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Child care and female employment decisions: A  
theoretical note

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### ABSTRACT

The empirical literature is divided over the issue of whether child care costs are a significant barrier to female employment. In this paper we develop a theoretical model that contributes to the literature (1) by allocating mother's time between work, leisure and child care and (2) by introducing the possibility of uncertainty in second period income because of a greater probability of divorce. We examine how these changes affect decisions on labour supply and purchase of child care. We show that although an increase in the price of child care reduces the demand for child care, it has an ambiguous impact on female employment decisions. From a policy point of view, this implies that government subsidies aimed at mitigating the cost of child care, may not have their desired impact in encouraging greater female labour force participation. However, an increase in the probability of child care unambiguously increases female labour supply and purchase of child care.

Keywords: childcare, female labour supply  
JEL codes: D, J1

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## 1. Introduction

It is often argued that the availability and affordability of child care is a significant factor affecting women's labour supply decisions. Traditionally studies on child care have modelled this decision using the labour-leisure choice model, assuming that leisure and parental child care time are substitutes. Using this framework, it is argued that an increase in child care costs leads to a substitution away from work. The empirical literature however, is divided over the issue of whether child care costs constitute a significant barrier to maternal employment. Some authors argue that higher child care costs reduce female labour force participation (see Kimmel, 1998; Ribar, 1995; Connelly, 1992; Schofield and Polette, 1998; Powell 2002). However, this view is by no means universal. Empirical studies from Australia such as Vandenheuvell (1996), Teal (1992), the ABS (1999) and Cobb-Clark *et al* (2000) disagree. According to these studies, although the greatest demand for formal child care comes for work-related reasons, child care costs do not appear to be a factor in limiting the use of child care.

In Australia, child care has emerged as an important policy issue at a time when the labour force participation of married mothers with children is at its highest level. According to ABS (1990, 1998a), in 1966 less than a third of married women aged 15-64 were in the labour force. This figure rose to 63 per cent by 1998. However, the participation rates of single women aged 15-64 increased by only 1 per cent from 66 to 67 per cent during the same period. Furthermore, much of the increase in female labour force participation has come through an increase in part-time and casual labour. For example, females constitute nearly 73 per cent of the part-time labour force (see ABS, ). Moreover, time-use surveys indicate that women continue to spend a greater proportion of their time in home production than men do. Australian women for example, contribute the bulk of unpaid non-

market work in families, with 78 per cent of all hours spent in home production (ABS, 1994).

Under these conditions accessibility and affordability of child care are likely to be important factors affecting women's labour supply decisions (see Olsberg, 1994; Redmond 1999). Since women are more inclined to work part-time or casually, they are also more likely to experience career breaks leading to a deterioration of skills and greater difficulty in re-entering the workforce.

Hence, it is possible that women with a strong labour market attachment may choose not to have any children. Alternatively, the high cost of child care may deter some women with children from participating in the work force. This is consistent with recent studies by Waldfogel (1998), Joshi (1998) and Redmond (1999), which show that while greater female labour force participation has contributed to a narrowing of the gender wage gap, there still exists a significant wage gap between childless women and women with children. These studies also point a greater labour market attachment by childless women relative to women with children.

Hence, a fundamental feature of child care policy in Australia has been to provide subsidies to child care, in a bid to encourage the labour supply of mothers with young children. However, these subsidies are typically means-tested and they are by no means only restricted to women in the workforce. This leads to a problem where there is excess demand for child care relative to supply. Because the subsidy (called child care benefits in Australia) is tax-financed, there is a restriction on the number of child care places. This creates a situation where women often take time from the labour force to care for their children. This

impacts not just on women's current income but also on their ability to accumulate future retirement income.

For example in Australia, old-age pensions are based on a two-tier system, a combination of a means and assets tested public pension and private superannuation savings which depend crucially on labour market attachment. Private superannuation savings are accumulated through regular contributions from both the employer and the employee, with a compulsory minimum employer contribution set down by government legislation. People that spend a longer time in the workforce are likely to accumulate a greater amount of savings. Moreover, these funds cannot be accessed until retirement age.

However, people on low incomes that do not satisfy the means and assets test qualify for an age-pension. Further, divorce rates in Australia are among the highest in the world, and this is also likely to impact on women's retirement income, particularly for those who withdrew from the labour force to care for their children. Under these circumstances, women face a trade-off between spending time with their children and current and future earnings.

In this paper we develop a theoretical model where time is allocated between work, leisure and child care. The model analyses how child care costs, the wage rate and taxes influence decisions on female employment and demand for child care. We adopt a life-cycle perspective and examine the implications of current labour supply choices on future retirement consumption.

Our model has an added feature that child care can be provided at 'home' by the mother or purchased from professional child care providers. Moreover, home-provided child care and professional care

are assumed to be perfect substitutes, and parents also derive utility from time spent with their children. Hence, labour force participation decisions by women affects not just their current period consumption, but also has implications for their potential to accumulate savings for retirement. However, their labour market decisions are contingent on a combination of labour market returns and on the affordability of child care.

The paper makes two contributions to the existing vast literature on child care: (1) we specifically incorporate leisure into the model, so that women face a tripartite choice between labour market participation, child care and leisure. (2) we introduce uncertainty in second period income because of a greater probability of divorce.

The incorporation of these two features greatly improves the analysis. It allows for situations where it is possible for labour supply to decrease accompanied by an increase in leisure and an increase in child care. Further, the incorporation of second-period uncertainty increases the opportunity cost of leisure and child care. Assuming that increasing female labour force participation is a desirable goal, the policy question then is whether child care subsidies or work-related incentives are better at encouraging greater female labour force participation.

We show that although an increase in the price of child care reduces demand for child care, it has an ambiguous impact on female labour supply decisions. This result is consistent with the ambiguity found in the empirical studies. It cannot then be argued that an increase in child care costs definitely reduce female labour force participation. From a policy point of view, this result suggests that government subsidies to child care aimed at encouraging greater female labour force participation may not have the desired affect. It may instead lead to a

reduction in female labour supply and a greater substitution towards leisure. However, an increase in uncertainty of second period income by increasing the opportunity cost of both leisure and child care leads to an increase in labour supply and purchase of child care.

Further, according to our model, the impact of an increase in the wage rate on labour supply and demand for child care is also ambiguous. Our model also predicts that in response to an increase in the wage rate, it is not possible for labour supply and demand for child care to move in opposite directions. Further, an increase in the marginal tax rate reduces both incentives to work and demand for child care.

Our model shows that the incorporation of uncertainty in second-period income through a greater increase in the probability of divorce, unambiguously increases female labour supply and purchase of child care.

The remainder of the paper is organised as follows: the next section provides the institutional context for the model. We provide some summary statistics on child care costs and female labour force in Australia. We also discuss recent changes in child care and superannuation policies. A two-period model is developed in Section 3, where women face a tripartite choice between child care, leisure and labour force participation. In Section 4 we analyse the comparative static properties of the model. Section 5 extends the model by incorporating future uncertainty in the form of possibility of divorce and finally Section 6 concludes.

## **2. Institutional Context**

In Australia, child care has emerged as an important issue at a time when the labour force participation of married mothers with children is at its highest level. Child care is defined by the Australian Bureau of

Statistics as “arrangements (other than parental care) made for the care of children under 12 years of age.” Formal child care is regulated and includes attendance at a pre-school, a child care centre, family day care or occasional care. Informal care on the other hand includes care by family members, friends, neighbours and paid babysitters. Parents may use a combination of formal and informal child care (ABS, 1999).

Child care costs are often cited by women as an important factor influencing their labour participation decisions. Recent studies have shown that women typically contribute more time to child care than men do. Hence their need for childcare is likely to be higher than men’s. For example, Bittman’s (1995) study of Australian women shows that between 1987 and 1992, women on an average spent three and a half times longer in child care than men did. Lower labour force participation among women with children is attributed among other things to factors such as career breaks experienced by mothers, a greater incidence of part-time work in this group, and the high cost of child care (see Olsberg, 1994; Redmond 1999). These factors are likely to lead to not only lower current income but also to a deterioration of skills and lower potential to accumulate pension savings for retirement. Hence, it is possible that women with a strong labour market attachment may choose not to have any children. Alternatively, the high cost of child care may deter some women with children from participating in the work force.

Table 1 summarises female employment trends in Australia for the 1989-1999 period.

Two points are worth noting. First females constitute nearly 3/4ths of the part-time labour force and of all female employees, 31.8 per cent are casually employed. In contrast only 12.5 per cent of male workers

work part-time. Further, approximately half of all women with children in the 0-4 age group participate in the labour market.

These figures are supported by Chapman *et al’s* (1999) study using NLS data. They find average annual earnings to be the highest for women with no children (\$18,292), relative to those that had one child (\$13,969) or three children (\$9933). This issue is of greater significance at a point when we take into account the high probability of divorce. According to the Australian Bureau of Statistics, in 1999, 46 per cent of all Australian marriages ended in divorce (ABS, 1999). Clare (2001) shows that while currently, married couples constitute 70 per cent of retired people with 20 per cent and around 20 per cent of such households consist of widowed or divorced women. Further, the number of divorced women is projected to double over the next twenty years.

The introduction of the Child Care Act in 1972, formalised the federal government’s funding of child care. Since then successive governments have made several attempts to reform the child care sector.

In 1997, the government introduced several measures including cuts in operational subsidies<sup>1</sup> to child care centres, a freeze in the fee ceiling against which child care assistance is calculated and a cut in the number of private child care centres. According to the government, these changes were introduced because of concern that child care facilities were increasingly being used by non-working individuals.

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<sup>1</sup> These are subsidies given to alleviate the running costs of child care centres.

The government also simultaneously introduced changes to tax policies for families. The Family Tax Initiative (FTI) as this was called, has two main components: it includes an increase in the tax free threshold for families (or single parent) with children. Accordingly, the tax free threshold increased by \$1000 for one member of a couple (or single parent) if taxable income was less than \$70,000. The second component of the FTI was the provision of an additional tax free area of \$2500. However, this was only given to single income families with low incomes and where at least one child is under the age of five years. Families with the same or lower level of total income earned by two working parents are not eligible for this benefit (see Brennan, 1998; Loane, 1997 for a more details).

The economic rationale for these policies was that the burden of child care should be borne by those who benefit most from it. However, these policies are likely to have a greater adverse impact on women relative to men. If child care costs act as a deterrent to re-entry into the workforce, then an increase in child-care fees due to cuts in operational subsidies combined with tax changes, further raise the cost of child care whereas the provision of a tax-free threshold for single income families acts as a transfer to stay at home parents. Together these policies raise the opportunity cost of labour force participation, particularly for women. Clare (2001) shows that despite increases in female labour force participation, women on an average spend fewer years in full-time work.

Lower labour market attachment by women however, also leads to lower accumulation of pension savings for retirement. This factor has become an issue as the Australian pension system is a combination of work-based superannuation and a basic pension that is income and assets tested. Currently superannuation funds are an important source

of savings for Australian households. According to empirical estimates they constitute 15 per cent of the personal wealth of all Australians (Bordow and Harrison, 1994). Retirement income in Australia is based on a two-tier system which includes an asset and means-tested pension and a superannuation scheme that relies on labour force participation. The means and assets tested pension is structured as follows: everyone above the age of 60 regardless of whether or not they participated in the labour market is eligible for a pension. Pension payments are however only made to those singles and couples earning below \$388.30 and \$647.80 per week respectively. In 1996 the pension amounts were \$8733 per annum for single retirees and \$14,570 for a couple. Currently, the pension level is approximately 40 per cent of the average working week (Bateman and Piggott, 1997).

The work-based superannuation (or pension) on the other hand is based on a combination of employer and employee contributions from working income. At current (1999) levels, the employer is required by law to make a contribution of 7 per cent of the employee's working income and the employee also makes a contribution of 3 per cent. Individuals are however allowed to make voluntary contributions above the mandatory requirement.

The low levels of public pension provide strong incentives to remain employed. What these changes effectively mean is that part-time and casual workers and individuals not in the labour force, face lower retirement incomes. As women are already over-represented in the lower income part-time labour group, incentives that encourage women to withdraw their labour supply during their working years imply lower retirement income as well. According to Clare (2000), although anyone who earns more than \$450 per month is eligible for compulsory superannuation contributions, in reality because a

significant proportion of women in the part-time and casual labour market, they are unlikely to receive the full-benefits of the Superannuation guarantee because they may earn less than the minimum amount for some months.

In the section below, we develop a simple two-period model where individuals make decisions on labour supply and purchase of child care subject to time and day care constraints. These decisions however, have implications for their future consumption since retirement income is contingent on their pension contributions during their working years. Under these circumstances, we examine how exogenous changes in taxation and superannuation policies affect these choices.

### 3. The Model

The theoretical model considers households with children. It is based on the assumption that households derive utility from consumption, leisure, and time spent with children. Furthermore, we also assume that children require care continuously, there are no supply constraints on child care, home-provided child-care is perfectly substitutable with professional child care, parents derive positive utility from spending time with children and that leisure time is separate from time spent with children. Parental retirement income is contingent upon their pension contributions during their working years.

Consider a representative household with two adults who live for two periods- working in the first and retired in the second. Assume that households have preferences over current and future consumption,  $c_1 \geq 0$  and  $c_2 \geq 0$  respectively; leisure,  $l \geq 0$  and time spent with their children,  $d \geq 0$ .

Following Lundholm and Ohlsson (1998), we assume that while female labour force participation decisions are constrained by the availability and affordability of child care, male labour force participation decisions are generally unconstrained by these issues. Therefore, in what follows we assume that  $c_1$  and  $c_2$  refer to female consumption in periods one and two. In period one, women work, have children and raise them using either their own time or professional child care. In the second period, they are retired and consume their pension savings acquired through labour market participation in period one.

Household preferences are described by an additively separable utility function  $U = u(c_1) + \rho v(c_2) + g(l, d)$ , which is strictly concave and twice differentiable.

Period one consumption is financed by exogenous household income,  $Y_1$  and by wage income (net of tax and pension contributions),  $wah(1-\tau)(1-s)$ . The ability parameter influences the individual's wage rate,  $w^i = a^i w$ , where  $w$  denotes the wage rate per efficiency unit of labour. Hence, wage income depends on the wage rate,  $w$ , an ability parameter  $a^i$ , and hours spent in the labour force,  $h$ . The terms  $\tau$ , and  $s$  denote taxes and pension contributions respectively. We assume that pension contributions are only made by those in paid employment and is an exogenously determined proportion of labour income.

Individuals face both time and child care constraints during their working period. The time constraint faced by the working-age parent (mother) is:

$$T \geq l + h + d \tag{1}$$

where  $T$  denotes the total hours available to the parent which could be spent consuming leisure ( $l$ ), in the labour market ( $h$ ), or in providing child care ( $d$ ). Hence if parents spend  $d$  hours in child care, purchased child care is:

$$\psi = D - d \quad (2)$$

where  $\psi$  refers to hours of professional child care purchased at price  $p$  and  $D$  is the total hours of care required by a child. Thus  $\psi$  can be re-written as:

$$\psi = l + h \quad (3)$$

i.e., purchased care must also equal hours of work plus leisure. Substituting (3) into (1) we have

$$d = T - \psi \quad (4)$$

The second period budget constraint is:

$$c_2 = Y_2 + wa^i h(1-\tau)s(1+r) + \varepsilon \quad (5)$$

Second period consumption is financed by exogenous household income  $Y_2$ ; returns on pension contributions made in the first-period,  $wa^i hs(1+r)$ ; and a means-tested public pension,  $\varepsilon$ . Accordingly, only those individuals whose first period income is below the basic pension amount  $\varepsilon$ , receive a public pension in the second period equivalent to the amount  $\varepsilon$ .

Households maximise their utility through choice of  $h$  and  $\psi$ , subject to (2), (4) and (5), which yields the unconstrained maximand:

$$U = u(Y_1(1-\tau) + wa^i h(1-\tau)(1-s) - p\psi n) + \rho v(Y_2 + wa^i h(1-\tau)s(1+r) + \varepsilon) + g(\psi - h, T - \psi) \quad (6)$$

The two first-order conditions with respect to  $h$  and  $\psi$  are:

$$U_h : u' wa^i (1-\tau)(1-s) + \rho v' w a^i (1-\tau)s(1+r) - g_1 = 0, h > 0 \\ < 0, h = 0 \\ > 0, h < T \quad (7)$$

$$U_\psi : -u' pn + g_1 - g_2 = 0, \psi > 0 \\ < 0, \psi = 0 \\ > 0, \psi < D \quad (8)$$

If equation (7) holds with equality,

$$u' wa^i (1-\tau)(1-s) + \rho v' wa^i (1-\tau)s(1+r) = g_1 \quad (9)$$

The LHS of (9) represents the present marginal value of labour force participation and the RHS is the marginal utility of leisure. Hence, optimum labour supply is characterised by an equilibrium between the marginal benefits and costs of labour force participation.



From (8), optimum purchase of professional child care occurs when the sum of the marginal disutility of child care costs and the marginal utility of leisure equals the marginal utility of spending time spent with the child.

#### 4. Analysis of the model

Consider first the two corner solutions:

Case 1: A household where the mother is working full-time, so that,  $h = T$ , and therefore  $l = 0$ ,  $d = 0$ , which implies that all child care is purchased,  $D = \psi$ .

From (7), if the present marginal value of labour force participation exceeds the marginal utility of leisure,  $u'wa^i(1-\tau)(1-s) + \rho v'wa^i(1-\tau)s(1+r) > g_1$ , then the marginal benefits from working outweigh the marginal disutility from working. This is likely if the mother has relatively high labour market returns,  $wa^ih$  or if her marginal utility of leisure is low.

Further, from (8), it must also be the case that  $g_1 - u_1pn > g_2$ . In other words, when marginal utility from leisure net of child care costs is greater than the marginal utility of spending time with children, there is a greater demand for child-care.

Case 2: Consider next households where the mother is not employed,  $h = 0$ ,  $wa^ih(1-\tau)(1-s) = 0$ ; and all child care is provided using mother's time,  $\psi = 0$ .

This is likely if the marginal utility of leisure exceeds the marginal present value of labour force participation, i.e.  $u'wa^i(1-\tau)(1-s) + \rho v'wa^i(1-\tau)s(1+r) < g_1$  in (7). Further from (8), it must also be the case that the marginal utility of spending time with the child exceeds the marginal cost of child care and the marginal utility of leisure,  $g_1 - u_1pn < g_2$ . This case describes a situation where the mother's opportunity cost of not being in the labour force is low or close to zero.

#### 4b. Comparative Statics Analysis

Assuming interior solutions, in the section below, we assess the comparative static properties of the model. In particular, we examine how changes in policy parameters such as the price of child care, taxes and the wage rate affect decisions on female labour supply,  $h$ , and demand for child care,  $\psi$ . All derivations are in the Appendix.

Consider first the effect of changes in the price of child care on labour supply and purchase of child care, summarised in Proposition 1 below:

*Proposition 1: An increase in the price of child care reduces demand for child care, but its affect on labour supply cannot be predicted;  $\partial\psi/\partial p < 0$ ,  $\partial h/\partial p \gtrless 0$ .*

As expected, the own price effect of an increase in the price of child care unambiguously reduces purchase of child care. The increase in home-provided child care comes via a reduction in either leisure or labour hours, or both.

However, the impact of higher child care prices on labour supply cannot be predicted. This is consistent with the ambiguity found in the

empirical literature. For example, while studies by Connelly (1992), Schofield and Polette (1998) argue that an increase in child care costs has a negative effect on female employment, others such as Vandenneuvel (1996), Ribar (1995), Teal (1992) and the ABS (1999) disagree.

Intuitively, this result follows because when child care prices increase, there is an income and substitution effect. However, it is not possible to predict *a priori* which of these two effects dominates. First, parents may reduce their labour supply, substitute towards greater home-provided child care and purchase fewer child care hours. In this case, leisure hours may remain the same or decrease. Second, the income effect of an increase in child care prices reduces parental disposable income. They may therefore work longer hours to pay for the higher costs. In this case, we cannot predict whether they will purchase more child care or substitute away from leisure towards more time in own-provided child care. If the substitution effect dominates, we expect higher child care prices to lead to lower labour supply, i.e.  $\partial h/\partial p < 0$ . The opposite is true if the income effect dominates.

From our comparative static results (A.10 in the Appendix), an increase in the price of child care increases labour supply if

$$\left| (u''\psi n \bar{W})F_{22} \right| > \left| (-u''p\psi(n)^2 + u'n)F_{12} \right| \quad (10)$$

Proof: See Appendix

Intuitively, this result is likely if the utility from being in the paid labour force outweighs both the disutility of higher child care costs and the utility of spending more time with the child. This is likely to

depend on the skill composition of women. For example, women in relatively high paid jobs are less likely to be affected by increases in child care costs, relative to those on low paid jobs. However, women on low-paid jobs have a low wage,  $w$ , relative to the price of child care. An increase in child care prices may induce these women to reduce their work hours, and perhaps spend a greater amount of time with their children. This is reflected as a switch from full-time to part-time employment. Indeed this is consistent with empirical evidence from Australia where according to the ABS (2000), females constitute nearly 3/4<sup>th</sup> of the part-time labour force and of all female employees, 31.8 per cent are casually employed. It is likely that these women reduce their labour supply in order to care for their children, hence  $\partial h/\partial p < 0$ .

Further, the impact on leisure of an increase in the price of child care is unclear. While an increase in the price of child care reduces labour supply if (10) holds, we cannot predict whether this leads to greater hours of leisure or an increase in demand for child care. From a policy point of view, an implication of this result is that government subsidies to child care aimed at encouraging greater female labour force participation may not have the desired effect in our model. This is because lower child care prices may increase the demand for child care, but lead to greater leisure consumption rather than higher labour supply.

Proposition 2 below describes the effect of a change in the wage rate on labour supply and demand for child care.

*Proposition 2: A change in the wage rate (i) has an ambiguous effect on both labour supply and demand for child care;  $\partial \psi/\partial w > 0$ ,*

$\partial h/\partial w \gtrless 0$ ; (ii) causes demand for child care and labour supply to move in the same direction.

Proof: See Appendix

According to our comparative static results, a change in the wage rate has an ambiguous effect on both labour supply and child care. As in the previous case, an increase in the wage rate has both an income and a substitution effect on labour supply. An increase in the wage rate raises real purchasing power, and since both leisure and child care are normal goods, cause people to consume more of both. However, an increase in the wage rate also raises the opportunity cost of leisure and own-provided child care. This may lead to a substitution away from leisure and time spent with children towards longer working hours. Which of these two effects dominates cannot be predicted.

What is the joint impact of a change in the wage rate on both labour supply and demand for child care? *A priori* when the wage rate increases, there are four possibilities: both labour supply and demand for child care may increase; both labour supply and demand for child care may decrease; labour supply may increase while the demand for child care decreases and finally labour supply may decrease while demand for child care increases.

However, our comparative static results show that in response to an increase in the wage rate, it can never be the case that labour supply and demand for child care move in opposite directions. For example, while a rise in the wage rate increases labour force participation, it also increases demand for child care. The opposite also holds true.

Next we examine the impact of a change in the marginal tax rate on labour supply and purchase of child care.

*Proposition 3: Suppose that  $|\bar{W}G| < |u'wa^i|$ , then  $\partial h/\partial \tau, \partial \psi/\partial \tau < 0$ .*

Accordingly, if the marginal utility of wage income is greater than the change in marginal utility of net income from period 1, then higher marginal tax rates reduce both labour supply and demand for child care.

From our comparative static results, the effect of an increase in the marginal tax rate on labour supply and purchase of child care is ambiguous. By reducing the opportunity cost of working, higher taxes encourage a greater substitution towards leisure or time with children. On the other hand, an increase in the marginal tax rate also reduces real income and in some situations may lead women to increase their labour supply to maintain the target income level.

Hence an increase in the marginal tax rate generates a substitution effect, which leads to a substitution towards greater home provided child care and possibly higher leisure hours.

## 5. Uncertainty in second-period consumption

A simple extension of the model is to incorporate the possibility of uncertainty in second period consumption due to a greater probability of divorce. We assume that in the event of divorce, retirement income for women is substantially reduced. We further assume that households are risk-averse. Therefore while (1) remains unchanged, (2) now incorporates the probability of divorce. Individuals now face the prospect,  $(\pi, 1-\pi : kY_2, Y_2)$ , where  $\pi$  and  $(1-\pi)$ , are the probabilities attached to the occurrence of the divorce and non-divorce

states respectively. Household income in the second period is  $kY_2$  if a divorce occurs and  $Y_2$  otherwise, where  $kY_2 < Y_2$ .

Define the notation:

$$\begin{aligned} c_2^L &= kY_2 + wa^i h(1-\tau)s(1+r) + \varepsilon \\ c_2^H &= Y_2 + wa^i h(1-\tau)s(1+r) + \varepsilon \end{aligned} \quad (11)$$

where  $c_2^L$  and  $c_2^H$  refer to consumption in the divorced and the non-divorced state respectively, and since  $kY_2 < Y_2$ , it follows that  $c_2^L < c_2^H$ . Substituting (11) for  $C_2$  the expected utility function becomes:

$$\begin{aligned} EU &= u(Y_1(1-\tau) + w a^i h(1-\tau)(1-s) - p\psi - n) \\ &\quad + \rho v (\pi(kY_2 + wa^i h(1-\tau)s(1+r) + \varepsilon) \\ &\quad + (1-\pi)v(Y_2 + wa^i h(1-\tau)s(1+r) + \varepsilon)) \\ &\quad + g(\psi - h, T - \psi) \end{aligned} \quad (12)$$

First-order conditions with respect to  $h$  and  $\psi$  are:

$$\begin{aligned} U_h : & u' wa^i (1-\tau)(1-s) + \rho v' (\pi(wa^i (1-\tau)s(1+r) \\ & + (1-\pi)(wa^i (1-\tau)s(1+r))) - g_1 = 0 \end{aligned} \quad (16)$$

$$U_\psi : -u'pn + g_1 - g_2 = 0 \quad (17)$$

*Proposition 4: An increase in the probability of divorce leads to both higher labour force participation and a greater use of professional child care, i.e., both  $\partial h/\partial \pi, \partial \psi/\partial \pi > 0$ .*

Proof: See Appendix

The intuition for this result is straightforward. An increase in the probability of divorce increases the uncertainty associated with second period income. Hence women prefer staying employed, and as a consequence they purchase more child care.

## 6. Conclusions

This paper has examined the effect of changes in the price of child care, wage rate and taxes on incentives to work and purchase child care in the context of a life-cycle model. The inclusion of leisure into the analysis has interesting implications on demand for child care and labour supply.

The model demonstrates that while higher child care costs lead to a decrease in demand for child care, its impact on labour supply cannot be determined *a priori*. From a policy point of view, this result has important implications since it suggests that reduction in child care prices directed towards encouraging greater female employment, may not have its desired effect. This is because lower child care prices may increase the demand for child care, but lead to greater leisure consumption rather than higher labour supply.

Our model also shows that in response to a change in the wage rate, labour supply and demand for child care always move in the same direction. An increase in labour supply leads to greater demand for

child care. However, the reduction in work hours associated with an increase in the tax rate, leads women to purchase greater child care hours and spend more time consuming leisure.

Finally, our model has important implications for retirement income. Our model predicts that an increase in the probability of divorce leads to higher labour force participation and a greater purchase of professional child care.

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## Appendix

### A.i Second-order conditions

The second order conditions are satisfied when  $F_{11}F_{22} - F_{12}^2 > 0$ . Using (7) and (8)

$$F_{11} \equiv \frac{\partial^2 U}{\partial h^2} = u''(wa^i(1-\tau)(1-s))^2 + \rho v''(wa^i(1-\tau)s(1+r))^2 + g_{11} = 0 \quad (\text{A.1})$$

$$F_{22} \equiv \frac{\partial^2 U}{\partial \psi^2} = u''(pn)^2 + g_{22} - 2g_{12} + g_{11} = 0 \quad (\text{A.2})$$

$$F_{12} \equiv \frac{\partial^2 U}{\partial h \partial \psi} = F_{21} \equiv \frac{\partial^2 U}{\partial \psi \partial h} = -u''pn(wa^i(1-\tau)(1-s)) + g_{12} - g_{11} = 0 \quad (\text{A.3})$$

From (A.1)-(A.4) since  $F_{11}, F_{22} < 0$  and  $F_{12}, F_{21} > 0$ , the second order conditions are satisfied. Hence  $|J| > 0$ .

### A.2: Comparative statics

Totally differentiating (7) and (8) with respect to  $p$ ,  $\tau$  and  $w$  yields the following system of equations:

$$\begin{aligned} & [-u''wa^i(1-\tau)(1-s)\psi n]dp \\ & + [-u'wa(1-s) - v'was(1+r) - u''(wa^i(1-s))^2(h(1-\tau)) - v''(wa^i s(1+r))^2 h(1-\tau)]d\tau \quad + \\ & [u''wh(a^i(1-\tau)(1-s))^2 + u'a^i(1-\tau)(1-s) + \rho v''hw(a^i(1-\tau)s(1+r))^2 wh + \\ & \rho v'a^i(1-\tau)s(1+r)]dw \end{aligned} \quad (\text{A.4})$$

$$[u''p\psi(n)^2 - u'n]dp - [u'a^i(1-\tau)(1-s)n]d\tau - [u''pna^i h(1-\tau)(1-s)]dw \quad (\text{A.5})$$

Define  $a^i(1-\tau)s(1+r) \equiv S$  and  $a^i(1-\tau)(1-s) \equiv \bar{W}$ , where  $G < 0$  and  $S, \bar{W} > 0$ .

**Proposition 1: Effect of changes in price of child care and wage rate on labour supply and purchase of child care decisions**

Using A.1 and A.2 and applying Cramer's Rule we get:

$$\begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix} \begin{pmatrix} \frac{\partial h}{\partial p} \\ \frac{\partial \psi}{\partial p} \end{pmatrix} = \begin{pmatrix} u''\bar{W}\psi n \\ -u''p\psi(n)^2 + u'n \end{pmatrix} \quad (\text{A.6})$$

We then have,

$$\frac{\partial h}{\partial p} = \frac{(u''\psi n \bar{W})F_{22} - (-u''p\psi(n)^2 + u'n)F_{12}}{|J|} \geq 0 \quad (\text{A.7})$$

$$\frac{\partial \psi}{\partial p} = \frac{(-u''p\psi(n)^2 + u'n)F_{11} - (u''\bar{W}\psi n)F_{21}}{|J|} < 0 \quad (\text{A.8})$$

Since  $F_{22}, F_{11}, u_{11} < 0$  and  $F_{12}, F_{21}, u_1, \bar{W}, p, S, \psi, n > 0$ ,  $\partial h/\partial p \geq 0$ , and  $\partial \psi/\partial p < 0$ .

From (A.7), the sign of  $\partial h/\partial p$  depends on whether  $|(u''\psi n \bar{W})F_{22}| \geq |(-u''p\psi(n)^2 + u'n)F_{12}|$ .

The LHS of the above expression is the product of the change in net marginal benefits from being employed and the change in marginal utility of child care, whereas the RHS is the sum of the marginal disutility of child care costs and the marginal utility of children multiplied by a change in marginal utility of labour supply from an increase in purchase of child care. If the LHS > RHS, an increase in the price of child care increases labour supply.

**Proof of Proposition 2:** Effect of change in the wage rate on labour supply and purchase of child care

From A.1 and A.2 and applying Cramer's rule,

$$\begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix} \begin{pmatrix} \frac{\partial h}{\partial w} \\ \frac{\partial \psi}{\partial w} \end{pmatrix} = \begin{pmatrix} -(\bar{W}(u' + u''\bar{W}wh) + \rho S(v''whS + v')) \\ u''pnh\bar{W} \end{pmatrix}$$

$$\frac{\partial h}{\partial w} = \frac{-u''pnh\bar{W}F_{12} - [\bar{W}(u''\bar{W}h + u') + \rho S(v''whS + v')]F_{22}}{|J|} > 0 \quad (\text{A.9})$$

$$\frac{\partial \psi}{\partial w} = \frac{u''pnh\bar{W}F_{11} + [\bar{W}(u''\bar{W}h + u') + \rho S(v''whS + v')]F_{21}}{|J|} < 0 \quad (\text{A.10})$$

Let  $\bar{W}u' + \rho S v' = A$ ,  $u''pnh\bar{W} = B$  and  $u''(\bar{W})^2 h + \rho v''wh(S)^2 = a$

Divide the numerators in (A.9) and (A.10) by  $F_{22}$  and  $F_{21}$  respectively.

$$\frac{\partial h}{\partial w} > 0 \quad \text{if} \quad |A + B(F_{12}/F_{22})| > |a| \quad \text{and} \quad \frac{\partial \psi}{\partial w} < 0 \quad \text{if} \quad |A + B(F_{11}/F_{21})| > |a| \quad .$$

Simplifying further,  $\partial h/\partial w > 0$  and  $\partial \psi/\partial w < 0$  only if  $|F_{12}/F_{22}| > |F_{11}/F_{21}|$



**Proof of Proposition 3: Effect of a change in marginal tax rate on labour supply and purchase of child care**

Using (A.5) and (A.6),

$$\begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix} \begin{pmatrix} \frac{\partial h}{\partial \tau} \\ \frac{\partial \psi}{\partial \tau} \end{pmatrix} = \begin{pmatrix} u'wa^i(1-s) + u''(wa^ih(1-s))^2 + wa^is(1+r)(v' + v''whS) \\ u''pnh\bar{W} \end{pmatrix} \quad (\text{A.11})$$

Applying Cramer's Rule,

$$\frac{\partial h}{\partial \tau} = \frac{[u'wa^i(1-s) + u''(wa^ih(1-s))^2 + wa^is(1+r)(v' + v''whS)]F_{22} - u''pnh\bar{W}F_{12}}{|J|} \begin{matrix} > \\ < \end{matrix} 0 \quad (\text{A.12})$$

$$\frac{\partial \psi}{\partial \tau} = \frac{u''pnh\bar{W}F_{11} - [u'wa^i(1-s) + u''(wa^ih(1-s))^2 + wa^is(1+r)(v' + v''whS)]F_{21}}{|J|} \begin{matrix} > \\ < \end{matrix} 0 \quad (\text{A.13})$$

**Proposition 4: Effect of an increase in probability of divorce on labour supply and purchase of child care**

Using and , the second-order conditions are:

$$F_{11} \equiv \frac{\partial^2 U}{\partial h^2} = u''(wa^i(1-\tau)(1-s))^2 + \rho v''((1-\pi)wa^i(1-\tau)s(1+r))^2 + \pi(wa^i(1-\tau)s(1+r))^2 + g_{11} < 0 \quad (\text{A.14})$$

$$F_{22} \equiv \frac{\partial^2 U}{\partial \psi^2} = u''(pn)^2 + g_{22} - 2g_{12} + g_{11} = 0 \quad (\text{A.15})$$

$$F_{12} \equiv \frac{\partial^2 U}{\partial h \partial \psi} = F_{21} \equiv \frac{\partial^2 U}{\partial \psi \partial h} = -u''pn(wa^i(1-\tau)(1-s)) + g_{12} - g_{11} = 0 \quad (\text{A.16})$$

From (A.14)-(A.16) since  $F_{11}, F_{22} < 0$  and  $F_{12}, F_{21} > 0$ , the second order conditions are satisfied. Hence  $|J| > 0$ .

Totally differentiating (11) and (12) with respect to  $\pi$  and applying Cramer's rule,

$$\frac{\partial h}{\partial \pi} = \frac{\rho v''(c_2^L - c_2^H)F_{22}}{|J|} > 0 \quad (\text{A.17})$$

$$\frac{\partial \psi}{\partial \pi} = \frac{-\rho v''(c_2^L - c_2^H)F_{21}}{|J|} > 0 \quad (\text{A.18})$$

**Table 1: Female employment trends in Australia- 1989-1999**

	1989	1991	1993	1995	1997	1999
<b>Females (of total labour force)</b>	40.8	41.4	41.9	42.7	43.1	43.3
<b>Females in the labour force with children aged 0-4 years (of all females with children aged 0-4 years)</b>	44.0	44.5	45.3	49.3	47.7	47.1
<b>Part-time workers (of total employed)</b>	20.1	21.7	23.5	24.4	25.2	26
<b>Male part-time workers (of total male employed)</b>	7.2	8.5	10.2	10.9	11.7	12.5
<b>Female part-time workers (of total female employed)</b>	38.9	40.2	41.7	42.5	42.9	43.5
<b>Female part-time workers (of total part-time employed)</b>	78.6	77.2	75.1	74.5	73.7	72.7
<b>Males casually employed (of all male employees)</b>	13.1	13.5	16.4	18.5	20.9	22
<b>Females casually employed (of all female employees)</b>	29.3	29	30.6	30.8	31.7	31.8

Source: ABS. Australian Social Trends 2000, Cat. 4102.0