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ORIGINAL PAPER

# When having many children pays: a case study from Taiwan

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**Abstract** The objective of this paper is to investigate the direct financial cost and benefit of raising children during a demographic transition in Taiwan, and to examine whether fertility decline is consistent with Caldwell's wealth flow theory, which states that fertility decline is caused by reduced benefits of children. The paper describes a method of estimating the average economic returns of children over the entire parental lifecycle, using a 42-year span of Taiwanese household and individual economic pseudo-panel data. Results show that returns to children may turn positive and are not highly negative all the time, as found in the previous literature.

**Keywords** Cost and benefit of children · Fertility · Familial transfers

**JEL Classification** J13 · D10 · I2

## 1 Introduction

Over the last few decades, Asian countries have experienced substantial fertility declines coinciding with a period of rapid economic growth. The question of what factors are behind the decline has caused considerable controversy.

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Theories and empirical research explaining why fertility changes have centered around social, institutional, and economic factors. Specifically, the theory of demographic transition posits that the economic and technological changes of the modern era lead to economic development, mass communications, effective programs of public health and curative medicine, and related social changes. On the other hand, economic theories (Becker 1960; Easterlin 1978; Schultz 1981) describe three major determinants on fertility behavior: demand for and supply of children, and the costs of fertility regulation. In particular, the factors that affect fertility include costs and benefits of children, opportunity costs of women's time, environmental and cultural factors, and government intervention through family planning programs. From another perspective, the ideational theory (Lesthaeghe and Surkyn 1988) stresses the effect on fertility of the importance that cultural values place on having children and on proscribing methods of fertility control. Traditional Chinese culture, for example, had a great preference for a high number of sons.

While no single factor can fully explain the fertility decline that has occurred in Asia, one of the determinants frequently examined in the previous literature is the cost and benefit of children. For individuals, rapid increases in the costs of raising children have influenced their child bearing decisions and family size. Evidence shows that fertility rates and costs of raising children are negatively associated (Becker 1960; Easterlin 1978; Easterlin et al. 1980). In many countries where public old-age welfare systems are nonexistent or limited, older people rely heavily on their adult children's support. In this case, parents may view children as an investment that they can fall back on when the need arises during their golden years. However, when the cost of raising children outweighs the benefits, having many children may be deemed an unwise investment decision. Caldwell (1976) asserts that low fertility is encouraged by negative economic returns contributed by children to their parents. This assertion has stirred disagreement from some researchers whose studies show that raising children has meant net costs to parents since the pre-industrial era, when fertility was high (Kaplan 1994; Kramer 2005; Lee 2000; Lee and Kramer 2002; Mueller 1976; Robinson et al. 2008; Stecklov 1999). This paper, however, argues that having many children does pay off when it occurs during a particular demographic transition, economic growth period, and social context. More specifically, Taiwanese parents born between the 1920s and 1940s are receiving net financial benefits from their children. This study poses four research questions: (1) on average, how much cost does a parent bear in raising children? (2) what are net economic contributions of children over a parent's lifetime? (3) does having many children ever pay off? and (4) does wealth flow theory hold in explaining the fertility decline in Taiwan?

Previous empirical studies that measure economic returns from children are lacking in four respects. First, existing studies do not measure the full lifecycle of transfers. Because transfers between parents and children occur throughout the lifecycle, estimates should include the lifecycle of the parent or the child. Second, measurements have not included both transfers occurring within a household and those between households. Transfers take place in

situations of both co-residence (intra-household transfers) and living apart (inter-household transfers), and therefore both types of transfers should be incorporated into the research. The difficulty is that data on transfers between households are usually available, but data on transfers within households are not. Third, previous estimates have mostly been based on the transfer flows for society as a whole by using estimates of societal averages (Stecklov 1999). This type of aggregate approach has a drawback for understanding the motivations of individual parents on fertility. A better approach is to measure the economic returns that parents may expect from bearing children over their entire lifecycle. Fourth, some previous work is based on subjective expectations for transfers. To assess the economic returns to childbearing, data must be based on economic values (quantitative data), and not on qualitative data.

The objective of this paper is to investigate the direct cost and benefit of raising children during a demographic transition from high to low fertility in Taiwan, and to examine whether this decline is consistent with Caldwell's wealth flow theory. This paper addresses the limitations of previous research by developing a method to estimate the economic returns from children in a parent's lifecycle using a 42-year span of household and individual economic pseudo-panel data. It is different from previous work as it measures financial costs and benefits of children by taking into account both actual economic growth and the changing age profiles, which is done by analyzing costs and benefits of children for parents of different birth cohorts using pseudo-panel data to capture the detailed patterns of consumption and household transfers over time. In addition, this paper also addresses a limitation of previous studies by including financial support that comes both from adult children to older parents living in a separate household (i.e., inter-household transfers) and from children living in the same household (i.e., intra-household transfers). Excluding intra-household transfers from estimation of the return on children is a serious drawback because it underestimates the total contribution of children to their parents in countries where a large number of people still co-reside with their adult children. By taking both intra- and inter-household transfers into consideration, this research yields a more accurate rate of returns from children than previous studies.

Taiwan is the focus of this study because there have been enormous demographic and economic changes there in the past few decades, but extended living and familial transfers remain remarkably high. For example, the total fertility rate declined sharply from 7.40 in 1951 to 1.03 in 2009. Life spans have lengthened, and the country will become an "aged nation" in the United Nations categorization by 2014. Rapid population aging is an issue of great concern. On the other hand, the real gross domestic product grew by an annual rate of 9.7% during the 1970s and 8.5% during the 1980s. Despite its economic growth, Taiwan's public welfare programs for older persons have not been fully developed. On the other hand, 60% of older persons were living with their offspring in 2005, an impressive maintenance of this custom in such a developed country. Familial transfers from children are important

in this society that practices strong Confucian filial piety to parents even today. Recent research (Mason et al. 2009) found that in 1998, one third of Taiwan's elderly consumption was supported by familial transfers while public transfers (e.g., government welfare programs) contributed one third, leaving the remaining one-third being financed by dis-saving and asset income.

The findings reported in this paper show that parents born in the 1930s and earlier receive net positive returns from children, while returns turn slightly negative for parents born after the 1930s. Specifically, the internal rates of return dropped from 4.4% to −2.2% for parents born in 1925 and 1945, respectively. These results are striking in two ways. First, the rates of return are positive and only slightly negative, indicating that raising children is not always a high financial loss, in contrast to what previous studies have found. This discrepancy in research results comes from this study's use of actual economic growth rates and age profiles over time instead of assuming constant age profiles with 1 year's data, as well as from the unique characteristics of the period being examined, in which Taiwan has been undergoing rapid socioeconomic transition. Second, parents born between the 1920s and 1930s received two to five times higher economic returns from children than parents born in the 1940s. One explanation for this change is that in the 1970s and 1980s, Taiwan experienced drastic socioeconomic development and institutional changes that led to rapid economic growth, escalation of education and child costs, and development of financial markets for savings.

Does wealth flow theory hold in explaining the fertility decline? The findings show a positive relationship between fertility and economic value of children. However, such a relationship can not explain whether there is a causality effect and if so, in what direction; that is, whether declining economic value of children caused a decline in fertility or vice versa. The causality issue, which is quite a controversial debate in the literature, is difficult to disentangle because motivations for having children vary, and include both economic and non-economic factors. A simple regression analysis is used to examine changes in fertility and economic value of children. Controlling the causality effect, the regression investigates whether change of the economic value of children is positively associated with change of fertility, as postulated by wealth flow theory. Results show that change of fertility is negatively associated with change of the economic value of children, which is inconsistent with the wealth flow theory's assertion. Nevertheless, the regression analysis findings have to be interpreted with caution, due to the small sample size and the study's limited ability to include all the relevant independent variables for the child-bearing decision using these data.

The remainder of the paper is divided into five main sections. Section 2 provides some background for the study by discussing the context of Taiwan and multiple theoretical perspectives on economic costs and benefits of raising children. The section also discusses the existing empirical evidence on the relationship between intergenerational transfers and fertility decisions. Section 3 presents the data descriptions, method for imputing intra- and inter-household transfer, and econometric procedures for estimating costs and benefits of raising

children. The research findings are discussed in Section 4. First, estimates of the average costs of children carried by a parent are presented. Second, measures of average benefits of children for a parent are described. Third, cost-and-benefit ratio and internal rate of return are computed to examine whether children ever pay off financially. Next, in Section 5, there is an analysis of the economics of children during the demographic transition. Section 6 concludes the paper.

## 2 Background

### 2.1 Taiwan

Since the early 1950s, Taiwan has experienced tremendous economic and social growth. In the past six decades, per capita GDP rose from US$137 in 1951 to US$17,507 in 2008, with an annual compound rate of 8.6%. Exports, led by electronics and machinery, generate about 70% of GDP growth, and have provided the primary impetus for economic development. During this period of growth, female educational attainment and labor participation increased tremendously. In 1978, only 16% of all females held high school diplomas; this doubled to 34%, equal to the rate for males, by 2003. The percentage of females in the labor force climbed from 35.48 to 49.62 between 1970 and 2009, while the male work force steadily declined to reach 66.4% in 2009. Nevertheless, females still participate in the labor force at a relatively low rate in Taiwan compared to other countries. Most females join the labor market after graduating from high school or college, but more than half of them leave the labor market after getting married to raise children.

During this period, the country has experienced a rapid fertility decline, with fertility dropping to replacement level in less than 30 years. The total fertility rate dropped from 7.04 in 1951 to 2.17 in 1983, and further declined to 1.03 in 2009. In the meantime, life expectancy at birth improved tremendously between 1966 and 2009 from an average of 69.7 to 82.46 years for females and from 62.2 to 75.88 years for males. With a low total fertility rate and longer life expectancy, Taiwan's population is aging rapidly, at a rate that is the second fastest in the world after Japan (Tsai 2008). The proportion of the population aged 65 and above reached 10.4% in 2008 and is forecasted to reach 14% by 2018, when Taiwan will enter the "aged nation" category. By 2045, it is predicted that one third of the population will be aged 65 and above while the dependency ratio of the older population (ages 65+) to the working-age population (ages 15–64) will have risen from 14.4% in 2008 to 59.0%. The increase of this ratio means that more economic resources will be shifted from the working age group to support the older population; at that point, it will be a long-term challenge to maintain a sufficient labor force, high standards of health care, and economic growth.

Family planning programs have been influential in Taiwan, but participation in them has been voluntary (Freedman 1998). In the 1960s, a government

campaign began to encourage couples to have three children or less to reduce population growth and promote economic development. Contraceptive use doubled from 28% to 56% between 1965 and 1975. Within two decades, the fertility rate dropped to below replacement rate. Since the 1980s, the government has been trying to increase the birth rate and now advocates that couples have two children. The current objective is to increase the country's fertility rate to replacement level by 2036.

Extended family living arrangements are impressively common in Taiwan, despite rapid industrialization and urbanization. Most older persons live with their children and consider the arrangement ideal, according to the Ministry of the Interior's 2005 Report of Senior Citizen Conditions Survey. There has been only a slight drop, from 70.2% in 1986 to 60.4% in 2005, in the proportion of people 65 or older who reside with their children. Nevertheless, over time, family structures are increasingly transforming from extended-family to nuclear-family households. For example, among married women aged 20–39, the percentage who lived in nuclear households rose from 35% in 1965 to 64% in 2001 (Tung et al. 2006). However, most of these households are "neo-extended" families, who live short distances from relatives, maintain frequent contact with them, and are likely to engage in informal social support exchanges with them.

Upward transfers from adult children to parents remain large, despite the rapid economic growth in Taiwan (Bernheim et al. 1985; Lai 2006; Lee et al. 1994; Mason et al. 2009). The practice of Confucian filial piety that includes supporting and repaying older parents holds firm. Most married children provide net financial support to their parents both as implicit loan repayment and out of altruism (Lee et al. 1994). The repayment contract works remarkably well in Taiwan and continues to be reinforced in the society; for example, lessons on filial piety that teach children that the greatest shame of all is to abandon one's parents continue to be incorporated into school textbooks (Lin and Fu 1990; Wilson 1970). In 1998, on average, familial transfers supported one third of Taiwan's older persons' consumption, while public transfers (e.g., government welfare programs) contributed one third; the remaining one third was financed by dis-saving and asset income (Mason et al. 2009). As nearly two thirds of all older persons live with their children, the greatest part of familial transfers are intra-household transfers.

Low fertility challenges the continuity of children's support because the ratio of children per parent is decreasing. The government has responded by increasing the role of public welfare programs that support the aging population. First, social insurance programs that give old-age allowances were initiated beginning in the 1990s. These include the Old Farmers Welfare Allowance, Old Citizens Welfare Allowance, and Old Aborigines Welfare Allowance, which give monthly stipends of NT$3000 (US$100). In 1995, National Health Insurance started providing health coverage to the whole population. This plan consolidated several existing employment-based plans for health insurance and extended insurance to the uncovered population, namely, children, older persons, and homemakers. In late 2008, the National

Pension plan started to cover the population without pensions. To be entitled to the pension benefits, one has to pay a monthly premium of NT$674 (US$22) for 40 years in order to receive NT$8,989 (US$300) monthly after age 65. These public programs reduce the financial reliance of older persons on their children and increase the role of the government in family life.

### 2.2 Economic costs and values of children

From the perspective of parents, economic costs of children occur both directly and indirectly. Direct costs include food, shelter, clothing, health, and education. Indirect costs include mothers' opportunities cost in rearing children or the potential loss of income and personal leisure time (Cain 1971; Cain and Weininger 1973; Schultz 1969). Costs of raising children are usually concentrated at the beginning of children's lifecycles, before they join the labor force. In addition, as the theories of Easterlin (1978) and Becker (1960) explain, these costs rise during demographic transitions. According to these theories, industrialization improves employment and education opportunities for women and thus, the opportunity cost of child-rearing increases and fertility declines. Further, children are more costly because their economic contribution decreases in the new economy that requires skilled workers. Instead of helping out their parents on the farms, children begin to attend school to increase their human capital value in the labor market.

Leibenstein (1957) proposed that parents derived utility from children in two ways: child labor and old-age security. With today's industrialized societies and anti-child labor regulations, children are less useful in labor production. On the other hand, the economic value of children as old-age security is still of great importance in some societies, such as those that practice Confucian customs or lack formal social security systems. Studies have attributed fertility to the old-age security hypothesis in India (Cain 1991; Dharmalingam 1994; Vlassoff 1991), Malaysia (Jensen 1990), China (Greenhalgh 1989; Johnson 1994; Lin 1994; Ogawa 1993; Tuan 1989), ASEAN countries (Jones 1993), and developing countries (Cigno 1992). However, when financial systems and pension systems improve, and economies stabilize to enable saving, financial insurance, and investment activities, older persons rely less on their children, as in Western societies where formal pension systems are well-established and in some advanced countries in Asia such as Japan (Retherford et al. 1996).

Over time, the economic value of children as old-age security has declined when income levels have increased. As a result, the principal remaining value of children has been reduced to what Leibenstein described as the "consumption utility" of children. Becker (1960) suggests, in his theory of demand for children, that as this value has become more widely held, parents increasingly focus on investing in high "quality" children instead of high "quantity." Japan provides a good example. Retherford et al. (1996) found that Japanese parents are very concerned to obtain education for their children in elite universities, and this results in parenting stress. In a survey that asked Japanese parents what they felt was most difficult about rearing children, more

than half discussed the psychological strain of educating and training them and the cost of education, while only 9% mentioned the difficulties of working in the job market and providing food and shelter.

### 2.3 Fertility and economic values of children

The literature on the recent rapid fertility transition occurring in the world has identified many factors that drive the transition from high to low fertility, including economic and social development factors and changes in values. Specific major factors include decreases in mortality, increases in employment opportunities for women, and decreases in the economic value of children. Decreasing mortality affects fertility decision making because fertility has always been used to counterbalance mortality. When mortality is high, fertility is encouraged to keep up with the rate of mortality, and vice versa. However, in a growing number of societies and economies, balancing mortality has become less of a concern. In many places, fertility is now on the verge of decline because birth control is widely available and because more women are educated and working. Rearing children is an opportunity cost to mothers. In addition, fertility is affected by changes in societal values on ideal family size, status of women, filial care for older persons, and the use of contraceptives (Cleland and Wilson 1987).

A key contribution to the study of the relationship between fertility and economic values of children is John Caldwell's wealth flow theory (1976, 1978, 1980). Caldwell asserts that the economic value of children and the direction of familial intergenerational wealth flows have a determining influence as incentives for childbearing. The wealth flow theory links intergenerational transfers across the life course to the fertility decision. If the value of the parental wealth transfers to children exceeds the value of all children's transfers to parents, the economically rational decision for parents is to desire fewer children. On the other hand, if the parents receive more wealth than they provide to children, parents desire as many children as possible. In this case, parents' wealth increases with the number of children.

In testing the wealth flow theory, previous studies employ several approaches. One way is to measure absolute wealth flows by comparing the consumption and production of children through the life course in non-industrial societies. Results are mixed. Some studies support the wealth flow theory and conclude that children are net economic beneficial to parents in high fertility societies. Cain (1977) analyzes the detailed household production activities of children in Char Gopalpur, a village in the north of Bangladesh. He found that children were net providers of resources in 1976. Sons produced more than they consumed at age 12 and generated surplus to the family. Cain (1982) has come to similar conclusions, with sons becoming net producers at later ages, in other Asian countries, as well.

However, a number of studies disagree with the wealth flow theory because these studies have found that children do not produce more than they consume during childhood in high fertility societies. In addition, in peasant societies, the

elderly remain active and produce a surplus instead of retiring and relying on children for old-age support. Therefore, net wealth flows are from parents to children; wealth flow theory is not supported by the studies of Mueller (1976) in the Third World; Kaplan (1994) in Paraguay and Peru; Lee (2000) in the Third World; and Lee and Kramer (2002) in Mayan areas. A summary of the results of these studies is presented in Table 1.

In the industrialized welfare-state societies, consumption and production methods are not suitable measures because children do not work during childhood. Also, wealth flow may be reversed, moving from children to parents (Ermisch 1989; Lee 2003), because the elderly in industrialized societies retire early and no longer produce a surplus. The consumption of the elderly is supported by younger generations through public welfare or family transfers.

Therefore, studies of industrialized welfare-state societies use other ways to estimate economic benefits received from children during parents' old age in order to measure the extent to which children are necessary for old-age support. Micro level analysis of Bhaumik and Nugent (2000) of Peru provides evidence of gross upward transfers from older children outside the parental home to parents. Other empirical studies find high fertility to be positively associated with expectations of old age support (Cain 1981; DeLancey 1990; Hugo 1997; Nugent and Gillaspy 1983). On the other hand, Vlassoff and Vlassoff (1980), using a qualitative survey, find no evidence that old age security motivates high fertility in India.

Stecklov (1999) developed a comprehensive method of estimating the economic returns from children in Cote d'Ivoire. In his method, he uses 1 year of household economic data (1986 data from the World Bank's Living Standard Measurements Study) to project the transfer flows for a parent's lifecycle.

**Table 1** Recent empirical assessments on economic returns

| Source | Data | Method | Results |
|---|---|---|---|
| Lai (2006) | Taiwan FIES 1978–2005, Taiwan FIES report 1964–1976, Education Statistics 1950–2005 | Inter-household and intra-household transfers over parent's birth cohort | Internal Rate of Return (IRR) with survival discounting: +4.4% (cohort 1925) to −2.4% (cohort 1945) |
| Lee and Kramer (2002) | Time allocation data for a group of Maya agriculturists in Yucatan, Mexico | Consumption and production | IRR (with survival discounting) of a child from birth through age of leaving home is highly negative |
| Lee (2000) | Adjusted from Mueller's (1976) data on Third World | Consumption and production | IRR −3.7% to −6.7% |
| Stecklov (1999) | 1986 data of World Bank's Living Standard Measurements Study: Survey of Cote d'Ivoire | Inter-household and intra-household transfers | IRR without survival discounting: −2.5% to −17.3% IRR with survival discounting: −6.4% to −31.5% |

His results show that children are a net drain economically in a Third World country, but the study has an important limitation: because the analysis was based on 1 year's data, it assumes that age profiles of costs and benefits of children are constant over time.

## 3 Data and methods

The primary data for this analysis come from 1976 to 2005 of the Survey of Family Income and Expenditure (FIES) of Taiwan. Other sources include summary reports of FIES (1964–1977), data on number of students by age for different school levels from the Ministry of Education, data on population and fertility from the Population Register of Taiwan, and the Statistical Yearbook of the Republic of China.

The FIES is a national representative survey of households and individuals. The survey is conducted by the Directorate-General of Budget, Accounting, and Statistics (DBGAS) of the Executive Yuan of the Republic of China. This survey is carried out as part of the computation of national income statistics, and was first conducted in 1964. Thereafter, it was conducted every other year until 1972, after which it began to be conducted every year. Each year, approximately 13,000 to 16,000 households and 60,000 civilians are surveyed through interviews and/or diaries.

The FIES survey contains detailed income and expenditure data at both household and individual levels, including employee compensation, entrepreneurial income, property income, inter-household transfer income, private transfers from abroad, social security benefits, social assistance grants, and others. Data on expenditures include private inter-household transfers, direct taxes, social security contributions, private pension contributions, and others. However, as with most surveys, consumption expenditure is collected at the household level. Examples of expenditures include household daily and annual outlays on food, beverages, tobacco, clothing and footwear, health, transportation, communication, recreation, education, culture, water charges, fuel and lighting, imputed rental values for housing, and other durable goods. In addition, the survey contains some basic demographic information.

The main variables used in this analysis are consumption and inter-household transfers from the FIES. Since data on consumption is collected at the household level, I allocate household consumption to individual household members based on the method of the National Transfer Accounts (Lai 2006; Mason et al. 2009). Briefly, age-targeted consumption such as education and health are allocated to household members using some simple regression methods. The remaining consumption is allocated using an equivalence scale of 1 for adults aged 20 or older, declines linearly to 0.4 from age 20 to age 4 and is constant at 0.4 for those aged 4 or younger. Detailed descriptions are available in Lai 2006 and also at http://www.ntaccounts.org. For estimates prior to 1964, survey data are not available. Therefore, private consumption

during this period is estimated based on the private consumption growth rate computed from the National Income Accounts of these years.

Financial benefits of children are measured by both net inter-household transfers and intra-household transfers received by a parent. Net inter-household transfers derive directly from the FIES survey. However, the survey does not report intra-household transfers, which is a common drawback of surveys. Therefore, intra-household transfers are estimated based on the method of the National Transfer Accounts (Lai 2006; Mason et al. 2009). The method assumes that household members support each other through intra-household transfers when any member has consumption deficits. A detailed description of this method is presented in Appendix 2 of electronic supplementary material.

Upward transfers are net familial transfers received by parents, which include both net inter-household and intra-household transfers. Historical estimates on upward transfers from 1978 throughout 2005 are computed from the Family Income and Expenditure Survey. For 2006 through 2030, a simple consumption-transfer model is used to project net upward transfers. This model assumes that consumption, earnings, and transfers follow an invariant age profile over the lifecycle, but shift up with growth. The projection is described and illustrated in Appendix 3 of electronic supplementary material.

## 4 Results

### 4.1 On average, how much cost does a parent bear in raising children?

One of the focuses of this paper is to find how much on average a parent bore in direct financial costs of children and how much financial benefit they received in return. Therefore, this analysis traces the financial transfers given and received by a parent in a particular birth cohort. Cost of children can be measured by financial transfers given by a parent to children. These transfers include both transfers within households and transfers between households. Transfers within households capture mostly the private consumption of a child less any earnings made by the child. Transfers between households are transfers given to children from other households, such as financial support from parents who do not live with their children.

To determine the cost of children, the average net present value of costs borne by a parent is computed, which is:

$$\text{net present value of costs} = \sum_{a}^{T} e^{-ra} \left(C^{-}_{a,c}\right) S^{ac}_{25} \tag{1}$$

where $C^{-}_{a,c}$ is the vector of length $T$ with single-year age intervals. This vector is indexed by $c$, the birth cohort of a parent. Also, the vector $C^{-}_{a,c}$ represents the average child costs given by a parent at age $a$ of birth cohort $c$. Then, the vector is multiplied by the survival probability at childbearing decision-making age, which is assumed to be 25. $S^{ac}_{25}$ is the survival rate of age $a$ from age 25 for

cohort *c*. Since the parent will not be in a position to make a fertility decision unless he or she is alive, calculations are conditioned on survival to the fertility decision age of 25. *T* is the final age, *r* is the discount rate.

On average, one child costs around NT$258,143 (or half of an average production of a prime-age adult) in year 2005 and NT$43,792 (or one third of an average production of a prime-age adult) in 1985 for private consumption that included health care, education, food and shelter, clothes, and other costs. Figure 1 shows that children are a few times more expensive for parents today compared to a few decades ago. Results show an upward trend in the present value of the average total costs of children born to parents of different cohorts. That means that although the number of children per parent is less over time, later parents carried higher costs. In addition, Fig. 1 shows the increasing cost of education over the parents' cohorts. For example, parents born in 1925 spent 10% of children total consumption on education (present value of NT$17,500), while parents of birth cohort 1945 increased it to 15% of children consumption (present value of NT$92,000).

The reason for the rising child cost is that the real consumption of a child has grown substantially over the last few decades. This is not surprising, because living standards increased when the economy prospered. In addition, the institutional and structural changes in Taiwan affected the cost of children. During the transition of the economy from an agricultural base to industry and service, the demand for a skilled workforce increased. In the 1970s and 1980s, several mega public construction projects and the development of the private sector escalated the demand for workers in "new-economy" occupations, such as chemical engineers, electronic engineers, civil engineers,

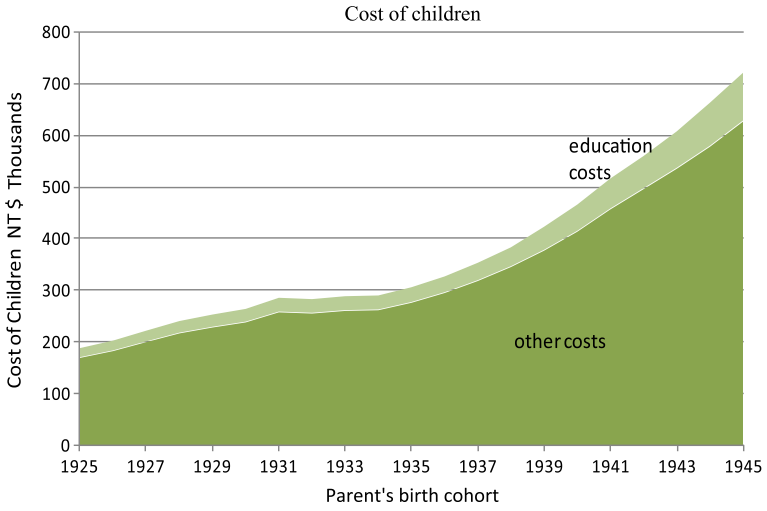


**Fig. 1** Costs of children by parent's birth cohorts, 1925–1945, net present values, Taiwan

architects, mechanics, medical doctors, accountants, and other skilled workers. The government/Ministry of Education responded by specifically designing education policies to achieve industrial development. About seven vocational schools and junior colleges geared towards meeting the new labor market needs were built annually from the 1960s through the 1980s, and education consumption increased tremendously within a short period of time. Before the 1970s, children received mandatory education in public schools, and private education spending on non-mandatory education was minimal. Pre-school education was negligible. After the 1970s, however, real per capita private education spending rose tremendously for the next 25 years.

Parents invest heavily on senior high and college education. In 2003, for example, households paid on average NT$120,000 (equivalent to half of an adult's private consumption or 10% of average household income) annually per child for higher education. One of the main explanations for the high spending is that the majority of the college students (approximately 70%) attend private institutions because access to public higher education is highly restricted and selective. Pre-school education investment is also unprecedentedly high, and today, spending on pre-school is as high as spending on college tuition in Taiwan. In addition, it is the norm for students to attend private classes, or cram schools, after school.

Why do parents invest so much in their children? First reason is that Confucian customs that place a high value on education are important in Taiwan. People have traditionally regarded education as a means to achieve political and socio-economic privileges. Therefore, human capital investment is extraordinarily high in Taiwan, which has allowed the country to achieve unprecedented educational levels by international standards within the short period of rapid development. Second reason is that implicit inter-generational contract to pay back parents works well in Taiwan with filial piety being a central Confucian ethic. In fact, the Civil Law requires Taiwanese citizens to support their parents financially, based on their means to do so. A third reason is that parents' education attainment (especially female schooling) increases rapidly and thus leads to higher investment in children and lower number of children, according to the "quality-quantity" trade off theory of Becker. This theory is supported by several studies that found that mother's schooling increases health outcome and education attainment of children in Taiwan (Chou et al. 2007; Kana and Tsai 2003; Parish and Willis 1993).

### 4.2 What are economic contributions of children over a parent's lifetime?

The many benefits of having children range from the social to the financial. The direct financial benefit of raising a child is the net upward transfers that parents receive, either when in co-residence with adult children or when living independently. This section measures the net upward transfers from children to parents by including both transfers within and between households. These transfer estimates are net of transfer received from and given to adult children.

To determine the benefits of children, the average net present value of benefits received by a parent is computed, which is:

$$\text{net present value of benefits} = \sum_{a}^{T} e^{-ra} \left(\tau_{a,c}^{-}\right) S_{25}^{ac} \tag{2}$$

where $\tau_{a,c}^{-}$ is the vector of length $T$ with single-year age intervals. The vector $\tau_{a,c}^{-}$ is indexed by $c$, the birth cohort of a parent. Also, the vector represents the average net upward transfers received by a parent at age $a$ of birth cohort $c$. This vector is multiplied by the survival probability at childbearing decision-making age, which is assumed to be 25. $S_{25}^{ac}$ is the survival rate of age $a$ from age 25 for cohort $c$. Since the parent will not be in a position to make a fertility decision unless he or she is alive, calculations are conditioned on survival to the fertility decision age of 25. $T$ is the final age, $r$ is the discount rate. I use FIES historical data from 1978 to 2005 to estimate upward transfers, and I employ a simple consumption-transfer model, described in Appendix 3 of electronic supplementary material, to project transfers between 2006 and 2030.

The average benefits/transfers in NT$ received by parents of different cohorts are remarkably stable in present value. Taiwanese parents still receive substantial support through upward transfers during their old ages shown in Fig. 2. However, the composition of these transfers has altered over time. In the 1970s, parents received familial transfers mainly through co-residence with adult children. Four-fifths of the familial transfers were intra-household transfers, while the remaining one fifth were inter-household transfers. Following industrialization and urbanization, Taiwan experienced a drastic transition in family structure. The percentage of extended households declined steadily from 66% in 1965 to 50% in 1980, and dropped further to 36% by 2001 (Tung et al. 2006). As a result, inter-household transfers increased proportionally relative to intra-household transfers (Tung and Lai 2010). In 2005, two-fifths of familial transfers were inter-household transfers, while the remaining three-fifths were intra-household transfers.

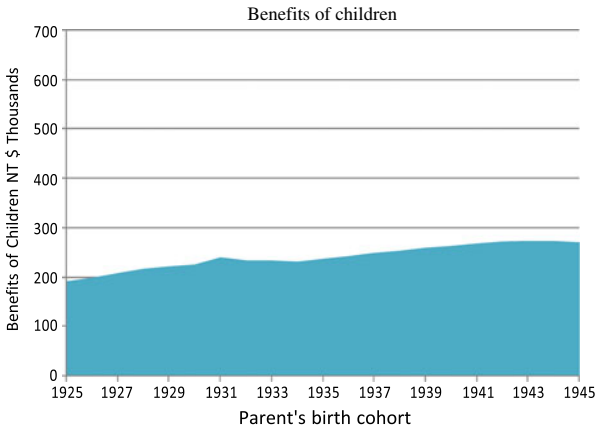


**Fig. 2** Benefits of children by parent's birth cohorts, 1925–1945, net present values, Taiwan

With the rapid changes in Taiwan's economy in the 1970s and 1980s, the transfers received from children remained stable in present value over time. This shows that the Confucian customs of repaying parents or the implicit inter-generational contract to pay back parents is working in Taiwan. In addition, parents of early cohorts enjoyed a transfer bonus because the rapid economic growth meant that their incomes were quite a lot lower than those of their children. The children of the generation born between 1925 and 1940 have incomes five to six times higher than the incomes of their parents. In Section 4.2, I found that transfers received from children are stable in present value but the costs of children are rising (Section 4.1) in present value. When combining both, the net benefit of having children is declining, this will be further analyzed in Section 4.3.

The transfers received by parents relative to their consumption are declining over time although the NT$ amounts were stable in present value. For example, almost half of the consumption of older persons aged 65 and above is supported by familial transfers. However, this support dropped to one fourth of consumption in 2005.The declining benefits of children relative to parents' consumption can be explained by socioeconomic, institutional, and structural changes in Taiwan. First, financial institutions and instruments developed and reformed rapidly, which made savings possible. From 1961 to 1991, the number of financial institution increased by 28% to over four hundred and eighty, while the number of location (branches) tripled to four thousands. Also, vigorous campaigns were held to promote financial products in the early years. For example, real interest rate on deposit was high, and interest income on bank deposits was tax-exempted. Therefore, parents were able to save and lessen the reliance on children at old age. Taiwan household saving rate was on an upward trend since the 1960s until 1990. During the same period, real interest rate was high but had little variability due to the remarkable macroeconomic stability. Athukorala and Tsai (2003) found that real interest rate is statistically significant and positive on household saving from 1951 through 1999 in Taiwan. Second, several public transfer programs are introduced starting 1990s, which increased the role of public in supporting old age consumption. Details of such programs are discussed in Section 2.1 earlier such as pension fund, labor insurance, National Health Insurance, and welfare subsidies. Third, the living arrangement changed so that more older persons lived independently, which reduced the intra-household transfers. However, the reduction of intra-household transfers was compensated by an increase of inter-household transfers. Nevertheless, the independent living of elderly is found accompanied by a decline of total familial transfers relatively to parents' consumption (Tung and Lai 2010).

### 4.3 Does having many children ever pay off?

Combining benefits and costs of children, what are the net economic costs of children, and what are the trends for these costs? Have parents ever received more than they invested in children? What is the net magnitude?

Two measures are used to answer these questions: benefit–cost ratio and the internal rate of return.

### *4.3.1 Benefit–cost ratio*

The benefit–cost ratio is the ratio of the net present value of benefits to the net present value of costs. The ratio is the current value of all future transfer flows discounted at a rate $r$. The rate $r$ may reflect the opportunity cost of investment or the interest rate. Dividing Eq. 2 over Eq. 1, the benefit–cost ratio is:

$$\text{benefit-cost ratio} = \frac{\text{net present value of benefits}}{\text{net present value of costs}} = \frac{\sum_{a}^{T} e^{-ra}\left(\tau_{a,c}^{f}\right) S_{25}^{ac}}{\sum_{a}^{T} e^{-ra}\left(c_{a,c}^{-}\right) S_{25}^{ac}} \quad (3)$$

where $a = 0, 1, 2, \ldots, T$.

Figure 3 presents benefit–cost ratios that are discounted by a survival rate of age $a$ from the childbearing decision age 25 for each cohort. Two different discount rates are employed: 2% and 3%. There are two striking results: First, the ratio declines between the parents' birth cohorts, indicating that parents are getting less financial benefits over time. Second, parents in the earlier birth cohorts receive positive returns while those born in the later cohorts obtain negative returns. For example, at a 2% discount interest rate, parents born before 1936 get more than they have invested in children. Specifically, a parent born in 1925 receives a 1.35 ratio, which means that he gains 35% more than what he has invested in children. However, parents born in 1945 only recover 60% of their investment in children. Although 0.6 is a financial loss, this number still can be considered remarkably high: these parents are able to get back over half of what they have invested in children. With pseudo-panel

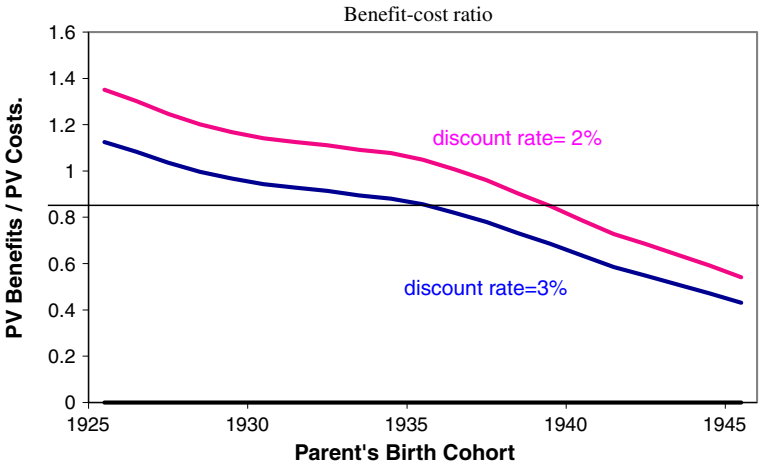


**Fig. 3** Benefit–cost ratios by parent's birth cohorts from 1925 to 1945, Taiwan

data, the economic returns found are not as highly negative as previous studies have found.

### *4.3.2 Internal rate of return*

Another measure by which to evaluate the economic contribution of children to their parents is the internal rate of return. This rate is the discount rate that makes the net present value of investment flows zero. This return rate is often used to assess and compare different types of investment options. Similarly, children are described as investments by parents who might be motivated to provide old age security. Therefore, the rate of return of children is compared with other physical investments.

The internal rate of return from investment in children is the discount rate at which the net present values of the costs and benefits of children would equal zero. Internal rate of return for a parent's birth cohort c, $R_c$, is computed by:

$$\sum_{a}^{T} \frac{B_{ac}}{(1+R_c)^a} = 0 \tag{4}$$

$$\text{where } B_{ac} = \sum_{a} \tau_{ac}^{f} \times s_{25}^{ac} - \sum_{a} C_{ac}^{-} \times s_{25}^{ac}$$

where $B_{ac}$ is the vector of average net benefits received and average costs paid by a parent at age $a$ for birth cohort $c$, $T$ is the final age, $R_c$ is the internal rate of return for cohort $c$, $C_{ac}^{-}$ is the vector of average child costs given by a parent at age $a$ of birth cohort $c$, $\tau_{ac}^{f}$ is the vector of average net upward transfers received by a parent at age $a$ for birth cohort $c$, and $S_{25}^{ac}$ is the survival rate of age $a$ from age 25 for cohort $c$. When computing the internal rate of return, problems often arise with series of flows that are non-monotonic. When the series of flows are non-monotonic, multiple roots may exist for the solution of Eq. 4. The negative root closest to zero has been used in all cases (Herbst 1990).

The internal rate of return is declining over parent birth cohorts, as Fig. 4 shows. Two results are presented: one at 5% growth rate, and another at 3% growth rate. Also, these transfers are adjusted with survival discounting. A positive internal rate of return shows that parents are receiving more than they have invested in children, indicating that net transfer flow is upward from children to parents. A negative internal rate of return shows that parents are receiving less than they invested in children, with net transfer flow downward from parents to children.

At 3% growth rate, parents born before 1940 are receiving more than they have invested in children. Specifically, parents born in 1925 have, on average, a rate of return of 4.4% from investing in children. However, parents born in 1945 receive a negative return rate of negative 0.4%. This payback is substantial compared to that found in the Western societies, where old age support has shifted from the family to the public, and therefore economic return on children is highly negative, according to estimates (Lee 2003).

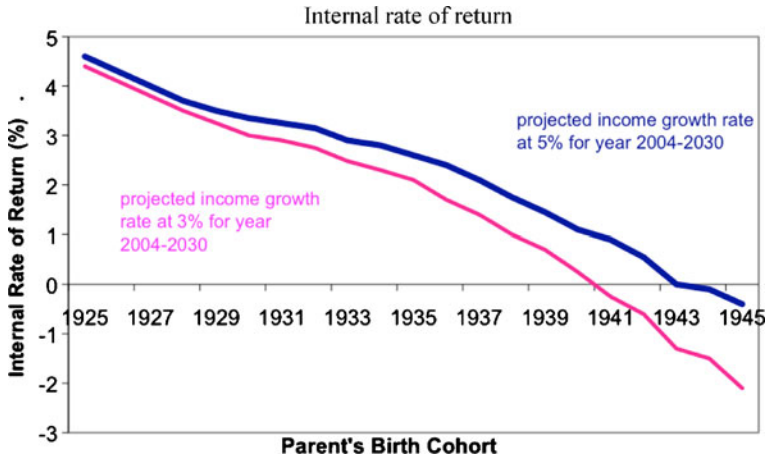


**Fig. 4** Internal rate of return by parent's birth cohort from 1925 to 1945, Taiwan

In Taiwan, where an old-age welfare system is not well established, children remain important assets for old-age security.

## 5 Economics of children during demographic transition

Taiwan experienced a rapid decline in birth cohort fertility between 1932 and 1952. Mothers born in the early 1930s had an average of four to five children. Ten years later, the number of children for each mother had dropped to three. One interesting issue is whether the fertility transition corresponds to the direction of net transfers, as claimed by Caldwell (1976).

The total fertility rate and internal rate of return for parents born between 1932 and 1945 is illustrated in Fig. 5. Fourteen points are plotted on the graph according to parents' birth cohorts. The graph starts on the far right with the

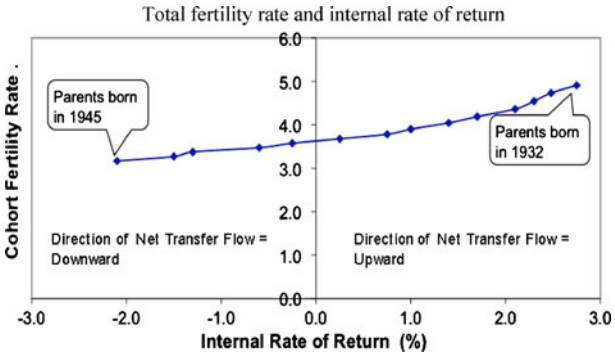


**Fig. 5** Total fertility rate and internal rate of return by parent's birth cohort from 1932 to 1945, Taiwan

cohort of parents born in 1932, and ends with the cohort born in 1945 on the far left. The vertical axis shows the cohort fertility rate and the horizontal axis presents the internal rate of return. Results show a negative relationship between fertility and internal rate of return. Parents of the high fertility cohorts (3.5 to 5 children) receive a positive internal rate of return, and the direction of net transfer flow is upward from children to parents. Later cohorts who have lower fertility (less than 3.5 children) receive a negative internal rate of return, with the direction of net transfer flow downward from parents to children.

Do these results agree with Caldwell's assertion that high fertility is motivated by positive economic returns from children to their parents? Economic values of children alone can not explain the decision of having children. Non-economic factors are important, such as, altruism, perpetuation of dynasty, and social values on ideal family size, status of women, filial care for older persons, and the use of contraceptives. Although children are highly costly, parents still decide to have children. That is to say, non-economic factors are not changing in a correlated fashion with economic values of children. Referring Fig. 5, fertility declined rapidly even though children yielded net economic benefits. Also, the positive relationship can not explain whether there is a causality effect so that declining economic returns of children caused parents to reduce the number of children they had or vice versa.

To investigate further the causality effect of fertility, a simple regression is run on the change of cohort fertility and net economic value of children. Two control variables are included, namely, the change of child mortality and the change of political uncertainty. Falling child mortality is one important "modernization" factor used in the demography literature in explaining demographic transition (Angeles 2010; Kirk 1996; Rutstein 1974; Zhang 1990). Other factors of modernization include economic development, education and urbanization. Due to the small observation size, I am not able to include all of the factors as control variables. The reason of including the change of political uncertainty is that Taiwan went through major political changes during the period of analysis. Therefore, political uncertainty may have influenced the fertility behavior (Iyer and Velu 2006; Bhaumik and Nugent 2010). Then:

$$\Delta F_c = \alpha + \beta_1 \Delta \text{Trans}_c + \beta_2 \Delta \text{Mor}_c + \beta_3 \Delta \text{PoUncertain}_c + \varepsilon_c \qquad (5)$$

where $c$ indexes birth cohort of parents, $\Delta F$ is the change of cohort fertility $F_{c+1} - F_c$. $\Delta \text{Trans}_c$ is the change of net benefits from one cohort to another. Net benefits are measured by taking present value of net upward transfers minus present value of net cost of children. This variable captures the net economic value of children for parents of different birth cohorts. $\Delta \text{Mor}_c$ is the change of child mortality from one cohort to another, $\Delta \text{PoUncertain}_c$ is the change of political uncertainty from one cohort to another, and $\varepsilon_c$ is a random error term. Political uncertainty measures government instability and political violence from one cohort to another. More specifically, several indicators are obtained from World Handbook of Political and Social Indicators by Taylor

and Jodice (1983). Indicators used are the sum of revolutions, coups, political demonstrations, probability of opposition takeover, assassinations, strikes, riots, armed attacks, deaths from political violence, political executions, and violent social change. An advantage of using change variables is that it can help to limit the potential for reverse causation. The sample size consists of 17 observations. The sample size is small because of the limits of the survey data for computing transfers by cohort level. The objective of this simple regression is to determine whether coefficient $\beta_1$ is significantly positive. A positive sign suggests that a decreased rate in economic value of children will cause a drop in the rate of fertility, which is the pattern postulated by the wealth flow theory.

Results are presented in Table 2. The coefficient $\Delta\text{Trans}_c$ is negative and significant at the 1% level, suggesting an association between a lower rate of economic value of children and a higher rate of fertility. That means that the result is not consistent with the wealth flow theory. Examining the change of net transfers of the latest few cohorts, the average change is about negative NT$30,000. That means if the net transfer dropped by NT$30,000, the change of fertility increases by 0.0453 ($1.51 \times 10^{-6} \times$ 30,000, refer column 5 Table 2). On the other hand, coefficient $\Delta\text{Mor}_c$ is positive and significant at 10% level. This positive result is consistent with the existing literature that shows that a decline of child mortality is accompanied by a reduction in fertility. Coefficient $\Delta\text{PoUncertain}_c$ is negative and significant at 10% level. Also, the negative result is consistent with the existing literature that shows that an increase of political uncertainty delays fertility decision.

**Table 2** Robust ordinary least-square estimates of net transfers on change of fertility

| | Column 1 Coef | Column 2 Coef | Column 3 Coef | Column 4 Coef | Column 5[d] Coef |
|---|---|---|---|---|---|
| Dependent variable | Change in cohort fertility | | | | |
| ΔTrans (net transfers from children) | $-9.88 \times 10^{-7}$ [b] (−2.45) | | | $-1.65 \times 10^{-6}$ [a] (−5.47) | $-1.51 \times 10^{-6}$ [a] (−4.90) |
| Δ Mor (cohort child mortality) | | | −0.04[a] (4.55) | 0.01 (1.70) | 0.01[c] (1.87) |
| $\Delta\text{Trans}_{c-10}$ (lagged net transfers from children) | | $-2.30 \times 10^{-6}$ [a] (−14.34) | | | |
| Δ Political uncertainty | | | | | $-8.04 \times 10^{-4}$ [c] (−1.82) |
| Constant | −0.14 | −0.11 | −0.07 | −0.16 | −0.16 |
| Observations | 18 | 18 | 28 | 14 | 14 |
| Adjusted $R^2$ | 0.2053 | 0.7612 | 0.3689 | 0.8138 | 0.8355 |

*t* value in brackets

[a] At 1% significant level

[b] At 5% significant level

[c] At 10% significant level

[d] Limited by sample size to use variable lagged net transfers from children in this regression

Another regression is examined using lagged net transfers received. I use lagged transfers both to diminish the likelihood of reverse causation and because most likely parents who make decisions on the number of their children predict costs and benefits of children based on their observations of existing transfer patterns experienced by parents of older cohorts. Then:

$$\Delta F_c = \alpha + \beta_1 \Delta \text{Trans}_{c-10} + \beta_2 \Delta \text{Mor}_c + \Delta \text{PoUncertain}_c + \varepsilon_c \qquad (6)$$

where $\Delta F_c$, $\Delta \text{Mor}_c$, and $\Delta \text{PoUncertain}_c$ are the same as in Eq. 5. $\Delta \text{Trans}_{c-10}$, however, is the present value of net upward transfers minus present value of net cost of children for parents of cohorts 10 years older than parents who make fertility decisions. I chose 10 years both because of the limited span of cohort data I have and because parents who are making decisions should find recent patterns more relevant and easy to observe. Results are presented in Table 2. The coefficient $\Delta \text{Trans}_{c-10}$, is again negative and statistically significant at the 1% level, suggesting that we can not accept that declining fertility is caused by the reduction of net transfer flows received by parents.

The regression findings have to be interpreted with caution, due to the small sample size and the study's limited ability to include all the relevant independent variables for this decision using these data. A more thorough analysis may yield better conclusions on wealth flow theory. However, the estimates here present new findings that children provide positive economic returns to parents born before the 1940s in Taiwan.

With positive internal rates of return, were children good investments in the old days? The average interest rates of time deposits (savings held in the bank for a fixed term) ranged from 7.5% to 6.5% in Taiwan during the period under study. Compared to the rate of return from investment in children (ranging from 4.6% to −0.4%), the return on time deposits was higher. That means that parents would earn more by saving money in the bank than by investing in children. Other investments, such as bonds and properties, yield far higher returns than time deposits.

Despite a return rate on children lower than time deposit investments, children still remain economic assets to parents. Pension systems and old-age welfare are not well established in Taiwan. In 1994, only two thirds of the population aged 25 and older was covered by pension insurance (mostly under Labor Insurance and Government Employee Insurance). One third of the population aged 25 and older was not covered. Most of these are housewives, self-employed workers, farmers, and small business workers. The pension coverage has a maximum amount of 45 times the last working month's salary, which is equivalent to 3.75 years of retirement pay. The elderly do not receive pension benefits until their last day. A national health care system was not implemented until 1995. Health insurance covers a large part of medical expenditures, but care and attention from children may be desired by parents during their old age. Children are still important to old age security.

## 6 Conclusion

Using a 42-year span of data from Taiwan's Survey of Family Income and Expenditure, the objective of this paper is to estimate and analyze the cost and benefit of raising children during demographic transitions in Taiwan. In this connection, I consider Caldwell's wealth flow hypothesis. A method was developed to use micro-level data to estimate net economic returns from children over a parent's lifecycle. These estimates appear to be one of the most comprehensive estimates of lifecycle transfers between parents and children in the literature.

Results show that parents born before the 1940s receive net positive returns, but returns turn negative for cohorts after that. Although their returns are negative, it is nonetheless striking that these parents still get back about half of what they have invested in children. Linking these returns to the period of demographic transition, results show a declining fertility trend that is accompanied by decreasing net economic returns from childrearing in Taiwan. However, this positive relationship is not sufficient to conclude the applicability of Caldwell's wealth flow theory because we do not know whether the fertility decline is caused by the diminishing value of children or vice versa. The direction of causality is not easy to determine, particularly with limited data points and a lack of survey data.

The economic values of children cannot alone explain fertility patterns. Except in the unusual context of Taiwan over the last several decades, where rapid economic growth combines with Confucian customs and other specifics of socioeconomic context, returns of children are likely to be negative. Therefore, Caldwell's wealth flow theory cannot be accepted. Reasons for having children may go beyond economic measures to include factors such as altruism, perpetuation of the family line, and social norms. Besides, children are important for time transfers such as personal attention and visits. Regarding the transfers that parents do receive from children, there is an even more intriguing question: Do parents receive financial transfers because they do not have enough assets to cover their expenses? Another question is whether human capital investment per child increases when the number of children per household is smaller; such an increase, if it were general in a society, might lead to economic growth over time.

There are several limitations in this study. First, the economic return estimate is the average return on a child, and not the marginal return on a child. The analysis sheds light on the average return from children for a parent, instead of the marginal return of an additional child. Second, the transfer estimates are focused on direct financial costs. Indirect costs such as time transfers and the opportunity costs to mothers taking care of children and elderly parents are not included. Data on time transfers are difficult to obtain and are not widely available. Third, the transfer estimates are limited by the data to include only inter-household transfers and intra-household transfers. Planned bequests or other asset transfers are not taken into account. If parents plan bequests for their children, the bequest should be treated as transfer from

parents to children and therefore would reduce the returns from childrearing. If bequests are accidental, as a product of lifecycle saving and uncertainty of age at death, then this analysis does not require additional information on bequests.

Taiwan did not implement substantial pronatalist programs until quite recently, in the late 2000s. Education subsidies were given to children of government employees, covering about two thirds of their tuition. However, this subsidy has now been halted. The latest measure provides a subsidy of NT$50,000 (US$1,650) per fertility treatment, about half of the cost, to low-income couples. A major development is the 2008 White Paper on Population Policy, initiated by the Ministry of Interior, which has the goals of increasing fertility and preparing for the aging population. This policy proposes several measures specifically to encourage fertility, such as building a public childcare system, improving maternal and paternal leave practices, providing financial support for families with dependent children, constructing friendly occupational environments for childbearing workers, improving the reproductive health care system, enhancing children's rights and the child protection system, and improving marriage opportunities and children's value as public goods (Lee 2009).

The Western and Northern European countries have improved their fertility levels with such pronatal policies (Björklund 2006), and Taiwan may be able to follow in their footsteps. A successful program would require cooperation from all parties including the public and private sectors, individual level as well as from the society as a whole. The value of children needs to be respected, working mothers must be given flexibility, financial subsidies have to be significant for parents, and gender equity in households needs to be realized. Taiwan's recent fertility subsidy of NT$50,000 may not be substantial to increase the fertility to replacement level. Based on the regression analysis results, if we look only at the absolute magnitude of the effect of financial costs of children on fertility rates, to increase Taiwan's fertility rate to the replacement level, meaning changing the fertility rate by 1.07, we would need to give subsidies or help parents to reduce the childrearing costs by six million Taiwanese dollars (US$200,000) per parent.

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