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An economic analysis of fertility and female labour force participation in New Zealand

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ABSTRACT

This paper focusses on the regional variation in female labour force participation rates and fertility in New Zealand. The paper progresses beyond earlier work by pooling regional cross-sections of three censuses, by addressing causality in the linkage between fertility and labour force participation explicitly and by testing for structural change in the behavioural equations. The empirical results provide support for the neoclassical demand system approach to fertility and labour force participation, in which both are influenced, but in opposite ways, by income and prices (primarily the real wage) and a range of socio-economic controls, which account for regional composition and demand-side effects.

It is also found that female labour force participation and fertility became less elastic with respect to male income and the female hourly wage over the 1976-86 decade. This phenomenon is attributed to sharply rising female labour force participation, a decline in the TFR, a greater time input of males in non-market work and changes in the home production technology.

KEYWORDS

Labour Force Participation; Fertility; Time Use; Census Data.

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1. Introduction

Fertility and female labour force participation are among the topics routinely covered in studies which analyse demographic trends in New Zealand (e.g. Population Monitoring Group, 1985; ESCAP, 1985). With the development of the "New Home Economics" (e.g. Becker, 1981) economists have suggested that labour force participation, fertility and other demographic phenomena, such as marriage and divorce, are all endogenous components of the same microeconomic model. This approach has not been adopted in New Zealand empirical research. While there have been a number of studies of labour force participation, such as Hyman (1979) and more recently Harris and Raney (1991), these consider the presence of children in households as an exogenously determined explanatory variable. Little has been done to establish how economic conditions affect fertility itself. However, Hockey and Khawaja (1984) found that the participation of a woman in the labour force negatively affected fertility in a regression model of sub-national differentials in fertility. Hence the question arises whether there is a causal relationship between fertility and labour force participation and, if so, in which direction the causality runs.

The objective of the present paper is to reconsider the determinants of sub-national variability in fertility and female labour force participation and the relationship between these two by means of regression models. The study departs in three ways from previous research in this area in New Zealand. First, the data are obtained by pooling information from three consecutive population censuses rather than being extracted from a single census. Second, the simultaneity and causality of the relationship between fertility and labour force participation is explicitly considered. Third, some attention is paid to the econometric issues implied by the nature of the data, specifically the presence of heteroscedasticity and a time-varying structure in the model.

It is accepted that the use of regional aggregates reduces the power of tests of postulated micro-level behaviour but samples of individual records of census data, which are now routinely used in studies of labour supply abroad, are unavailable in New Zealand. High-dimensional census cross-tabulations are costly to obtain. In contrast, regional aggregates are readily available. Moreover, the present study, by using such data, allows a direct comparison with earlier work.

The next section reviews briefly the microeconomic framework which can be used to explain fertility and labour force participation. Section 3 describes the data, while regression models are reported in Section 4. The penultimate section returns to the issue of causality in the relationship between fertility and female labour force participation. The last section sums up and suggests topics for further work in this area.

2. Theoretical considerations

The notion that demographic phenomena can be studies within a standard neoclassical microeconomic framework was first made explicit by Becker's (1960) study of fertility. Becker interpreted, rather inelegantly, children as both durable consumption and production commodities and suggested that a higher income would lead to the demand for a higher quantity and quality of children, but with the income elasticity of quality exceeding that of quantity.[1] Since empirical evidence often pointed to a negative relationship between income and fertility (e.g. Simon, 1974), this contradiction with the early theory was subsequently resolved by taking account of the fact that the raising of children requires time as well as money. Since any in the household produced final commodities (meals, recreation etc.) require such inputs of time and market goods (Becker, 1965), increases in income raise the shadow price of time and may lead to a substitution away from time-intensive activities, among which the rearing of children (e.g. Schultz, 1974). This idea can be applied to related questions of the division of labour within the household, marriage and other demographic phenomena and these issues have been fully explored in the New Home Economics (Becker, 1981; Cigno, 1990). The prediction of this theory regarding the relationship between income earned by males, the wage available to females and fertility was first empirically confirmed by Willis (1973); and subsequently for a sample of ten countries by Siegers (1987).

The traditional model of the allocation of time in the family applies by no means to all households. The proportion of households which consists of a couple with one or more children dropped in New Zealand from 45.4 percent in 1971 to 37.6 percent in 1986. However, including single parent and multiple family households, families with children accounted for just over one half of all households in 1986, with the percentages for Maori and Pacific Island households being much higher: 73.3 and 82.4 percent respectively. While the model discussed below refers to the traditional case, the implications for other family types such as single parent families are discussed where appropriate.

Formally stated, a family will aim to maximise a utility function

$$U=U(Z_C,Z_G) \qquad (1)$$

where Z_C refers to the desired number of children and Z_G to a composite bundle of final untraded consumption commodities. Both children and consumption commodities are enjoyed by combining inputs of market goods and time according to constant returns to scale production functions

[1] See e.g. Bagozzi and van Loo (1979) for an overview of the literature on the notion of children as consumption items.

$$Z_i = f_i (X_i, T_i^M, T_i^F) \qquad (2)$$

where X_i is a composite bundle of market goods, T_i^M is time of male and T_i^F time of female in the production of Z_i (i=C,G). There are two budget constraints. One relates to market income and expenditure

$$Y = p_C X_C + p_G X_G = w^M T_L^M + w^F T_L^F + V \qquad (3)$$

where money income is obtained through the male working T_L^M hours at wage w^M, the female T_L^F hours at wage w^F and V is other income. The income is spent on market goods with price indices p_i (i=C,G). The second constraint concerns the allocation of time:

$$T_C^M + T_G^M + T_L^M = T_C^F + T_G^F + T_L^F = T \qquad (4)$$

with T being the maximum time available to either partner. Since market income depends on hours worked, it is useful to consider full income I, i.e. that income that might be potentially earned by both partners if they both worked full-time in the market. Hence,

$$I = T\, w^M + T\, w^F + V \qquad (5)$$

If π_C and π_G are the full shadow prices of a child and a unit of other goods respectively, they can be computed by

$$\pi_i = \frac{w^M T_i^M + w^F T_i^F + p_i X_i}{Z_i} \qquad i = C,G \qquad (6)$$

and hence

$$I = \pi_C Z_C + \pi_G Z_G \qquad (7)$$

The exogenous factors in this model are w^M, w^F, p_C, p_G, V, the household production technology and the preferences schedule. The elasticity of the parent demand for children with respect to the wage rate of the female, male and their other income,

$\eta Z_C w^F$, $\eta Z_C w^M$ and $\eta Z_C V$ respectively, can be decomposed by means of the standard Slutsky equations in a compensated price effect and an income effect. The effects on female labour force participation follow then by considering the effect of a change in the demand for children on the shadow price of a woman's time. At the aggregate level, an increase in the shadow price of time reduces the proportion of women for whom the market wage exceeds the opportunity cost of time. Thus, as noted already by Mincer (1963), the effect on female participation of an exogenous price or income shock is therefore in the standard static neoclassical model the opposite of that on the demand for children. Indeed, the demand for home time (the negative of the demand for hours worked) and the demand for children can be interpreted as being part of the same complete consumer demand system and there is no direct causality between these two endogenous variables in the static model. Yet labour force participation can be adjusted in the short-run much more readily to a shock in the labour market wage than the actual number of children and participation may therefore be conditioned by the presence of young children. Increasing fertility would then cause a decline in participation. An alternative view is that a woman's current labour force participation may postpone childbearing in anticipation of an increased probability of unemployment and a decline in pay and conditions that may follow maternity leave. Increasing participation would in this case cause a decline in fertility. We will turn to empirical aspects of this issue in Section 5.

Returning to the static model, the equation for the effect of a change in the wage of the female on the demand for children is as follows (see also e.g. Schultz, 1981):

$$\eta Z_C w^F = \eta Z_C \pi_C \left(\frac{T_C^F w^F}{\pi_C Z_C} - \frac{T_G^F w^F}{\pi_G Z_G} \right) + \eta Z_C I \frac{T_L^F w^F}{I} \qquad (8)$$

Given a standard preference schedule, the own-price effect $\eta Z_C \pi_C$ is negative and the income effect $\eta Z_C I$ is positive. While, as noted earlier, traditional role patterns and nuclear family type households are becoming less common, it is still plausible to assume that children are on average intensive in their mother's time. Hence the female time share of the full cost of children exceeds the average value share of her time in all household commodities taken together. This implies that $T_C^F w^F / \pi_C Z_C > T_G^F w^F / \pi_G Z_G$ and the negative price effect and the positive income effect result together in an indeterminate sign for the uncompensated price effect $\eta Z_C w^F$.

However, some firmer predictions can be made when the role of female labour force participation is considered. If the shadow price of the female's time (evaluated by means of the dual optimisation problem) exceeds the market wage, she will not

participate and provide zero market income. In this case, an increase in the female wage generates only a price effect: $\eta Z_C w^F$ is negative. In the aggregate, the reallocation of household resources away from children generates a situation in which the market wage may now exceed the opportunity cost of time for some women and labour force participation increases. For women who are already in the labour force there is the possibility of a backward bending supply curve, but we shall not consider a model for hours worked.[2] If most women work full-time, it is possible that the income effect of the demand for children outweighs the price effect at the aggregate level, despite the likely low income elasticity of the demand for the quantity of children. On balance, though, we expect a negative effect of w^F on the demand for children and a positive effect on female labour force participation.

The magnitude of the effect of w^F on the demand for children may change over time. Juster and Stafford (1991) recently noted that certain observations about the allocation of time in a household can be explained by changes in the household production technology, specifically the elasticity of substitution between time and market goods in the production functions (2). Similarly, (8) shows that secular changes in the contribution of female market income to full household income also affects $\eta Z_C w^F$. The regression models in this paper will provide some empirical evidence of time-varying coefficients in the New Zealand case.

Similar arguments can be put forward for the effect of an increase in the male wage on the demand for children, where

$$\eta Z_C w^M = \eta Z_C \pi_C \left(\frac{T_C^M w^M}{\pi_C Z_C} - \frac{T_G^M w^M}{\pi_G Z_G} \right) + \eta Z_C I \frac{T_L^M w^M}{I} \qquad (9)$$

Is is plausible that $T_C^M w^M / \pi_C Z_C < T_G^M w^M / \pi_G Z_G$ when men spend relatively less time with their children than women. In this case the effect of an increase in the male wage on the demand for children is conclusively positive since the price effect and income effect are now both positive. The effect on female labour force participation of an increase in the male wage is also quite determinate: it leads to an increase in the demand for all normal final household commodities (including children) and raises therefore the shadow price of the woman's time. Consequently, the proportion of women for whom the shadow price of time now exceeds the market wage goes up and the rate of female labour force participation declines.

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[2] See Harris and Raney (1991) for New Zealand estimates of the elasticity of the female wage on hours worked.

Finally, the effect of a change in other income on the demand for children is given by

$$\eta Z_C V = \eta Z_C I \frac{V}{I} \qquad (10)$$

Hence, the effect of a change in other income on the demand for children is positive, but the elasticity is expected to be quite small since for most households with women of childbearing ages income from non-human wealth is only a small proportion of full income. Among those for whom non-market income is the main source of income, there would be many single parent households who would receive the domestic purposes benefit or other social security benefits and for whom, following an increase in benefit payments, an adjustment in fertility is obviously less likely than an adjustment in expenditure per child. Moreover, we noted already that the income elasticity for the quantity of children $\eta Z_C I$ is itself small. However, it must be assumed here that the amount of other income is exogenous and not related to the amount of time allocated to market work.

The reasoning above regarding fertility, labour force participation and the allocation of time is usually extended by considerations regarding "child supply" conditions and labour demand. A first point to note is that slackness in the regional labour market may generate the well known added worker and discouraged worker effects. The former refers to the increased participation of women whose spouses are actually unemployed, or are exposed to an increased risk of unemployment. The latter effect takes place when, in a slack labour market with a high unemployment rate and a condensed distribution of job offers, the cost of job search is high and the benefit of search is low (through a reduction in the mean of the wage offer distribution) to the extent that some women will no longer be actively seeking work. In that case they withdraw from the labour force and participation declines. Although Rankin (1991) argues that the added worker effect has at times led to a considerable increase in female labour force participation in New Zealand, the consensus from the international literature is that the discouraged worker effect outweighs the added worker effect.[3] The coefficient of the unemployment rate in the labour force participation equation is therefore likely to be negative. Based on the static allocation of time model, one may therefore expect a positive coefficient of unemployment in the fertility equation. However, a contrary view arises when we introduce a distinction between a transitory and a permanent component of income. Transitory income has here the conventional meaning of the deviation of actual income from permanent income, which in turn is the expected return to human and non-human wealth. A decline in transitory income is likely to lead to a postponement in the demand for children. Since the observational unit in the present paper is a region,

[3] See Hyman, 1979, pp.116-117, and the references mentioned there.

median income of the regional labour force may be interpreted as a measure of permanent income, while the unemployment rate can serve as a proxy for transitory income. Following this argument, the effect of high unemployment on fertility is negative. A study of female labour force participation based on a single (1971) cross-section of regional data in The Netherlands provided supporting empirical evidence (Siegers, 1983).

Another demand effect in the labour market is the sectoral composition. Since occupational segregation has led to the majority of women being employed in the services sector, female labour force participation is expected to be higher in the regions where this type of employment takes a larger share of total employment. Consequently, the effect of this variable on fertility is expected to be negative.

It is obvious that the actual number of children and the desired number of children are not identical, even after completed fecundity. Temporary or permanent infertility may for some couples lead to an unsatisfied demand for children, despite the increasing practice of adoption of a child from generally poor countries with high fertility. At the same time, fertility control is not perfect despite the presence of effective contraceptive methods since the early 1960s. Thus, the actual number of children may, and often does, exceed the ex ante desired number. Ex post downward adjustment through abortion, or later through adopting-out or otherwise, raises many moral and ethical issues which are not discussed here. In any case, one may expect that the quality and effectiveness of contraceptives increases with the level of education of the woman (e.g. Michael, 1974). Hence, regions in which the population has an above average level of education are expected to have lower average fertility. Consequently, labour force participation will be higher in such regions, ceteris paribus. There may be four additional factors which may lead to a positive effect of education on participation. First, post-compulsory education is an investment in human capital which requires participation in paid work to reap the benefits. Second, the jobs available to the educated female may be relatively more attractive (interesting, creative) and yield positive utility. Third, the efficiency and effectiveness of job search are greater for those with higher levels of education. Fourth, education may lead to a more efficient household production technology or a modified preference schedule which induces women to substitute time at work for time at home.

Traditionally, and irrespective of the controversial issue of whether women are more efficient in allocating time to home activities than men, the shadow price of a woman's time in a partnership or family situation has at the margin tended to exceed the available wage. The persistence of a sex-based wage gap after controlling for human capital characteristics, despite equal pay and comparable worth legislation, is partly responsible for this state of affairs. In any case, the labour force participation of women who are married or in a de facto relationship is lower than of single women. This

suggests that a regional cross-section must control for marital status. It is evident that fertility is higher in regions where the proportion of females remaining single is smaller, ceteris paribus. However, given the increase in de facto relationships, nuptiality as measured by the census may be an increasingly less useful indicator of fertility behaviour.

The model above provides a role for the effect of ethnicity on the allocation of female time in a number of ways. First, there are significant ethnic variations in infant mortality with the infant mortality of the Maori being higher than of the Pakeha to the extent that in the regions in which the Maori population is concentrated, life expectancy at birth is lower than the national average (Population Monitoring Group, 1989, pp.26-27). With respect to infant mortality two mechanisms can be distinguished: the expectations mechanism and the replacement mechanism (Schultz, 1969). The first suggests that parents take full account of existing death rates. The higher infant mortality, the higher the excess of the number of births over the number of surviving children that is required to attain a desired family size. The replacement mechanism implies that parents, if a child dies, try to compensate the loss by means of an additional birth. That these mechanisms are relevant for the Maori is suggested by the observation that New Zealand Maori women do not only commence child-bearing earlier, but also continue it longer than their European counterparts (Hockey and Khawaja, 1984, p.7). On the basis of these mechanisms, we would expect that regions with high infant mortality, proxied by the proportion of the population of Maori descent, have high fertility. The resulting increase in the shadow price of time of Maori women is likely to reduce their participation, all else being equal. However, Harris and Raney (1991) found that the observed differences in labour force participation between the Maori and Non-Maori segments of the population could not be fully explained by differences in socio-economic characteristics between the ethnic groups. Ethnicity may also have a cultural influence on participation.

International studies suggest that the demand for children is affected by religious affiliation.[4] Practicing Roman Catholics tend to have generally higher fertility than non-Catholics, although there has been a narrowing of this difference. Our hypothesis is nonetheless that the regions with a disproportionately large number of Catholics would have higher fertility, all else being equal.

While for many components of consumer demand a static approach is quite adequate, fertility and female labour force participation are aspects of family behaviour which ideally warrant a longer run dynamic perspective. A dynamic optimisation approach was first attempted by Cohen and Stafford (1974) and Moffit (1984), but gained a more prominent position in the literature recently through the New Classical models of Becker and Barro (1988, 1989). In their models, the utility of parents does not

[4] See the studies referred to by Hockey and Khawaja (1984, p.8).

only depend on a couple's own consumption and the number of children they have, but also on the utility of each child, i.e. parents are altruistic. This implies that the welfare of all generations of a family are linked through a dynastic utility function that depends on the consumption, fertility and number of descendents in all generations. The head of such a dynastic family would act as if he or she maximises dynastic utility subject to a resource constraint based on inherited wealth, the cost of rearing children and earnings. In this model, fertility depends positively on the real interest rate and the degree of altruism and negatively on the rate of technical progress. A permanent change in these variables has a permanent effect on fertility. Permanent declines in child mortality, in the cost of raising children and in the level of social security benefits all increase fertility, but in each of these cases it can be shown that the effect on fertility is only temporary. As before, higher fertility makes a claim on the time available for work and reduces the average propensity of females to participate in the labour force.

While theoretically appealing, this new dynamic theory cannot be fully tested with the data used in the present paper. One reason is that real interest rates do not vary across sub-national regions and there is also no regional variability in social security benefits, at least in the New Zealand context. The pooling of three consecutive censuses can also hardly be considered a test of a dynamic theory and, in any case, the regional variables are measured in deviations from the sample mean for reasons which will be elaborated in Section 3. Nonetheless, the theory does provide pointers to which regional characteristics may contribute to interregional variability in fertility. First, similarly to the notion that preferences may vary between ethnic groups, this could also be true with respect to the degree of altruism and this suggests again that the ethnic composition of regions may affect fertility and labour force participation. Ethnic composition may here also again affect these variables through ethnic differences in infant mortality.

An additional variable emerges when considering that the model predicts that fertility tends to be lower in regions with faster economic growth. In a cross-section, these tend to be the more urbanised regions because positive externalities are responsible for the increasing returns which are a major factor in real income growth (e.g. Lucas, 1988) and which are primarily found in cities (e.g. Jacobs, 1984). Moreover, the direct resource costs of children are likely to be higher in urban areas than in rural areas. Schultz (1969) gives three reasons. First, the direct cost to feed and lodge a large family is likely to be higher in an urban area. Secondly, compared with the family farm there is less opportunity for urban children to be productive in a family business. Third, urban parents invest more in child quality through seeking advanced public or expensive private education.[5] Thus, higher urbanisation is expected to reduce fertility and indirectly

[5] Children are also more expensive in urban areas than in rural areas because urban wages tend to be higher and therefore the shadow price of the female's time is higher in urban areas. However, this effect is in our model of course measured directly by the wage variable.

increase female labour force participation. Similarly, there are a number of reasons why there is a direct positive effect of urbanisation on participation. First, females are segregated in occupations for which there are relatively more jobs in the larger urban areas. While this effect may be partly captured by a variable measuring the percentage of women in the services sector, there is also a greater supply of part-time and shiftwork-type jobs in the larger urban areas, which may also increase female participation. Second, there are also better child care facilities in the larger centres. Finally, a relatively large proportion of males in rural areas is employed in agriculture. While many of their spouses may carry out tasks on the farm, they may be counted in the census as persons carrying out "unpaid household duties" rather than being a "relative assisting unpaid". This reduces the measured labour force participation in rural areas.[6] Hence, the degree of urbanisation is a final possible explanatory variable of fertility and labour force participation with a negative effect on the former and a positive effect on the latter.

3. The data

Previous research in New Zealand on fertility and female labour force participation has been hampered by a lack of data. Hyman (1979) examined the variation in female labour force participation across the Main Urban Areas in New Zealand in 1971. Her statistical inference was therefore based on 24 observations. Hockey and Khawaja (1984) examined sub-national differentials in New Zealand fertility in 1976 using a range of definitions of regions, namely Local Government Administrative Regions (19), Main Urban Areas (24) and a type of rural regions (19). Hence, their analysis was based on a single cross-section of at most 24 observations.

It has proved possible, however, to compile a data base from the 1976, 1981 and 1986 population censuses based on socio-economic characteristics of the 22 Local Government Regions as they were defined in the early 1980s. Consequently, 66 observations were available.[7] The regions used in 1976 were 22 United Council Areas which were not identical to, but largely overlapping the subsequent Local Government Regions. There have been a number of relatively minor differences in the questions and coding of the relevant census information. Such changes may affect the comparison of levels of variables across censuses and to ensure intertemporal consistency, all regional observations were therefore standardised within each census file.[8] Hence if x_{irt} refers to an observation for variable i in region r and census t, the regression models use $x^{*}_{irt} =$

[6] The large urban areas also attract a disproportionally large share of immigrants, who tend to have above average labour force participation. However, this tends to be mainly the result of differences in age-composition between the immigrants and the locally born reference group (e.g. Poot et al. 1988, pp. 27-29) and age-composition is in our model explicitly taken into account.

[7] A diskette with the full data set is available from the authors upon request.

[8] There was therefore no need to deflate nominal income and wage observations.

$(x_{irt} - m_{it})/s_{it}$ where m_{it} and s_{it} are the mean and standard deviation respectively of variable i across regions in census t.

All published census data were mainly obtained from Lowe (1983, 1988) and Department of Statistics (1982, 1987). The endogenous variables in the model are female labour force participation and fertility. When considering regional variations in participation, we must take account of the effect of age-composition since female labour force participation exhibits a well known and pronounced bi-modal age profile (e.g. Poot, 1988). Hence the participation variable is defined as the difference between the observed female labour force participation rate and the age-expected female labour force participation rate. The observed participation rate is the fraction of women aged 15 years and over who are in the labour force. The labour force consists of all females working one hour or more per week for pay, profit or as relative assisting, plus those actively seeking work.[9] The age-expected regional participation rate is computed by assuming that age-group by age-group the female labour force participation rate in a region is identical to the corresponding national rate. The difference between the actual rate and the age-expected rate measures simply the regional variability in participation which cannot be attributed to age-composition.[10]

The theoretical model also yields predictions regarding hours worked by females. The determinants of hours worked in the female labour force have been explored by Harris and Raney (1991) using disaggregated 1986 census data. However, there was insufficient information to estimate hours worked equations with our pooled cross-section time series data.

Fertility is measured by the regional total fertility rate (FERTRT). This is the average number of births a woman would have during her reproductive life if she was exposed to the fertility rates characteristic of various childbearing age-groups for a given region in a given year, i.e. the total fertility rate is the sum of the age-specific fertility rates. The 1981 data were published in Department of Statistics (1989), while unpublished information was provided by the Department for 1976 and 1986. Our fertility variable is preferred to a census measure of fertility, such as the number of infants in the region at the time of the census divided by the number of women aged 15 to 45, because such measures are sensitive to the age-composition of the regional population.

The theoretical discussion suggested the following explanatory variables:

MYMALE: Annual median income of males in receipt of income. This variable measures the combined effect of male wage income and other household

[9] There was no regional information on persons working 19 hours or less in 1976, hence these persons are excluded from the participation rate computations for 1976.

[10] The alternative way of dealing with age-effects is to introduce the percentage of females in various age groups as explanatory variables. This is less attractive in macro-level studies since such an approach takes up a considerable number of degrees of freedom and can lead to severe multicollinearity.

income since it is likely that traditionally any income a household received from assets would have been reported in the majority of cases by the male census respondent.

FEWAGE: The average hourly earnings of females employed full-time.

FUNEMR: The number of females unemployed and seeking work, divided by the female labour force.

ESERVI: The fraction of the full-time labour force employed in services.[11]

TEREDU: The fraction of the population that attended a form of post-secondary education.[12]

FNUPTI: The fraction of women aged 15 years and over that is married.

MAORIR: The fraction of the population that is half or more of Maori descent.

ROMCAT: The fraction of the population that is Roman Catholic.

URBANI: The degree of urbanisation measured by the fraction of the population living in municipalities of 10,000 people and over.

Table 1 summarises the expected signs of the effects of the explanatory variables. Given that fertility and female labour force participation are assumed to be part of the same demand system, we expect the effect of a variable on labour force participation to be of opposite sign of the effect of this variable on fertility. If there would be a direct causal relationship between fertility and female labour force participation, and assuming that this relationship can be identified, estimation of the reduced form may result in coefficients of which the signs of some are the opposite of those given in Table 1. This causality issue is addressed in Section 5.

Table 1: Expected Signs of Coefficients in Regression Models

	FLFPRT	FERTRT
MYMALE	-	+
FEWAGE	+	-
FUNEMR	-/+	+/-
ESERVI	+/-	-/+
TEREDU	+	-
FNUPTI	-	+
MAORIR	-	+
ROMCAT	-	+
URBANI	+	-

[11] These are: wholesale, retail, restaurant, transport, storage, communication, finance, insurance, property, community, social and personal services.

[12] The 1986 information is actually based on qualifications gained rather than attendance. Standardisation of the data has resolved this potential problem.

4. Regression models

While the pooling of regional cross-section information has yielded considerably more observations than has been the case in earlier New Zealand work in this area, the problem remains that this macro-type of analysis can often not discriminate between competing specifications which appear equally plausible on the basis of statistical tests. A particular danger is that too much attention is paid to goodness of fit, as tends to happen for example when resorting to stepwise regression procedures. We shall resist the temptation to such data data mining and, instead, adopt the prior that female labour force participation and fertility are jointly determined by the full set of factors identified in Section 2. Including all potential variables in the regression equation has the risk of including irrelevant variables, with the consequential reduction in precision of the parameter estimates, but the strategy provides at least unbiased coefficients and a properly estimated disturbance variance (e.g. Johnston 1984, p.262). By pooling three censuses, the problem of multicollinearity has been somewhat reduced. No conclusions are drawn from coefficients which are significant above the 5 percent level.

Columns 1 and 2 in Table 2 report the initial labour force participation equation and the fertility equation respectively. As the variables are standardised, there is no constant term. Since FERTRT is not included as a variable in the FLFPRT equation and vice versa, OLS is an appropriate procedure. The two equations could have alternatively been estimated with Zellner's Seemingly Unrelated Regression (SUR) equations technique, to take account of the correlation between corresponding disturbances in the two equation-system, but it is well known that the SUR approach gives identical results in this case because the two equations use the same values for the regressors.[13] The equations can nonetheless be interpreted as a subset of a full consumer demand system since labour force participation is inversely related to the demand for time allocated to home production. To estimate the entire consumer demand system, the usual restrictions on the parameters would need to be taken into account, but in our partial approach the only prior restrictions are that some coefficients of the explanatory variables in the labour force participation equation should have the opposite sign of those in the fertility equation.

We gauge the performance of the model by noting how many of the unrestricted parameter estimates have the prior signs. Ten of the eighteen coefficients in columns 1 and 2 of Table 2 are statistically significant at the 5 or 1 percent level, and nine of these ten have the signs indicated in Table 1. The exception occurs in the fertility equation: FUNEMR has a negative effect on fertility. We suggested earlier that a negative effect of unemployment on fertility may be justified by the associated decline in transitory income.

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[13] See e.g. Judge et al. (1988, p.448).

Table 2: Regression Models

Model	1	2	3	4	5	6
Dependent Variable	FLFPRT	FERTRT	FLFPRT	FERTRT	FLFPRT	FERTRT
Method	OLS	OLS	WLS	WLS	CHTA	CHTA
MYMALE	-0.208*	-0.017	-0.373**	0.281*	-0.336**	0.227**
	(0.090)	(0.104)	(0.134)	(0.133)	(0.115)	(0.085)
FEWAGE	0.858**	0.061	1.101**	-0.247*	1.011**	-0.215*
	(0.090)	(0.105)	(0.124)	(0.123)	(0.100)	(0.103)
FUNEMR	-0.421**	-0.227*	-0.481**	-0.255**	-0.390**	-0.148**
	(0.086)	(0.100)	(0.078)	(0.077)	(0.073)	(0.044)
ESERVI	0.044	-0.318*	0.131	-0.227*	-0.006	-0.462**
	(0.122)	(0.142)	(0.107)	(0.106)	(0.097)	(0.103)
TEREDU	-0.053	-0.168	-0.098	-0.215	-0.037	0.005
	(0.111)	(0.129)	(0.109)	(0.109)	(0.092)	(0.082)
FNUPTI	-0.001	0.320**	0.032	0.220*	-0.004	0.274**
	(0.096)	(0.111)	(0.106)	(0.106)	(0.074)	(0.073)
MAORIR	-0.037	0.826**	0.033	0.914**	-0.069	0.792**
	(0.088)	(0.102)	(0.085)	(0.084)	(0.074)	(0.058)
ROMCAT	-0.197**	0.211*	-0.151*	0.254**	-0.174*	0.277**
	(0.071)	(0.082)	(0.076)	(0.075)	(0.741)	(0.079)
URBANI	0.298**	0.215	0.286*	-0.010	0.369**	0.190
	(0.110)	(0.127)	(0.112)	(0.111)	(0.087)	(0.110)
MYMA81	-	-	0.131	-0.210	0.078	-0.162*
			(0.159)	(0.158)	(0.131)	(0.079)
MYMA86	-	-	0.533*	-0.499*	0.480**	-0.365**
			(0.204)	(0.203)	(0.159)	(0.122)
FEWA81	-	-	-0.231	0.279	-0.260*	0.193*
			(0.145)	(0.144)	(0.103)	(0.083)
FEWA86	-	-	-0.619**	0.473*	-0.548**	0.311*
			(0.187)	(0.186)	(0.142)	(0.120)
R^2	0.8553	0.8048	0.9435	0.9075	0.9534[a]	0.9233[a]
s	0.3999	0.4645	0.3162	0.3141	1.0729	1.0866
ρ	-	-	-	-	0.171	0.566

[a] Buse R^2

Note: Standard Errors in Parentheses
*: $\alpha < 0.05$; **: $\alpha < 0.01$

The labour force participation equation is generally more consistent with the theory of the allocation of household time than the fertility equation: MYMALE and FEWAGE have the expected signs and are both significant at the 5 and 1 percent level respectively in column 1, but are insignificant in column 2 of Table 1. The response on labour force participation of a one standard deviation increase in the own-wage of the woman is about four times as large as the response to an increase in the wage of the partner.[14]

The female unemployment rate has a significantly negative effect on labour force participation, suggesting that the discouraged worker effect outweighs the additional worker effect, as expected. The variables ESERVI, TEREDU, FNUPTI and MAORIR are not statistically significant.[15] An interesting variable is ROMCAT, the fraction of the population that is Roman Catholic. This variable is ignored in behavioural equations of labour force participation when its effect is assumed to have been captured by the fertility rate, but in our demand system approach it is the former variable which should be included, not the latter. ROMCAT is indeed significant at the 1 percent level. Female labour force participation is also significantly greater in the more urbanised regions, as can be seen by the coefficient of URBANI. However, the strongest influences on participation are the conventional economic ones: MYMALE, FEWAGE and FUNEMR.

Moving now to the determinants of fertility, the regression for FERTRT is not as satisfactory as for FLFPRT. The coefficient of determination R^2 is about 5 percent less. There are four statistically insignificant variables: MYMALE, FEWAGE, TEREDU and URBANI. The three socio-demographic variables FNUPTI, MAORIR and ROMCAT are all significant and have the expected effects on fertility. Overall, the standard economic theory of the allocation of time is not confirmed by the fertility equation, but we shall see below that this is partly due to the neglect of a time-varying structure in the model.

Tests of the normality of the residuals in the models of columns 1 & 2 showed that there was no significant departure from normality.[16] However, cross-section data based on regional indicators often generate heteroscedastic errors in regression models. To overcome this problem, observations for the more populated regions usually need to be weighted more heavily than observations for the less populated regions.

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[14] Translating these effects back to the elasticity of the effect of the level of male income and the female wage on the percentage rate of participation, the elasticities are 3.6 and 9.5 respectively.

[15] Is can be suggested that the insignificance of TEREDU is due to the presence of FEWAGE, since education is an important component of human capital which determines the wage. However, at the macro level the two are only mildly correlated (r=0.566) and labour market search theory suggests a separate role for education, which was the reason for including the variable in equation 1.

[16] The Jarque-Bera asymptotic LM test statistic, which has here a $X^2(2)$ statistic, was computed (see e.g. Judge et al. 1988, pp.890-892). It had a value of 0.351 in regression model 1 and 0.065 in model 2, with the critical value at the 5 percent level being 5.991 (2 d.f.). Hence in neither case there was a significant departure from normality.

Standardisation of our data may have removed much of this problem. There was indeed no evidence of heteroscedasticity in model 1, since the Breusch-Pagan LM test of the effect of regional population size on the model disturbances yielded a chi squared test statistic of 1.146, which is not significant at the 5 percent level with a critical value of 3.841 with one degree of freedom (see Breusch and Pagan, 1979). In model 2 there appeared, albeit weak, evidence of population-related disturbances: the Breusch-Pagan statistic for this model was 4.053, which is significant.

It was noted in the theoretical section that the elasticity of fertility with respect to the wage of the male or female in the household is a function of their respective shares of market income in full income. It is well known that female labour force participation has increased sharply in recent decades (e.g. Revell and Brosnan, 1986; Poot, 1988). Moreover, the national TFR declined over the 1976-86 decade (Department of Statistics, 1989). Also, the contribution of males to housework and the care of children is expected to have increased.[17] Finally, there has been a well known long-run increase in the substitutability between market commodities and time in home production (e.g.associated with the introduction of microwave ovens). However, if we consider the full range of household activities, the degree of substitutability between market goods and household time may have become relatively less in the care of children than in other activities (particularly chores such as cooking and cleaning), in which case the caring for children would become a relatively more time-intensive activity. This would suggest a declining income elasticity of the demand for children. It can be easily verified by means of the Slutsky decomposition that all these phenomena imply that the elasticities of female labour force participation and fertility with respect to male income and the female hourly wage would be expected to have become smaller in absolute terms over the 1976-86 decade.

Equations 3 and 4 test if these secular trends have affected the coefficients of MYMALE and FEWAGE in the participation and fertility equations. For example, the Slutsky equations predict that when most women already participate, the income effect of an increase in the female wage becomes important. The compensated price effect remains negative as long as children take up a large proportion of the female's time. Hence we expect that the coefficient of FEWAGE in the fertility equation becomes less negative. Similarly, as women now supply a larger proportion of full income, the income effect of an increase in male income on fertility becomes less positive. The price effect, however,

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[17] While the former two trends are well documented in New Zealand, there has as yet not been a full-scale time use survey. A pilot survey was conducted in August 1990 (Department of Statistics, 1991). This survey of 418 persons suggested basic patterns of time use similar to those of other developed countries.The authors are unaware of data which from which long-run trends can be drawn. However, Juster and Stafford's (1991) literature survey reports a clear upward trend in the amount of time men devote to housework (routine chores, home projects and child care) in a range of developed countries. New Zealand would not be an exception.

remains positive as long as men devote little time to their children. The coefficient of MYMALE in the FERTRT equation would consequently become smaller. We would expect similar trends, but in the opposite direction in the FLFPRT equation. We test this by introducing time-varying coefficients for MYMALE and FEWAGE. Despite the somewhat inconclusive results of the LM tests for heteroscedasticity in models 1 and 2, it was considered prudent to control for this and Weighted Least Squares was applied with the square root of the region's population providing the weights.

The effects of introducing time-varying coefficients for MYMALE and FEWAGE are shown in columns 3 and 4 of Table 1. These were obtained by introducing the articifical variables MYMA81, MYMA86, FEWA81 and FEWA86. MYMA81 is the same as MYMALE for regional observations in census year 1981 and equal to zero for observations in the other two census years. The other three variables are defined similarly.

MYMALE and FEWAGE are now statistically significant in both equations and have the expected signs. Nonetheless, these columns show that there has been indeed a change in the wage and income elasticities on fertility and female labour force participation. As expected, the change in the fertility equation is in the opposite direction of the change in the participation equation. The coefficient of MYMALE in the participation equation (column 3) changes from -0.373 in 1976 to -0.242 in 1981 (the coefficient of MYMA81 is the marginal change) and subsequently to +0.160 in 1986. The own-wage effect of female labour force participation reduces to +0.870 in 1981 and +0.482 in 1986. In the fertility equation, the coefficient of MYMALE changes to from 0.281 in 1976 to -0.218 in 1986, via +0.071 in 1981, and the coefficient of FEWAGE changes from -0.337 to +0.032 and subsequently to +0.226. The change in 1986 is statistically significant in all cases. However, an F test of structural change in the coefficients of MYMALE and FEWAGE taken together is less conclusive: the test supported structural change in the case of the labour force participation equation, but not in the case of the fertility equation.[18]

What is puzzling is the apparent reversal of the sign of the coefficients in three of the four cases. Although the regression results are consistent with secular trends over time in the increasing participation of women, declining fertility and the more equal sharing of domestic duties, the magnitudes of such effects appear exaggerated by the model. Eventually, if men and women shared child care time equally and both worked equal hours, and the income elasticity for the demand for children is small, we would expect that the effect on the price of children of a change in the real wage outweighs the

[18] The F statistic for the FLFPRT equation was 3.18 with a critical value of 2.54 (at 5 percent with 4 and 53 degrees of freedom). The F statistic for the FERTRT equation was 2.04.

income effect and that rising real incomes and economic growth lead to a secular decline in fertility.

Given the limited number of observations, tests for time-varying coefficients in all possible variables have low power. A standard F test of different coefficients in each of the three periods was not significant at the 5 percent level in the FLFPRT equation, nor in the FERTRT equation.[19]

An alternative regression model which makes better use of the knowledge that the data consists of three vectors of census observations for 22 regions is the cross-sectionally heteroscedastic time-wise autoregressive (CHTA) model proposed by Kmenta (1986, pp.616-625). Having only observations at three points in time necessitated the assumption that the autoregressive parameter is the same for all regions and that the residuals were not cross-sectionally correlated. The results are given in columns 5 and 6 of Table 1. The procedure resulted in an autoregressive parameter of 0.171 in the FLFPRT equation and 0.566 in the FERTRT equation. Hence there are certain aspects of fertility which are not captured by the regression model, but which make fertility in certain regions untypically high or low. These factors are present in all periods. This is far less the case in the labour force participation equation. Nonetheless, the CHTA does not really yield any new or contradicting information regarding the influence of the variables considered here, since the statistically significant coefficients in the CHTA model are fairly similar to those in the WLS model.

5. Causality

The demands on a woman's time when there are small children in a household are often incompatible with paid work. It is therefore to be expected that there is a negative correlation between the presence of young children in a household and female labour force participation. In the pooled cross-sections of census data which we have used for the empirical analysis in this paper the simple correlation coefficient of the relationship between fertility and female labour force participation is -0.419. Hence age-standardised participation tends to be higher in the regions which have a lower TFR, although the correlation is not very strong (but statistically significant at the 1 percent level).

Such a correlation is in itself not informative about causation. There are four possibilities:

- The causation runs from labour force participation to fertility;
- The causation runs from fertility to labour force participation;
- There is a reciprocal causal influence;

[19] The F statistics were 1.55 and 1.21 respectively, with a critical value of 1.88 (with 18 and 39 degrees of freedom).

- Fertility and labour force participation are both influenced in opposite ways by a number of factors, without there being a direct causal relationship between the two.

As noted earlier, the last possibility was supported by Mincer's (1962) work on the United States. Mincer found that male full-time income had a negative coefficient in a regression equation for female labour force participation, while (potential) full-time income of the female had a positive effect. The signs in the fertility equation were the opposite of those in the participation equation: positive for male income and negative for female potential income. Table 2 showed that this is also true in the New Zealand case. When adding labour force participation as an additional explanatory variable in the fertility equation, Mincer found that its coefficient was insignificant and concluded that there is no direct causal relationship between fertility and female labour force participation.

Again the same is true in the New Zealand case. Taking equations (5) and (6) of Table 1 and adding FERTRT and FLFPRT respectively as regressors, neither of these two variables is statistically significant. This can be seen from columns 1 and 2 in Table 3. These results suggest that there is no "chicken or egg" problem and that Mincer's (1962) classic conclusion that fertility and labour force participation are inversely related because they are affected in opposite ways by the same economic variables has validity in the New Zealand context. As noted earlier, the explanation of this result is that the demand for children and the demand for leasure fit within the same demand system, a view expounded particularly by Schultz and Rosenzweig (e.g. Schultz, 1981; Rosenzweig and Wolpin, 1980; but see also Bagozzi and Van Loo, 1982, p.260).

However, from a stochastic dynamical perspective this view is less plausible than from the perspective of deterministic optimisation in which a couple formulates once and for all at the beginning of their relationship an optimal consumption plan, including the demand for children, the timing of labour force participation and hours supplied. In practice, participation is much easier adjusted to exogenous shocks than fertility. Desired fertility may be a control variable in an optimal consumption plan over the life cycle and actual fertility may be correlated with intentions, but there are unlikely to be smooth adjustments over time in response to exogenous shocks. In contrast, labour force participation does tend to be quite responsive to short-run labour market conditions. For example, labour shedding in New Zealand manufacturing in recent years has led to a predictable downward response in female labour force participation (Brosnan and Rae, 1991). If participation is more flexible than fertility behaviour, fertility may directly affect participation, but participation may not directly affect fertility.

Table 3: Direct Interaction Between Female Labour Force Participation and Fertility

Model	1	2	3	4
Dependent Variable	FLFPRT	FERTRT	FLFPRT	FERTRT
Method	CHTA	CHTA	3SLS	3SLS
FLFPRT	-	-0.041	-	0.429*
		(0.096)		(0.211)
FERTRT	-0.057	-	-0.025	-
	(0.096)		(0.096)	
MYMALE	-0.336**	0.226*	-0.412**	0.357*
	(0.118)	(0.090)	(0.125)	(0.150)
FEWAGE	1.007**	-0.196	0.973**	-0.504*
	(0.103)	(0.135)	(0.115)	(0.253)
FUNEMR	-0.406**	-0.161**	-0.411**	-
	(0.079)	(0.055)	(0.064)	
ESERVI	-0.035	-0.434**	-0.203	-
	(0.104)	(0.104)	(0.097)	
TEREDU	-0.029	-0.001	0.140	-0.363**
	(0.097)	(0.083)	(0.092)	(0.105)
FNUPTI	0.034	0.256**	-0.009	0.409**
	(0.090)	(0.080)	(0.088)	(0.097)
MAORIR	-0.129	0.802**	-	0.787**
	(0.110)	(0.058)		(0.105)
ROMCAT	-0.171	0.287**	-	0.142
	(0.079)	(0.078)		(0.089)
URBANI	0.386**	0.173	0.421**	-
	(0.093)	(0.117)	(0.093)	
MYMA81	0.064	-0.173*	0.047	-0.209
	(0.137)	(0.082)	(0.315)	(0.197)
MYMA86	0.482**	-0.373**	0.481*	-0.630*
	(0.165)	(0.126)	(0.184)	(0.250)
FEWA81	-0.234*	0.194*	-0.153	0.294
	(0.112)	(0.089)	(0.151)	(0.205)
FEWA86	-0.537**	0.309*	-0.501**	0.588*
	(0.151)	(0.130)	(0.184)	(0.256)
R^2	0.9444[a]	0.9223[a]	0.8564	0.7459
s	1.0850	1.0375	0.3702	0.4925
ρ	0.158	0.542	-	-

[a] Buse R^2

Note: Standard Errors in Parentheses
*: $\alpha < 0.05$; **: $\alpha < 0.01$

There are many empirical studies in which causal relationships between fertility and labour force participation are tested. Siegers (1985) found in a review of 26 of these studies that the effect of fertility on labour supply was equally likely to be significant as insignificant, while the effect of labour supply on fertility was only significant in a minority of cases. Significant effects were more likely to be found in developed countries than in developing countries. This is consistent with the conclusion of McCabe and Rosenzweig (1976, pp.144-145) that paid work and children are less compatible in developed countries than in developing countries.

In the New Zealand case, Hyman (1979) found that fertility as measured by the average number of children per married woman in a region did have a downward effect on female labour force participation, but the effect was only significant in a subset of the regression specifications considered. Hockey and Khawaja (1984) carried out many regressions of sub-national fertility in 1976, and found that three independent variables featured in all regressions: the percentage of New Zealand Maoris in the population, the percentage of females married in the 20-24 years age group and income. All three variables exerted a strong positive influence on fertility. Female labour force participation only played a role in a subset of the regressions.

To test for direct causality between female labour force participation and fertility, two equations have been estimated which adopted a traditional structural approach rather than the demand system approach. The results are in Table 3. Column 3 reports an equation for female labour force participation with eight explanatory variables, with FERTRT now being one of these. Time-varying coefficients for the male and female wage are again allowed for. The variables MAORIR and ROMCAT have now been deleted, because these would normally not be found in behavioural labour force participation models. Similarly, column 4 reports the equation for fertility, with industry composition, unemployment and urbanisation deleted as determinants, but with participation included. To allow for simultaneity between FLFPRT and FERTRT, a systems estimator is required. By imposing the a priori restrictions regarding which variables should be included in the two structural equations, both equations are overidentified and the equations can be estimated by means of 3SLS.[20]

As before, FERTRT is not significant in the equation for FLFPRT (column 3). However, column 4 displays the surprising result that female labour force participation has a positive effect on fertility, although not significant at the 1 percent level. Perhaps higher female labour force participation raises family income and makes a larger family

[20] This procedure makes the strong assumption that both equations are correctly specified and the system is considered complete. In this case 3SLS is more efficient than 2SLS (e.g. Johnston, 1984, p.489). In our case, the use of 3SLS reduced the standard error of both equations by about 8 percent and provided the strongest contrast with columns 1 and 2 of Table 3. Using 2SLS, the coefficients are numerically nearly the same as in columns 3 and 4, but FLFPRT and FEWAGE in the FERTRT equation are only significant at the 10 percent rather than the 5 percent level.

more affordable, when time constraints can be resolved through the availability of child care facilities. Alternatively, women who are in the labour market may have better access to child care facilities than those who are not (e.g. those sponsored by firms or institutions). The positive coefficient would be consistent with Hockey and Khawaja's finding (1984, p.27) that in their New Zealand regional cross-section low incomes were incompatible with high fertility levels. However, another explanation for the unexpected positive coefficient of FLFPRT is that the equations are misspecified. Compared with equations 3 and 4 of Table 1, 3 and 4 of Table 2 provide a far inferior fit to the data than the former two and the latter must therefore be interpreted with caution.

Further speculation about causality in the relationship between fertility and female labour force participation is probably not very fruitful without an explicit dynamical approach in which it is clear what is to be considered predetermined, what is to be the role of expectations and in which longitudinal date are available for empirical verification. If we consider, in addition to fertility and labour force participation, education, occupational choice etc. also as jointly endogenous, there is little left to act as exogenous variables and the model equations are likely to become underidentified. As in other areas of economics, the choice of exogenous variables in the economics of fertility and labour supply depends on the specific research questions and the limitations of the available data (see e.g. Turchi, 1984, pp. 347-348 in reaction to Schultz's demand system approach). When we consider a period analysis in which at a certain point in time the number of children gained in the past and any previous involvement in the labour market is given, the effect of the presence of children on labour supply will be stronger than the effect of labour supply on fertility. Family size can not be adjusted downwards, but labour supply is relatively flexible (see Montgomery and Trussell, 1986, p. 259). This explains, as noted earlier, that the presence of children is more likely to affect labour supply than vice versa.

6. Conclusions

In this paper we reconsidered the regional variation in labour force participation rates and fertility in New Zealand. The paper progressed beyond earlier work by pooling regional cross-sections of three censuses, by addressing the causal linkage between fertility and labour force participation explicitly and by testing for structural change in the behavioural equations. The empirical results provided support for the neoclassical demand system approach to fertility and labour force participation, in which both are influenced, but in opposite ways, by income and prices (primarily the real wage) and a range of socio-economic controls, which account for regional composition and demand-side effects.

It was also found that female labour force participation and fertility became less elastic with respect to male income and the female hourly wage over the 1976-86 decade.

This phenomenon is attributed to sharply rising female labour force participation, a decline in the TFR, a greater time input of males in non-market work and changes in the home production technology.

As labour force participation continues to be the means to obtain market income and financial independence, the depressed state of the New Zealand labour market with rising unemployment and declining labour force participation is a serious issue. At the same time a turnaround to an increasing TFR has emerged in the last few years, not just in New Zealand but also in other developed countries such as Sweden. The results of the present paper suggest that the two phenomena are interrelated, but further research is required since the traditional explanation for the rising fertility is simply one of age cohort effects and changes in the timing and spacing of children. However, it is intriguing that the New Classical models of Becker and Barro (1988,1989) also correctly predict the rising fertility in New Zealand on the basis of increases in real interest rates, the low level of total factor productivity and the decline in social security benefits. A formal test of this model and the competing labour supply-related explanation by means of an econometric analysis of long-run time series will be the subject of another paper.

There is also a need for more in-depth analysis at the micro-level. Tests of a non-spatial microeconomic theory of labour supply and fertility behaviour by means of regional aggregates is blurred by the inevitable role of certain region-specific factors. The significant autocorrelation coefficients of the CHTA models suggested that certain aspects of regional structure which were not accounted for, may have been important. Micro-level methods would involve the construction of synthetic micro-level data by setting-up high dimensional cross-tabulations, such as in Harris and Raney (1991) or the analysis of unit record data. The reluctance to release a sample of New Zealand census unit records with locational characteristics and certain outliers removed, to preserve confidentiality, is to be deplored. While in, say, a 1 percent sample certain levels of categorical variables may be absent and certain population sub-groups therefore not represented, the available information would allow a micro-level analysis of a range of labour market-related issues by means of techniques developed since the mid-1970s for mixtures of categorical and quantitative data and which now used extensively elsewhere. For example, such data would readily enable the estimation of individual earnings functions, on which surprisingly little empirical work has been done in New Zealand. There are also other sources which have as yet not been exploited to the full extent for econometric analysis of labour market issues. An example is the HLFS, reviewed by Brown (1989). Of particular interest for the issues raised in this paper is also the recent pilot survey of time use (Department of Statistics, 1991). However, the small sample

size (418) limits the usefulness of the pilot survey for statistical inference, but the results show that a substantive survey would be feasible and desirable.

The realisation that the removal of trade barriers, subsidies and other market distortions, corporatisation, privatisation and market-oriented reshaping of the institutional system, such as through the 1990 Employment Contracts Act, have intensified the disequilibrium in the labour market rather than reduced it, may finally lead to the political realisation that more resources need to be devoted to labour market research to provide an input into the formulation of new policies rather than to act as an afterthought. If so, New Zealand would simply be following the lead of other countries, such as in Western Europe, where this idea was accepted more than a decade ago.

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