1-2008

Career and Family Choices in the Presence of Uncertainty

Alison Watts
Southern Illinois University Carbondale

January 7, 2008

Career and Family Choices in the Presence of Uncertainty

By

Alison Watts

Department of Economics
Southern Illinois University Carbondale
Carbondale, IL 62901, U.S.A.
(E-mail: wattsa@siu.edu)

Abstract

It is well known that women's career outcomes are tied to fertility decisions and that occasionally educated women who had planned to stay in the labor market after childbirth exit the market. We examine women's career, fertility, and educational choices in an environment of uncertainty regarding the possibility of achieving both a high-powered career and a family. In a simple framework, we show that although women may prefer to have both a prestigious career and a family they may choose a less prestigious job or no family due to the uncertainty involved in being able to achieve both a career and family. In an overlapping generations model, we examine how women's beliefs about the probability of a career separation due to family obligations are formulated and show that a simple belief updating structure exists in which future generation's beliefs may converge and certainly do not diverge from the true probability of a career separation. Lastly, we examine the impact of grandparent child care networks on career and family choices in both a static and overlapping generations model.

JEL Classification: J00, D80, C70
Keywords: Career Separation, Child Care, Uncertainty, Updating Beliefs, Grandparent Networks

1 Introduction

It is well documented that women often exit the labor market due to family obligations such as child care; see for instance Goldin (2006). In fact, Boushey (2005) found that although highly educated women were more likely to stay in the labor force than less educated women, of those highly educated women not in the labor force, 87 percent had a child at home. Additionally, although most women with children are employed (see Boushey (2005)), they are traditionally less likely to have a "career"[1] than are women without children (see Goldin (1997) and Blau (1998)), and educated women are less likely to achieve a goal of having both a career and a family than are educated men (see Goldin (1997 and 2004), Perna (2004), and Blau (1998)). Thus, it is clear that some educated women exit the labor force once they have children, while other women choose either not to pursue high-powered careers or not to have children. There have been many studies of the impact of a long labor force separation on women's wages.[2] Instead, we focus here on the impact of some educated women exiting the labor force due to child care on women's child bearing decisions, career decisions, and educational achievements, in an environment of uncertainty regarding the possibility of achieving both a career and family.

Specifically, we assume all women desire to have both a career and family, where we define a career to be a prestigious job requiring an educational investment and a family (as in Goldin (2004)) to mean having at least one child. In our model, women first decide whether or not to invest in education where investment secures them a prestigious career which is not always compatible with having a family while non-investment in education secures them a less prestigious but more flexible job which is always compatible with having a family. Second, a woman chooses whether or not to have a child, where if a woman has a prestigious

[1] Goldin (2004) defines having a career as having an income for at least two years of at least the amount that the bottom 25th percent of college educated men receive.

[2] For instance, Ruhm (1998), Francesconi (2002), and Phipps, Burton, and Lethbridge (2001) all show that a long job force separation significantly increases the gender wage gap. While Wood, Corcoran, Courant (1993) and Filipppin and Ichino (2005) show that for highly educated women, a decrease in labor supply significantly lowers women's future wages.

career, then there is a positive probability that having a child will cause her to exit the labor force. In this simple framework, we show that although a woman may prefer to have a high-powered career with a family, a woman may choose a high powered career with no family or a family with a less prestigious job because of the uncertainty involved in being able to obtain both a career and family.

We also examine what happens in terms of career and family decisions if the uncertainty regarding the possibility of achieving both a career and family is overestimated or underestimated. If women overestimate the probability that having a family will cause a high-powered career loss, then women will be too cautious in their decisions and will choose less prestigious jobs or no children when in fact it may be optimal for them to choose prestigious jobs with families. If women underestimate this probability and are thus overly optimistic in their beliefs, then they will choose prestigious careers with families when in fact the optimal choice may be either less prestigious jobs or no families.

Given the importance of overestimating and underestimating the uncertainty of being able to achieve both a career and family, we ask how such beliefs regarding this uncertainty are formulated. Initially, women do not know the probability of a family causing a career separation[3], but attempt to learn this probability in an overlapping generations framework. A woman inherits the beliefs of her mother, but is also able to observe the job and family outcomes of the previous generation. We then ask if there is a simple rule for updating beliefs such that beliefs either converge to the true probability of a career loss or at least do not diverge from the true probability. We show that such a simple rule exists, where if a woman observes either direct evidence that a member of the previous generation had no career separation (or achieved having both a career and family) or had a career separation, then she updates the beliefs of her mother, but if no such evidence exists then beliefs are not updated. We show that with this simple rule initial beliefs never diverge further from the true probability of a career loss, but given certain initial conditions beliefs can become stuck at an

[3]For simplicity, this probability is assumed to be the same for all women across all generations.

incorrect probability. Our rule for updating beliefs is simple and fairly naive and has a flavor of other simple updating rules used in different contexts. For instance, Ellison and Fudenberg (1993 and 1995) consider naive updating rules in the context of technology adoption with word of mouth communication[4], and Börgers and Sarin (1997) consider somewhat naive updating rules where players use only a limited amount of information in a stochastic learning context.

Lastly, we examine the impact of family child care networks on career and family choices. Grandparents provide a considerable amount of child care to grandchildren in the U.S. which has in fact increased in recent years. According to the U.S. Census, 18.6% of preschoolers of employed mothers were primarily cared for by grandparents while their mothers worked in 2002, while in 1991 this percentage was only 15.8%; see Johnson (2005). Additionally, Fuller-Thomson and Minkler (2001) found that 40% of grandparents had provided some child care in the last month using National Survey of Families an Households data collected in the 1990s.[5]

We model grandparent child care as a family network where a grandmother who does not have a prestigious career can provide grandchild care enabling her daughter to keep a prestigious career regardless of her family status. A grandmother with a prestigious career cannot help with grandchild care, but is able to provide financial assistance to her daughter which lowers the cost of education for the daughter. In a static framework, we find that if a grandmother has a less prestigious job, then her daughter will always choose to have a family. While if a grandmother has a prestigious career, then her daughter may choose different job and family combinations depending on the cost of education and the amount of financial help a grandmother provides as well as, preferences, and the daughter's beliefs regarding the probability of a career separation due to child care.

[4] For a slightly more sophisticated updating rule in this context, see Banerjee and Fudenberg (2004).

[5] See also Lei (2006) and Cardia and Ng (2003) who examine the impact of grandparents helping their children either financially or with grandchild care on the likelihood of a child receiving such help and on the decision to subsidize child care, respectively.

We then consider an overlapping generations model and ask how family networks influence the career and family choices of a woman's descendants. In particular, we are interested in whether or not the choices of a woman's descendants converge over time. Propositions 5, 6, and 7 give conditions under which career and family choices converge to the less prestigious job with a family, the prestigious job with a family, and the prestigious job with no family, respectively. Finally, Proposition 8 shows that if the cost of education is low and if the probability of a family induced career separation is high, then career and family choices may cycle from generation to generation between the prestigious job with a family and the less prestigious job with a family.

Perhaps the most closely related paper to the current one is Breen and García-Peñalosa (2002) who analyze why gender job segregation occurs in a Bayesian learning framework. As in our model, there are two types of jobs one conducive to child care and one not, but unlike our model agents are uncertain of their success in the prestigious job. If an agent chooses a prestigious job he (respectively, she) can update his (her) beliefs after he (she) succeeds or not and passes these beliefs on to his (her) son (respectively, daughter). It is shown that if men and women have different initial preferences, then men and women in future generations can end up with different beliefs which can cause gender job segregation. Although both the current paper and Breen and García-Peñalosa (2002) analyze whether or not beliefs in future generations converge to true beliefs, the applications are quite different as well as the model structure. For instance, in Breen and García-Peñalosa (2002) agents have different abilities and thus cannot learn from observing others while here information regarding the probability of a career loss can be learned from observing others.

As women's job outcomes are often tied to fertility decisions we allow both job and fertility decisions to be endogenous in an uncertain environment. There are other papers which also examine women's outcomes with multiple endogenous decision variables. These papers include Caucutt, Guner, and Knowles (2002), Dessy and Djebbari (2005), and Sheran (2007), who examine the impact of endogenous marriage and fertility decisions on job and family outcomes. While Erosa, Fuster, and Restuccia (2002) investigate how fertility and job switching decisions affect wages. Additionally, Erosa, Fuster, and Restuccia (2005) examine the impact of fertility and labor market decisions on wages in an environment with and without mandatory maternity leaves.

The paper proceeds as follows. In sections 2 and 3 the model and basic results are presented. The formulation of beliefs is examined in section 4, family networks are examined in section 5, and concluding remarks are presented in section 6.

2 Model

There are n agents with $N = \{1, 2, ..., i, ..., n\}$. Each agent lives for two periods. There are three possible job outcomes $j \in \{A, B, 0\}$. The first are A jobs which are high skilled and involve educational investment, I. These jobs involve long hours, travel, and are prestigious. The second type are B jobs which are less skilled and involve educational investment $I' = 0 < I$; these jobs are 40 hours a week or less and involve no travel.[6] Lastly, if an agent has no job, then $j = 0$.

Each agent i receives utility from both her job and from her children. Utility is represented by $u_i(j, c) - k$ where $c \in \{0, 1\}$ represents having a child or not, and $k \in \{0, I\}$ represents i's educational investment. We assume that preferences have the following properties for all $i \in N$:

(i) $u_i(A, c) > u_i(B, c) > u_i(0, c)$ for all $c \in \{0, 1\}$, and

(ii) $u_i(j, 1) > u_i(j, 0)$ for all $j \in \{A, B, 0\}$.

Additionally, we define person i to be a *career type* if $u_i(B, 1) < u_i(A, 0)$ and we define i to be a *child type* if $u_i(B, 1) > u_i(A, 0)$. We assume that each person is either a career or child type. (Thus $u_i(B, 1) = u_i(A, 0)$ is not allowed.)

[6] The creation of two jobs one of which is conducive to childcare and the other of which is not, is similar to assumptions made in Breen and García-Peñalosa (2002).

There are two types of children an agent can have: a high maintenance child or a low maintenance child. A high maintenance child requires more care. Anyone having a high maintenance child can still perform a B job, but is unable to perform an A job and must quit and become unemployed. (We assume that B employers prefer to hire young employees and will not hire someone who has left a previous job for an extended child care leave; thus someone who leaves an A job cannot obtain a B job later.)[7] Anyone having a low maintenance child can perform in either type of job.[8]

Each agent i lives two periods. In the first period, agents are born and at the end of the first period an agent decides to invest in the education required for an A job or not. At the beginning of the second period, the agent starts either the A job (if she invested in education) or the B job and then decides whether or not to have a child. If an agent decides to have a child, with probability $0 \leq p \leq 1$ she has a low maintenance child and with probability $1 - p$ she has a high maintenance child. At the end of the second period, an agent receives utility $u_i(j, c) - k$, where j represents the agent's job at the end of period 2. Thus, if person i chooses an A job and to have a child, then his a priori expected utility is $pu_i(A, 1) + (1 - p)u_i(0, 1) - I$. If i chooses an A job and no child, his expected utility is $u_i(A, 0) - I$. If person i chooses a B job, then having a child never affects whether or not i can keep a job. Thus, given the assumptions on preferences it is always better to have a child and i's expected utility is $u_i(B, 1)$.

[7] Alternatively, one could assume that mothers are less likely to be hired, as was found to be true in the recent study of Correll, Bernard, and Paik (2007), or that women who exit the labor force receive significantly lower wages on re-entry (see Ruhm (1998) and Phipps, Burton, Lethbridge (2001)) making it less appealing for them to re-enter.

[8] Instead, one could assume that all children are identical, but that mothers have different preferences regarding child care which they do not learn until after childbirth. Thus, women with "high maintenance" children can be interpreted as women who are uncomfortable leaving a child in daycare (or some other non-family child care arrangement) for long periods of time (which is necessary if a woman has an A job). While women with "low maintenance" children can be interpreted as those more comfortable with this arrangement.

3 Results

Next we examine an individual's job choice and decision of whether or not to have a child. To achieve this goal, we solve the model backwards by first looking at the decision of whether or not to have a child given that the person already has a job. Then we look at the decision of which job the person will choose.

Proposition 1 *(i) If $u_i(A,0) > pu_i(A,1) + (1-p)u_i(0,1)$ and i is a child type, then i always chooses job B and chooses to have a child. If instead i is a career type, then i chooses the A job and no child if $u_i(A,0) - I > u_i(B,1)$ and i chooses the B job with a child if $u_i(A,0) - I < u_i(B,1)$. (ii) If $u_i(A,0) < pu_i(A,1) + (1-p)u_i(0,1)$, then regardless of i's type i chooses the A job with a child if $pu_i(A,1) + (1-p)u_i(0,1) - I > u_i(B,1)$, while i chooses the B job with a child if $pu_i(A,1) + (1-p)u_i(0,1) - I < u_i(B,1)$.*

Notice that in case (ii) of Proposition 1 if $I = 0$, then the career type always chooses the A job with a child since $u_i(B,1) < u_i(A,0) < pu_i(A,1) + (1-p)u_i(0,1)$.

Proof. Solving the model backwards, we start in period 2. Person i already has a job, but must choose $c \in \{0,1\}$. If i has an A job, then i will choose $c = 0$ if the payoff is higher or if $u_i(A,0) - I > pu_i(A,1) + (1-p)u_i(0,1) - I$. Person i will choose $c = 1$ if this inequality is reversed. As discussed previously, if i has a B job, then i always chooses $c = 1$.

Next we look at i's period 1 decision to choose the A or B job. First, assume $u_i(A,0) > pu_i(A,1) + (1-p)u_i(0,1)$ or that if i has an A job, then i chooses $c = 0$. Person i chooses the A job over the B job if i's utility is higher or if $u_i(A,0) - I > u_i(B,1)$. If $u_i(A,0) - I < u_i(B,1)$, then i chooses the B job; note that this inequality is always true if i is a child type. Second, assume $u_i(A,0) < pu_i(A,1) + (1-p)u_i(0,1)$ or that if i has an A job, i chooses $c = 1$. Person i chooses the A job if it yields a higher utility or if

$pu_i(A,1) + (1-p)u_i(0,1) - I > u_i(B,1)$, while i chooses the B job if the reverse inequality is true. ∎

Next we look at the two extreme cases of $p = 0$ and $p = 1$. If $p = 0$, then no person can keep the A job if she has a child.

Corollary 1 *Let $p = 0$. If i is the child type, then i always chooses the B job with a child. If i is the career type, then i chooses the A job with no child if $u_i(A,0) - I > u_i(B,1)$, and i chooses the B job with a child if $u_i(A,0) - I < u_i(B,1)$.*

The results for the child type follow from Proposition 1 and the fact that in case (ii) of Proposition 1 $pu_i(A,1) + (1-p)u_i(0,1) - I = u_i(0,1) - I$ which is always smaller than $u_i(B,1)$. The results for the career type follow from Proposition 1 and the assumption that $u_i(A,0) > u_i(B,1) > u_i(0,1) = pu_i(A,1) + (1-p)u_i(0,1)$.

If $p = 1$, then a person can always keep the A job regardless of her child bearing decision. Such a person will only take the B job if the educational investment in the A job is high.

Corollary 2 *Let $p = 1$. Regardless of i's type, i chooses the A job with a child if $u_i(A,1) - I > u_i(B,1)$, and i chooses the B job with a child if $u_i(A,1) - I < u_i(B,1)$.*

Corollary 2 follows from case (ii) of Proposition 1, since $p = 1$ and the assumption that $u_i(A,0) < u_i(A,1)$ excludes the possibility of case (i).

Notice that the uncertainty regarding the type of child a person will have causes various types of ex-post mistakes. For instance, if an agent chooses the A job with a child, then $(1-p)$ percent of the time she ends up with no job instead. If an agent chooses the B job with a child, then p percent of the time the person could have had the A job with a child which is preferred if $u_i(A,1) - I > u_i(B,1)$. If a career type chooses the A job and no child, then p percent of the time she could have chosen the A job with a child and been better off.

Next we consider what happens if players misestimate p or make an a priori mistake. Let player i's estimate of p be $\widetilde{p^i}$. If $\widetilde{p^i} < (>)p$, then agent i thinks the probability of having a low maintenance child is smaller (respectively, larger) than it actually is. Corollaries 3 and 4 show how such a misestimate of p can cause a player to behave either too conservatively (in the case of underestimating p) or too boldly (in the case of overestimating p).

Corollary 3 *Assume* $\widetilde{p^i} < p$ *for* $i \in N$. *(i) If* $\widetilde{p^i}u_i(A,1) + (1- \widetilde{p^i})u_i(0,1) < u_i(A,0) < u_i(B,1)+I < pu_i(A,1)+(1-p)u_i(0,1)$, *then* i *chooses the* B *job with a child no matter what* i*'s type is. If* i*'s beliefs had been correct, then* i *would have chosen the* A *job with a child. (ii) If max* $\{u_i(B,1)+I, \widetilde{p^i}u_i(A,1)+(1- \widetilde{p^i})u_i(0,1)\} < u_i(A,0) < pu_i(A,1)+(1-p)u_i(0,1)$ *and if* i *is a career type, then* i *chooses the* A *job with no child. If* i *is a child type,* i *chooses the* B *job with a child. In either case, if* i*'s beliefs had been correct, then* i *would have chosen the* A *job with a child.*

Corollary 4 *Assume* $\widetilde{p^i} > p$ *for* $i \in N$. *If* $u_i(B,1) + I < \widetilde{p^i}u_i(A,1) + (1- \widetilde{p^i})u_i(0,1) > u_i(A,0) > pu_i(A,1) + (1-p)u_i(0,1)$, *then* i *chooses the* A *job with a child no matter what* i*'s type is. If* i*'s beliefs had been correct and if* i *is a child type, then* i *would have chosen the* B *job with a child. If* i*'s beliefs had been correct and if* i *is a career type, then* i *would have chosen the* A *job with no child if* $u_i(A,0) - I > u_i(B,1)$, *and* i *would have chosen the* B *job with a child if* $u_i(A,0) - I < u_i(B,1)$.

Corollaries 3 and 4 follow directly from Proposition 1.

4 Formulation of Beliefs

Next we ask how people formulate beliefs regarding p. Here agents try to learn the correct p, when the true p is unknown. Let there be an infinite number of periods $T = \{0, 1, 2, ..., t, ...\}$, with new agents born in each period. Each agent lives two periods as before. Agents in their first period can observe the outcomes of all agents finishing their last period. Thus, there are overlapping generations with two generations alive at any given period. At time t, let the number of agents finishing their second period be n_t. At time $t = 0$, let each agent i who is in her second period at $t = 0$ have an initial belief $\widetilde{p}_0^i$ regarding p. Subsequently, in period $(t-1) \geq 0$ each agent i born in $(t-1)$ observes the occupational and child outcomes of the previous generation at the end of period $t-1$ and observes the beliefs $\widetilde{p}_{t-1}^i$ of i's mother and formulates her own belief $\widetilde{p}_t^i$ based on these observations. Agent i will hold this belief $\widetilde{p}_t^i$ at the end of $(t-1)$ and in period t when i makes her own occupational and child choices.

Next we ask how the beliefs $\widetilde{p}_t^i$ for $t > 0$ are formulated. One possibility is that agents ignore the beliefs of the previous generation $\widetilde{p}_{t-1}^i$ and simply calculate $\widetilde{p}_t^i$ based solely on the outcomes of the previous generation.

Definition 1 Naive belief formulation: *If an agent observes outcomes $(A, 1)$ or $(B, 1)$ in the previous generation, then she believes the corresponding child is low maintenance. If an agent observes outcomes $(0, 1)$ or $(A, 0)$, she believes the corresponding child is high maintenance (or would have been high maintenance).*

Let $\mu_t(j, c)$ represent the number of agents in their second period having job j and child outcome c at the end of t, and let $\overline{\mu}_t(j, c)$ represent the number of agents choosing (j, c) at the beginning of t. Under naive belief formulation, $\widetilde{p}_t^i = \frac{\mu_{t-1}(A,1)+\mu_{t-1}(B,1)}{n_{t-1}}$. If at time t, every agent in their second period chooses $(A, 1)$, then p percent of these agents end up with $(A, 1)$ while the remaining $(1-p)$ percent end up with outcome $(0, 1)$. Thus, if n_t is large, then $\widetilde{p}_{t+1}^i = p$. But, as the following proposition and example illustrate even if $\widetilde{p}_{t+1}^i = p$, beliefs may not remain at p.

Proposition 2 *Naive belief formulation can cause cycles where beliefs cycle between correct and incorrect beliefs, and occupational and child choices also cycle.*

Proposition 2 is proved true by the following example.

Example 1 *Let n be large. At $t = 0$, let all agents in their second period have beliefs such that $(j, c) = (B, 1)$ is their best choice. At $t = 1$, $\widetilde{p}^i_1 = 1$. If for all i, $u_i(A, 1) - I < u_i(B, 1)$, then by Corollary 2 each agent chooses $(B, 1)$ in every period $t \geq 1$ and $\widetilde{p}^i_t = 1$ for all $t \geq 1$. If for all i, $u_i(B, 1) + I < u_i(A, 0) > pu_i(A, 1) + (1 - p)u_i(0, 1)$, then by Corollary 2 all agents choose $(A, 1)$ in period $t = 1$. Thus $\widetilde{p}^i_2 = p$. By Proposition 1, in period 2 career types choose $(A, 0)$ while child types choose $(B, 1)$. Thus $\widetilde{p}^i_3$ will depend on the number of career types versus child types in the population. If instead for all i, $u_i(A, 0) < pu_i(A, 1) + (1 - p)u_i(0, 1) > u_i(B, 1) + I$, then by Proposition 1 agents choose $(A, 1)$ in period 2. Thus beliefs and choices remain stable at $(A, 1)$ and $\widetilde{p}^i_t = p$ for all $t \geq 1$.*

However, if for all i, $u_i(A, 1) - I > u_i(B, 1)$, then by Corollary 2 all agents choose $(A, 1)$ in period $t = 1$. Thus $\widetilde{p}^i_2 = p$. If for all i, $u_i(B, 1) + I > u_i(A, 0) > pu_i(A, 1) + (1 - p)u_i(0, 1)$, then by Proposition 1 in period 2 all agents choose $(B, 1)$. Thus, beliefs and choices cycle and agents choose $(B, 1)$ and have beliefs $\widetilde{p}^i_t = p$ in even periods while in odd periods agents choose $(A, 1)$ and have beliefs $\widetilde{p}^i_t = 1$.

Next we ask whether or not there exists beliefs which are easy to calculate, but which have better convergence properties than beliefs formulated naively.

Definition 2 Less naive belief formulation: *If agent i observes outcome $(A, 1)$, then she believes the child is low maintenance. If i observes $(0, 1)$, then she believes the child is high maintenance. If i observes $(B, 1)$ or $(A, 0)$, then i believes that the probability the child is low maintenance is $\widetilde{p}^i_{t-1}$.*

If i's mother has beliefs $\widetilde{p}^i_{t-1}$, then with less naive belief formulation $\widetilde{p}^i_t = \frac{\mu_{t-1}(A,1)+(\mu_{t-1}(B,1)+\mu_{t-1}(A,0))\widetilde{p}^i_{t-1}}{n_{t-1}}$. Without loss of generality, in the remainder of this section we will refer to agent i and her descendants all as agent i.

Proposition 3 *Let agents have beliefs which are formulated less naively and assume every $i \in N$ has some initial belief $\widetilde{p}^i_0 \in [0,1]$. Then $\mid \widetilde{p}^i_t - p \mid \leq \mid \widetilde{p}^i_{t-1} - p \mid \leq \mid \widetilde{p}^i_0 - p \mid$ for all $t > 0$ as $n \to \infty$.*

Proof. If at time t, all agents choose $(B,1)$ or $(A,0)$, then $\widetilde{p}^i_{t+1} = \widetilde{p}^i_t$. It at time t, some agents choose $(A,1)$, then at the end of t these agents end up with either $(A,1)$ or $(0,1)$. Thus, if $\frac{\overline{\mu}_t(A,1)}{n_t}$ has positive measure as $n \to \infty$, then $\widetilde{p}^i_{t+1} = \frac{\mu_t(A,1)+(\mu_t(B,1)+\mu_t(A,0))\widetilde{p}^i_t}{n_t} = (1 - \frac{\overline{\mu}_t(A,1)}{n_t})\widetilde{p}^i_t + (\frac{\overline{\mu}_t(A,1)}{n_t})p$. If $\frac{\overline{\mu}_t(A,1)}{n_t}$ does not have positive measure as $n \to \infty$, then $\widetilde{p}^i_{t+1} = \widetilde{p}^i_t$. Thus, $\mid \widetilde{p}^i_t - p \mid \leq \mid \widetilde{p}^i_{t-1} - p \mid \leq \mid \widetilde{p}^i_0 - p \mid$. ∎

If agents have beliefs which are formulated less naively, then according to Proposition 3, future beliefs cannot diverge further from the true p than initial beliefs do. Thus, the cycle of beliefs we observed with naive belief formulation is not possible here.

Corollary 5 *If $\widetilde{p}^i_t = p$ for some $t \geq 0$, then $\widetilde{p}^i_{t+k} = p$ for all $k > 0$ as $n \to \infty$.*

This corollary follows directly from Proposition 3 and shows that if at any time agent i has the correct beliefs, then i keeps the correct beliefs. But as the following example shows, less naive beliefs can be incorrect.

Example 2 *Let $\widetilde{p}^i_0 = 0$ for all i, but let $p = 1$ and let $u_i(A,0) - I < u_i(B,1) < u_i(A,1) - I$. At time $t = 0$, all agents (regardless of type) choose $(B,1)$. Thus, $\widetilde{p}^i_1 = 0$ and $\widetilde{p}^i_t = 0$ for all $t > 1$ and the outcome for all $t > 1$ is $(B,1)$. But since $p = 1$ and $u_i(B,1) < u_i(A,1) - I$, the outcome should be all agents choosing $(A,1)$ in all periods.*

5 Family Networks

Now assume that each agent lives three periods. Let the first two periods be as before, but add a third period where an agent continues her job from period 2 and additionally can perform child care for her grandchild as long as she does not hold an A job in periods 2 and 3. We assume that agent i and all of her descendants have identical preferences and are of identical types.

Assume that for each agent i, if i's mother holds an A job, then investing in education for an A job costs $\underline{I} < I$. Thus, such a mother may have knowledge she can pass on to her child that makes education less costly; alternatively, such a mother may have accumulated more wealth which she can use to supplement her child's education. However, such a parent is unable to help with child care. Assume, that if i's mother holds a B job (or no job), then she can help agent i with child care. Thus, if i has a high maintenance child, then she is able to keep an A job because her mother can provide supplemental child care.

If i has an A parent and chooses an A job, then i's expected payoff is $\max\{u_i(A,0), pu_i(A,1)+(1-p)u_i(0,1)\} - \underline{I}$. If i has an A parent and chooses a B job, then i's expected payoff is $u_i(B,1)$. If i has a B parent and chooses an A job, then i's expected payoff is $u_i(A,1) - I$, while if i chooses a B job, then i's expected payoff is $u_i(B,1)$.

Proposition 4 *(i) If i has a B parent, then i chooses $(B,1)$ if $u_i(A,1) - I < u_i(B,1)$ and i chooses $(A,1)$ if $u_i(A,1) - I > u_i(B,1)$. (ii) If i has an A parent and i is a career type, then i chooses $(A,0)$ if $u_i(A,0) > pu_i(A,1) + (1-p)u_i(0,1)$ and $u_i(A,0) - \underline{I} > u_i(B,1)$. If i is either type, i chooses $(A,1)$ if $u_i(A,0) < pu_i(A,1) + (1-p)u_i(0,1)$ and $pu_i(A,1) + (1-p)u_i(0,1) - \underline{I} > u_i(B,1)$. And i chooses $(B,1)$ if i is a career type and $u_i(A,0) > pu_i(A,1) + (1-p)u_i(0,1)$ and $u_i(A,0) - \underline{I} < u_i(B,1)$ or if i is either type and $u_i(A,0) < pu_i(A,1) + (1-p)u_i(0,1)$ and $pu_i(A,1) + (1-p)u_i(0,1) - \underline{I} < u_i(B,1)$.*

Proposition 4 follows directly from Proposition 1, Corollary 2, and the fact that if i has a B parent, then i can always keep her job while if i has an A parent then the cost of investing in education is $\underline{I} < I$.

Comparing Proposition 4 to Proposition 1, notice that if i has an A parent, then the only difference from the two period model is that the cost of investing in education for the A job has decreased. Thus, if $u_i(A,0) > pu_i(A,1) + (1-p)u_i(0,1)$ and i is a child type, then i chooses $(B,1)$ in both models. If i is a career type, then she is now more likely to choose $(A,0)$ than in the two period model (since $\underline{I} < I$ and i chooses $(A,0)$ if $u_i(A,0) - \underline{I} > u_i(B,1)$ and chooses $(B,1)$ if $u_i(A,0) - \underline{I} < u_i(B,1)$). If $u_i(A,0) < pu_i(A,1) + (1-p)u_i(0,1)$, then both types are more likely to choose $(A,1)$ than before (as i chooses $(A,1)$ if $pu_i(A,1) + (1-p)u_i(0,1) - \underline{I} > u_i(B,1)$ and i chooses $(B,1)$ if $pu_i(A,1) + (1-p)u_i(0,1) - \underline{I} < u_i(B,1)$). If instead i has a B parent, then i behaves as if $p = 1$, and the likelihood of choosing $(A,1)$ increases.

Next we investigate how i's family network influences the choices of i's descendants. Specifically, we are interested in whether or not the choices of i's descendants converge to a single occupational and child choice.

Proposition 5 *Let $0 < p < 1$ and let $n \to \infty$. If $I > u_i(A,1) - u_i(B,1)$ and if either $u_i(A,0) < pu_i(A,1) + (1-p)u_i(0,1)$ and/or $u_i(A,0) - \underline{I} < u_i(B,1)$, then the child and occupational choices of i's descendants will converge to $(B,1)$.*

Proof. If i's mother has a B job or is unemployed, then since $I > u_i(A,1) - u_i(B,1)$ by Proposition 4 agent i and similarly all of i's descendants will choose $(B,1)$. If i has an A parent, then since either $u_i(A,0) < pu_i(A,1) + (1-p)u_i(0,1)$ and/or $u_i(A,0) - \underline{I} < u_i(B,1)$ by Proposition 4 agent i will never choose $(A,0)$. Thus i chooses either $(B,1)$ or $(A,1)$. If i chooses $(B,1)$, then i's descendants will continue to choose $(B,1)$ since $I > u_i(A,1) - u_i(B,1)$. If i chooses $(A,1)$ and if i's outcome is $(A,1)$, then i's child will also choose $(A,1)$, etc.

However, each time i or her descendants choose $(A, 1)$ there is a probability $(1 - p) > 0$ that outcome $(0, 1)$ will occur. Once this occurs, as explained above the rest of i's descendants will choose $(B, 1)$. Since $0 < p < 1$ and since $n \to \infty$ we know that with probability 1 either i or one or her descendants will have outcome $(0, 1)$. ■

According to Proposition 5, if the cost of education is high and the utility from the prestigious job with no child is low, then career and family choices converge to the less prestigious job with a child. Intuitively, if a woman ever chooses the prestigious job with a child and experiences a subsequent career separation, then since the cost of education is high and since she cannot help her daughter financially, her daughter chooses the less prestigious job with a child.

Proposition 6 *If* $I < u_i(A, 1) - u_i(B, 1)$, $u_i(A, 0) < pu_i(A, 1) + (1 - p)u_i(0, 1)$, *and* $pu_i(A, 1) + (1 - p)u_i(0, 1) - \underline{I} > u_i(B, 1)$, *then* i *and her descendants all choose* $(A, 1)$.

Proof. If i or any of i's descendants have a B parent, then by Proposition 4 i chooses $(A, 1)$ since $I < u_i(A, 1) - u_i(B, 1)$. For the same reason, if i or any of i's descendants have an unemployed parent, then that agent chooses $(A, 1)$. If i or any of i's descendants has an A parent, then by Proposition 4 that agent will choose $(A, 1)$ since $u_i(A, 0) < pu_i(A, 1) + (1 - p)u_i(0, 1)$ and $pu_i(A, 1) + (1 - p)u_i(0, 1) - \underline{I} > u_i(B, 1)$. ■

Here the cost of education is low and the probability of facing a career separation due to child care is low. Thus even having a parent who loses a job does not deter an agent from choosing $(A, 1)$ regardless of the type (career or child) that the agent is.

Proposition 7 *Assume* i *and her descendants are career types. If* $I < u_i(A, 1) - u_i(B, 1)$ *and if* $u_i(A, 0) > pu_i(A, 1) + (1 - p)u_i(0, 1)$ *and* $u_i(A, 0) - \underline{I} > u_i(B, 1)$, *then either* i *or one of her descendants will choose* $(A, 0)$ *and* i*'s descendants end.*

Proof. If i has a B parent or unemployed parent, then by Proposition 4 since $I < u_i(A,1) - u_i(B,1)$ agent i chooses $(A,1)$. If i or one of i's descendants has an A parent, then by Proposition 4 that agent chooses $(A,0)$ since $u_i(A,0) > pu_i(A,1) + (1-p)u_i(0,1)$ and $u_i(A,0) - \underline{I} > u_i(B,1)$. ■

Proposition 8 *Assume* $0 < p < 1$. *If* $I < u_i(A,1) - u_i(B,1)$, $u_i(A,0) < pu_i(A,1) + (1-p)u_i(0,1)$, *and* $pu_i(A,1) + (1-p)u_i(0,1) - \underline{I} < u_i(B,1)$, *then* i*'s descendants cycle between choosing* $(A,1)$ *and* $(B,1)$.

Proof. If i or any of her descendants have either a B parent or an unemployed parent, then by Proposition 4 they choose $(A,1)$ since $I < u_i(A,1) - u_i(B,1)$. If i or any of her descendants have an A parent, then by Proposition 4 they choose $(B,1)$ since $u_i(A,0) < pu_i(A,1) + (1-p)u_i(0,1)$ and $pu_i(A,1) + (1-p)u_i(0,1) - \underline{I} < u_i(B,1)$. Thus, choices will cycle between $(A,1)$ and $(B,1)$ where with probability $(1-p)$ any $(A,1)$ choice may turn into outcome $(0,1)$ prompting this agent's child to choose $(A,1)$. But since $0 < p < 1$ some $(A,1)$ choices will result in $(A,1)$ outcomes. Thus, i's descendants will never choose just $(A,1)$ but will always cycle between $(A,1)$ and $(B,1)$. ■

According to Proposition 8, career and family choices can cycle if the cost of education is low and the probability of facing a career separation due to child care is high. If the cost of education is low, then a woman who has a parent with a less prestigious job will choose the prestigious job with a child since the grandparent can provide child care. And since the probability of a career separation is high, a woman with a parent with a prestigious job will choose the less prestigious job with a child, since the grandparent cannot help with child care.

6 Concluding Remarks

Women's family and career choices were examined in an environment of uncertainty regarding the possibility of achieving both a career and family. In addition, we showed that women's beliefs regarding the probability of a career separation can be updated such that the beliefs of future generations do not diverge from the true probability of a career separation. Lastly, we studied the impact of grandparent child care networks on family and career decisions in both a static and overlapping generations framework.

The model can be extended in various ways. For instance, we assumed that all women have the same probability of a career separation. Perhaps women have different probabilities depending on their specific job. Thus, a woman in a certain law firm may find her job more or less conducive to child care than a woman in a different law firm. So, the probability of a career separation would be learned by a person observing others at her firm instead of by observing everyone. Alternatively, perhaps the probability of a career separation changes over time, thus a more complicated belief updating rule would be needed.

Additionally, we assumed that women with high maintenance children automatically separate from high-powered careers. Instead, we could allow such women to bargain with their spouses over how to divide child care. Thus, if a spouse has a less prestigious job, then perhaps bargaining would lead to the spouse contributing more to child care. Lastly, one could study the impact of certain public policies such as on site child care or subsidizing grandparent child care on career and family choices to see if one policy is better than another at allowing women to obtain both a career and family.

References

[1] Banerjee, A., and D. Fudenberg (2004) "Word-of-mouth learning," *Games and Economic Behavior* 46, 1-22.

[2] Blau, F.D. (1998) "Trends in the well-being of American women, 1970-1995," *Journal of Economic Literature*, 36, 112-165.

[3] Börgers, T., and R. Sarin (1997) "Learning through reinforcement and replicator dynamics," *Journal of Economic. Theory* 77, 1-14.

[4] Boushey, H. (2005) "Are women opting out? Debunking the myth," Center for Economic and Policy Research, Briefing Paper, 2005.

[5] Breen, R., and C. García-Peñalosa (2002) "Bayesian learning and gender segregation," *Journal of Labor Economics* 20, 899-922.

[6] Cardia, E. and S. Ng (2003) "Intergenerational time transfers and child care," *Review of Economic Dynamics* 6, 431-454.

[7] Caucutt, E.M., N. Guner, and J. Knowles (2002) "Why do women wait? Matching, wage inequality, and the incentives for fertility delay," *Review of Economic Dynamics*, 5, 815-855.

[8] Correll, S.J., S. Benard, and I. Paik (2007) "Getting a job: Is there a motherhood penalty?", *American Journal of Sociology*, 112, 1297-1138.

[9] Dessy, S., and H. Djebbari (2005) "Career choice, marriage-timing, and the attraction of unequals," Mimeo: Laval University.

[10] Ellison, G., and D. Fudenberg (1993) "Rules of thumb for social learning," *Journal of Political Economy* 101, 612-643.

[11] Ellison, G., and D. Fudenberg (1995) "Word-of-mouth communication and social learning," *The Quarterly Journal of Economics* 110, 95-126.

[12] Erosa, A., L. Fuster, and D. Restuccia (2002) "Fertility decisions and gender differences in labor turnover, employment, and wages," *Review of Economic Dynamics*, 5, 856-891.

[13] Erosa, A., L. Fuster, and D. Restuccia (2005) "A general equilibrium analysis of parental leave policies," Federal Reserve Bank of Richmond: Working paper 05-08.

[14] Filippin, A. and A. Ichino (2005) "Gender wage gap in expectations and realizations," *Labour Economics*, 12, 125-145.

[15] Francesconi, M. (2002) "A joint dynamic model of fertility and work of married women," *Journal of Labor Economics*, 20, 336-380.

[16] Fuller-Thomson, E. and M. Minkler (2001) "American grandparents providing extensive child care to their grandchildren: prevalence and profile," *The Gerontologist* 41, 201-209.

[17] Goldin, C. (1997) "Career and family: college women look to the past", in *Gender and Family Issues in the Workplace*, edited by F. Blau and R. Ehrenberg. New York: Russell Sage Foundation.

[18] Goldin, C. (2004) "The long road to the fast track: career and family," *The ANNALS of the American Academy of Political and Social Science*, 596, 20-35.

[19] Goldin, C. (2006) "The quiet revolution that transformed women's employment, education, and family," *American Economic Review, Papers and Proceedings*, (Ely Lecture) 96, 1-21.

[20] Johnson, J.O. (2005) "Who's minding the kids? Child care arrangements: Winter 2002," Current Population Reports, P70-101. U.S. Census Bureau.

[21] Lei, X. (2006) "Grandchild care, financial transfers and grandma's labor market decisions," Mimeo: Department of Economics, UCLA.

[22] Perna, L.W. (2004) "The relationship between family responsibilities and career outcomes for women and men faculty," CSWEP Newsletter, Winter, 12-14.

[23] Phipps, S., P. Burton, and L. Lethbridge (2001). "In and out of the labour market: long-term income consequences of child-related interruptions to women's paid work," *Canadian Journal of Economics*, 34, 411-429.

[24] Ruhm, C.J. (1998). "The economic consequences of parental leave mandates: lessons from Europe," *The Quarterly Journal of Economics*, 113, 285-317.

[25] Sheran, M. (2007). "The career and family choices of women: a dynamic analysis of labor force participation, schooling, marriage, and fertility decisions," *Review of Economic Dynamics*, 10, 367-399.

[26] Wood, R.G., M.E. Corcoran, and P.N. Courant (1993) "Pay differences among the highly paid: the male-female earnings gap in lawyer's salaries," *Journal of Labor Economics*, 11, 417-441.