Why Are More Women Working in Britain?

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In Britain, female labor force participation rose steadily from the Second World War to 1977. To explain this, we estimate a pooled time-series, cross-section supply function for single-year age groups of women. The life-cycle pattern is explained quite well by the presence of children. At a second stage we try to explain the rising level of the cohort intercepts estimated at the first stage. Real wage growth may be an explanatory factor, as cross-section evidence suggests it should be. Finally, we point to the 15% rise in the relative pay of women in the mid-1970s caused by the Equal Pay Act. This did not cause the expected decline in the relative demand for female employees.

This paper is a shortened version of a longer paper (Joshi, Layard, and Owen 1983), which itself draws on another paper (Joshi et al. 1981). For further analysis of various demographic aspects see also Joshi and Owen (1981). The data used in our computing have been deposited in the ESRC Data Archive at Essex University under the title *Female Fertility and Employment by Cohort*. We are very grateful to Y. Deshpande and A. Tripathy for their computing and to L. Llorens, S. Rodriguez, and Z. Tzannatos for research assistance. We are also grateful for advice and comments to many colleagues in our respective centers. We should like to thank the Economic and Social Research Council, the Department of Employment, and the Leverhulme Trust Fund for financial support.

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1. Introduction and Summary

The increasing number of women at work is one of the most striking phenomena in the history of postwar Britain. In 1931 only 32% of women aged 20–64 were in the labor force; by 1981 the proportion had risen to 58%. Why is this? There is clearly a demand side as well as a supply side to the story. After laying out the facts in Section II of this paper, we concentrate on a supply model in Section III and conclude in Section IV with some reflections on the largely unresolved problems relating to the demand side.

Female participation rose steadily from the Second World War until 1977, from which time it has been static. Until the 1970s the main increase was among married women aged over 35. Most of the extra workers have been part time.

To explain the increase in labor supply we estimate a pooled time-series, cross-section supply function for single-year age groups of women from 1950 to 1974. This function is estimated in two steps, for reasons to do with the pattern of serial correlation. In the first step, the proportion of women working in each age group is explained by the number of children they have of different ages, by age itself, by the state of the business cycle, and by a dummy for each individual birth cohort. As one might expect, the cohort dummies pick up most of the secular increase in participation, while the children and age variables map out the life-cycle pattern of participation. To understand the secular rise in participation we need to explain the coefficients on the cohort dummies, the second stage of the estimation process. We do this by various measures of early work experience, as well as by time and by the real wage levels prevailing at certain stages of life.

A key issue is the role of real wages. It is impossible to separate the influence of male and female wages, since the relativity between them was almost constant from 1950 to 1974. But we can examine the effect of the general wage level. We concentrate on the level of wages when the cohort was aged 35. If this variable is included but the time trend is excluded, the implied elasticity of participation with respect to the real wage level is about .4, while if the time trend is included the elasticity falls to .3, with a t-statistic of 2.4. However, we do not want to claim too much for this estimate, given some of the other less satisfactory experiments reported below.

It is interesting to compare these elasticities with those obtained from cross-section estimates on individual data relating to married women. These are based mostly on the General Household Survey (GHS) (a continuous survey of households in Great Britain published annually by the Office of Population Censuses and Surveys) and they differ according to which year's data set is used and which model. The GHS estimates

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of the effect of an equiproportional rise in all wages and incomes range from .34 to zero (see App.).

So what does explain the postwar rise in participation? It is certainly not explained by demographic trends, since up to the end of the 1960s the number of young children at home was growing. It could be the growth in real wages, but the evidence here is suggestive rather than conclusive.

One would like to have an explanation that accounted also for the earlier trends in women's work. From the mid-nineteenth century up till the Second World War there was no trend at all. At the same time there was a fairly steady rise in real wages and from the 1880s a fairly steady fall in the number of young children at home. There was also increased schooling keeping children out of the home. It is hard to see why these influences did not produce an increase in women's paid work over that period.

Three possible explanations suggest themselves. First, job rationing in the interwar period may have discouraged female labor supply. In particular, employers may have had little incentive to provide part-time jobs, which have proved particularly attractive to women in the postwar period. One can well imagine that even with no change in hourly wages many women would be willing to take part-time jobs if these became available, even if they were not willing to take the equivalent full-time job.[1]

Second, the postwar period witnessed two major developments, which we have not documented and which affected the supply side. First were dramatic falls in the real prices of domestic appliances (especially of refrigerators, gas and electric cookers, noncoal heating appliances, vacuum cleaners, and washing machines) and the prices of processed foods and easy-care fabrics. This drastically reduced the time required to feed a family to a given standard, to keep a house clean, and to wash the clothes and linen. Theory does not enable one to sign the effect of such price changes, but on balance one would expect them to reduce the supply of housework. Second was a major fall in the morbidity of children, which made it much easier for women to offer a reliable supply of labor outside the home.

Finally, we offer the tentative thought that changes in women's labor supply may not be easy to explain in terms of recent values of any variable. Rather they may reflect long-term changes in the roles women see for themselves in life. The basic exogenous change here could be the reduction in the late nineteenth and early twentieth centuries in the mortality of children and young adults. This lowered the number of

[1] This proposition depends simply on the quasi-concavity of the utility function.

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children needed in order to generate a given number of adult survivors. Again, theory does not predict the effect on fertility, but what actually happens is that people choose to have fewer children. At the same time the life expectancy of adult women rises, so that the fraction of her adult life a woman spends rearing children falls dramatically. This releases the woman for other roles. But it could easily take decades for labor supply behavior to react fully to this opportunity.

In Section IV we turn to the demand side. The puzzle here is that the relative hourly earnings of women (compared with men) rose by 15% from 1973 to 1976 because of the Equal Pay Act, but apparently with no effect on relative employment. Indeed, in the typical private-sector industry the employment of women relative to men increased sharply. What can explain this? One possible explanation is the Sex Discrimination Act, which outlawed discrimination in employment (rather than in pay). But most observers believe this law to have been too weak to account for what happened. The alternative explanation is simply that employers began to realize the true worth of female labor.

II. Trends in Women's Work, Pay, and Fertility

The growth in women's work is a relatively modern phenomenon. The proportion of adult women who were economically active remained at around one-third from the mid-nineteenth century until the Second World War (see table 1). Except briefly during the First World War things began to change only after the Second World War. Between 1931 and 1981 the economic activity rate of women aged 20–64 rose from 32% to 60%.

Until the 1970s the main increase was among women over 35. This shows clearly in table 2. Until the 1970s there was little increase among women in their childbearing twenties. But in the early 1970s, when the birthrate was falling, this group participated much more, while for women in mid-life the trend continued strongly upward. However, from around 1977 both trends stopped dead in their tracks, despite the economic recovery in 1978–79.

The main growth has been among married women (see table 3). Between 1951 and 1981 their participation rate more than doubled, and for mothers of dependent children the rise was proportionately more.[2] However, at the same time, the proportion of women who were married rose sharply, so that the overall participation rate of women rose less than it otherwise would have done.

Remarkably, there has been no growth at all in the propensity to

[2] Nowadays nearly all women return to work at some point after childbearing—a practice that was formerly rare. For data on work histories see Martin and Roberts (1984).

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Table 1
Activity Rates: Women Aged 20–64 (%)

	All	Married	Single, Widowed, and Divorced
Census years:			
1851	34.5	n.a.	n.a.
1861	35.2	n.a.	n.a.
1871	34.5	n.a.	n.a.
1881	33.1	n.a.	n.a.
1891	33.5	n.a.	n.a.
1901	33.9	13.0	65.6
1911	32.5	10.5	66.4
1921	30.6	9.4	65.2
1931	31.6	10.9	66.7
1941	n.a.	n.a.	n.a.
1951	36.3	23.2	70.0
1961	41.0	31.6	73.3
1966	48.3	41.8	72.0
1971	51.5	45.9	72.7
1981	57.7	54.0	68.9
Recent years:			
1971	52.0	46.8	72.9
1972	52.7	47.6	72.4
1973	55.6	51.4	72.3
1974	57.3	53.4	72.5
1975	57.4	54.0	72.2
1976	58.6	55.3	71.7
1977	60.0	57.0	71.4
1978	59.9	56.7	71.7
1979	59.8	56.5	72.4
1980	59.7	56.2	72.0
1981	59.9	56.5	72.2

SOURCES.—Census years: Original census reports. Data for 1861–1931, England and Wales only: otherwise Great Britain; 1851–71 are obtained as follows. The census in 1871 and earlier uses a different concept of the occupied population from the census of 1881 and after. But a consistent series of the occupied population has been estimated in Department of Employment and Productivity (1971), table 102. We compute the ratio of this to the population ages 20–64 in 1851–81. For 1851–71 we divide this ratio by the ratio of its value in 1881 to the actual proportion of women ages 20–64 occupied in 1881. Recent years: *DE Gazette* (April 1981) adjusted to exclude students from numerator and denominator. The Department of Employment series is based on a variety of sources, especially the *Labour Force Survey*.

work full time. The whole growth has been in part-time work (see table 4).[3]

As table 5 shows, there has been a big increase in female unemployment (using survey definitions). In the early postwar years, unemployment was low, about the same for women and men. Since the early 1970s it has risen sharply, but rather less for women than men.

[3] Trends in part-time work during the 1970s differ according to the data source. Details available on request.

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Table 2
Age-specific Activity Rates (%)

	Age 20–24	25–34	35–44	45–54	55–64	20–64
Census years:						
1851	59.1	41.3	35.5	36.8	37.0	42.1
1861	...	...	...	...	...	...
1871	60.0	40.4	36.3	38.4	39.5	42.5
1881	55.9	29.0		26.1		33.1
1891	58.1	33.0	25.1	25.4	24.4	33.5
1901	56.5	31.5	25.8	28.2	29.2	33.9
1911	62.0	33.8	24.1	23.0	20.4	32.5
1921	62.2	33.5	22.9	21.0	19.3	30.6
1931	65.1	36.3	24.5	21.1	17.8	31.6
1941	...	...	...	...	...	...
1951	65.4	40.5 33.5	35.2	34.4	27.6 15.0	36.3
1961	62.3	39.5 36.6	42.4	43.3	36.9 20.4	41.0
1966	61.6	40.4 41.5	52.7	54.8	46.3 27.0	48.3
1971	60.2	43.1 45.0	57.2	60.4	51.0 28.0	51.5
1981	69.2	55.4 53.4	65.5	66.0	52.3 22.4	57.7

	Age 20–24	25–34	35–44	45–54	55–59	60–64	20–64
Recent years:							
1971	64.1	44.0	57.4	60.6	51.1	28.2	52.0
1972	65.6	44.9	58.0	61.2	51.3	28.2	52.7
1973	66.8	48.7	62.3	65.2	52.6	28.2	55.6
1974	68.4	51.2	65.3	66.1	53.3	28.2	57.3
1975	68.8	52.0	65.9	66.3	53.3	28.2	57.4
1976	70.9	53.8	67.5	66.9	55.0	26.8	58.6
1977	72.4	56.5	68.7	67.1	57.3	25.0	60.0
1978	73.4	56.2	69.0	67.2	56.0	22.8	59.9
1979	73.3	56.2	68.5	67.5	54.9	21.3	59.8
1980	73.8	56.3	68.3	67.8	54.9	20.5	59.7
1981	73.2	56.2	68.2	68.4	54.6	19.2	59.9

SOURCES.—See table 1. In table 2 there is a break in the series between 1871 and 1881 for which we have not attempted to adjust, whereas we did attempt an adjustment in table 1.

Wages

We can now look at two main variables that might explain the trends in female labor supply: real wages and fertility. Real wages of women and men have been rising ever since the eighteenth century, and though the rate of growth has been most rapid since the Second World War, the proportional increase from, say, 1850 to 1950 was greater than that since 1950. As figures 1 and 2 and table 6 show, women's wages rose relative to men's during the Second World War, and the relativity rose again sharply between 1973 and 1975, by around 15%. This 15% rise happened both for manual workers, shown in the table, and for nonmanual workers. It was due to the Equal Pay Act of 1970, which outlawed the use of separate rates of pay for men and women from

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Table 3
Activity Rates by Marital Status and Age: Marriage Rates, Female Nonstudents, Great Britain (%)

		Age									
Marital Status	Year	Under 20	20–24	25–34	35–44	45–54	55–59	60–64	65–69	70 and Over	All Ages	20–59
Single	1951	94.9	92.4	87.1	79.8	74.5	66.4	35.0	21.6	6.8	76.4	76.7
	1961	94.3	91.9	89.5	85.1	81.7	75.1	39.2	19.6	6.3	76.1	86.1
	1971	90.3	93.6	85.8	85.1	82.6	76.4	33.3	16.6	4.4	71.1	87.5
Married	1951	38.3	37.1	24.5	24.9	23.4	15.6	6.7	3.6	1.5	21.5	24.2
	1961	41.8	41.8	29.5	36.4	33.9	26.0	12.7	5.2	1.5	29.4	33.7
	1971	41.5	45.8	38.4	54.2	56.8	45.1	24.8	10.0	2.6	42.0	48.8
	1981	45.7	55.1	48.6	64.0	64.4	49.7	22.3	6.9	2.0	47.3	57.2
Widowed and divorced	1951	100.0	64.4	67.6	66.2	53.9	38.1	18.4	10.1	2.9	20.9	52.4
	1961	75.0	62.7	68.4	71.7	67.7	51.8	28.2	13.4	3.0	22.9	62.3
	1971	38.9	52.4	60.2	70.9	73.9	62.2	33.7	15.0	2.8	23.1	66.8
All	1951	92.0	66.7	37.1	34.7	34.0	27.7	14.4	9.0	3.2	35.0	42.4
	1961	91.8	63.9	39.5	36.6	42.0	36.9	20.4	10.3	3.1	38.3	43.4
	1971	88.3	63.6	44.0	57.1	60.6	50.9	28.0	12.7	3.0	43.9	54.6
	1981	91.8	74.5	54.9	65.7	66.1	52.3	22.4	7.6	2.0	47.4	62.3
Percentage of women never married	1951	95.7	52.7	18.8	13.9	15.6	15.9	15.9	16.8	16.6	24.5	26.6
	1961	93.7	43.0	13.5	10.0	11.3	14.2	14.8	15.3	16.0	20.8	15.5
	1971	82.8	36.7	10.7	7.4	8.4	10.0	11.8	13.9	15.4	17.5	12.6

SOURCES.—Census reports on occupation, economic activity, and education. In the adjustment to exclude students all students were assumed to be single (approximately true in 1971).

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Table 4
Full- and Part-Time Work among Women Aged 20–64 (%)

	Full-Time Workers	Part-Time Workers	Unemployed	All Active
1951	30.3	5.2	0.8	36.3
1961	29.8	10.2	1.0	41.0
1966	31.7	15.2	1.4	48.3
1971	29.0	20.2	2.3	51.5
1981	31.6	22.4	3.7	57.7

SOURCE.—Census reports, for Great Britain. In 1951, 13 out of 15 of self-employed were assumed full time. The percentages of all women aged 20–64 who were self-employed in the 5 years were 1.5, 1.7, 1.9, 2.0, and 2.6
NOTE.—Full time means worked more than 30 hours normally (or 24 for teachers).

January 1976 onward.[4] Two main pieces of evidence are sufficient to establish this causality. First there is the timing: the rise corresponds exactly to the last possible moment allowed by the law, and the relativity has remained fairly stable ever since. Second, if one looks at wage rates negotiated in national collective bargaining agreements, the rates of women relative to men moved in almost exactly the same pattern as for earnings—though, as one would expect, relative earnings rose slightly less.[5]

There is little reason to think that human capital accounts for the recent narrowing of the male-female wage gap. The educational attainment of women relative to men was constant or declining for cohorts entering the labor force up to the 1960s, as attested by the *Education Tables* of the 1961 census and the *Qualified Manpower Tables* of the 1971 census. It is true that since then women have increased their educational activity rather more rapidly than men, but the quantitative effect of this on the human capital in the labor force has been small.[6] Moreover, most of the newly educated are still quite young, and for young adults extra education directly raises earnings but also indirectly reduces earnings by reducing work experience.[7]

[4] In addition to requiring equal pay for equal work (i.e., the same work), it insisted that where job evaluation was in force there should be equal pay for work of equal value. However, the general principle of equal pay for work of equal value was only being introduced in 1983.

[5] *DE Gazette* (see App. B). The data relate to manual workers. The question how women's pay is determined is examined at length in Zabalza and Tzannatos (1983), who show that conventional demand-side factors explain very little of the rise. They also show that among workers covered by collective bargaining agreements, the relative rise occurred entirely through changes within bargaining groups with no change in men's relative pay between groups.

[6] See the various reports of the General Household Survey (GHS) published by the Office of Population Censuses and Surveys (OPCS).

[7] At older ages this would not matter so much if the effect of experience on earnings is concave. Note that the available evidence does not enable one to calculate trends in the work experience of women currently working. The work

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Table 5
Unemployment Rates (%)

	Census Data (Survey Definition)		Department of Employment (Registered Unemployment Rate)	
	Women	Men	Women	Men
Census years:				
1951	1.9	2.2	0.9	0.9
1961	2.5	3.0	0.9	1.3
1966	3.2	2.8	0.6	1.4
1971	4.8	5.4	1.2	4.2
1981	7.4	11.4	7.7	13.3
	General Household Survey (Survey Definition)		Department of Employment (Registered Unemployment Rate)	
Recent years:				
1971	3.6	3.3	1.2	4.2
1972			1.4	4.6
1973	3.3	3.2	1.0	3.3
1974	2.0	3.2	0.8	3.2
1975	3.2	4.3	1.6	4.9
1976	3.6	5.6	3.3	6.9
1977	4.8	5.4	4.0	7.2
1978	4.4	5.1	4.2	6.9
1979	4.7	5.4	4.1	6.3
1980	6.2	6.7	5.2	7.8
1981	9.4	11.1	7.7	13.3
1982	9.4	12.4	8.9	15.2

SOURCES.—Census reports, data for Great Britain. Registered unemployment, annual average: *DE Gazette*.
NOTE.—Covers all ages, except for General Household Survey, which relates to women under 60 and men under 65.

Fertility

Fertility fell from around the 1880s, when the total period fertility rate was about 4.5, until the 1930s when it was under 2 (see fig. 3 and table 7). It rose briefly after each world war, but there was a sustained rise from the mid-1950s to the mid-1960s. From the late 1960s there was a precipitate fall until 1978, when a slight recovery began. Thus fertility, unlike wages, has been anything but trended.

of Zabalza and Arrufat (1983) argues that human capital explains most of the female-male wage gap in the late 1970s. Whereas the actual hourly earnings of married women were 62% of males' earnings, they would have been between 67% and 73% if they had been determined by the male rather than the female earnings function. On this issue see also Stewart and Greenhalgh (1984).

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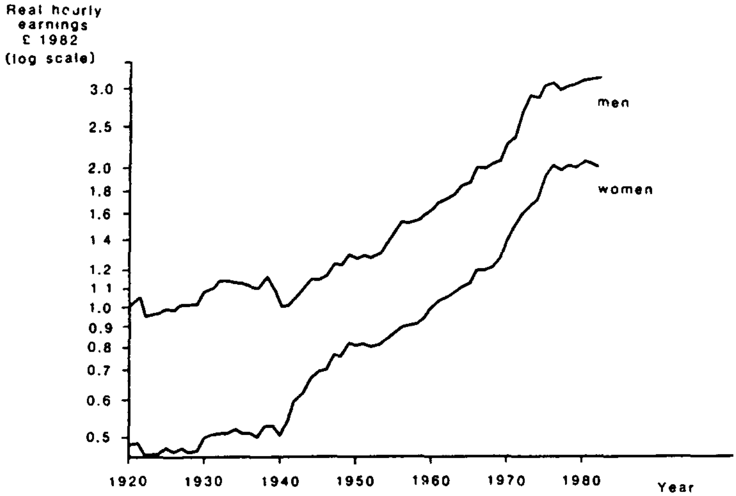

FIG. 1.—Real hourly earnings of men and women, Great Britain, 1920–82

III. The Supply Model

We turn now to the problem of explanation. For this purpose we use as dependent variable the proportion of women of each age who worked as employees in each year from 1950 to 1974.[8] There are clearly two main features to be explained: the life-cycle pattern of participation and the difference in pattern between the different cohorts.

These two features are illustrated in figure 4. This shows the work history of six selected cohorts of women over the period 1950–74. Each cohort is labeled by the date at which it was age 20. Thus for the cohort age 20 in 1962 we see an early fall in participation, followed by the beginning of a return to work. For those age 20 in 1954, we see more of this pattern of reentry. Indeed, we can see how steep it is and how misleading it would be to infer life-cycle behavior from the evidence of the cross section. The cross section of work in 1974 can be obtained by joining up the loose ends of each cohort profile. This suggests that participation is falling between ages 48 and 56, whereas the profile for the 1938 cohort rose over those ages. The apparent drop is due to differences in the behavior of the different cohorts, rather than an effect of aging. Figure 4 also makes it clear that the main increase in women's

[8] There is no annual series on labor force participation. The employment series we use is based on a survey of one-half of 1% of all employees covered by National Insurance. This was discontinued in 1975 and no subsequent time-series data exist on age-specific employment (except from surveys with large sampling error).

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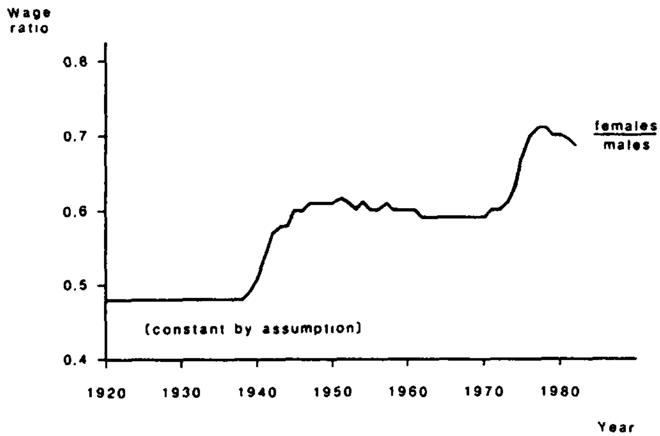

FIG. 2.—Ratio of female to male hourly earnings, Great Britain, 1920–82

work has been in midlife. However, the graph does not bring out the full increase in participation at younger ages that happened in the 1970s.

The age-specific employment rates are explained by three kinds of variables:

i) those whose values change from year to year and are age specific (e.g., number of children under 5)—we call these life-cycle variables;

ii) those whose values change from year to year but affect all ages

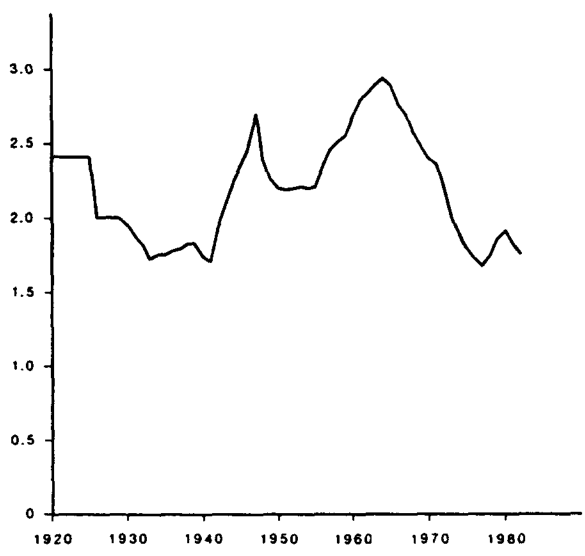

FIG. 3.—Total period fertility rate, England and Wales, 1920–82

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Table 6
Average Hourly Real Earnings of Adult Full-Time Manual Workers
(1982 Prices in £'s = 1)

Year	Women over 18	Men over 21	Women as Proportion of Men	Year	Women over 18	Men over 21	Women as Proportion of Men
1920	.47	1.01	.47	1950	.79	1.29	.61
1921	.48	1.05	.47	1951	.80	1.30	.62
1922	.43	.95	.47	1952	.78	1.28	.61
1923	.44	.96	.47	1953	.79	1.31	.60
1924	.45	.96	.47	1954	.84	1.37	.61
1925	.47	.99	.47	1955	.86	1.44	.60
1926	.46	.97	.47	1956	.89	1.50	.60
1927	.47	1.01	.47	1957	.90	1.48	.61
1928	.46	1.01	.47	1958	.92	1.52	.60
1929	.46	1.01	.47	1959	.94	1.58	.60
1930	.50	1.09	.47	1960	.99	1.66	.60
1931	.51	1.10	.47	1961	1.04	1.73	.60
1932	.51	1.13	.47	1962	1.05	1.77	.59
1933	.51	1.13	.47	1963	1.07	1.80	.59
1934	.52	1.12	.47	1964	1.11	1.88	.59
1935	.51	1.12	.47	1965	1.13	1.92	.59
1936	.51	1.11	.47	1966	1.20	2.03	.59
1937	.50	1.10	.47	1967	1.20	2.03	.59
1938	.53	1.15	.47	1968	1.22	2.10	.58
1939	.53	1.09	.49	1969	1.29	2.20	.59
1940	.51	1.00	.51	1970	1.41	2.38	.59
1941	.55	1.01	.54	1971	1.48	2.46	.60
1942	.60	1.06	.57	1972	1.60	2.65	.60
1943	.64	1.10	.58	1973	1.69	2.78	.61
1944	.67	1.15	.58	1974	1.74	2.76	.63
1945	.69	1.15	.60	1975	1.95	2.92	.67
1946	.70	1.17	.60	1976	2.06	2.94	.70
1947	.76	1.25	.61	1977	1.97	2.77	.71
1948	.76	1.25	.61	1978	2.05	2.87	.71
1949	.80	1.31	.61	1979	2.02	2.90	.70
				1980	2.10	3.00	.70
				1981	2.07	3.01	.69
				1982	2.05	3.02	.68

SOURCES.—Data relate to April. Wages (£): 1938–82; U.K. Department of Employment and Productivity (1971), tables 46–48; and comparable *DE Gazette* thereafter ("April survey" grafted backward onto New Earnings Survey). Earlier: The *Abstract* gives data for male/female weekly wage ratios in 1935. It also gives data on average hourly wages (for men and women combined) back to 1920. We assumed that the male/female ratio for 1920–35 was constant. Prices: *Abstract* Tables 89–93 and *Department of Employment Gazette* thereafter (1982 prices = 1).

NOTE.—Weekly earnings of women relative to men did not change between 1886 and the interwar period (Department of Employment and Productivity 1971).

equally (e.g., the state of the economy)—we call these calendar-time variables; and

iii) those that differ between cohorts but do not change over the life cycle (e.g., year of birth)—we call these cohort variables.

If t denotes date and j denotes cohort, we can refer to these three sets of variables as L_{tj}, B_t, and C_j respectively. Hence if E_{tj} is the proportion of nonstudent women at work as employees, $E_{tj} = f(L_{tj}, B_t, C_j)$. The particular variables we consider are (i) life-cycle variables: children of

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Table 7
Total Period Fertility Rate

Year	Total Period Fertility Rate	Year	Total Period Fertility Rate
1841–45	4.59	1951	2.14
1851–55	4.62	1952	2.16
1860–65	4.66	1953	2.21
1871–75	4.81	1954	2.20
1881–85	4.58	1955	2.22
1891–95	4.01	1956	2.35
1901–05	3.46	1957	2.45
1911–15	2.83	1958	2.51
1916–20	2.42	1959	2.53
1921–25	2.39	1960	2.66
1926–30	2.00	1961	2.77
1930	1.94	1962	2.84
1931	1.89	1963	2.88
1932	1.82	1964	2.94
1933	1.72	1965	2.84
1934	1.75	1966	2.76
1935	1.75	1967	2.66
1936	1.77	1968	2.58
1937	1.79	1969	2.48
1938	1.83	1970	2.41
1939	1.83	1971	2.38
1940	1.74	1972	2.19
1941	1.71	1973	2.02
1942	1.92	1974	1.90
1943	2.02	1975	1.79
1944	2.24	1976	1.73
1945	2.04	1977	1.68
1946	2.46	1978	1.75
1947	2.69	1979	1.86
1948	2.38	1980	1.90
1949	2.26	1981	1.82
1950	2.18	1982	1.77

SOURCES.—Office of Population Censuses and Surveys, *Birth Statistics* (1980), table 1.4., and *Population Trends* (Spring 1983).
NOTE.—Fertility rate = $\sum_i (B_i/P_i)$, where i is age $15 < i > 44$, B is births, and P is female population.

different ages, wages, and age; (ii) calendar time variables: business cycle (vacancies); and (iii) cohort variables: completed family size, male and female wages at specified ages, education, unemployment experience early in working life, experience of wartime working, and trend.[9]

Our aim is to estimate a supply function for female labor (in terms of numbers of workers rather than woman-hours). There is an obvious problem of identification, since for data reasons the dependent variable has to be age-specific employment, not labor force.[10] However, there is

[9] For exact definitions of variables see Joshi et al. (1981), annexes A, C; or Joshi and Owen (1981), annexes A, B.

[10] The National Insurance Card data also give, separately by age, data on those not employed but receiving "credits." But these exclude unregistered unemployed and include the sick.

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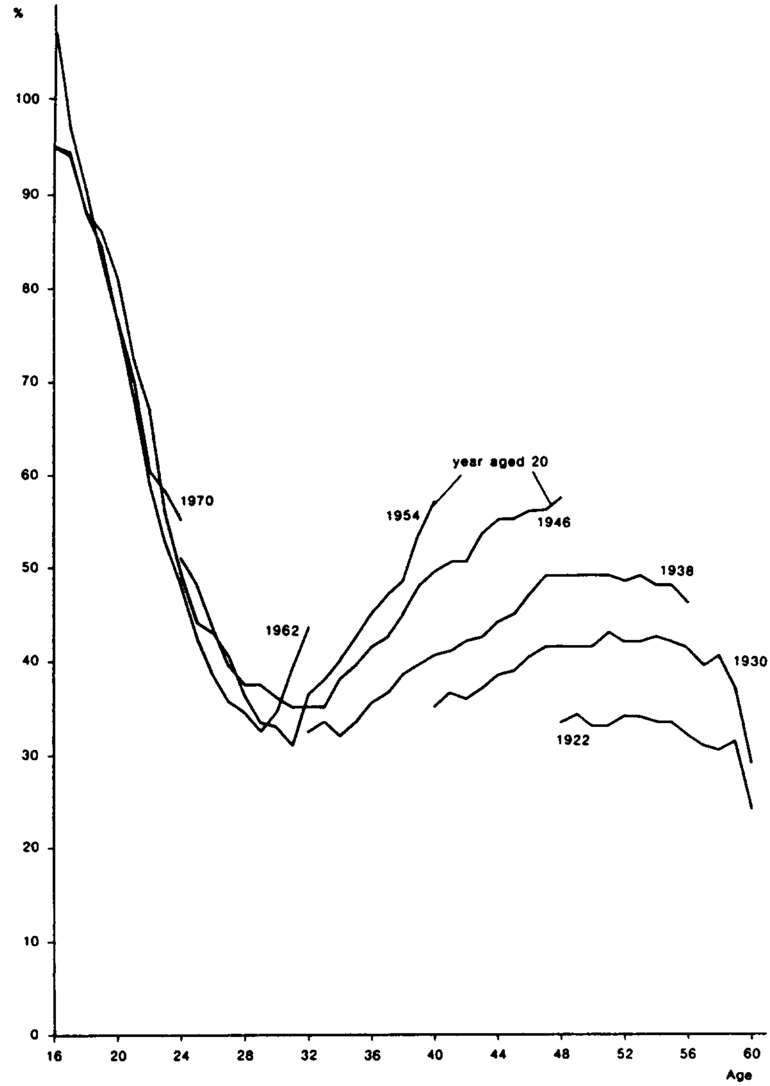

FIG. 4.—Percentage of women in employment as employees: selected cohorts, 1950–74

a relationship among employment (E), labor supply (S), and vacancies (V) given by the U/V curve: $E = S + \gamma V +$ constant. There is also a supply relation, in which supply may respond to vacancies as well as to other variables (Z): $S = Z\beta + \alpha V +$ constant. Hence, eliminating S, $E = Z\beta + (\alpha + \gamma)V +$ constant. This means that all is well, provided we include vacancies in our equation.

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Our estimation proceeds in two steps. First, in equation (1), we estimate the effect of all variables that are not purely cohort variables. We estimate their effect simultaneously with a vector of coefficients (**a**) on the vector of cohort dummies ($\mathbf{D}_j$). Thus we estimate

$$E_{tj} = \mathbf{L}_{tj}\mathbf{b} + \mathbf{B}_t\mathbf{c} + \mathbf{D}_j\mathbf{a} + u_{tj}. \tag{1}$$

Then as a second stage we estimate the effects of the cohort variables by regressing the $\hat{a}_j s$ estimated in equation (1) on the purely cohort variables ($\mathbf{C}_j$):

$$\hat{a}_j = \mathbf{C}_j c + v_j. \tag{2}$$

This two-stage approach is necessary if we are to handle problems of autocorrelation in a satisfactory manner.[11] There are two dimensions in which we found important serial correlation. One is serial correlation in the unexplained behavior of a given cohort over its life cycle (i.e., between adjacent ages for the same people). This is captured in the error terms of equation (1).[12] The second is serial correlation in the unexplained behavior of adjacent cohorts, captured in the error term of equation (2). For both equations, ρ was estimated by grid search.

The equations are estimated for ages 20–59 for the 43 cohorts on which there were at least 10 observations at these ages during the period 1951–74.[13]

Results

Table 8 shows estimates of equation (1) and table 9 shows estimates of equation (2). Let us look at these one by one. Table 8 enables us to look at the effect of the life-cycle and calendar-time variables, while table 9 turns to the cohort variables. As we go through the variables, we shall first describe them and then document their effects.

[11] As an estimation strategy, this is a standard procedure for pooled time series. It resembles the procedure adopted by Heckman and MaCurdy (1980) for their micro-panel data: they specify fixed effects, to capture "permanent" variables among individuals, analogous to our a_j.

[12] Once cohort dummies were included there was little serial correlation in the error terms of adjacent time periods holding age constant, or adjacent age groups holding time constant. (ρ was .16 and .20, respectively, in regression 1 of table 9.)

[13] We restrict our analysis to ages 20–59 to avoid specific questions associated with women's retirement age and educational enrollment. There was some doubt about the National Insurance data on teenage employment, but data for ages below 20 are used where necessary to allow for lags.

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Table 8
Estimates of Equation (1)

Explanatory Variables (other than Cohort Dummies)	Regression Coefficients (with t-Statistics) 1	2	3	4
Age	−.0052	−.0058	−.0047	−.0064
	(19.98)	(13.86)	(12.38)	(8.45)
$(\text{Age} - 39.5)^2$	−.00013	−.000079	−.00013	−.000089
	(7.29)	(2.53)	(7.34)	(3.24)
Children ages 0–4 per woman	−.346	−.339	−.350	−.336
	(38.17)	(34.65)	(37.75)	(31.64)
Children ages 5–10 per woman	−.141	−.134	−.140	−.128
	(28.72)	(22.37)	(28.68)	(14.39)
Children ages 11–14 per woman	−.072	−.0707	−.0735	−.066
	(8.78)	(8.62)	(8.94)	(7.47)
(Children ages 11–14 per woman) × (cohort birth year − 1925)	.0030 (4.47)	.0032 (4.71)	.0032 (4.67)	.0031 (4.57)
Vacancies × 10^{-6} × dummy (age 20–39)	.058 (12.07)	.0578 (11.89)	.0615 (12.07)	.0579 (11.92)
Vacancies × 10^{-6} × dummy (age 40–59)	.040 (8.36)	.0412 (8.49)	.0434 (8.53)	.0412 (8.54)
Age-specific wage ratio males to females, 1968		.0306 (1.81)		
Current real wage of women			−.00045	
			(1.82)	
(Cohort birth year − 1000) × age spline*				.0000023 (1.73)
Dependent variable: proportion of nonstudent women employed				
$\hat{\rho}$	.6	.6	.6	.6
DW	2.13	2.13	2.14	2.15
$\bar{R}^2$	.997	.997	.997	.997
SSE	.07415	.07385	.07383	.07388
df	799	798	798	798
N	850	850	850	850

* Age spline = (age − 30) × dummy (30–59) − (age − 50) × dummy (50–59). For full definition of variables see Joshi et al. (1981), annex C.

Life-Cycle and Calendar-Time Variables

Children. Children are not exogenous if chosen jointly with work decisions. Thus a reduced-form supply function of work would have in it the cost of children rather than their number. However, we can eliminate the cost variable by substituting in from the demand function for children, to get a relationship between work and children.[14] This is the only practicable procedure if we want to trace out the life-cycle pattern of work.

Cross-sectional work on micro data makes it clear that the effect of children is best measured by the presence of any child, interacted with

[14] We are assuming that between cohorts those with a high "taste" for work have on average a normal "taste" for children.

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Table 9
Estimates of Equation (2)

Explanatory variables	Regression Coefficients (with t-Statistics) 1	2	3	4	5	6	7	8
Cohort birth year	.0057		.0011	.0023	.0013	.0052	.0084	.0082
	(8.50)		(.51)	(1.22)	(.68)	(10.73)	(4.59)	(6.14)
Years at ages 20–29 during World War II	.0031	.0040	.0038	.0048	.0041	.0036	.000024	.00040
	(1.46)	(2.00)	(1.87)	(3.13)	(2.77)	(2.62)	(.0079)	(.68)
Average unemployment rate at age 15–24 (%)	−.0046	−.0080	−.0072	−.0042	−.0012	.0028	−.0045	.0043
	(1.97)	(4.38)	(2.95)	(1.91)	(.40)	(1.11)	(1.66)	(1.73)
Log average real wages of men and women at age 35		.166	.138	.153	.119			
		(9.40)	(2.39)	(2.90)	(2.25)			
Log male wage − log female wage at age 35				.190				
				(2.37)				
Log average real wages of men and women at age 20							−.120	−.134
							(1.76)	(2.34)
Log male wage − log female wage at age 20					−.309	−.395		−.480
					(2.37)	(3.18)		(3.91)
Constant	−2.221	.121	−.314	−1.379	−.425	−3.046	−2.601	−4.806
	(7.4)	(3.33)	(.37)	(1.23)	(.40)	(7.74)	(4.36)	(5.73)
(Dependent variable: cohort coefficient $\hat{a}_i$)								
$\hat{\rho}$	.5	.5	.5	.3	.3	.2	.6	.2
DW	2.28	2.29	2.32	2.28	2.14	1.98	2.40	2.03
$\bar{R}^2$	.887	.902	.899	.952	.952	.959	.836	.964
SSE	.00809	.00706	.00701	.00640	.00639	.00725	.00753	.00629
df	38	38	37	36	36	37	37	36
N	42	42	42	42	42	42	42	42

NOTE.—For full definition of variables, see Joshi et al. (1981), annex C.

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Table 10
Hypothetical Effect on Female Employment of Changes in the Child Population, 1951–81, Great Britain (1,000s)

Children	Change in Population			Effect on Employment		
	1951–61	1961–71	1971–81	1951–61	1961–71	1971–81
0–4 years	−76	238	−1044	26	−82	361
5–10 years	212	998	−964	−30	−141	134
11–14 years	801	−112	215	−58*	5*	−3*
Total	937	1124	−1793	−62	−218	492
Actual change in employment of women aged 20–59				564	1,149	687

SOURCE.—Census reports.
NOTES.—Estimated effect on employment calculated using coefficients from table 8, equation (1).
* Change in population of ages 11–14 times the coefficient on children 11–14 at end year (reflecting effect of the interaction with cohort).

the age of the youngest child.[15] However, no time series evidence is available for this. Instead we use three variables: (i) children under age 5 (preschool) per woman, (ii) children 5–10 (primary school age) per woman, and (iii) children 11–14 per woman (15 being the minimum school-leaving age till 1973). Each variable measures the number of children (born to the cohort) per woman (married and unmarried) in the cohort.[16]

Turning to the results, the final column of table 8 shows our preferred equation. Each preschool child lowers participation by 35%, each primary school child by 14%, and each secondary school child by 7% (for the cohort age 20 in 1945).

It is interesting to see how children affect the fraction of a woman's life that she works as an employee. Each child reduces the years a mother works by about 2.9, so that if mothers averaged 2.5 children they would work about 7 fewer years than childless women. Put another way, these average mothers would work 44% of the years between ages 20 and 59, while the average childless woman would work 62% of that time.

We can next examine how far fertility changes explain the evolution of postwar female employment. Table 10 shows on the left-hand side the changes in the number of children over each decade and on the

[15] The number of children also has a minor, nonlinear effect (Joshi and Owen 1981, sec. 4(i)).

[16] The numbers are derived from data on births and therefore ignore mortality and migration. Joshi and Owen also experimented with other variables such as marital status and the existence of any child, some of which marginally improved the fit.

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right-hand side the predicted effect of these changes on female employment. The changes in the number of children between 1951 and 1971 seem to have depressed female activity to a relatively small extent, whereas the sharp decline in the number of young children between 1971 and 1981 would produce, given these coefficients, a marked rise (of almost half a million workers). Thus, of the actual intercensal changes in female employment (shown at the bottom of the right-hand panel), the increases observed between 1951 and 1971 occur *despite* increased numbers of children and must be explained by other factors. On the other hand, most of the estimated increase between 1971 and 1981 *is* attributable to falling numbers of children.

One puzzle is why participation has increased more over time at older rather than at younger ages. We have in part picked this up by finding that the deterrent effect of secondary school children declined over time.[17]

Real wages. We do not have time-series data on age-specific wages. Instead we use data on age-specific wages for 1 year and on aggregate wages for all years. The former could explain a part of the life-cycle pattern of participation (see Smith 1973; Becker and Ghez 1975), while the latter could explain time-series variation. We take them in that order.

The cross-sectional ratio of hourly earnings of women relative to men in 1968 was as follows:

Age					
18–20	21–24	25–29	30–39	40–49	50–59
.81	.73	.70	.62	.58	.63

SOURCE.—*New Earnings Survey,* 1968 (described in App. B), table 40B.

The relative earnings of women are highest early in life, which may help to explain why they participate most then; but the data do not suggest that there is any relative wage incentive for women to return to work in midlife. It is therefore not surprising that the variable attracts the wrong sign (in col. 2 of table 8).

Turning to the time-series wage variables for men and women (hourly earnings of adult full-time manual workers), these are almost perfectly collinear, since there was no appreciable change in the male/female wage ratio between 1950 and 1974. We therefore included only the female real wage. This too attracted the wrong sign (see col. 3 of table 8). Note that this result is obtained in the presence of a vector of cohort dummies that are picking up the positive trend in participation.

Age. Age itself could have an effect in two ways. The waning of

[17] There is no evidence for a changing deterrent effect of younger children.

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vitality later in life, particularly if anticipated, suggests that work should be done earlier rather than later. But even apart from this, it will make sense to concentrate work earlier in life if the return to savings sufficiently compensates for the postponed enjoyment of consumption and time at home.[18] This pattern will be further reinforced if retirement and pension arrangements lead to higher consumption in old age than would be freely chosen. The sample is restricted to ages below 60 to exclude any impact of the formal retirement age.

We include as variables not only age but age squared. It appears that age leads to a decline in participation at an increasing rate, so that between 20 and 59 it reduces participation by 20 percentage points. In order to try to allow for the fact that the main growth in participation is at older ages, we included an interaction term between cohort birth year and an age spline (col. 4). This had a positive but very small effect and was not highly significant.[19]

Vacancies. Vacancies (for men and women) registered at employment exchanges are more or less untrended between 1950 and 1974. We tried them, as well as two other indices of the business cycle—the male unemployment rate and a Wharton index of excess capacity—both of which yielded less stable estimates. We had reason to expect a differential impact of demand on the employment of women at different ages (Joshi 1981), and after experimentation discovered a different effect above and below 40. However, the vacancy effects are rather low.

To conclude our analysis of equation (1), various tests suggested that results were extremely similar when the sample was confined to cohorts having a full 25 observations, or to ages over 30. Splitting the sample over calendar time (into three equal periods) significantly improved the fit, but not strongly so ($F_{90/709} = 2.12$), the main differences from the overall estimates being rather minor ones during the period 1951–58. If the equation was estimated separately for the age group 20–29, it became somewhat less stable.

In a separate analysis we investigated whether it is better to specify equation (1) only with an autoregressive error, as above, or also with a lagged dependent variable (which might reflect state dependence in work behavior). We concluded that the choice makes little difference to any of our other results and that it is intrinsically difficult to determine the issue.

[18] If the interest rate exceeds the pure rate of time preference, individuals will consume more later in life, and hence, if the price of home time in terms of goods is constant, they will also consume more home time later in life. For models of life-cycle planning see Smith (1973) and Heckman and MaCurdy (1980).

[19] The effect of age per se disappears at ages below 40 when family structure is specified in more detail (see Joshi and Owen 1981).

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Differences between Cohorts

The coefficients on the cohort dummies generated by the preferred version of equation (1) ($\hat{a}_t$) show a fairly linear trend up to the cohort at age 20 in 1955. After that the trend flattens off, though one should note that for these later cohorts most of our data are on participation in their twenties only.[20] If these cohorts should in fact conform to the rising trend only when they reach mid-life, we would not have enough evidence to detect this from participation early in life.

Table 9 shows the results of fitting equation (2) to explain the cohort coefficients. Before discussing the results, we shall review all the variables considered for the analysis, some of which were eventually rejected.

Completed family size. We have already allowed for the influence of children at the time when they are at home. However, we also want to know whether family size has an effect at times other than when the children are young. For example, if a woman has been out of the labor force for a long time with children, she may be less likely to work when they are grown up. She may also be less likely to work before she has a family if she expects to have a large one (though this could go the other way if the need to accumulate savings was strong enough). We therefore look at the effect of *completed* family size as proxied by numbers of children born by age 36. This grew steadily from the cohort aged 20 in 1928 to that aged 20 in 1958. We also experimented with the proportion of women who ever had children by age 36. This also grew very sharply: comparing the 1928 and 1958 cohorts, we have the following approximate changes: fertility (cumulated to age 36), +60%; percentage who ever had children (by age 36), +20%; children per mother (by age 36), +30%. However, as our data come from a period dominated by an upswing in fertility, it is not surprising that completed fertility attracted a perverse sign in our regressions, and we therefore rejected it as an explanatory variable.

Education. Another factor possibly affecting women's work is education, which may act directly as well as through its effect on wage levels. If we look at the crude differences in participation between different educational groups we see the joint effect of these forces. Table 11 shows how in 1961 better-educated women were more likely to work than less-educated women, holding age constant. However, the difference between the different groups is so small that, even if all women had moved from the lowest to the highest educational group, it would only

[20] The coefficients for cohorts aged 20 in 1922 to 1964 were .64, .67, .67, .66, .70, .70, .71, .73, .72, .74, .74, .77, .75, .78, .78, .78, .79, .79, .83, .81, .82, .82, .84, .84, .85, .87, .88, .89, .89, .88, .90, .89, .91, .94, .92, .93, .92, .92, .91, .93, .93, .93, .92.

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Table 11
Female Economic Activity Rates by Terminal Education Age, 1961 (%)

	Terminal Education Age				
Age	Under 15	15	16	17–19	20 and Over
15–19	(83)	93	95	94	. . .
20–24	(57)	59	78	78	87
25–44	40	39	42	43	56
45 and over	26	29	31	29	46
All	31	56	49	45	56

SOURCES.—Data for Great Britain constructed from census of England and Wales, 1961, *Education Tables*, and census of Scotland, 1961, *Terminal Education Age Tables*.
NOTE.—Parentheses indicate small base numbers.

account for a fraction of the actual increase in women's participation since World War II.

To isolate the direct effect of education on women's work (rather than its effects via wages), we included in our regressions a variable that reflected the minimum compulsory school-leaving age for the cohort in question. We also included as an alternative the proportion of the cohort with A-level standard qualifications or above (higher secondary) (from the *Qualified Manpower Tables* of the 1971 census). Both were highly correlated with the trend, and it proved impossible to detect a distinct education effect.

Early unemployment and wartime work experience. Past job rationing may influence present activity. If a cohort experiences severe job rationing early in life, it fails to acquire human capital in a way that our wage series (which are not age specific) fail to identify. In addition, the cohort's perception of job opportunities may be permanently affected, even if actual job opportunities are not. We therefore include as a variable the average percentage unemployment rate during the years when the cohort was age 15–24.

The Second World War enormously increased women's participation in all kinds of work. Female employment rose by about 45% between 1938 and 1943, and then after the war returned to about halfway between its prewar and wartime levels. The experience of warwork led many women (especially in their twenties) to acquire skills they would not otherwise have acquired. This must have made many of them more willing to work later. We therefore include as a cohort variable the number of wartime years experienced by cohorts when they were between 20 and 29.

Real wages. The variables mentioned so far are not going to do very much to explain the strong trend in the coefficients on the cohort dummies. An obvious candidate for this job is real wages. From cross-

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sectional work we have some a priori expectations about the effects of wage changes. If the man's wage increases, the wife's labor supply will fall. But if the wife's wage increases, her labor supply will increase, and this effect is usually found to be sufficiently strong to ensure that an equiproportional increase in husband's and wife's wage will lead to a net increase in the wife's labor supply. It may of course be the case that labor supply depends in part at least on individual wages relative to the general average. If this is so, the cross-section estimates of wage effects will exceed in absolute magnitude the time-series effects.

In time series, men's wages and women's wages are highly correlated (for 1950–74, $r = .99$, and each is nearly as highly correlated with time). Thus it is not easy to distinguish their separate effects, although one may still be able to estimate the net effect of a rise in the *general* level of real wages.

In our regressions we experimented with earnings when the cohorts were age 20 and again when they were 35. We also included the level of men's pay relative to women's at both ages.

Trend. Finally there may be omitted trended variables that help to explain the upward tendency in participation (e.g., social attitudes, better health). The natural way to allow for this is to include a time trend: the date of birth of the cohort. There are many other variables we would have liked to include that may or may not be adequately proxied by a time trend. Notable among these are child-care facilities and the prevalence of family breakup, both of which involve several elements that are not systematically recorded.[21]

Results of Analysis of Cohort Dummies

We can now turn to table 9, which is estimated with an autoregressive error. Column 1 shows a simple time trend, plus the effects of the war and of early unemployment, which are as expected. The time trend is .57% per year. Column 2 drops the time trend and replaces it by the wage level when the cohort was 35. This highly trended series implies a wage elasticity (at average participation) of .36, which compares with the cross-sectional elasticity computed by Layard, Barton, and Zabalza (1980) of .21 for an equiproportional increase in husband's and wife's wages. Thus one might say that the cross-sectional estimate "explains"

[21] For broken families we only know the proportion of women *currently* divorced or widowed. The former was still quite small in 1974, reaching a maximum of 3.8% in the 32–36 age bracket. The number of widows has been falling and in 1974 was 5% at 48 years and 12% at 56. There are no good time series on the proportion of lone women with children, but in any case they are a small proportion of all mothers (7% in the 1975 General Household Survey). If they were to be adequately treated, we should also have to bring in their income maintenance opportunities (see Horton 1979).

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roughly half the time series changes. The next step, however, is to see whether the time series can yield their own estimate of wage elasticities when some reasonable allowance has been made for the effect of other trended variables. Thus in column 3 we include both a time trend and the wage variable and let them fight it out. The result is that the wage effect falls by about one-fifth of itself, and the time trend is correspondingly about one-fifth of .57% per year. However, we do not want to put too much weight on these results, given the high correlation of this wage variable and the trend.

In the rest of the table we explore other variants. Column 4 adds the wage of men relative to women at age 35—with significant effects of a perverse sign. However, the wage ratio at age 20—reflecting the big differences between the wage ratio for cohorts beginning work before and after World War II—does yield a negative sign, shown in column 5. This variable is highly correlated with the unemployment level in early life and greatly reduces the measured impact of the latter. The *t*-value is higher on the wage ratio at 20, but one cannot be very confident about which variable is playing the greater role. The remaining columns of the table show perverse signs on the level of the wage at 20.

IV. Some Demand-Side Issues

We turn now to the demand side. There is a major puzzle here for economic theory, which we feel is worth airing. As a result of the Equal Pay Act, between 1973 and 1976 the relative wage of women rose by 15% and stayed there. Most economists would have predicted that in the private sector at least this would reduce the relative employment of women. But no such result occurred. Why was this?[22]

A possible explanation is that two acts were passed in 1970: the Equal Pay Act and the Sex Discrimination Act. The latter outlawed any discrimination in employment practices (especially hiring and firing) on grounds of sex or marital status. If there had formerly been massive discrimination in employment, which was suddenly reduced in 1976 when the Sex Discrimination Act became operative, this could have offset the effect of the Equal Pay Act, as it was intended to. However, the impact of the Sex Discrimination Act is not generally believed to have been large, and the number of cases brought to tribunals has been quite small.[23] The number of cases under the Equal Pay Act has also

[22] For a further discussion of this issue see Zabalza and Tzannatos (1983).

[23] On average, the annual number of applications has been around 200, the number of cases actually heard around 80, and the number of cases upheld around 15. For this reason we reject the approach of Landes (1968), which argues that if employers are faced with a cost if they discriminate against women this will raise their demand price for women.

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Table 12
The Composition of Employment (Employees Only)

Year	Whole Economy: Female Hours / Male Hours (1)	Whole Economy: Demand Index (2)	Proportion of Women in Private Sector (3)	Proportion of Men in Private Sector (4)	Private Sector: Female Hours / Male Hours (5)	Private Sector: Demand Index (6)
1950	.412	.377	.762	.688	.457	.408
1951	.413	.379	.763	.691	.456	.408
1952	.405	.375	.757	.687	.446	.402
1953	.409	.378	.760	.689	.452	.405
1954	.409	.379	.761	.692	.450	.404
1955	.404	.377	.762	.698	.441	.399
1956	.403	.378	.757	.698	.437	.398
1957	.400	.383	.754	.703	.428	.401
1958	.396	.383	.747	.698	.424	.401
1959	.393	.387	.743	.701	.416	.403
1960	.393	.388	.745	.711	.412	.400
1961	.392	.390	.739	.712	.407	.399
1962	.392	.394	.734	.711	.405	.402
1963	.388	.397	.728	.710	.398	.403
1964	.386	.399	.728	.717	.392	.402
1965	.388	.401	.723	.719	.390	.400
1966	.398	.404	.715	.720	.395	.400
1967	.398	.405	.699	.712	.391	.398
1968	.403	.410	.700	.713	.395	.399
1969	.405	.412	.691	.712	.393	.398
1970	.415	.415	.682	.712	.397	.397
1971	.412	.420	.667	.713	.398	.394
1972	.432	.428	.668	.710	.406	.401
1973	.435	.427	.662	.713	.404	.397
1974	.449	.420	.686	.725	.425	.396
1975	.469	.428	.642	.699	.431	.393
1976	.470	.445	.618	.700	.415	.407
1977	.476	.444	.619	.704	.419	.406
1978	.482	.450	.622	.704	.426	.413
1979	.492	.451	.619	.699	.435	.414
1980	.505	.456	.612	.688	.443	.418

SOURCES.—Column 1: total employment: *DE Gazette*. Percentage part-time, census year 1951: census; 1961–66: Department of Employment and Productivity (1971); 1971: census, assuming those with hours not stated are self-employed; and 1981: census; intercensal years to 1971: linear interpolation; *General Household Survey* used to interpolate between 1971 and 1981. Hours per person, to 1970, April survey of manual workers grafted onto *New Earnings Survey* (1970–81) manual workers. Column 2: $\Sigma_i\,(F_i/M_i)_{70}(M_{it}/M_t)$, where M_i is male employment in the ith industry, and F_i is female employment, the resulting measure being standardized to equal col. 1 in 1970. Columns 3 and 4: *DE Gazette*, employment by industry tables (private sector = agriculture, manufacturing, construction, distributive trades, insurance, etc., and miscellaneous services). Column 5: cols. 1, 3, and 4. Column 6: as col. 2 but for the restricted range of industries.

been fairly small,[24] but then one should bear in mind that collectively bargained pay is more visible and any one case will affect more people.

To investigate these issues, we first calculate the relative employment of women and men in man-hours (see table 12). The results of this

[24] In the first year (1976), there were 1,742 applications, 709 cases heard, and 213 upheld; in 1982 these numbers had fallen to 39, 13, and 2, respectively.

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exercise will surprise many people. They indicate that the proportion of hours contributed by women fell somewhat from 1951 to the mid-1960s and rose sharply only during the 1970s when the rise was continuous (see table 12, col. 1). The reason is that the number of full-time women workers fell slightly, while the number of male workers rose sharply and more than enough to offset the rise in part-time workers.

Turning to the explanation of labor demand, the most obvious influence to examine first is the effect of changes in the pattern of employment between more and less female-intensive industries. We do this by means of an index in which the female/male ratio in each industry (assumed constant) is weighted by the (changing) fraction of all males working in that industry.[25] This index is shown in table 12, column 2. There was a steady rise in the female intensity of the structure of the economy, but at a much more rapid pace in the 1970s than earlier. During the 1970s the index rose by 4.5 percentage points, reflecting the vast expansion of service industries. But the actual ratio of woman-hours to man-hours rose twice as much as this, by nine points. Thus there were also sharp increases in the proportion of women workers within each industry, in spite of the sharp rises in women's pay.

One might not perhaps be surprised by this if it happened in the public sector. So let us see what happened in the private sector (cols. 5, 6). The structure of demand index for the private sector rose very little, reflecting only a mild shift toward private rather than public services. But the actual ratio of female to male employment rose quite sharply. So our puzzle holds even when we confine our gaze to the private sector.

To see whether we could resolve the puzzle we did some very crude regressions for the private sector, shown in table 13. In the first of these we regressed the employment ratio on the structure of demand, vacancies, time, and the wage ratio. The coefficient on the wage ratio was highly significant but of the wrong sign. This confirmed the results of earlier work in which it proved possible to estimate a sensible demand system for labor in manufacturing up to 1969 (Layard 1982) but impossible to extend the work into the 1970s. The only way to save the situation is to introduce dummies to represent the effect of the Sex Discrimination Act. This is done in column 2. The dummy allows for anticipatory effects and takes the value $\frac{1}{6}$, $\frac{2}{6}$, $\frac{3}{6}$, $\frac{4}{6}$, $\frac{5}{6}$, and 1, respectively, in each year from 1971 to 1976, and 1 thereafter. The result is that the wage becomes significantly negative, but a huge and implausible effect has been attributed to the Sex Discrimination Act.

[25] The index is thus $\sum_i (F_i/M_i)_0 (M_{it}/M_t)$. The rationale is as follows. Suppose the demand function in each sector is $(F_{it}/M_{it}) = a_i f(R_t)$, where R_t is relative wages. Hence $(F_{it}/M_{it}) = (f(R_t)/f(R_0))(F_i/M_i)_0$ and $(F_t/M_t) = \sum (F_{it}/M_{it})(M_{it}/M_t) = (f(R_t)/f(R_0)) \sum (F_i/M_i)_0 (M_{it}/M_t)$.

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Table 13
Regressions to Explain Log Female/Male Employment Ratio in Private Sector

	1	2
Constant	.59	−.29
	(1.41)	(.92)
Log demand structure index	.63	.49
	(1.25)	(1.46)
Log vacancies	.04	−.01
	(1.93)	(.60)
Time	−.01	−.01
	(5.16)	(9.09)
Log female/male hourly earnings	.80	−.76
	(4.59)	(2.62)
Dummy for Sex Discrimination Act		.28
		(5.85)
$\bar{R}^2$	.70	.87
DW	.66	1.32

NOTE.—*t*-statistics in parentheses. Vacancies are vacancies/employment, where vacancies have been adjusted from 1974 onward using the Confederation of British Industry series on labor shortages. The dummy is described in the text. Dependent variable is log of table 12, col. 5.

Appendix A

Cross-sectional Supply Responses

Table A1 shows the main elasticities that have been estimated on British data for married women. In addition Joshi (1984) estimated for nonmarried women that the net supply response is .32 (.40 − .08). This may be biased upward since the imputed wage is based on work experience.

To obtain a net supply response for all women (married and nonmarried) one should note that about one fifth of women ages 20–59 are nonmarried.

The work of Blundell and Walker (1982) does not use data on nonparticipants and is not therefore quoted.

Appendix B

Sources of U.K. Official Statistics

For the most part we have used material which refers to that part of the United Kingdom known as Great Britain, namely, England, Wales, and Scotland but not including Northern Ireland. A source frequently cited is the *Gazette* of the Department of Employment (DE) and its predecessors. The monthly publication has been known as the *Employment Gazette* since 1971, *Employment and Productivity Gazette* from 1964 to 1970, and the *Ministry of Labour Gazette* before that. We refer to it in all these incarnations as *DE Gazette*. The Department of Employment and its predecessors also produce, annually, another series which we

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Table A1
Elasticities of Participation of Married Women

	Source	Own Wage	Husband's Wage/Earnings	Unearned Income	Net Effect
1. Layard et al. (1980)	1974 GHS	.49	−.28	−.04	.17
2. Arrufat and Zabalza (1983)	1974 GHS	1.41	−.93	−.14	.34
3. Zabalza (1980)	1975 GHS				.06
4. Greenhalgh (1980)	1971 GHS	0.36	−0.35		.01
5. Greenhalgh (1977)	1971 census	1.35	−.88	−.23	.24
6. Joshi (1984)	1980 Women and Employment Survey	0.87	−.28		.59

NOTE.—Models:
1. Logit model of participation.
2. Maximum likelihood on hours of work (including zero). This supercedes Zabalza (1983).
3. OLS model of participation.
4. OLS model of participation.
5. OLS on participation rates.
6. OLS on activity (0/1 dummy). The wage was imputed on basis of actual work experience, which may impart upward bias to wage elasticity.

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have quoted by the year when its data were collected (in April), the *New Earnings Survey.*

We have also made extensive use of a large number of census reports from successive decennial censuses of population, 1851–1981; there was also one midterm census in 1966 for a 10% sample. The organization currently (i.e., since the census of 1971) responsible for conducting the population census in England and Wales is the Office of Population Censuses and Surveys (OPCS). They produce the published *Tables for England and Wales and for Great Britain* (incorporating material collected in Scotland by the General Register Office, Scotland). These tables are published in a number of volumes for each census by HMSO in London. We have principally used those tables concerning occupation, and latterly, economic activity. Where necessary, we have consulted tables published by HMSO in Edinburgh to collect information from the Scottish census to amalgamate with data published separately for England and Wales. The OPCS was preceded as the "author" of the census of England and Wales by an organization known as the General Register Office. The author of censuses from 1861 to 1921 appears as Census of England and Wales, and for 1951 as Census of Great Britain.

HMSO also publishes for the OPCS series which we have cited: *General Household Survey* and *Birth Statistics* (annually), and *Population Trends* (quarterly).

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