Australian National University

Centre for Economic Policy Research

DISCUSSION PAPER

THE FOREGONE EARNINGS FROM CHILD REARING REVISITED

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DISCUSSION PAPER NO. 407

August 1999

Paper presented to the
Centre for Economic Policy Research, ANU Conference

Labour Market Trends and Family Policies:
Implications for Children
14-15 July 1999 Canberra

ISSN: 1442-8636
ISBN: 0 7315 2271 0

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We are grateful for the research assistance of Tony Salvage. The authors are responsible for any errors.

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1 Introduction

In 1988 John Beggs and Bruce Chapman estimated the earnings foregone from child-rearing in Australia using cross-sectional data collected in 1986.[1] The Beggs and Chapman exercise inferred that earnings differences between women according to the number of children they have were the result of choices made with respect to time allocation. That is, if a woman chose to spend time in child-rearing activities this was seen to have a market opportunity cost; earnings were foregone as a result of these activities. The study followed the then-traditional methodology of comparing the earnings of women in regression analyses controlling for a host of human capital, demographic and fertility characteristics.

That research suggested that a first child was associated with a woman earning (after tax) over her lifetime about $435,000 (in 1997 terms) less than childless women. Second and third children seemed to be associated with about $75,000 and $55,000 lower lifetime earnings respectively. Beggs and Chapman suggested that these figures were the foregone earnings from child-rearing in Australia at that time. This was perhaps incautious, it being more accurate to see the data as a benchmark, a beginning, to the calculation of the true foregone earnings of child-rearing, for reasons considered in Section 2.

Even given the need for caution in interpretation of the data using the Beggs and Chapman method, there are good reasons to repeat the exercise with contemporary information. The most important is that it is always of interest to re-examine labour market relationships and their changing dimensions after a significant period of time. This is particularly true in a context of changes in female fertility and employment experience, which have been major social phenomena over the last half of this century.[2]

Like much econometric research the analysis is essentially descriptive. The data presented are illustrative only of female wage and salary differences given the presence and number of children. This point is now explored further.

2 Estimating Foregone Earnings from Child-Rearing: Method and Caveats

(i) Background

As with many areas of applied labour market research it is not possible to determine what would have happened if history was re-run. Yet this is essentially the question being posed in the current exercise, which can be expressed as follows: if a mother had decided instead not to have children, what would have been the consequences for her lifetime earnings? This is the essence of the method traditionally adopted, and is now explained more fully.

(ii) The Counter-factual Comparison

The Beggs and Chapman and similar exercises compare the earnings of childless women with the earnings of women with one, two and three or more children, and attribute the

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[1] See Beggs and Chapman (1988).

[2] For example, the participation rate of women increased from 47.7 per cent to 54.2 per cent over the 1986-97 period (ABS Cat. No. 6202.0).

differences to labour market decisions related to children. This approach assumes that the presence, number and age of children affects a household's decision concerning women's labour market behaviour and outcomes. The way in which these decisions impact on earnings is assisted through consideration of the following identity:

Annual Earnings = (Annual Hours Worked)x(Average Hourly Wage)

Breaking this down further, annual hours worked depends on two decisions: whether or not to take paid employment and, if the employment decision is taken, how many hours should be devoted to paid employment. The presence of children impacts on these different dimensions.

The basic story is that raising children takes time, and that the opportunity cost issue concerns both how much time out of the labour market is involved and at what rate the market would value this time. Since earnings require employment, the effect of children on labour force participation is fundamental. Raising children affects their parents' choice as to the number of hours spent in paid employment.

The final part of the analysis concerns the effect of children on hourly wage rates. Child-rearing affects the hourly wage rate in two ways. First, it impacts on women's labour market experience, an important wage determinant. Second, periods of absence from the labour market are associated with a diminution of the value of labour market skills, a process known as atrophy (Mincer and Polachek, 1974). There is evidence for Australia that atrophy affects women's wages (Rummery, 1992).

(iii) The Assumptions Implicit in Using the Counter-factual Comparison

To attribute differences in lifetime earnings between women to the presence, number and age of children only would be incorrect. In the first place many measurable characteristics associated with both having children and a woman's earnings need to be controlled for. These include: education, household income, labour market experience and potential welfare benefits. In exercises of these types such variables are usually held constant through regression analysis, and this is the approach adopted here.

Of more significance are unmeasured variables, and what they might mean for labour market and fertility choices. There are a host of these, and it is likely that they are significant confounding factors in an interpretation of income differences as reflections only of the presence and number of children. The most critical are as follows.

First is the issue of self-selection, which has at least two dimensions. One is that the decision to have a child, and after that, further children, is likely to reflect a women's interest in and capacity to spend time rearing offspring. Related to this is that the choice to participate in paid work, and the number of hours chosen, will be conditioned in part by her comparative advantage in paid employment. These factors must affect interpretation of the simple counter-factual measures as only foregone earnings associated with having children.

Second, fertility, child-rearing and labour market decisions must be understood as reflections not only of the mother's decision, but as choices made in the context of the household.[3] This matters for (at least) two reasons.

One is that a woman's household choices will be conditioned in part by the characteristics of her partner. Usually these characteristics are ignored in the simple analyses of foregone earnings from child-rearing, but should affect our interpretation of the effect of children on a women's earnings.

Another reason that household decisions affect interpretation of earnings differences concerns the endogeneity of a husband's responses to the labour market decisions of his wife. In particular, if the mother chooses to do less paid work because of a desire to spend time rearing children, it is highly probable that her decision will impact on the father's choice concerning both market time allocation and commitment in other ways to paid employment. Indeed, this process is likely to have a dynamic, perhaps even life-cycle, perspective, in that fertility and market time allocation decisions for the household would be an on-going process.

It is therefore not credible to attribute differences in the earnings of women to children, as if fertility is an exogenous event. Choices concerning whether to have a child, and how many children to have, cannot be considered in isolation from a range of unobservable factors. And because these variables are not measured, nor modelled, the counter-factual employed in the following exercise will not yield unambiguous estimates of the true market opportunity cost of children.

(iv) So Why Bother with the Simple Counter-Factual Exercise?

Given the power of the above caveats, the question arises: why should we use the simple counter-factual? An answer is that description of the data offers a useful starting point. The benchmark should provide guidance as to the extent to which the above issues might compromise simplistic interpretation of the data.

That is, if the direction of confounding influences can be established from theory or empirical evidence, our benchmark might serve as a starting point for establishing empirical boundaries of the earnings consequences of child-rearing. An example helps here.

Assume that the fertility/work decision is influenced by unobservable variables related to a woman's comparative advantage in the workplace relative to full-time child-rearing. Imagine further that independent research reveals that women choosing not to have children have unobservable characteristics that result in their hourly wage being ten per cent higher than that of women who choose not to take employment. In this example the so-called foregone earnings of child-rearing described in the following exercise are at least[4] ten per cent lower than the estimates imply; the benchmark estimates can then be adjusted to take this into account.

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[3] See Apps (1981) and Apps and Rees (1998).

[4] The term “at least” is used because the labour market comparative advantage of working women will also impact positively on decisions related to the number of hours worked.

There is a further, empirical, point. If the fertility/work decision is endogenous and influenced importantly by unobserved variables, there is currently no completely convincing econometric method available to address the problem. The challenge is to find instruments which permit unambiguous identification of the role of measured variables in these various but inter-dependent decisions. But most of what the researcher observes in this context will affect all these decisions, leaving us with considerable and still unresolved problems of interpretation.

(v) The Bottom Line on Method

As an estimate of the foregone earnings from child-rearing the simple counter-factual method employed in this paper is open to serious question. That is, it would be incautious to interpret the earnings differences between women associated with the presence, number and age of children as reflecting only the foregone earnings associated with child-rearing. There are many other possible interpretations.

However, the simple exercise is of interest as a descriptive benchmark of the possible role of children. What now follows provides useful estimates of earnings differences between women which are associated with having children. It is also of interest to see the extent to which these benchmark estimates have changed over the last decade or so. But it has to be acknowledged that this is a small statistical step towards the unravelling of the issue.

3 The Data

(i) The Negotiating the Life Course Survey

The data used are from the first wave of an Australian random sample panel study initiated in the Research School of Social Sciences at the ANU in 1996 and known as The Negotiating the Life Course Survey (NLCS). The survey began in 1997 with the sample numbering approximately 2400 people, who were then aged between 18 and 54. While the plan is to follow this group over a 10 year period, currently there is only one available wave, meaning that the exercise in this paper uses a single cross-section of data.

The first wave of the NLCS gathered information on both individual level and household variables. It contained almost 300 questions on the following issues.

On the individual level data are available on demographic variables including educational attainment, family structure, employment status and income sources of respondents and their partners.

On the household level the survey includes information concerning household time allocation and child care arrangements. There were also more unusual questions, for example concerning attitudes regarding workplace issues, family relations and household responsibilities.

While much of this information is currently available from other sources, the NLCS has several potential advantages. One is that there are retrospective data concerning education and labour market experience, with respondents documenting their histories

from the age of 15 years. Second, the NLCS could become an on-going random panel on Australian families, a resource which has been sorely lacking from official data sources.[5]

The NLCS has both strengths and weaknesses for an examination of income determinants in the context of the presence of children. There are three problems.

The first is that it has not been possible to estimate hourly or weekly wage equations, at least not plausibly. This is because the earnings variable is documented in annual terms, but the number of weeks worked in the year are not known. In part this has conditioned the econometric choices adopted and reported below.

Second, there is too much missing data relating to questions about social security payments. For instance, only 497 responses were received to the question on the amount of total allowances. In addition, the data concerning social security payments is too aggregated to allow an adjustment for family assistance measures. Most significantly, it is not possible to determine accurately the level of social security payments resulting from family income and the number of (and age) of children, because the type of welfare benefit received is in many cases unknown. This is unfortunate because approximations of the income losses associated with child-rearing should take into account government allowances conditional on the presence of children. Ideally, if we can identify those who only received one type of government allowance, namely, either family payment or home child care allowance, then we could isolate the effect of such payments on the foregone earning of women.

However, out of 486 positive responses to total allowances received, only 201 can be identified as receiving family payment alone and just two as receiving home child care allowance only. These data limitations precluded analysis of the direct role of social security from the Survey. Nevertheless, we were able to simulate family payments (which differ by the number of children); the method and results are reported below.

Finally, child-rearing choices must be affected by the costs of childcare, but the responses to questions on the issue in the NLCS are poor. If we exclude all the missing values, we only have 375 records on the costs of childcare. If we further disaggregate the costs of child care into different types of child care, the sample size falls further. For instance, amongst those who responded to the question on the costs of childcare, only 271 used formal care, and only about 60 used informal/parental care.

(ii) The Statistical Characteristics of the Data Used

The sample used is 1123 women aged 18 to 55 in 1997. Different cohorts exhibit different characteristics in terms of their employment status, work hours and annual earnings. Table 1 shows an inverted U-shaped relationship between cohorts and the proportion of women in paid employment. Around 15 per cent of the women in paid employment were in the youngest cohort, while 23 per cent of them fell into the oldest cohort. Over 62 per cent of the employed women were between 25 to 45 years of age.

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[5] There are now, and have been, several Australian longitudinal surveys, but all of these focus on particular groups (such as youth, immigrants or Aboriginal and Torres Strait Islanders). The fact that a university chose to set up its own random sample longitudinal survey should be seen as a reflection of a frustration in Australian academic circles that such an initiative has not happened from other, more appropriate, sources.

This may be attributed to the interruptions in paid employment due to childbirth. Among those who worked, women in the youngest cohort worked longer hours—about 37 hours per week on average.

Table 1
Characteristics of Different Age Cohorts

	Under 25	25 to 34	35 to 44	Over 44
Employed	14.6	30.2	31.8	23.4
Hours worked if employed	36.6	35.0	32.9	33.6
Annual Wage and Salary Earnings (after tax)	$11736.5	$13821.8	$12933.3	$13946.2

Table 2 presents aggregate data on the major characteristics for women with and without children. About 30 per cent of the total sample did not have any children. The data illustrate that women with children are different from those without, with respect to age, education, employment status and income sources. Eighty-four per cent of the women under 25 years of age had no child. Only 8 per cent of the women in the oldest cohort were without any children. Half of the women over 45 years of age had at least three children. In general, women with at least one child were older with an average age of 35. Amongst those who had less than secondary education, only 18 per cent of them were childless. However, 42 per cent of the secondary graduates and 34 per cent of the degree holders had no children.

Approximately 66 per cent of respondents reported positive earnings. Among those who did not report any earnings, over 65 per cent had at least two children. In terms of the income, Table 2 shows that women with no children had higher average annual earnings. On average, childless women had annual earnings of $18,292. For women with one child and women with at least three children, their average annual net wage income were $13,969 and $9,933 respectively. However, they reported lower average partners' income.

Table 3 shows that in each cohort over 60 per cent of women are in paid employment. Eighty-one per cent of the women without children were employed. About 60 per cent of the women with at least two children were in paid employment. Amongst those with three or more children, only 56 per cent were in paid work. Further, labour force status varies with level of education. Most of the degree holders were employed (84 per cent). Amongst those with lower than secondary education, only 56 per cent were in paid work.

Table 2
Major Characteristics of the Sample
by Number of Children

	No child	1 child	2 children	3 or more
Age (years)	28.8	34.5	38.9	41.8
Under 25 (per cent)	83.9	11.0	3.2	1.9
25 to 34 (per cent)	39.5	20.2	24.4	16.0
35 to 44 (per cent)	15.0	10.6	41.0	33.4
Over 44 (per cent)	8.3	9.5	32.9	49.2
Not finished secondary (per cent)	18.0	14.9	30.4	36.7
Finished secondary(per cent)	41.9	11.7	26.7	19.7
Trade(per cent)	11.1	25.0	36.1	27.8
Degree or above (per cent)	33.9	12.7	29.7	23.7
Married (per cent)	17.7	13.9	36.0	32.4
Migrants from NESB (per cent)	34.1	13.2	29.7	23.1
Earnings (incl. zeros)	$18,292	$13,969	$10,840	$9,933
Partner's income (incl. zeros)	$13,571	$22,801	$29,338	$26,852
Employed (per cent)	37.9	12.6	26.2	23.3
Weekly work hours (excl. zeros)	41.0	31.1	29.4	30.8

Table 3
Characteristics of female respondents
by employment status

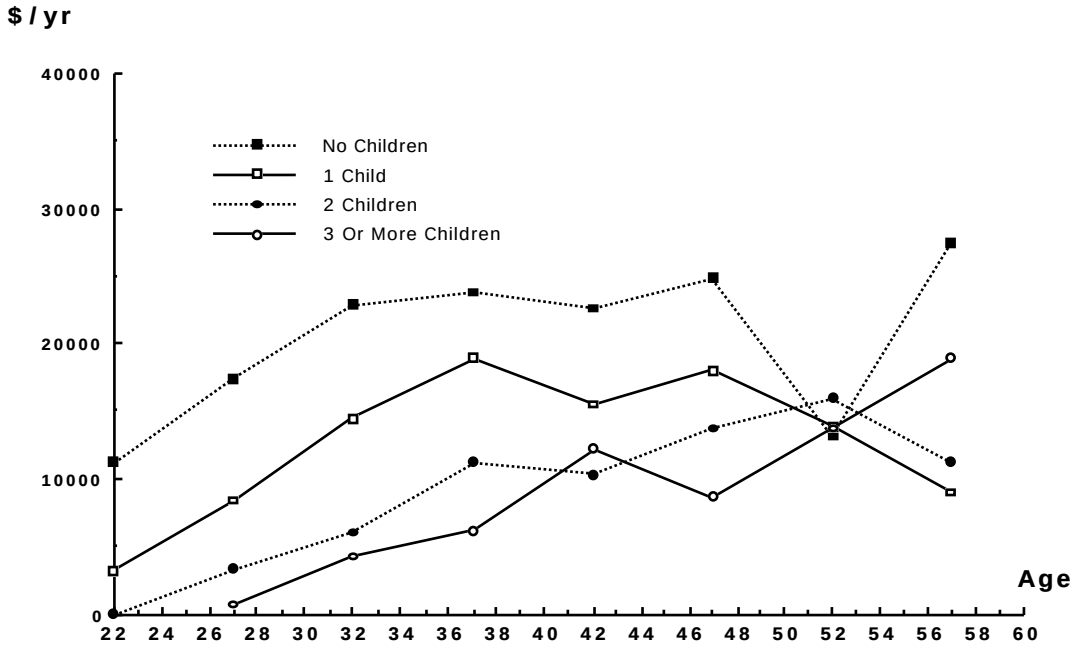
	Employed	Not Employed
Age (years)	36.2	35.5
Under 25 (per cent)	69.7	30.3
Between 25 to 35 (per cent)	62.5	37.5
Between 35 to 45 (per cent)	65.5	34.5
Over 45 (per cent)	67.4	32.6
No children (per cent)	80.9	19.1
One child (per cent)	61.6	38.4
Two children (per cent)	60.2	39.8
At least three children (per cent)	56.6	43.4
Married(per cent)	63.6	36.4
Migrants from NESB (per cent)	55.0	45.0
Not finished secondary (per cent)	56.4	43.6
Finished secondary (per cent)	68.4	31.6
Trade(per cent)	86.1	13.9
Degree or above (per cent)	83.9	16.1
Earnings (incl. zeros)	$20,335	$0
Partner's income (incl. zeros)	$23,083	$22,612
Weekly work hours (excl. zeros)	34.1	0

(iii) Net Annual Income by Number of Children

Critical to our enquiry is female annual earnings after tax. Figure 1 shows the average data for five-year cohorts in a life-cycle context for women with zero, one, two and three or more children. Some of the apparently large changes with age—for example, the big measured decrease in earnings for childless women in their early 50s—are a consequence of very few data points.

Even so, these averages are indicative of potentially robust relationships, suggesting strongly that additional children are associated with much lower net annual earnings. For example, the difference in net annual earnings between a childless woman and a mother of at least three children at the age of 32 is about 81 per cent.

Figure 1
Average Net Annual Earnings, by Number of Children and Age



(iv) Summary

The above average data suggest that there are major differences in the demographic and labour market experiences of women, and that a major part of this is related to the presence and number of children. Regression analysis clarifies the role of particular variables and is now reported.

4 The Tobit Analysis

(i) Introduction

The conceptual challenges and problems of estimating the effects of child-rearing on the life-time earnings of Australian women have been outlined. The simple counter-factual assumes that child-rearing has an effect upon women's annual earnings in three ways: the

probability of employment, the number of hours worked if employed, and the hourly earnings. The association between child-rearing and annual earnings can be illustrated by combining these factors.

Beggs and Chapman (1988) separately estimate the effects of child-rearing on the probability of employment, on the number of hours worked and on the hourly wage rate. An advantage of their approach is that the influence of each factor can be isolated. However, the data from the Negotiating the Life Course Survey do not allow this luxury, because hourly earnings cannot be determined with confidence. What this means for the empirical work is now outlined.

(ii) Empirical specification

Economic theory suggests that a range of variables determine earnings. For our exercise the important behavioural issues concern choices and outcomes related to labour market participation, hours worked and hourly wages. The theoretical bases underlying these relationships are well known and will not be documented here[6]. In the context of the estimation procedure it is important to understand the following issues.

First, as a result of data limitations we have chosen to estimate directly the effect of children on the annual earnings variable, which will reflect the aggregate influence of participation, hours worked and hourly wages. While this limits hypothesis testing with respect to underlying behavioural responses, the results still provide a useful aggregative benchmark approximation of the association between children and women's earnings.

Second, because we do not have panel data, it is difficult to capture changes in the relationships over time. But if there have been structural changes, not taking them into account imposes the incorrect assumption that the circumstances of an average 50 year old woman in 1997 will be replicated by the average 25 year old woman when she is 50, in the year 2022. Given the extraordinary changes in female participation over the last several decades, this is not credible.

To take the above issue into account, at least in part, we have included age cohort dummy variables. This approach means that, for example, those aged less than 25 are allowed to have different earnings levels than other age cohorts, in addition to the controls for the usual age-earnings relationship. Specifically there are dummy variables for being aged: 24 years or less; 25 to 34 years; 35 to 44 years; and 44 years or older.

Third, we have included controls for marital status, being a migrant from a non-English speaking country, and education level (by category of highest qualification). Further, theoretical models and empirical results have found that the income of a woman's partner is an important determinant of her labour supply decision and consequently the estimation includes this variable.

Fourth, the association between children and annual income is picked up by a number of variables. A dummy variable is included which takes the value of one if a women has ever had a child. In addition there are a series of dummy variables which allow for having: one child under 5 years of age; two or more children under the age of 5; one child

[6] The Beggs and Chapman (1988) discussion of the literature provides the background, the point being that the estimation underpinning the current exercise is grounded in conventional theory.

between the ages of 5 and 15; 2 children between the ages of 5 and 15; and 3 or more children between the ages of 5 and 15.

Finally, in a more complex specification we allow the effects of age on annual earnings to vary by the number and age of children. This is done by interacting the above children dummy variables with age and age squared, with this being labelled Model 2. Understanding the rationale behind Model 2 is particularly important, and this issue is taken up further below.

Formally the models are:

ANNUAL EARNINGS = b0 + b1AGE + b2AGE2 + b3AGE_24 + b4AGE25_34 + b5AGE35_44 + b6MAR + b7NESB + b8YR12 + b9TRADE + b10DEGREE + b11P_INC + b12CHILD + b13CH5_1 + b14CH5_2 + b15CH15_1 + b16CH15_2 + b17CH15_3 + e (1)

ANNUAL EARNINGS = b0 + b1AGE + b2AGE2 + b3AGE*CHILD + b4AGE2*CHILD + b5AGE*CH5_1 + b6AGE2*CH5_1 + b7AGE*CH5_2 + b8AGE2*CH5_2 + b9AGE*CH15_1 + b10AGE2*CH15_1 + b11AGE*CH15_2 + b12AGE2*CH15_2 + b13AGE*CH15_3 + b14AGE2*CH15_3 + b15AGE_24 + b16AGE25_34 + b17AGE35_44 + b18MAR + b19NESB + b20YR12 + b21TRADE + b22DEGREE + b23P_INC + b24CHILD + b25CH5_1 + b26CH5_2 + b27CH15_1 + b28CH15_2 + b29CH15_3 + e (2)

Variable Definitions

Annual Earnings	Annual Wage And Salary Income (After Tax)
AGE	age
AGE2	age squared
CHILD	dummy variable for ever had a child
CH5_1	dummy variable for having one child less than 5 years
CH5_2	dummy variable for having two or more children less than 5 years
CH15_1	dummy variable for having one child aged 5 to 15 years
CH15_2	dummy variable for having two or more children aged 5 to 15 years
CH15_3	dummy variable for having three or more children aged 5 to 15 years
AGE_24	dummy variable for being aged 24 years or less
AGE25_34	dummy variable for being aged 25 to 34 years
AGE35_44	dummy variable for being aged 35 to 44 years
MAR	dummy variable for being married (includes de facto)
NESB	dummy variable for being a NESB migrant
YR12	dummy variable for having a highest educational attainment of year 12
TRADE	dummy variable for having a highest education attainment of a trade qualification
DEGREE	dummy variable for having a highest education attainment of a diploma or degree qualification
P_INC	partner's income (zero if not married or de facto).

In the regression analysis the omitted categories are: having less than year 12 education, not being married or de facto, being born in Australia or being a migrant from an English speaking country, and being aged over 45 years.

(iii) Issues of functional form

It is important to note that the specification is very much a reduced form approach, and does not allow the effect of several critical factors to be isolated. Most significantly, we have not used information on labour market experience (or job tenure), but it is well known that this is an important explanator of participation, hours worked and hourly wage. The reason for this simplification is as follows.

Our essential goal is to illustrate the associations between the number of children and a woman's earnings over the life-cycle. This goal is made much simpler through the estimation of the models using age than it would be using labour market experience, the more correct variable. This is because our technique allows us to avoid the explicit modelling of experience and fertility, and makes the illustration of age-earnings relationships very easy.

Even so, age is not the right variable in an annual earnings estimation because the presence of children means that for an additional year of age a woman will have less actual experience which will impact on her future earnings. This problem justifies strongly the use of Model 2 since such a specification allows the effects of age on earnings to vary with the number, age and presence of children. Thus, to the extent that children impact on experience, the less restrictive Model 2 takes some account of this. To test for the extent that using age instead of experience biases results, we also estimated the models using the direct measure of experience constructed from the retrospective questions concerning past employment status, and found that the overall extent of the problem is not great.[7]

The estimations impose a number of restrictions with respect to the way in which different fertility patterns affect annual earnings. First, the inclusion of a dummy variable for ever having had a child imposes the restriction that ever having had a child (irrespective of the child's age) has a permanent (and constant effect) upon annual earnings. The effects of children under the age of five are assumed to be different from the effects of children between the ages of 5 to 15. Children over the age of 15 years are assumed to have no effect upon earnings other than through the permanent effect of ever having had a child. That is, having one child aged over 15 is assumed to have the same effect upon annual income as having four children aged over 15 years.

By including dummy variables for the number of children under the age of 5 and between the ages of 5 and 15 we are allowing the marginal effect of each additional child to vary as the number of children changes. This turns out to be quite important.

The annual income variable includes women who do not work — and who therefore have zero wage and salary income (approximately one third of the sample)—as well as women who are employed. The significant proportion of non-working women means

[7] For example, the earnings reduction associated with the first child was about the same in our calculations using direct measures of labour market experience. Even so we are not confident that this result will hold for subsequent children.

that ordinary least squares (OLS) will produce incorrect estimates of the effects of the explanatory variables on annual income.

A way of estimating the models given the large number of zeros is through Tobit regression. This technique takes account of the fact that we observe zero earnings for women who are not employed and positive earnings only for the women who are working. Details of the Tobit estimation can be found in Greene (1997).

The Tobit estimator imposes a number of restrictions on the way in which the variables affect the probability of employment and earnings if employed and the error structure of the model. Of particular importance is that the effects of the explanatory variables on the probability of employment and earnings if employed are restricted to be the same.[8]

(iv) Data and estimation results

Table 4 presents the descriptive statistics for the variables and the sample used in the estimation, which is 13 observations smaller than the sample used in the cross-tabulations due to missing measures. The data are presented for the entire sample and separately according to employment status.

Table 5 presents the coefficient estimates for models (1) and (2). The results of Model 1 suggest that age, education, country of birth, and all the child dummies are statistically significant,[9] and have the expected signs. Joint significant tests in Model 2 for the interactions of the child dummies and the age (and age squared) variables reveal that these are also statistically significant.

Further, the age cohorts results suggest that successively younger groups of women have higher annual earnings than the ten year cohort before them, which is evidence for the proposition that women's labour market behaviour has been changing over time in ways not captured by the measured variables.

The size of these associations are now considered.

(v) Effects of variables on annual income

The size of the associations implied by the coefficients are now shown in Table 6. The most important associations are related to the presence, number and age of children. They can be illustrated with the following examples from the Model 2 coefficients.

There is a permanent effect on a mother's earnings from ever having had a child, of the order of $6,500 per year. If a woman has an additional child her annual earnings are decreased by about a further $4,800 for every year that the child is aged less than five. Once children reach the age of school attendance, the extent of earnings reduction falls by about $500, and by a further $4,250 when the child reaches age 15.

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[8] The Tobit estimator is a special case of the Heckman sample selection model, which involves estimating first the employment probability model and, conditional on this, estimating the determinants of annual income (for the employed sample) with a sample selection correction which corrects for the fact that the women who are employed may differ in unobserved ways from the women who do not work.

[9] At the 5 per cent level.

Table 4
Summary Statistics of the Variables Used in the Tobit Estimates

	All women		Employed		Not Employed	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
EARNINGS	$13299.0	$15524.2	$20335.4	$15029.1		
AGE	35.9	9.6	36.1	9.7	35.5	9.2
AGE_24 (per cent)	0.140	0.347	0.149	0.356	0.122	0.328
AGE25_34 (per cent)	0.317	0.465	0.300	0.459	0.348	0.477
AGE35_44 (per cent)	0.321	0.467	0.321	0.467	0.322	0.468
MAR (per cent)	0.639	0.480	0.616	0.487	0.683	0.466
NESB (per cent)	0.081	0.273	0.067	0.251	0.106	0.309
DEGREE (per cent)	0.104	0.306	0.134	0.340	0.049	0.217
TRADE (per cent)	0.032	0.175	0.041	0.199	0.013	0.113
YR12 (per cent)	0.456	0.498	0.475	0.500	0.421	0.494
< YR12 (per cent)	0.402	0.491	0.344	0.475	0.512	0.501
P_INC	23175.8	24328.7	23669.3	24986.6	22245.1	23040.1
CHILD (per cent)	0.692	0.462	0.620	0.486	0.829	0.377
CH5_1 (per cent)	0.176	0.381	0.123	0.328	0.278	0.449
CH5_2 (per cent)	0.061	0.240	0.023	0.151	0.132	0.339
CH15_1 (per cent)	0.191	0.393	0.165	0.372	0.239	0.427
CH15_2 (per cent)	0.143	0.350	0.136	0.343	0.156	0.363
CH15_3 (per cent)	0.062	0.241	0.051	0.220	0.083	0.276
Observations	1110		726		384	

Table 5
Determinants of (after tax) Annual Earnings:
Tobit Estimation

	Model 1		Model 2	
	Coef.	t	Coef.	t
Age	2722.473	2.831	3541.348	2.736
age2	-28.2995	-2.251	-40.9575	-2.193
AGE*CHILD			-2116.25	-1.015
AGE2*CHILD			27.21707	1.022
AGE*CH5_1			2052.374	0.669
AGE2*CH5_1			-25.908	-0.581
AGE*CH5_2			5000.309	0.596
AGE2*CH5_2			-77.6924	-0.584
AGE*CH15_1			-1989.72	-0.799
AGE2*CH15_1			24.10949	0.745
AGE*CH15_2			940.9315	0.289
AGE2*CH15_2			-10.027	-0.241
AGE*CH15_3			1030.581	0.17
AGE2*CH15_3			-6.45378	-0.075
AGE_24	13340	2.055	13062	1.993
AGE25_34	10244	2.211	8505	1.73
AGE35_44	3667	1.122	3249	0.954
MAR	-1025.25	-0.529	-827.763	-0.424
NESB	-7469.51	-3.279	-7563.71	-3.319
DEGREE	17796.33	8.456	17729.02	8.339
TRADE	15330.05	4.489	15115.61	4.395
YR12	7238.174	5.227	7180.697	5.166
P_INC	0.052541	1.447	0.052602	1.444
CHILD	-6773.63	-2.998	33013.93	0.818
CH5_1	-7828.71	-3.691	-47230.4	-0.89
CH5_2	-22579.2	-6.555	-102568	-0.779
CH15_1	-5308.52	-2.732	34271.05	0.733
CH15_2	-4115.04	-1.845	-24988.5	-0.398
CH15_3	-9012.02	-2.975	-37827	-0.353
_cons	-52571.2	-2.795	-63898.6	-2.86
Number of obs	1110		1110	
LR chi2(17)	255.79		260.24	
Pseudo R2	0.0146		0.0149	
Log likelihood	-8624.5		-8622.3	

Table 6
Effects of the Explanatory Variables on Annual Earnings – Model 2

Variable	Total Effect on Earnings
Age[+]	$479.41
Cohort aged less than 25	$8,950.35
Cohort aged 25 to 34 years	$4,695.30
Cohort aged 45 years plus	-$2,750.04
Married	-$713.07
NESB migrant	-$6,176.64
Degree	$9,648.76
Incomplete secondary	-$5,884.11
Partner's income	$917.53
Ever had a child	-$6,429.82
1 child aged under 5 years	-$4,797.01
2 children aged under 5 years	-$12,277.13
1 child aged 5 to 15 years	-$2,273.45
2 children aged 5 to 15 years	-$2,956.06
3 children aged 5 to 15 years	-$6,109.14

Notes: The marginal effects are calculated relative to a woman who is 36 years old and is in the age cohort 35 to 44 years, has no children, has year 12 level education, born in Australia or is a migrant from an English-speaking country and has no partner-income.

[+] Estimated at the average

The other annual earnings determinants are familiar. For example, compared to not completing high school a degree/diploma adds around $9,500 to earnings per year, and completing high school is associated with about an additional $5,900 per annum. Compared to being in the 45 plus age cohort, those aged 15–24, 25–34 and 35–44 earn additional annual earnings respectively of about 9.0, 4.7 and 2.7 thousand dollars per year. Immigrant women from non-English speaking countries earn around $6,000 less per year than other Australian born and migrants from English-speaking countries.

It is possible to use these estimates in simulations designed to show in a stylised way the associations between a woman's annual earnings and the presence of children over her life-cycle. This follows.

5 Simulating Women's Earnings by the Number and Presence of Children

(i) Method

The regression coefficients from the Tobit modelling can be used to simulate the associations between child-rearing and women's earnings, and these exercises are now reported. To simplify the presentation, and to allow direct comparisons with the Beggs and Chapman analysis, we consider four different scenarios with respect to children. However, these earnings are allowed to differ by three education levels: degree or

diploma, completed year 12, and not completed year 12.[10] These are the same groupings used by Beggs and Chapman (1988).

In all cases the hypothetical woman is assumed to be: not a NESB migrant; married;[11] and in the cohort aged 35 to 44 years (chosen because age 36 is the average age in the sample). Her partner's income is assumed to be $25,203, (the mean in the data), and stays constant over the woman's life[12]. The following scenarios are the basis of the simulations.

The hypothetical woman is assumed to marry at age 23 and face the decision of whether or not to have a child at age 25. If she decides not to have the child at this time, she remains childless.

Women becoming mothers at age 25 then decide whether or not to have a second child, which happens at age 28 for women who choose to have more than one child. Women not having a second child at age 28 are assumed to only ever have one child.

Women with two children then face the choice of whether or not to have a third child, which will happen at age 31. Women choosing not to do so are assumed to have only two children in their lifetimes.

Those women choosing a third child at age 31 do not have any further children. However, the simulations involving this group use the regression coefficients applying to the category of "three or more" children.

(ii) Predicting Lifetime Earnings

Figures 2-4 show the simulated annual earnings for each level of education. Several features stand out.

First, for childless women the fall in earnings at ages 25, 35, and 45 reflect the age cohort effects. These effects are also part of the scenarios for women with children, but are less obvious in the Figures given the other earnings changes. In particular, earnings increase significantly as children reach age five, and by a lower but still important amount when children reach age 15.

[10] There were too few women in the Trades category to allow meaningful simulations for this group.

[11] The assumption concerning marriage doesn't matter empirically because there are no earnings affects from marriage once the effects of children are taken into account.

[12] Like marriage, the assumption concerning partner's income is not likely to be very important because its role in the earnings modelling is small.

Figure 2
Age Earnings Profiles by Number of Children for Degree/Diploma Holders

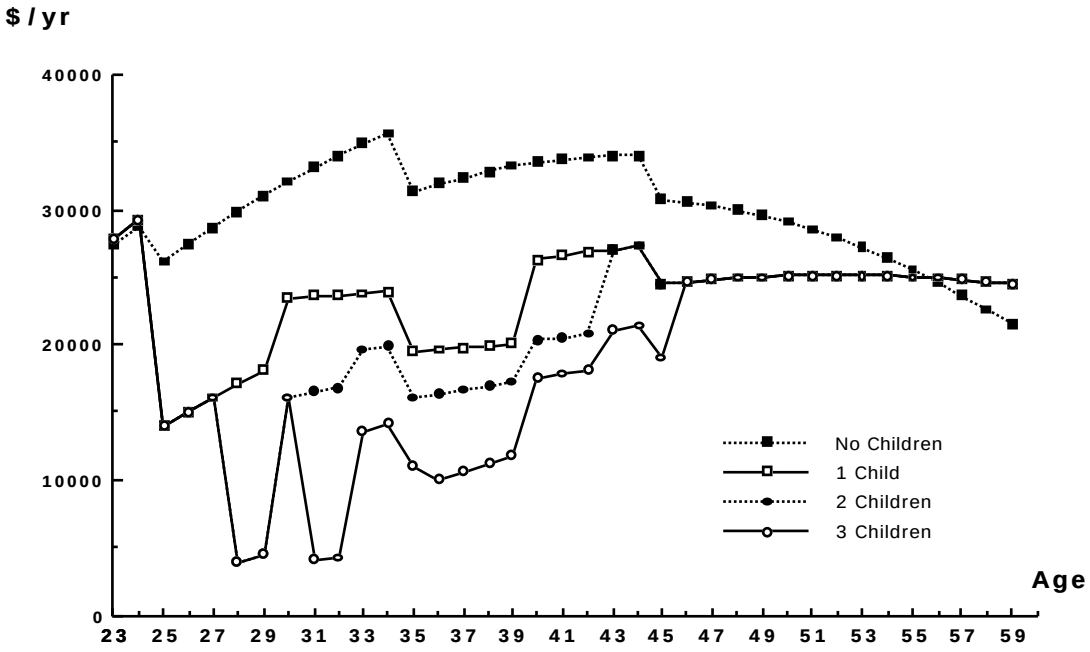


Figure 3
Age Earnings Profiles by Number of Children
for Those Completing High School

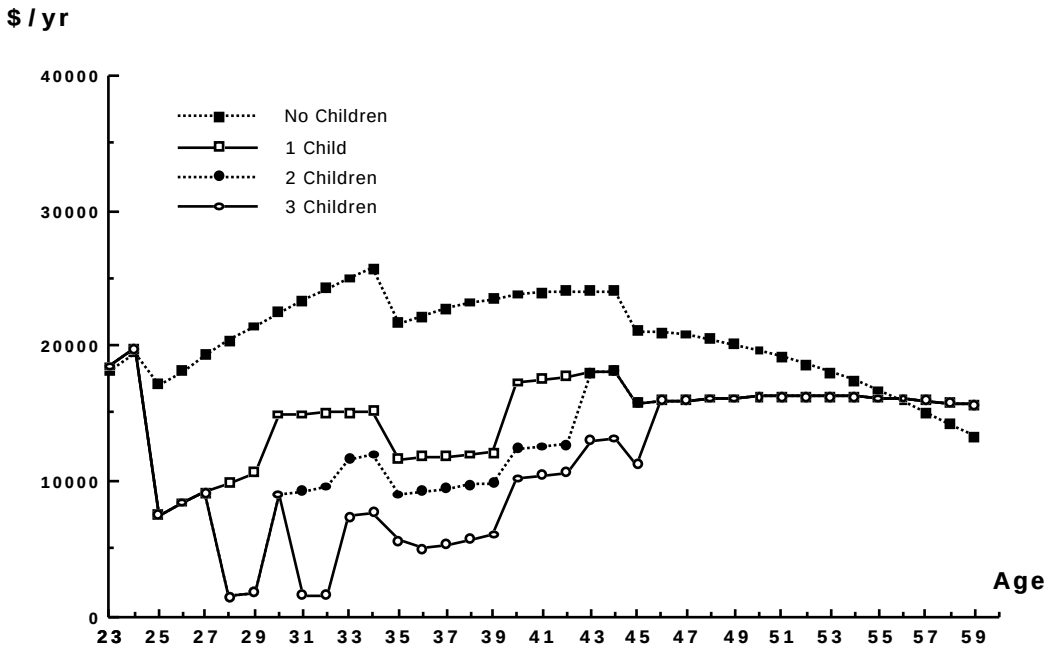
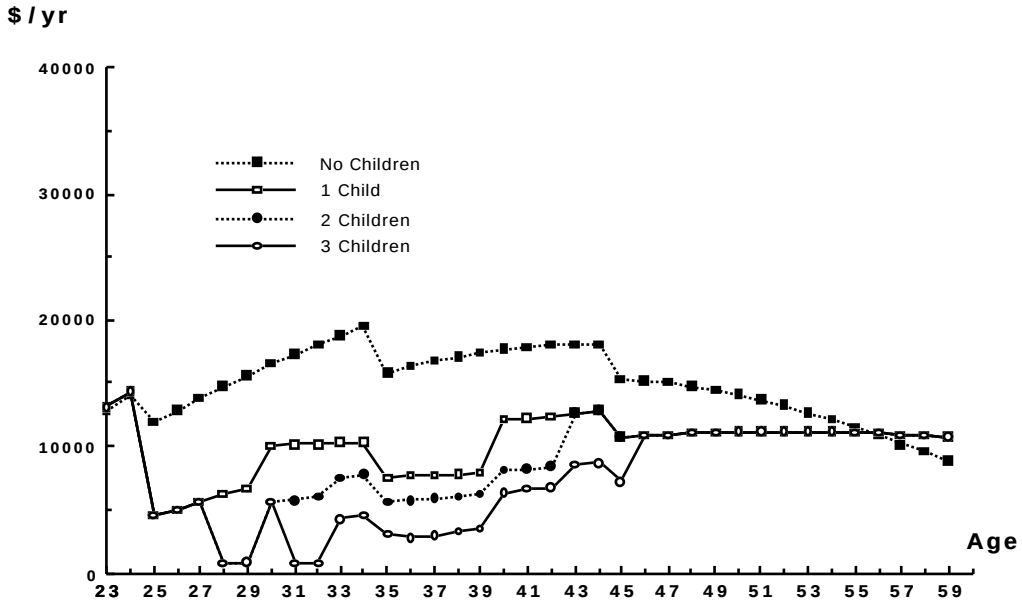


Figure 4
Age Earnings Profiles by Number of Children
for Those Not Completing High School



(iii) Net present value calculations of lifetime earnings

The above simulations can be used to calculate net present values of lifetime earnings associated with different choices concerning how many children a woman chooses to have. The calculations use the following approach.

Women with different levels of education are assumed to make choices at the age of 23 on the number of children they will have; none, one, two or three or more. The children will be born at the age of the hypothetical women illustrated above, and it is assumed that the average earnings effects shown above apply.

Tables 7-9 show the calculations for women with different levels of education.

Table 7
Net Present Values of Lifetime Earnings, Degree/Diploma Holders

Number of Children	NPV Discount Rate 0%		NPV Discount Rate 5%		NPV Discount Rate 10%	
		As % 0f (i)		As % 0f (i)		As % 0f (i)
(i) 0 Children	$1,086,328.87		$468,887.37		$257,105.08	
(ii) 1 Child	$847,230.23	77.99%	$340,739.49	72.67%	$179,560.24	69.84%
(iii) 2 Children	$765,109.73	70.43%	$293,465.81	62.59%	$150,342.48	58.48%
(iv) 3 Children	$680,645.14	62.66%	$252,000.97	53.74%	$128,379.35	49.93%

Table 8
Net Present Values of Lifetime Earnings, Women Completing High School

Number of Children	NPV Discount Rate 0%		NPV Discount Rate 5%		NPV Discount Rate 10%	
		As % of (i)		As % of (i)		As % of (i)
(i) 0 Children	$741,516.79		$316,159.52		$170,480.59	
(ii) 1 Child	$539,939.26	72.82%	$210,235.01	66.50%	$107,513.97	63.07%
(iii) 2 Children	$480,534.86	64.80%	$176,915.02	55.96%	$87,390.43	51.26%
(iv) 3 Children	$421,003.40	56.78%	$148,494.17	46.97%	$72,700.76	42.64%

Table 9
Net Present Values of Lifetime Earnings, Women not Completing High School

Number of Children	NPV Discount Rate 0%		NPV Discount Rate 5%		NPV Discount Rate 10%	
		As % 0f (i)		As % 0f (i)		As % 0f (i)
(i) 0 Children	$536,152.88		$226,377.70		$120,398.22	
(ii) 1 Child	$369,212.04	68.86%	$140,153.54	61.91%	$69,939.45	58.09%
(iii) 2 Children	$325,634.26	60.74%	$116,187.79	51.32%	$55,721.35	46.28%
(iv) 3 Children	$282,826.48	52.75%	$96,200.86	42.50%	$45,594.24	37.87%

There are several points worth noting from the Tables. The discussion here focuses only on the undiscounted figures. First, for all education groups, there is a considerable earnings reduction associated with having a child. In percentage terms this amounts to 23, 28 and 32 per cent of total life-time earnings for women with high, average and low education respectively.

Second, the absolute dollar amounts are large. For women with high, average and low education respectively these figures are $239,000, $201,000 and $157,000. Third, successive children are associated with much larger earnings reductions. Taking only those women who have completed high school, the percentage decrease in earnings from second and third (or more) children are respectively an additional eight and seven per cent of the earnings of childless women. In absolute dollar terms this translates into about $60,000 from the presence of both second and third children.

(iv) Comparison with the Beggs and Chapman results

An important motivation for the current exercise is to examine the extent to which lifetime earnings associated with child-rearing have changed over the last decade or so.

Consequently it is of interest to compare some of the figures reported above with those reported by Beggs and Chapman. Tables 10-12 report these latter data.

Table 10
Beggs & Chapman's Net Present Values of Lifetime Earnings,
Degree/Diploma Holders

Number of Children	NPV Discount Rate 0%		NPV Discount Rate 5%		NPV Discount Rate 10%	
		As % of (i)		As % of (i)		As % of (i)
(i) 0 Children	$1,193,216.29		$512,014.45		$284,882.49	
(ii) 1 Child	$699,238.90	58.60%	$273,069.17	53.33%	$147,266.99	51.69%
(iii) 2 Children	$570,301.51	47.80%	$217,487.74	42.48%	$118,326.24	41.54%
(iv) 3 Children	$463,164.90	38.82%	$176,617.65	34.49%	$99,653.12	34.98%

Table 11
Beggs & Chapman's Net Present Values of Lifetime Earnings,
Women Completing High School

Number of Children	NPV Discount Rate 0%		NPV Discount Rate 5%		NPV Discount Rate 10%	
		As % of (i)		As % of (i)		As % of (i)
(i) 0 Children	$807,313.67		$345,853.27		$193,540.06	
(ii) 1 Child	$371,692.97	46.04%	$154,498.07	44.67%	$88,624.81	45.79%
(iii) 2 Children	$297,971.53	36.91%	$121,899.89	35.25%	$71,285.05	36.83%
(iv) 3 Children	$241,962.74	29.97%	$99,726.47	28.83%	$60,901.75	31.47%

Table 12
Beggs & Chapman's Net Present Values of Lifetime Earnings,
Women Not Completing High School

Number of Children	NPV Discount Rate 0%		NPV Discount Rate 5%		NPV Discount Rate 10%	
		As % of (i)		As % of (i)		As % of (i)
(i) 0 Children	$625,050.63		$265,330.10		$148,555.29	
(ii) 1 Child	$234,398.83	37.50%	$101,884.80	38.40%	$61,245.01	41.23%
(iii) 2 Children	$185,688.18	29.71%	$80,593.74	30.37%	$49,952.24	33.63%
(iv) 3 Children	$150,944.18	24.15%	$66,844.91	25.19%	$43,475.04	29.27%

The important points in the comparison between the 1986 and 1997 data are not affected by the discounting process, so the focus here is on the undiscounted data. For simplicity

we focus only on women who have completed high school, the typical education level. The following conclusions are noteworthy.

First, there has been a significant change in the earnings decrease associated with having a first child. In 1986 and 1997 respectively the percentage reduction was 54 and 28 per cent. In 1997 dollars, these proportions translate into about $435,000 and $200,000. Apparently there has been a radical change over the last decade in the lifetime earnings of women associated with having a child.

Second, having a second child has similar earnings decreases in 1997 as it did in 1986. That is, in 1986 the earnings decrease from a second child was about $75,000 (an additional nine percentage points earnings reduction relative to having one child), while in 1997 the figures are about $60,000 (an additional eight percentage points earnings reduction relative to having one child). The corresponding figures for the third child are, respectively, $55,000 (seven percentage points) in 1986 and $60,000 (eight percentage points) in 1997.

The above points imply that most of the changes in the earnings/children relationships over the last decade or so are related to female paid work behaviour given the presence of very young children. Exploring this issue further should be given high priority.

6 Conclusion

The work reported is essentially a descriptive exercise designed to illustrate relationships between women's after tax earnings and the presence, age and number of children. We wanted to explore the extent to which the relationships have changed since the Beggs and Chapman (1988) study, and as a consequence followed closely the approach adopted by them.

The paper presents useful results concerning children/earnings relationships. The most important of these are as follows.

First, as for 1986, in 1997 there were very large decreases in a women's earnings associated with having a child.

Second, the extent of earnings decreases from having a first child have apparently fallen considerably over the last decade, perhaps by as much as half.

Third, the relative earnings decreases associated with having a second and a third child have not changed.

What these findings mean for policy has not been explored. Instead, what we have done is sort out the data and present relationships in accessible and interesting ways. The results should become a useful part of future research and policy development in the area of child-rearing and its meaning in a labour market context.

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Appendix I
The Effects of Family Payments on Women's Earnings

Estimates of net relative earnings associated with child-rearing ideally should take into account the effects of social security payments, which in Australia are related to the number and age of children. The income estimates presented above do not take account of social security payments because reliable data by type of payment are not available from the NLCS.

In what now follows the implications of family payments for the estimates of foregone income are explored using simulations for the hypothetical women analysed in this paper. The data limitations discussed above make it necessary to make assumptions about partner's income for our hypothetical women. As a result the exercise is essentially illustrative

The simulation results suggest that taking into account the effects of family payment reduces the foregone income costs of children, but that the differences are relatively small with the exception of women with year 12 and less than year 12 education who have three children for whom the foregone income costs are reduced somewhat.

The estimates of the effects of children on a women's wage and salary income are adjusted for two types of family payments which are related to the number and age of children, Basic Family Payments and Additional Family Payments.

The level of the Basic Family Payment varies with the age of children differing between children: under the age of five years; aged 5 to 12 years; and aged 13 to 15 years. The family payments associated with a child cut out when the child reaches the age of 15. Both types of payments are only made to families with children. Additional family payments are payments which are made to low income families and are in addition to the Basic Family Payments.

In order to adjust for the effects of family payments on the estimates foregone income we calculate the family payments which would have been paid to each of the twelve hypothetical women. For the married women it is assumed that their husband earns $23,000 per annum (the average in the data) regardless of the women's age or education level. Our results in qualitative terms will be robust to quite large changes in the level of the partner's income because family payments do not cut out until a relatively high family income is reached (around $65,000 per annum).

The procedure used to correct for family payments involves first estimating the level of family payments for each of the hypothetical women - who vary in the number and age of children. These family payments are then added to the estimated income stream for each hypothetical women and the NPV of each of the family payment adjusted income streams is then calculated.

The estimates of the lifetime value of family payments are presented in Appendix Table 1. Women with no children of course receive no family payments. The family payments increase as the number of children increases. For all levels of educational attainment (predicted stream of income) the first child leads to lifetime family payments of $9,734. The second child increases lifetime family payments to $19,734. The lifetime family

payments differ by level of education for women with three children. For high education women the family payments are estimated to be $31,6553, for year 12 education family payments are $35,072 and for low education women they are $35,072.

Appendix Table 1
Estimates of Lifetime Family Payments

Number of Children	Degree/Diploma	Year 12	Not Finished Year 12
0 Children	0	0	0
1 Child	$9,734.40	$9,734.40	$9,734.40
2 Children	$19,468.80	$19,468.80	$19,468.80
3 Children	$31,653.40	$35,072.12	$35,072.12

Appendix Tables 2 to 4 show the NPV of lifetime earnings adjusted for family payments for each of the hypothetical women. These can be compared to the NPV of unadjusted lifetime earnings presented in Tables 7 to 9. While the adjustment for family payments reduces the foregone income of children for the hypothetical women, in general the adjustments make relatively little difference to the magnitudes of the foregone income. The only exception is for year 12 and low education women with three children for whom the reduction in foregone income from having children (in percentage terms) are quite substantial. This is because these women have relatively low income (and family income) and hence receive relatively large family payments.

Appendix Table 2.
Net Present Value of Lifetime Earnings Adjusted for Family Payments, Degree/Diploma Holders

Number of children	NPV Discount Rate 0%		NPV Discount Rate 5%		NPV Discount Rate 10%	
		As % of (i)		As % of (i)		As % of (i)
(i) 0 Children	$1,086,328.87		$468,887.37		$257,105.08	
(ii) 1 Child	$856,964.63	78.9%	$346,720.17	73.9%	$183,494.08	71.4%
(iii) 2 Children	$784,578.53	72.2%	$304,612.82	65.0%	$157,231.87	61.2%
(iv) 3 Children	$712,298.54	65.6%	$269,154.27	57.4%	$138,483.18	53.9%

Appendix Table 3
Net Present Value of Lifetime Earnings Adjusted for Family Payments,
Women Completing Highschool

Number of children	NPV Discount Rate 0%		NPV Discount Rate 5%		NPV Discount Rate 10%	
		As % of (i)		As % of (i)		As % of (i)
(i) 0 Children	$741,516.79		$316,159.52		$170,480.59	
(ii) 1 Child	$549,673.66	74.1%	$216,215.69	68.4%	$111,447.81	65.4%
(iii) 2 Children	$500,003.66	67.4%	$188,062.04	59.5%	$94,279.82	55.3%
(iv) 3 Children	$456,075.52	61.5%	$167,825.45	53.1%	$84,233.15	49.4%

Appendix Table 4
Net Present Value of Lifetime Earnings Adjusted for Family Payments,
Women Not Completing Highschool

Number of children	NPV Discount Rate 0%		NPV Discount Rate 5%		NPV |Discount Rate 10%	
		As % of (i)		As % of (i)		As % of (i)
(i) 0 Children	$536,152.88		$226,377.70		$120,398.22	
(ii) 1 Child	$378,946.44	70.7%	$146,134.22	64.6%	$73,873.29	61.4%
(iii) 2 Children	$345,103.06	64.4%	$127,334.81	56.2%	$62,610.74	52.0%
(iv) 3 Children	$317,898.60	59.3%	$115,532.14	51.0%	$57,126.63	47.4%