment opportunities for women and a waste of potential labour.

The regression equations in table 3 measure the relationship between the proportion of females in employment and the proportion of local job opportunities and thus quantify the problem raised above by Westergaard. The equations also show to what extent other factors influence the female participation rate.

The fact that the availability of local employment is the most important variable determining the female participation rate

---

20. Westergaard J., appendix to the written evidence submitted by the Centre of Urban Studies to the Royal Commission on Local Government in Greater London. See 'Written Evidence from Local Authorities, Miscellaneous Bodies and Private Individuals', Volume V, page 687, H.M.S.O., 1962.

21. ibid., page 686.

enables an optimistic view to be taken about the manpower deficiency envisaged in the National Plan.[22] A positive partial correlation exists between the female participation rate and the proportion of jobs for females. Line (16) on figure 1 shows that the participation rate does tend towards some maximum level in boroughs with high concentrations of female employment. However, the number of boroughs with these high job levels is negligible. In the majority of boroughs there is scope for higher participation rates by increasing the availability of suitable employment.

The analysis of the residuals carried out in the last section can also be related to the manpower problem. Two groups of boroughs, the outer eastern and the south eastern, have a negative value for the weighted average residual which appears to be caused by a deficiency of female employment in the areas. From a manpower point of view these two areas would seem to offer the greatest potential for increasing the labour force. All that should be needed is some policy to steer female employment into these areas.

Finally reference must be made to the fact that, in 1961, the proportion of young children had a very much reduced impact on the female participation rate compared with 1951. This seems to indicate that married women are less reluctant to let even the youngest children deter them from taking employment. This may be a reflection of the fact that, in an attempt to get staff, firms are now more willing to take on married women on a part-time basis. It would obviously be easier for women with very young children to work part-time, but even this involves finding somebody to look after the children. The number of married women in part-time employment is given in the Census for local authority areas with a total population in excess of 50,000. In 1951 a total of 75 out of the 122 boroughs exceeded this limit. In these 75 boroughs there were 1,412,600 economically active females of whom 142,680 or 10.1% were married women in part-time employment. In 1961 a total of 82 boroughs exceeded the 50,000 population level. These 82 boroughs had 1,612,120 economically active females of whom 319,230 or 19.8% were married women in part-time employment. These figures show quite clearly that the increase in the

---

22. 'The National Plan', op.cit., Chapter 3.

Number on Map	Name of Borough
	14-18 miles from the centre
93	Walton and Weybridge
94	Esher
95	Leatherhead
96	Banstead
97	Caterham and Warlingham
98	Dartford
	18-22 miles from the centre
99	Thurrock
100	Brentwood
101	Welwyn Garden City
102	Hemel Hempstead
103	Chorley Wood
104	Slough
105	Egham
106	Chertsey
107	Dorking
108	Reigate
109	Sevenoaks
	22-30 miles from the centre
110	Basildon
111	Harpenden
112	Berkhamstead
113	Chesham
114	Beaconsfield
115	Woking
116	Gravesend
117	Luton
118	High Wycombe
119	Maidenhead
120	Guildford
121	Tonbridge
122	Rochester