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Can Health Insurance Boost Fertility? The Fertility Effect of National Health Insurance in Taiwan

健康保險能促進生育率嗎? 臺灣全民健保對生育率的影響

Elyse Mark 麥麗施
Adviser: Dr. Yu-hsuan Su

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Abstract

The implementation of Taiwanese National Health Insurance in 1995 affected almost every Taiwanese citizen's healthcare options and coverage. Inclusion of low-cost prenatal and postnatal care, delivery services, and child healthcare coverage indicates the implicit pronatalism of NHI policy. Given the endogeneity of healthcare availability to childbearing decisions, this study uses the 1995 implementation of NHI to estimate the impact of national healthcare on Taiwanese fertility. We first approach this question using OLS regression to test for correlation between completed childbearing and an NHI dummy, among other demographic factors. In the second approach, difference-in-differences methodologies estimate the effect of 1995 NHI implementation on the treatment group of Taiwanese women and state-insured control group. Our data sources are the 1979-2016 waves of the Women's Marriage, Fertility, and Employment Survey conducted by the Statistical Department of the Taiwanese Ministry of the Interior. We hypothesize that the 1995 NHI policy change increased the fertility of Taiwanese women around the cutoff date despite sub-replacement national fertility beginning in the 1980s. OLS analysis fails to show a positive correlation between NHI and women's fertility in Taiwan, however. Further, DID estimations using a maternal age and a conception time both reject the hypothesis that lowered cost of childbearing through NHI stimulated Taiwanese fertility.

Keywords: Taiwan, National Health Insurance, fertility, pronatalism, difference in differences

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摘要

自 1995 年臺灣實施全民健康保險起，健保幾乎影響了所有臺灣居民的醫療選擇。臺灣的健保包括產前和產後檢查、分娩服務、兒童保健的費用補助，表明健保政策潛在的鼓勵生育性。本研究利用 1995 年全民健保的實施估計國家醫療保健對臺灣生育率的影響，首先用普通最小平方法估計完成生育子女數與健保以及其他的人口因素之間的相關性，並使用差異中之差異方法來估計健保實施對實驗組和對照組的影響。我們的數據來源是內政部 1979 年至 2016 年的婦女婚育與就業調查。我們假設 1995 年的健保政策減緩了臺灣婦女自 1980 年代開始的生育率下降趨勢。然而，普通最小平分析未能顯示健保與臺灣婦女生育率的正相關。此外，使用母親年齡和受孕時間作為截止點的差異中之差異估計也拒絕了通過健保降低生育成本會刺激臺灣生育的假設。

關鍵字：臺灣，全民健康保險，生育率，差異中之差異

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1. Introduction

In the 20th century, Taiwanese fertility underwent a dramatic transformation, declining from a peak total fertility rate of 7.04 births per woman in 1951 to below-replacement level fertility in 1984. Since then, fertility rates have stagnated below 2.1 births per woman until the present day (G. H. Lee & Lee, 2014). Low fertility is not an isolated Taiwanese problem, but rather a demographic crisis endemic to many economically developed countries, and felt acutely in Western Europe and East Asia. Sub-replacement fertility does not automatically bring about population decline. When the momentum of a large childbearing cohort is lost, however, and in the absence of immigration to offset low birthrate, low fertility causes to population shrinkage. While this might lower the environmental burden of a large population, sustained low fertility threatens state capacity to provide pensions for aging populations, promote stable economic growth, and fund vital public services like education or healthcare. From Japan to Norway, nations around the world have undertaken natalist policies in an attempt to boost fertility, ranging from the provision of public childcare to anti-discrimination employment law and paid parental leave (Nakajima & Tanaka, 2014; Rindfuss, Guilkey, Morgan, & Kravdal, 2010).

Previous studies on the efficacy of pronatal policy aimed at increasing domestic fertility through cash or non-cash incentives in developed countries have yielded mixed results. Most governments work concurrently through implicit and explicit policy channels to promote childbearing, which presents analytical challenges for researchers hoping to identify successful pronatal incentives. Because fertility decisions lie at the intersection of social, economic, and cultural crossroads, intercountry generalization is unreliable, if not impossible. Little consensus exists regarding whether or not policy incentives are able to stimulate fertility at all, much less which types of incentive structures are the most effective.

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This paper narrows the broader academic debate over pronatal policy solutions to sub-replacement fertility by concentrating on the Taiwanese case during the 1990s. The primary purpose of the study is to determine the effect of national health insurance (NHI) implementation on the childbearing decisions of Taiwanese women, working on the premise that NHI coverage almost universally lowered financial barriers to childrearing. Given its inclusion of various birth and child healthcare benefits, NHI may be considered a form of implicit pronatal policy in Taiwan, and one that circumvented contemporary political opposition to other more explicit forms of pronatal policy. Data for this paper are from the Women's Marriage, Fertility, and Employment Survey (WMFES), conducted periodically by the Statistical Department of the Taiwanese Ministry of the Interior since 1979. The study uses multivariate OLS regression and difference-in-differences (DID) designs to analyze the fertility effects of the universal implementation of Taiwanese NHI in 1995, examining conditional fertility and monthly birthrate as outcome variables, respectively.

The organization of the paper is as follows. The next section provides a brief background on the Taiwanese demographic transition. Section 3 reviews the wider literature on fertility decline in developed countries and Taiwanese national health insurance. In Section 4, I elaborate on the empirical methods data sources of this study. Section 5 reports findings from the OLS and DID estimations, and the final chapter concludes with further discussion of results and policy implications in contemporary Taiwan.

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2. Background

2.1 Taiwanese Fertility Transition

Taiwan has undergone a well-documented demographic reversal over the last century, transforming from an island with high fertility to low fertility in the 1950s, and from low fertility to sub-replacement levels beginning in the 1980s. Fertility decline on the island has lowered fertility from its peak TFR of 7.04 children born per woman in 1951 to a stagnant 1.75 between 1986 and 1997, decreasing again to approximately 1.12 by 2007, where it remains stable today. Beginning in the 1920s, the decreasing death rate fast-tracked Taiwan's population growth. Combined with an increase in birth rate after World War II, Taiwan's fertility peaked in the 1950s with a crude annual birth rate of over 40 children per 1000 population. The combination of a household registration system and periodic national knowledge, attitude, and practice (KAP) family planning surveys since 1965 reflects long-standing state interest in tracking population trends, making Taiwanese fertility an ideal case for exploration.

The 1950s to 1980s was generally a period of fertility reduction for Taiwanese women of childbearing age. Government introduction of the 1964 Family Planning Program, combined with increased opportunities for private economic gain, radically influenced Taiwanese childbearing preferences. The program employed civil servants as Pre-pregnancy Health Workers (PPHWs) or part-time Village Health Education Nurses (VHENs) in each of Taiwan's 361 townships, tasking them with traveling door-to-door to private residences to recruit women into the program (Montgomery & Casterline, 1993). Through the family planning program, PPHWs provided recruits with various contraceptives such as intrauterine devices, oral contraceptives, condoms, and distributed propaganda encouraging smaller family sizes.

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Presence of the family planning program during Taiwan's fertility decline from the 1960s onward and high usage of contraceptives by Taiwanese women indicates the program was successful. In their analysis of diffusion of fertility control in Taiwan, however, Montgomery and Casterline (1993) find that the actual estimate of the program impact varies dramatically depending on statistical design. Weighted least squares regression shows the program reducing marital fertility no more than 5% from 1968-80, with increases in marital fertility in the early years of the program, while their diffusion based curves put that number somewhere between 5 and 22%. Li (1973) supports the claim that the family planning program neither induced nor increased Taiwanese fertility decline 1954-1970, pointing to evidence from Taichung (a target area of the program) to show that action programs had little appreciable effect on childbearing. Rather, they point to decreased infant mortality as likely explanatory variable throughout the country, and rising educational levels as an important urban factor.

Nuptiality and martial fertility have also been cited as causes for Taiwanese fertility decline. Sun, Lin, and Freedman (1978) first showed that about 1/3 of the decrease in birth rate 1961-1984 was caused by changing marriage patterns, while in contrast Feeney (1991) claims that nuptiality contributed nothing to fertility change in this period. His study shows a sustained high level of marriage and motherhood for Taiwanese women throughout the 1980s, asserting contrast between his and the Chang, Freedman, and Sun (1987) study is due to methodological differences related to his focus on women's probability of first marriage and Chang et al. examining age specific birth rate. However, his later claim that Taiwan "may not be below replacement level after all" (in the 1990s) belies the strength of that argument (Feeney, 1991, p.

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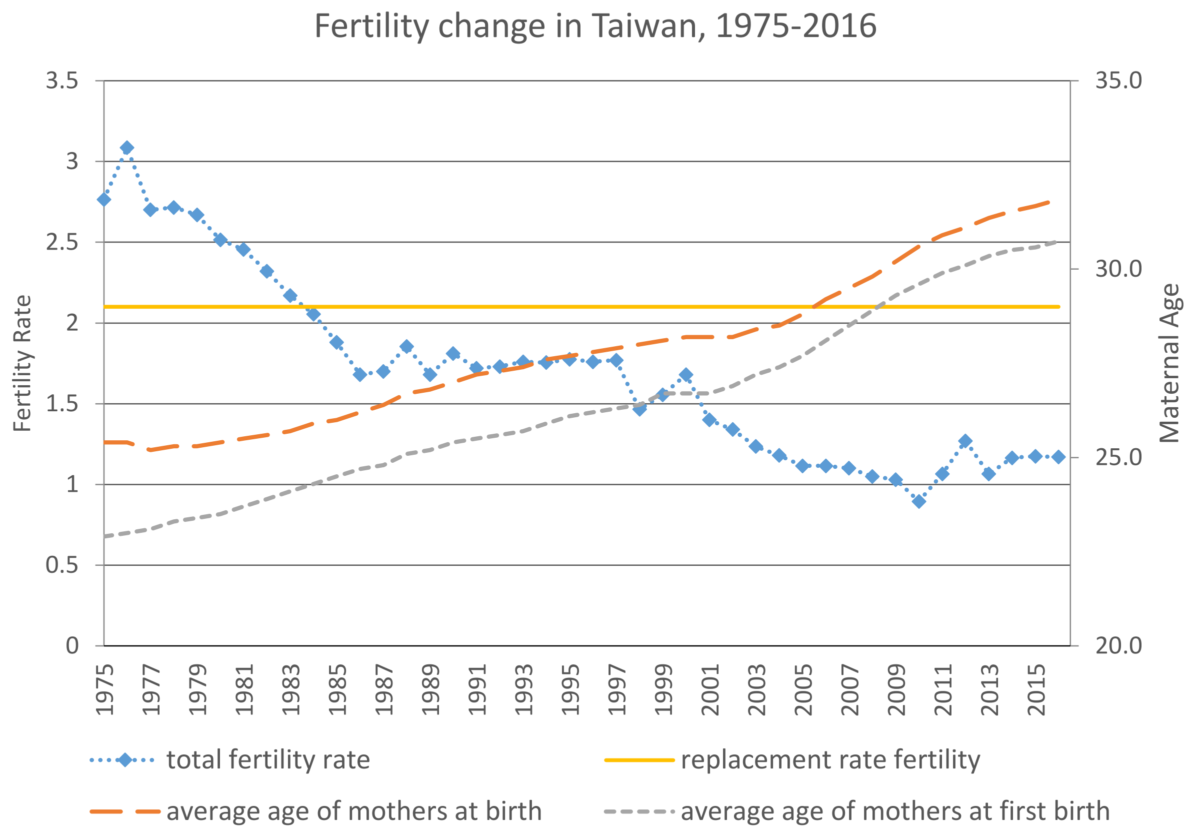

Figure 1: Fertility change in Taiwan, 1975-2016

476). Chang (2006) found that 2/3 of the decrease in birth rate 1965-1980 was attributable to declining marital fertility, and the remaining 1/3 due to nuptiality patterns.

In 1983, the combination of an extremely low death rate and large cohort of women of childbearing age resulted in a high population growth rate, which prompted the Taiwanese government to push a second wave of the family planning program. During the 1980s, statistics show fertility reduction for women under 30 years of age and a trend of delaying childbearing until the late twenties; by the 2000s the average age of mothers at first birth was into the early thirties (see Figure 1; plotted with data from R.O.C. Ministry of the Interior). Despite overall fertility decline, martial fertility actually increased between 1985 and 2007 (Luoh, 2007 as cited in Lee & Lin, 2016). Taiwan has extremely low extramarital fertility, and childbearing has been

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named as the de facto cause of marriage for many Taiwanese women (K. Chen & Yang, 2005 as cited in Lee & Lin 2016).

2.2 Pronatal Fertility Policy

Taiwanese fertility policy reflects its demographic reversal, lagged by two decades. Clear antinatalism underlies the 1964 national family planning program, which boosted contraceptive use and promoted the social and economic advantages of small families; by 1992, however, the revised Guideline for Population Policy acknowledged the need for more stable population growth in Taiwan. The "link between Taiwan's family planning program and rapid economic progress" obstructed the state's ability to increase Taiwanese family size, as did pressure to adopt a universal pension plan in the late 1990s (M. Lee & Lin, 2016, p. 270).

Explicit pronatal policy did not pass until the 2008 publication of a Pronatal Population Policy White Paper, due in part to backlash from feminist and environmentalist groups throughout the 1990s and 2000s, who questioned the gendered and environmental consequences of increasing the national population. Actual quantitative fertility targets were not published until the 2013 revision of that paper, along with strategies to address low fertility. In the midst of this controversy, 1995 passage of National Health Insurance (NHI) in Taiwan included several incentives for higher fertility, such as free prenatal and neonatal care, child delivery, child health insurance, one-month cash benefit for childbirth, and complete premium coverage for low-income families. By the end of 1995, 97% of the population had registered for NHI coverage (L. Chen, Chen, & Yang, 2008). Prior to NHI, only women covered by Government Employee Insurance had access to free prenatal care through public health insurance. Given the pronatal incentives in NHI, the present study aims to determine the effect of nationwide implementation of National Health Insurance on Taiwanese fertility.

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3. Literature Review

3.1 Low Fertility in the 20th Century

Low fertility is a relatively recent social phenomenon. Populations today have greater access than ever before to family planning tools such as contraceptives and voluntary sterilization procedures, especially in economically developed areas where a variety of cultural, economic, and political factors convene to decrease the demand for children. The majority of historical fertility studies have analyzed the influence of variables such as cultural norms, social or health policy, female labor force participation, or education on fertility, under the assumption that lower fertility is a demographic goal, particularly for developing countries. If so many developing countries strive for low fertility through family planning programs or other state policy, then why do other states consider low fertility a threat?

From a governmental perspective, low fertility is essentially an issue of potential "market failure," wherein population reductions threaten support for governmental programs and the private market (Demeny, 1986, p. 339). More specifically, below-replacement fertility decreases the tax base needed in many richer countries to finance retirement benefits, state-sponsored medical care for the elderly, among other programs targeted towards vulnerable segments of the population. A growing body of literature not only acknowledges the increasing importance of low fertility in other areas of the world, but also addresses the effectiveness of pronatal policies adopted by those countries vulnerable to this demographic trend. In a broad sense, the abstract justification for pronatal government interventions derives from the preservation of the state and protection of its citizens' economic and social well-being.

Nearly half of the world population lives in countries with below replacement-level fertility. During the twentieth century, the entire European continent has come to experience

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serious fertility decline and population growth rates nearing zero, particularly in Western and Northern European nations (Chesnais, 1996; Legge Jr & Alford, 1986). Even in southern Europe, where Mediterranean countries are commonly understood to have "traditional, Catholic, and family oriented" societies valuing larger family sizes, fertility has been at sub-replacement levels since the 1990s (Chesnais, 1996, p. 729). Today, low fertility remains pervasive throughout Europe and poses a serious demographic problem in North America and East Asia. Despite the widespread nature of this trend, the literature explaining low fertility trends remains divided, ranging from sociological or cultural arguments based on industrial modernization to microeconomic household theories.

3.1.1 Theoretical Explanations for Low Fertility. Theoretical explanations for low fertility in developed countries vary widely, blaming industrial modernization, microeconomic household theories, and even values-based trends that defy direct state intervention. Below, I have organized current and historical fertility theories into three categories: modern transition theory, the economic model of fertility, and other sundry approaches. Although I only list these three headings, throughout history, many scholars have attempted to summarize their understandings of population into fertility theories; these three segments simply represent the most politically and academically significant theories of fertility decline over the past two hundred years.

Demographic Transition Theory. Demographic transition (DT) theory, also known as modern transition theory, has its roots in a nineteenth century Malthusian approach to fertility decline popularized in Europe and the United States. This theory links voluntary lower fertility with expanded economic opportunity for social mobility. DT theory flourished in the beginning of the twentieth century, as the European demographic transition from a high mortality-high

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fertility region to low mortality-low fertility one slowed. Key proponents include Davis (1945), Notestein (1945) and Landry (1987). DT theory claims that fertility decline arises from the "structural transformation of the economic and social systems generated by the industrial revolution," given inevitable shifts in cultural norms, values, and socioeconomic classes that arise due to industrialization (Demeny, 1986, p. 343). In early industrialization stages, fertility is high and uncontrolled and mortality is declining because of increasing quality of life. For example, the industrialization improves food availability, public health, urbanization, agriculture, and contraceptive technologies, among other factors (Szreter, 1993).

Demographic transition theory has been the predominant theory used to explain fertility trends in policymaking (Demeny, 1986), and the correlation between fertility decline and socioeconomic development at the national level is well accepted. This theory, however, assumes that industrialization's population effects are mainly economic, and does not recognize the role of social changes like gender equity or labor force participation (Demeny, 1986; Zaidi & Morgan, 2017). In addition, it fails to account for the role of migration in population size. The second demographic transition framework is an extension of demographic transition theory for already low-fertility countries, put forth in the 1980s by Lesthaeghe and van de Kaa (Van de Kaa, 1987; Zaidi & Morgan, 2017). It attributes the sub-replacement fertility of industrialized countries in North America and Western Europe to complete control of fertility, and childbearing is influenced by factors like the popularity of contraceptives and increased female labor force participation (Van de Kaa, 1987, 2001). Further, its proponents argue that childbearing decisions increasingly depend on value-based, rather than purely economic, factors (Zaidi & Morgan, 2017).

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The Economic Model. During the 1960s, the school of new household economics[1] emerged to rival the explanatory power of demographic transition theory regarding fertility decisions. On a foundation of microeconomic analysis and statistical evidence, rather than normative assumptions, this model understands fertility by placing children in a household economic framework. In his earliest analysis of fertility, Becker (1960) explains that children may be consumed as a source of "psychic income or utility," and that past a certain age they may also contribute pecuniary income to the family, thus acting as a productive good (Becker, 1960, p. 213). Becker's later works further develop theories on the allocation of time at the household level, speaking of opportunity cost of childbearing. That cost is the foregone earnings that parents sacrifice, as measured by "the amount of time used per dollar of goods and the cost of unit per time" (Becker, 1965, p. 503). Becker theorizes that households in richer countries forfeit earnings in exchange for psychic income gained by having and raising children. Since childcare is not monetarily productive, its relative opportunity cost is higher for families enjoying higher incomes.

Critics of this microeconomic model argue that it emphasizes empirical data to the exclusion of significant cultural, social, and historical influences on fertility (Demeny, 1986). While Demeny (1986) also claims that "policy applications of the findings from the new types of [microeconomic] analyses were scarce," today we see that many pronatal policies actually do rely on the concept of the lowering the financial cost of children to incentivize fertility (p. 344).

Rational choice theory is a variant of the economic model, related to, and often studied in conjunction with new household economics vis-à-vis fertility. Childbearing is defined as a purely rational economic decision, determined by strict cost-benefit analysis, and influenced by parental

[1] This school of fertility theory is also known as new home economics theory (Gauthier, 2007).

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income constraints and consumer preferences. McDonald (2002) notes that the benefits of children are psychological rather than economic, especially in societies where elder care does not remain within the family. He thus categorizes children as consumption instead of investment goods. Gauthier (2007) separates the cost of children into direct and indirect categories, with indirect costs as the foregone (monetary) earnings given up during the childbearing/rearing process; these are equivalent to Becker's opportunity cost of childbearing. Direct costs, on the other hand, are "the actual dollar expenditure on the child less any financial benefits" received by parents because of the child or children, such as financial transfers, tax exemptions, or subsidized child services (McDonald, 2002, p. 424). The direct cost of children may affect later order births more significantly than indirect costs, which level as the number of children increases, and may primarily affect first-order births.

One caveat to the concept of the psychological value of children is the effect of birth order on perceived benefits of the child. McDonald (2002) writes:

> Having the first child provides benefits including the status of being a parent, "being a family", having offspring who will carry on the family, meeting the expectations of others, having a baby who will be fun and will grow up and love you, fulfilling childhood dreams, or providing vicarious pleasure from the child's success. The decision to have a second child may be more related to the strength of the notion that each child should have at least one sibling or the desire for a child of the other sex. Those who have a third child may value at least three children as a "real" family, or they may be still trying for a child of the sex that they don't have … It is likely that the level of the net psychological benefits threshold falls as birth order rise… [and] that the level of the threshold falls as people get older (p. 422-23).

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According to rational choice fertility theory, decreasing the cost of children or increasing parental income through pronatal policy should increase demand for children. Because raising the psychological benefits of children is not within the scope of policy, the welfare state approach lowers the costs of children through financial transfers, the tax system, or subsidized services (McDonald, 2002, p. 424). As seen above, however, theoretically policy may affect birth spacing more than overall fertility, by incentivizing earlier childbearing rather than having more children (Gauthier, 2007).

Gauthier (2007) observes five main assumptions of the economic model of fertility. (1) An increase in income is expected to increase demand for children; (2) Parents and individuals have complete information about the cost of childbearing and births and perfectly planned; (3) Marriage and childbearing are economically rational choices; (4) Policies may impact fertility by decreasing the cost of children or increasing parental income; (5) Childbearing preferences are homogenous among the family or household. Two key criticisms of the economic model involve the first and fifth points. Regarding the first assumption, an increase in income could increase the quality of children rather than the quantity. This means expenditure on children could rise (e.g. more expensive education, extracurricular development, health care) and increase the overall cost of children, keeping the demand for children low. The fifth assumption reveals that the economic model ignores the role of gender dynamics in fertility. If the demand for children is heterogeneous in the household, then local gender dynamics may affect how pronatal policy influences childbearing.

Risk aversion theory describes another facet of rational choice theory, minus the assumption that individuals and households have perfect information on the costs and benefits of childbearing. Without that assumption, couples consider children a source of potential economic,

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interpersonal, or romantic risk. For example, childbearing almost guarantees a period of lower income, delayed return to the workforce by one or both parents, and higher consumption costs (McDonald, 2002). The best, and possibly the only, policy solution according to this theory is the welfare state approach, which lowers risk of childbearing throughout economic and social spheres for citizens in general.

Additional Approaches. In the literature, there are several other notable theories of fertility change. Easterlin (1975) proposes a cyclical pattern of fertility that fluctuates between baby booms and low fertility periods. Fertility reflects relative income in this theory, meaning that couples will try to achieve a minimum standard of living that is equal to or higher than that of their childhood. Childbearing trends are predicated upon expected/realized economic wealth and subject to spontaneous recovery of higher fertility, decreasing the need for pronatal state interventions (Demeny, 1986).

Post-materialist fertility theory suggests that a sustained level of development in wealthy countries has caused an ideational shift from materialism to self-realization. When values such as personal growth, liberalism, and individual freedom are celebrated over traditional family values, fertility decreases. Post-materialist values theory dovetails with second demographic transition theory. As previously mentioned, second demographic transition theory proposes a post-WWII decoupling of marriage and procreation in advanced countries, which, along with increasingly available contraceptive technologies, leads to below-replacement fertility. It is assumed that shifting ideational systems prompt these changing demographic patterns (Van de Kaa, 2001; Zaidi & Morgan, 2017).

McDonald (2002) suggests that reason for this discrepancy is the unaddressed issue of gender equity in childbearing decisions. His gender equity theory of fertility divides society into

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individual-oriented institutions (i.e. education and market employment) and family-oriented institutions (e.g. social security, the industrial complex). In advanced modern societies, he claims, gender equity is high and rising within education systems and the much of the labor force. That said, the traditional male breadwinner model still prevails as the foundation of many family-oriented institutions, and if children are present, obliges women to be caretakers and men economic providers within traditional heterosexual relationships (McDonald, 2002). Childbearing limits the increased economic and career opportunities afforded to women by rising gender equity, and women likewise limit their fertility. This theory of fertility explains the low fertility of traditional patriarchal societies such as southern Europe and Japan well, where there is a large discrepancy of gender equity between individual and family systems.

3.1.2 Pronatal policy. The prevalence of low fertility over the past half century has led to a variety of pronatal policies intended to stabilize population growth. Pronatal policies may be divided into two kinds, nonmaterial and material incentives for childbearing.

Nonmaterial pronatal policy. Nonmaterial pronatal policy promotes fertility through nonfinancial channels, and falls into distinct categories: anti-discrimination legislature, restrictive fertility legislature, or values reeducation programs. In general, these policies provide broad legal support for combining employment and family, or for social changes conducive to increased childbearing. McDonald (2002) describes several options in the policy toolbox to address low fertility. Antidiscrimination legislation preventing unfair hiring practices based on gender, relationship, or family status supports the growth of economically sustainable families, as does guaranteed maternity and paternity leave with full or partial benefits. Policy ensuring a parent’s return to work after childbirth guarantees some economic stability for new families; some policies may even allow a part-time return to work with continued partial benefits.

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Parental leave policy immediately raises questions about who pays leave benefits, what the criteria are for receiving those benefits, and how long of a leave period is guaranteed. That said, parental leave policies may help people reconcile work with family, and gender-neutral policies may even encourage greater gender equity in childrearing responsibilities (McDonald, 2002). European evidence in France and former East Germany shows that role incompatibility for working mothers has had a significant impact on fertility (Legge Jr & Alford, 1986), and that parental leave policies were correlated with higher fertility in Canada, Finland, Norway, and Sweden (Gauthier, 2007). Rindfuss and Brewster (1996) find, however, that in the United States, research from the latter half of the twentieth century suggests that maternal leave policies and cash benefits did not promote childbearing in the absence of other family policy. Thus while parental leave policy is associated with more stable fertility among low fertility countries, evidence remains mixed as to its effect on fertility in isolation.

Values reeducation ties back to the second demographic transition / post-materialist approach to low fertility and would (hypothetically) involve governmental support for programs to reshape citizen's attitudes towards family size. Demeny (1986) argues that pronatal values reeducation is not an appropriate route for politically developed countries, given that:

> Democratic states are ill-equipped to engage in specialized value education of their citizens: values are embedded in and conveyed by the deeper institutional structures…Ministerial exhortations, posters of happy three-child families, and medals to heroine mothers are neither well-received nor effective in influencing fertility (p. 347).

On a similar note, restricting access to contraceptives, abortion, and other family planning methods presents an illiberal approach to pronatal policy unsuitable for modern democracies. In countries where contraceptive knowledge and use has already become widespread, and where the

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internet enables rapid communication, such retroactive measures may not be possible. Furthermore, evidence from Legge Jr and Alford (1986) in Romania indicates that abortion restriction is both unlikely to raise fertility and very likely to harm the health of women and children. After World War II, many Eastern European countries promoted population policy to combat fears about a diminishing labor force and regional population distribution; Romania accomplished this through extreme abortion restriction and childlessness taxes. In general, for Eastern Europe in the 1950s-60s, birth control access was rarely available, and abortion and the pullout method were the primary means of birth control. The Romanian case demonstrated that in the absence of legal family planning methods, women turned to illegal abortion to prevent births, with severe health consequences. Moreover, results show that the economic incentive structures of contemporary Hungary and former East Germany had a more lasting positive effect on birthrate in those regions.

Material pronatal policy. Financial incentives for childbearing span a wide range of options, from direct cash infusions for new parents to subsidized goods and services for family support. Cash-based pronatal policy uses direct monetary incentives to motivate limited childbearing among women and couples. In a broad review of thirteen macro-level studies on family cash benefits and fertility, Gauthier (2007) concludes that in general, higher child benefits (of any of these material policy types) are associated with higher fertility among a diverse range of methodologies. However, she asserts that these aggregate studies show that cash benefits are more likely to affect birth timing than completed fertility, and proposes they may only speed up the timeline of childbearing decisions. Micro-level data reviewed also supports the correlation between child or family benefits and fertility, but with inconclusive results regarding magnitude of effect on birth order.

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Specifically, material incentives may include financial assistance measures like periodic or one-time birth benefits, and tax exemptions for parents. Periodic payment schemes provide regular cash transfers for parents by the state, depending on the age of the child or its birth order. A key flaw of such policies is reliance on the assumption that the household equally shares income and childrearing responsibility, and failure to address the role of gender equity in the family. The state similarly might dispense one-time child benefits to parents, usually paid upon the birth of a child or at another, significant age (for example, when the child begins school). Both of these types of redistributive policy are intended to increase horizontal equity by supplementing parental income in recognition of the cost of having and raising a child (Demeny, 1986; McDonald, 2002).

Tax deductions, exemptions, or credits given to parents are another form of redistributive fertility policy. Whittington, Alm, and Peters (1990) examine implicit pronatalism in U.S. income tax personal exemptions for dependents, showing that personal exemptions led to a significant increase in birthrate for middle-income families. The obvious reason for this type of tax-based pronatal policy is to provide a child subsidy, which offsets the costs of raising a child to adulthood. In the Whittington et al. (1990) study, all specifications demonstrated that the personal exemption policy had a positive and significant impact on birthrates in the U.S. Even stronger evidence of a pronatal effect from tax incentives comes from Canada, in analysis of the Quebec Allowance for Newborn Children policy. Milligan (2005) shows that women eligible for the maximum child benefit (C$8000) increased their fertility by 16.9%, and women on average increased childbearing by 12%. Milligan reconciles these findings with previously inconclusive or weak findings from U.S. welfare literature by interacting income with the policy dummy, finding a strong income effect that indicates unexplained heterogeneity in the sample. He

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hypothesizes that the stronger relationship between policy and childbearing for higher income women may be tied to the higher incidence of planned births in that income bracket, for which previous studies failed to acknowledge.

Besides direct monetary transfers or tax savings, another form of material incentive for childbearing is subsidized goods or services for children and the family. Housing subsidies (via periodic, one-time, or tax-based payments) may contribute to a sense of economic security that encourages childbearing. In most economically developed countries, public education systems offer free schooling for children until adulthood, and these may also be considered subsidized child welfare services. Many contemporary studies on fertility and material pronatal policy focus on childcare availability, with mixed results (Gauthier, 2007). The French, Norwegian, and Swedish governments have famously taken this approach via subsidized nursery schools (McDonald, 2002). In Norway, Rindfuss et al. (2010) find that increasing publicly subsidized childcare not only speeds up birth timing, but also increases overall levels of childbearing. Further, they find that childcare availability could increase fertility by up to 0.5-0.7 children per woman; or, put another way, if the results of this study are generalizable to other sub-replacement fertility countries, increasing public childcare from 0% to 60% availability could bring total fertility back up to replacement level. In Japan, G. H. Lee and Lee (2014) find that increased childcare availability through the Angel Plan and New Angel Plan (largescale national pronatal policies) between 1971 and 2009 had little effect on fertility. Additionally, they did not find evidence that role incompatibility of working mothers limits fertility, as proposed by Rindfuss and Brewster (1996).

Pronatal healthcare policy. Healthcare and medical insurance policies fall into the category of material incentives for childbearing, since they function by lowering the monetary

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cost of children in a similar fashion as tax credits or cash payment systems do. Analysis of the RAND Health Insurance Experiment in the U.S. by Leibowitz (1990) shows that women randomly assigned to free medical care for 3-5 years evidenced a 29% higher birthrate than those assigned to cost-sharing insurance. This study indicates a pronatal effect of medical care programs, but notes that this effect may speed birth timing in the short term rather than increase fertility in the long run. In the United States, there is a robust literature on the state-sponsored low-income health insurance program known as Medicaid. Between the 1980s and early 1990s, significant reform of Medicaid enrollment criteria doubled eligibility rates for women 15-44 in the United States, extending coverage of prenatal care and child healthcare regardless of family structure and other limiting factors (Zavodny & Bitler, 2010). According to standard fertility theory, decreasing the cost of childbearing and childcare should increase fertility; analysis of panel birth certificate and U.S. census data reveals only weak fertility effects of Medicaid reform, however.

Zavodny and Bitler (2010) explore the effect of Medicaid eligibility expansion on birthrate through OLS regression, disaggregating results by maternal race (white and black only), educational attainment, and marital status. They find that the expansion had little substantial effect on overall fertility during the period 1982-1996, and a 1% increase in eligibility was associated with a statistically significant but small 0.9% increase in birthrate for white women (a 0.3% birthrate increase in the black sample was statistically insignificant). This small boost in fertility was significant and larger among less-educated white women (those without a high school diploma). The pronatal effects of increased eligibility were generally larger for unmarried or less-educated women as compared to married, women with beyond a high school education in either racial group—but those results were found to be largely statistically insignificant at the

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10% level. Looking specifically at enrollment expansions between 1987 and 1991, Joyce, Kaestner, and Kwan (1998) find that raising the income ceiling for Medicaid enrollment increased birthrates among white American women by 5%, with no significant effect among black women. Though pronatal effects of Medicaid were found after eligibility expansion, increases in birthrate were only statistically significant for certain demographic groups.

Further Medicaid analysis by DeLeire, Lopoo, and Simon (2011) using state fixed-effects modeling find a small but positive relationship between Medicaid eligibility expansions in the 1980s-90s and births, using state birth count as the dependent variable. A 1% increase in eligibility correlated with a 1.2% increase in births for white women, and 2.4% increase for black women. These results were not robust to state and year fixed effects across cells disaggregated by race, maternal age, education, and marital status, though, and once fixed effects were introduced the magnitude of any fertility effect often decreased to a trivial extent. Both of the above studies conclude that there is no robust relationship between recent Medicaid eligibility expansion and childbearing patterns in the United States.

Similar research on a 2005 U.S. insurance mandate reform by Schmidt (2007) analyzes the effect of increased coverage of infertility services on fertility rates, under the same premise that decreasing the cost of health services could stimulate usage of those services, and thus, increase childbearing. Difference-in-differences modeling on birth certificate and U.S. census data finds that mandate states were associated with a small negative effect on birthrate overall (with a coefficient of -0.05). The presence of an infertility mandate increased first birth rates for white women 35 and older by 8%, significant to various robustness tests. But like DeLeire et al. (2011), once control variables (including demographic and geographic information) were introduced into regression, no significant effects of the mandates were found for any of the

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women in different age or racial groups. These studies are in line with the larger literature on the fertility effects of Medicaid and other insurance reform in the U.S.; while they seem to imply some positive correlation between health insurance and fertility, they also indicate that this relationship is either weak or not well understood.

Relatively fewer studies have approached the potential pronatal effects of healthcare policy outside of the United States. Nakajima and Tanaka (2014) determined that subsidized health checkup services increased the probability of couples having at least one child in Japan. Their results show that a 10% increase in state expenditure for health checkup services increases the probability of a couple having a child by 0.5-0.9%. In Korea, S.-S. Lee (2009) similarly finds that introduction of the state-sponsored “health and nutrition system” supporting maternal and child health as part of the First Basic Planning for Low Fertility and Aged Society policy, had a positive effect on first and second-order birthrate in logistic regression in 2007. Other sections of this major population policy, such as maternal labor law reform and childhood educational reform, also had positive fertility effects during this period.

Debate continues over the usefulness of fertility policy, nonmaterial and material alike. Population scholars, including Paul Demeny (1986, 2005) and Anne Gauthier (2007), argue that policy is more likely to affect fertility timing than completed fertility; they further claim that the types of pronatalist policy acceptable to liberal developed cultures is often expensive and ineffective. The literature on pronatal policy and fertility remains inconclusive, in part because such policies often combine financial incentives for childbirth with non-cash incentives, making it difficult to pinpoint which program, if any, stimulated fertility. For example, in Frejka and Zakharov (2013), results show that two waves of comprehensive pronatal policy in Russia (during 1981 and 2007) that included material and nonmaterial birth incentives both failed to

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promote domestic fertility. Did none of the policies, from parental leave, to maternal capital, to child cash benefits, have any effect on domestic childbearing decision-making? Because of the bundling of cash and noncash benefits, it is difficult to compare the effectiveness of the individual policies from historical analysis alone.

Analysis of the fertility effects of healthcare policy implementation or reform, on the other hand, often benefits from the availability of information about timing and benefits of individual policy changes. In addition, policy initiatives like Medicaid eligibility reform or Taiwanese NHI implementation affect a large portion of the population in a relatively short period – this lends itself more readily to empirical assessment.

3.2 NHI Implementation and Taiwan

3.2.1 NHI and the Taiwanese Population. Of studies addressing the effect of NHI implementation on population in Taiwan, only two have focused on increased prenatal healthcare, one of the program's key offerings in 1995. An initial study by L. Chen et al. (2008) focused on the different ways women perceive prenatal care access pre- and post-NHI along the urban/rural divide, given that NHI implementation dramatically increased the number of facilities where women could seek prenatal care nationwide. Using national survey data from two cohorts before (1990-1992) and after (1998-1999) NHI implementation, L. Chen et al. (2008) examined where Taiwanese women sought prenatal care and the perceived convenience of that care for urban and rural residents. The study found that post-NHI provision rural women increased their demand for prenatal care in big hospitals, while urban women had no change in usage; there was no perceived change in convenience of transportation to care facilities by rural women, however, urban women did report increased convenience. Differences in transportation

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convenience are ascribed to the tendency of rural women to seek prenatal care in large hospitals rather than local clinics, due to their higher perceived value.

C.-S. Chen, Liu, and Chen (2003) further analyzed changes to Taiwanese prenatal care usage before and after the 1995 NHI implementation, finding increased usage of healthcare services primarily among unemployed women and various aboriginal communities of central Taiwan. Data from the Taiwan Maternal and Infant Health Survey included two cohorts of Taiwanese women from all 23 administrative districts, the first who gave birth during May 1989 and the second who gave birth during February 1996. Using a two-part negative binomial model to estimate the effect of NHI on prenatal care patterns in Taiwan, C.-S. Chen et al. (2003) found that maternity clinics experienced the highest volume of visits post-NHI, previously uninsured working women and government employees increased their care use compared to female labor workers and farmers, and care use increased most dramatically in central Taiwan. The authors imply that some of the consumption patterns seen in the study might have been due to societal trends, such as women delaying marriage, and as a result, more frequently turning to high technology solutions to help them conceive for multiple births at higher ages. This supports the hypothesis that increased access to prenatal care from NHI implementation would influence women's fertility choices, as argued in the present study.

L. Chen et al. (2008) and C.-S. Chen et al. (2003) both indicated a significant uptake in care usage by rural women after NHI implementation, especially of in central Taiwan (a more rural area), despite different data sources and methods. At the same time, L. Chen et al. (2008) notes that the probability of rural women seeking prenatal care in large hospital increased 6.54 times between 1990 and 1999, which seems to contradict C.-S. Chen et al. (2003)'s finding that medical clinics saw a greater increase in demand for prenatal services in the post-NHI period.

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Both of these studies analyze usage of prenatal care services and various demographic characteristics – location of residence, insurance, industry of employment. These discrepancies possibly stem from unobserved differences in the birth cohorts selected by the two studies, or from recall bias issues. While NHI introduction overall increased demand for Taiwanese prenatal care overall and especially among rural women, it is unclear where exactly that demand was concentrated (in clinics or hospitals) and what reasons underlie women's treatment preferences.

Chou, Grossman, and Liu (2014) went beyond examining the effect of NHI on prenatal care usage by analyzing the impact of NHI on Taiwanese post-neonatal infant mortality. Using 1990 census data instead of randomized surveys, the study incorporates insurance data from the public and private sectors from before and after NHI implementation to determine whether NHI provision lowered infant mortality. Before NHI implementation, only government employees had full insurance coverage for childbirth and infant healthcare, but after 1995, coverage was extended to private sector and agricultural workers via NHI. Results show that NHI introduction decreased neonatal mortality by 8-16% for those born in farm households, but not in other sectors. Farm families in general have fewer financial, educational, and health advantages than those in other sectors; the findings of this study thus "suggest that health insurance improves infant health outcomes of population subgroups characterized by lower levels of education, income, and health" (p. 90). A final finding notes the marked reduction in the mortality rate of preterm infants in the post-NHI data, a difference of between 20-41% (p. 89). Overall, Chou et al. (2014) conclude that Taiwanese national health insurance improved neo-natal infant mortality rates in Taiwan, but not equally among different industries and population subgroups.

Besides its direct effects on infant mortality and healthcare usage, Chou, Liu, and Hammitt (2003) also studied the indirect effect of NHI implementation on precautionary savings

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in Taiwan, using difference in differences methodology. They posited NHI as an ideal natural experiment to test the effect of insurance on savings, given the universality of its implementation and its lack of means-tested eligibility. Rather than redirecting healthcare savings into household savings, national health insurance decreased savings by 8.6-13.7%, with this reductive effect particularly strong for households with the highest financial risk—those in the lowest savings bracket. This study also uses a control group based on joint employment of husband and wife, where households with at least one government employee constituted the control group, like the present study does.

The effects of NHI on precautionary saving may be tied back to fertility through the concept of "yang er fang lao" (養兒防老), or raising children to provide for family members in old age, as discussed by Lai and Tung (2015). In Taiwan, familial transfers have long been a primary source of income security for the elderly, along with personal savings and public (state-sponsored) programs. Lai and Tung (2015) found that even as consumption level of the elderly increased between 1985 and 2005, and health consumption costs increased from 9% to 17% during this period, the role of family transfers decreased significantly. If NHI constitutes a public program that reduced income uncertainty enough to affect precautionary savings, it may also have affected childbearing decisions that formerly played an important part in long-term financial planning.

3.2.2 NHI and Taiwanese Fertility. Despite a rich history of literature analyzing population change, there remains a lack of consensus on the main drivers of low fertility today. Certainly, economic and social factors must jointly influence childbearing decisions in any culture, and the fertility decline is widely considered a social effect of industrialization and modernization in developed countries. Evidence from pronatal policies of the last half century is

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equally mixed; because of the mixed nature of reform, it is sometimes impossible to separate the effects of financial and nonfinancial fertility incentives and determine which is most effective.

A variety of methodological challenges afflicts contemporary fertility studies. For country-level studies, period total fertility rate (TFR) is often the statistic of choice for the outcome variable. TFR, however, is a hypothetical statistic that generalizes average number of births per 1,000 women of average childbearing age, regardless of marital status and actual age distribution of mothers. The preferred statistic (when available) appears to be cohort fertility rate (CFR), which by nature offers a higher level of detail on age-specific fertility, birth order, and other factors. Hoem (2008) reports an ongoing debate over which type of fertility data, period or cohort, offers more insight. Period data may reveal short-term effects of policy, he claims, while cohort data is more suited to examination of long-term social change.

In addition, endogeneity is an unavoidable issue in demography or fertility studies. Unobserved variables affecting both fertility and its potential causal factors, whether political, social or economic, undermine the validity of isolated statistical findings. Fertility change may drive policy; policy change may encourage or discourage fertility. Ashraf, Weil, and Wilde (2013) portray academic frustration with these obstacles: "We detect a general cynicism regarding the ability of social scientists to say anything useful about the economic effects of fertility – the issue is viewed as political rather than scientific, and conclusions from empirical analyses are assumed to reflect the preexisting views of authors" (p. 33). Despite these obstacles, the seeming inevitability of population aging and shrinkage spurs continued research into the underlying mechanisms of fertility change.

In Taiwan, fertility has been a relevant policy topic for decades, first in the 1960s when the state promoted smaller family sizes through the 1964 family planning program, and again

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when sub-replacement fertility became an issue in the 1980s. A wealth of research has examined Taiwan's initial transition from high to low fertility (D. S. Freedman, 1975; R. Freedman, Hermalin, & Chang, 1975; R. Freedman & Sun, 1969; Hermalin, 1976; Li, 1973; Rutstein, 1974), as well as its more recent decline from low to lower fertility (R. Freedman, Chang, & Sun, 1994; Keng & Sheu, 2011; M. Lee & Lin, 2016; Montgomery & Casterline, 1993; Parish & Willis, 1993) with regard to the social and economic factors driving population change. The question of how healthcare availability has affected Taiwanese fertility, however, has gone unanswered.

There is a lack of studies on universal healthcare as an implicit form of pronatal policy in the broader literature, as well. Given the existing lack of scholarly consensus on which pronatal policies are most effective, it is important to continue questioning different avenues through which the state might influence childbearing behavior. The present study approaches fertility from an economic perspective, on the foundational assumption that lowering the cost of children via state subsidized healthcare will lower the barrier to childbearing. Among Taiwanese fertility studies related to NHI implementation, most focus on child quality outcomes such as infant mortality or usage of health services and not on how increased access to healthcare might affect reproductive decision-making.

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4. Methods

4.1 Theoretical Framework

The decision to have a child rests on a variety of different medical and non-medical factors including "income, child costs, knowledge, uncertainty, and tastes" (Becker, 1960, p. 231). Women's fertility and healthcare decisions are jointly determined given that having a child requires women incur the financial cost of pre- and postnatal care, delivery, infant health services, as well as foregone salary from having a child. These factors affect women's opportunity cost of childbearing and their lifetime allocation of time, influencing the utility model of the household.

A theoretical framework for understanding how health insurance might affect women's childbearing decisions is presented in the Becker and Lewis (1973) child quantity-quality model, which posits child quality and quantity are related under household budget constraint. When child quality (cost required for the rearing of each child) increases, the shadow cost of having children (child quantity) also increases. At the same time, the higher the quantity of children, the costlier it is to increase the quality of each child because the cost of goods accumulates (Becker & Lewis, 1973). With the 1995 introduction of NHI in Taiwan, low-cost or free access to a variety of fertility and childcare services was extended to all Taiwanese citizens, permanently lowering the cost of having children. In essence, the shadow cost of child quality fell, allowing parents to recapture some opportunity cost of childbearing and diminishing the effect of the quantity-quality tradeoff.

4.2 Data

The data source is the Women's Marriage, Fertility, and Employment Survey (WMFES) conducted by the Statistical Department of the Taiwanese Ministry of the Interior. This survey,

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conducted periodically since 1979, interviews Taiwanese women aged 15 or older about marriage, childbearing, family composition, employment status, and other factors. Eligible respondents live throughout Taiwan, with women in the military and prisoners excluded, covering approximately 20,000 households in total. The questionnaire covers not only demographic characteristics, but also topics such as marital status and history, employment, childbearing, and child sex preference. Our analysis uses all available WMFES waves 1979-2016 (total of 18 years of surveys).

The WMFES project provides recent detailed information on demographic and family-related factors, making it ideal for analysis. The key dependent variable considered is number of children born per woman at time of survey, which is assumed to equal completed fertility. Descriptive statistics on average fertility and sex composition of children (number of sons and daughters) from the WMFES survey are provided in Table 1 for married respondents.

Table 1: Fertility of Married Women

Variable	Observations	Mean	Std. Deviation	Minimum	Maximum
Whole period					
Fertility (live births)	347,777	3.25	1.98	0	20
Son fertility	347,777	1.70	1.28	0	20
Daughter fertility	347,777	1.55	1.38	0	14
Pre-1960 birth cohort (including 1960)					
Fertility (live births)	279,690	3.61	2.00	0	20
Son fertility	279,690	1.89	1.30	0	20
Daughter fertility	279,690	1.73	1.43	0	14
Post-1960 birth cohort					
Fertility (live births)	68,087	1.78	1.01	0	10
Son fertility	68,087	0.93	0.81	0	10
Daughter fertility	68,087	0.85	0.85	0	6

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The average number of births per woman for the whole sample is 3.25 with a mean of 1.70 boys and 1.55 girls. The sample is further divided into two groups: women born before 1960 and after 1960. Those in the pre-1960 birth cohort would be 35 years old in 1995, at the time of NHI implementation. Fertility is significantly higher in the older group, at an average of 3.61 children born per woman; in the younger group, only a mean of 1.78 children born. More sons than daughters are born in both groups, but the effect is more significant in the older cohort, pointing to a possibility of underlying sex preference.

Other questions of interest in the WMFES survey include marital status, spousal employment, educational attainment, and child sex (son) preference. These questions relate to the insurance coverage of the family (families containing a state employee already had state health insurance) and power dynamics of the family, which may influence the economic cost of childbearing for mothers and influence overall fertility. Additional descriptive statistics on these variables for the whole sample, control group, treatment group, and pre- and post-1960 birth cohorts are shown in Table 2. The control group consistently had a higher percentage of spouses who were also government employees, for both the pre- and post-treatment groups. Educational attainment increased over time, and in the highest category (college and above) was higher for the control group, with a difference of 47.39% in the whole sample, 43.45% in the pre-treatment group, and 51.75% in the post-treatment group. Child sex preference declined over time and was lower for the control group of government employees than the treatment group in all periods.

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Table 2: Characteristics of Married Women by Treatment Status

	Whole sample	**Control group: Government employees**	**Treatment group: Private employees**
	%	%	%
Whole period			
Husband is a government employee	8.47	39.24	7.14
Educational attainment			
None-elementary	61.08	11.90	63.20
Middle-vocational school	30.26	34.00	30.10
College and above	8.66	54.10	6.71
Son preference	33.82	26.19	65.85
N	347,777	14,374	333,403
Pre-1960 birth cohort (inclusive)			
Husband is a government employee	8.55	40.60	7.33
Educational attainment			
None-elementary	73.18	16.31	75.34
Middle-vocational school	21.64	36.65	21.07
College and above	5.18	47.04	3.59
Son preference	38.58	33.46	38.78
N	279,690	10,237	269,453
Post-1960 birth cohort			
Husband is a government employee	8.17	35.90	6.37
Educational attainment			
None-elementary	11.36	0.99	12.03
Middle-vocational school	65.67	27.44	68.14
College and above	22.97	71.57	19.82
Son preference	14.28	8.22	14.67
N	68,087	4,137	63,950

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4.3 Empirical Methods

According to statistics from the R.O.C. Ministry of the Interior[2], in 1995 the average age of Taiwanese mothers at birth was 27.7 years. NHI regulations list 34 years old as the minimum age for receiving advanced maternal age NHI insurance benefits; this study uses 35 years as the first cutoff point for DID empirical analysis. Women younger than 35 years old in 1995 were likely to have future fertility decisions affected by NHI childbirth and childcare benefits (treatment group), and women older than 35 were less likely to have their fertility decisions influenced by NHI (pre-treatment group). For the current study, respondents of interest are Taiwanese women aged 15 years and older (born in or after 1980 during NHI implementation in 1995. Figure 2 compares data from the Ministry of the Interior on the number of births for the

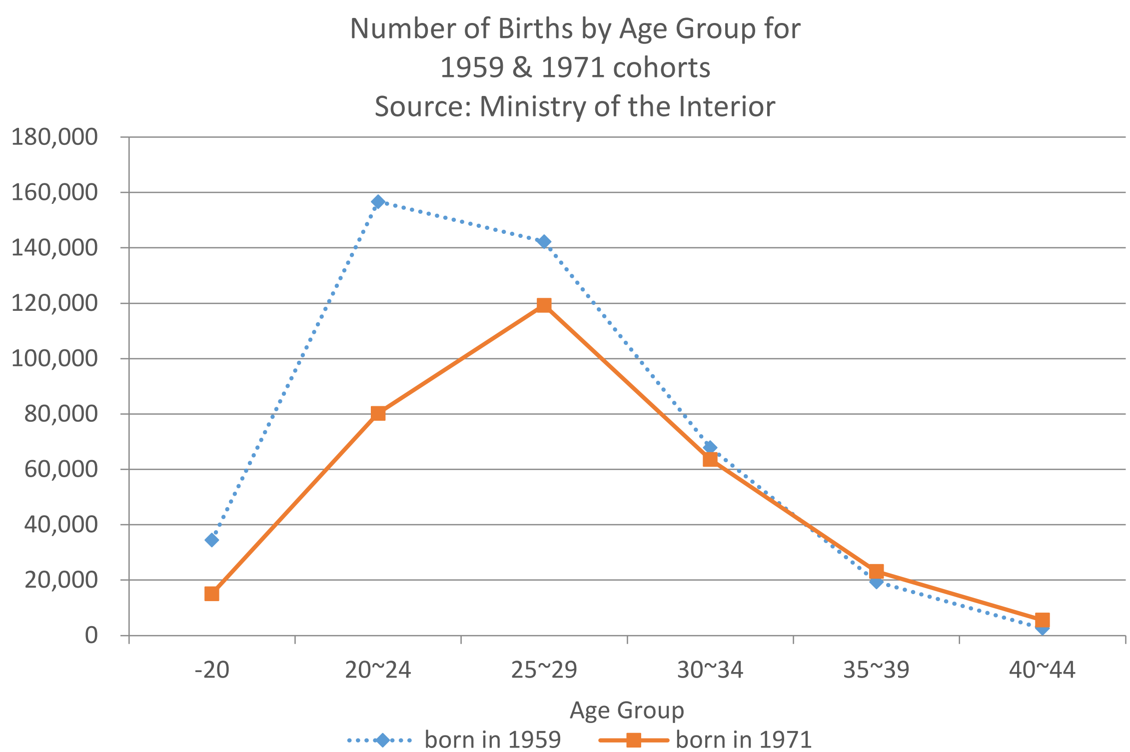

Figure 2: Number of births by maternal age group for 1959 and 1971 cohorts

[2] Data available at: https://www.gender.ey.gov.tw/gecdb/Stat_Statistics_DetailData.aspx?sn=lT4902z3YmLGBZadLKLSzQ%3D%3D

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1959 and 1971 birth cohorts. These two cohorts are subsamples of the treatment and pre-treatment groups mentioned above. The figure shows that women in the 1971 cohort (affected by the NHI implementation) had in general fewer births than those in the 1959 cohort, particularly for the sub-20 through 20-24 years age groups. The 1971 cohort's fertility was slightly higher in the 35-39 and 40-44 years age groups however, indicating a possible external change that influenced cohort fertility of the younger group (such as NHI implementation). There is a possibility that the fertility outcome is more relevant to the age of stopping giving birth or the last birth, but we lack relevant statistics for testing. Therefore, we will also use 40 and 45 years old as additional cutting points for robustness checks for DID analysis.

4.3.1 Graphical Analysis. Straightforward graphical analysis provides the first glimpse into the relationship between NHI passage and fertility. Figure 3 shows the mean births per woman (average fertility) by maternal birth year from 1955-1966, as presented in the appended WMFES 1979-2016 data. Following the DID cutoff maternal age of 35 years, the data in Figure 3 is broken into two groups, first the 1955-1960 maternal birth cohorts, 35 years or older at the time of NHI implementation (called the pre-NHI group), and then the 1961-1966 maternal birth cohorts, under 35 in 1995 (called the post-NHI group). Fertility declined for both groups in the data. The older group, however, exhibits a steeper downward fertility trend related to birth year with a slope of -0.18), as compared to -0.08 in the younger group, whose childbearing decisions are more likely to have been affected by new childcare provisions in national health insurance. One possible explanation is the NHI effect, where lower-cost healthcare led to a pickup in fertility for the younger women by lowering the cost of childbearing. Given the limits of this graphical presentation, this study will further use DID to estimate the potential effect of NHI implementation on fertility choices.

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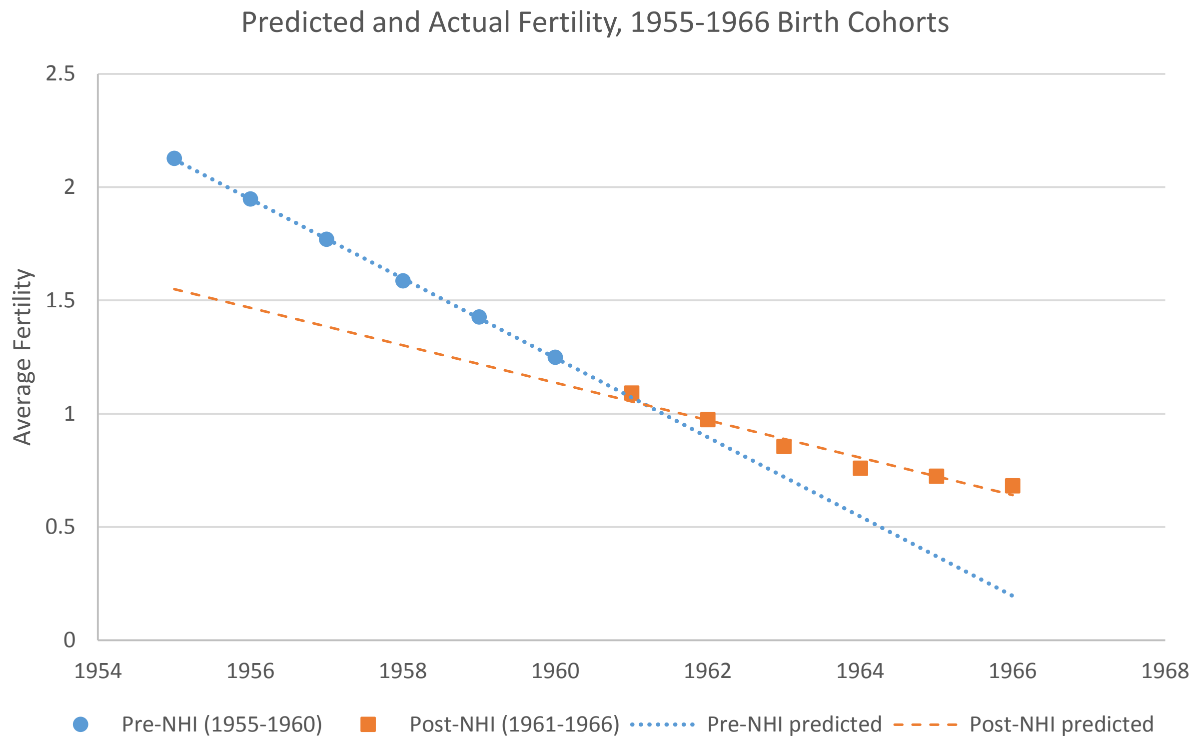

Figure 3: Mean number of live births by maternal birth year (WMFES 2016)

4.3.2 Multivariate Regression. This paper first uses ordinary least squares regression to examine the relationship between NHI and fertility in Taiwan. We regress the natural logarithm of respondents' completed fertility (Y_i), that is, the total number of children they report having, on a dummy for NHI implementation, which equals 1 when the survey year is after 1995 and 0 otherwise. All regressions also include variables for respondent age, educational attainment, monthly income, and child sex preference.

$$Y_i = \beta_0 + \beta_1 NHI_{dummy} + \beta_2 age + \beta_3 education + \beta_4 income + \beta_5 sexpref + \varepsilon_i \quad (1)$$

Respondent age is self-reported and measured in years for each survey wave, ranging between 15 and 71, with a mean age of 31 years old (Table 3). We restrict the sample to women born after 1945 to increase comparability between respondents, and exclude the oldest cohort of women, born prior to Japanese occupation of Taiwan. Monthly income is a continuous variable

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measured in New Taiwan Dollars (NTD) for the household, adding together the husband's and wife's monthly income for all available observations. Income data is only available for WMFES surveys since 1988. The income variable likewise has been stratified into three classes: (1) low income, ranging from 0-39,999 NTD per month, (2) middle income, ranging from 40,000-69,999 NTD per month, and (3) high income, 70,000 NTD per month and beyond. The mean income is approximately 18,000 NTD per month, as seen in Table 3.

Educational attainment is a categorical variable with the following possible responses: illiterate, self-study only, elementary school, middle school, high school, vocational training, specialist vocational training, undergraduate degree, master's degree, and doctoral degree. We group these responses into three broad levels of educational attainment: (1) low education, ranging from illiteracy to an elementary education, (2) intermediate education, including a middle to high school education, and (3) high education, spanning from vocational training to a doctoral education. Nearly one-third (26.76%) of respondents had only an elementary level of education, with another 52.61% having earned a high school diploma. Only 20.63% of respondents had attained post-secondary education. This variable is dummied in OLS regression. Child sex preference is addressed in different ways throughout the 18 waves of data. For the most recent three waves, the WMFES survey directly asks about son preference and about the ideal number of children, male and female, for husbands and wives respectively. For the majority of the survey years, however, only the (female) respondent's answer is reported, so we use respondent child sex preference in this study. For our analysis, when the ideal number of sons reported is greater than 50% of the ideal number of children (total), a dummy variable is equal to one. This indicates son preference, and otherwise the dummy equals zero. The majority of

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respondents (74.68%) demonstrated no child sex preference for sons in the survey data. Summary statistics for these categorical variables are available in Table 3.

Table 3: OLS Summary Statistics

Variable	**N**	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
Post-NHI (= 0, before 1995; = 1, after 1995)	339,767	0.41	0.49	0	1
Respondent age	339,767	31.34	12.44	15	71
Monthly income	175,023	17,731.62	33,127.98	0.00	1,089,999.00
Son preference (= 0 if no sex preference)	339,767	0.25	0.43	0	1
Educational attainment	339,767	1.94	0.69	1	3
Low (illiteracy to elementary school)	90,920	0.27			
Intermediate (middle to high school)	178,741	0.53			
High (vocational training to doctorate)	70,016	0.21			

Notes: Sample restricted to women born after 1945.

In analysis of the OLS models, this paper explores both the magnitude of coefficients on the NHI dummy as well as whether or not those coefficients are consistent across different demographic and educational groups. The OLS regressions reveal potential correlation between NHI implementation and completed fertility of Taiwanese women in the sample, and how that relationship differs by demographic stratification.

4.3.3 DID Approach. Difference-in-differences (DID) is the next methodology used to analyze the effect of NHI on fertility in this study. This approach compares the fertility of the treatment and control groups before and after NHI implementation, with the assumption that

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other exogenous societal influences are the same for both groups. The control group (T = 0) is comprised of married women who were government employees (or whose husbands were government employees), since they would have had the generous benefits of government health insurance before NHI implementation. Those benefits include a large cash birth benefit (covering delivery), prenatal care, neonatal and postnatal care. Those without insurance, or covered by labor or farmer insurance lacked those prenatal benefits and had to choose between a birth benefit and coverage of difficult deliveries (Chou et al., 2014). After NHI implementation, non-government employees gained childbearing and child healthcare benefits similar to the government control group, and comprise the treatment group (T = 1) for this natural experiment.

For part 1 of the DID analysis, the pre-treatment and post-treatment periods (t = 0,1) are determined by maternal age. Women born in 1960 and earlier are the pre-treatment group, as they would have been 35 (having reached advanced maternal age status) in 1995 when NHI implementation occurred, and those born after 1960 are the post-treatment group. DID regression will show the difference in treatment effect for the government (control) and non-government (treatment) groups after the introduction of NHI. The DID estimator is depicted below, and summary statistics for the pre- and post-treatment groups are shown in the following chapter.

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 t_i + \delta(T_i \cdot t_i) + \varepsilon_i \quad (2)$$

Part 2 of the DID analysis changes the outcome variable from conditional fertility to monthly birthrate in the treatment and control groups, and uses the actual timeline of NHI implementation to determine pre- and post-treatment periods. Conception dates are calculated by lagging (monthly) birthrate by nine months, with the assumption of full-term infants for all births. Births occurring just before and just after December 1995 (for infants conceived before and after the March 1995 NHI implementation, respectively) should share general societal

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conditions; the 1995 NHI implementation represents a major disparity between the treatment and pre-treatment groups surveyed. Birthrates for the treatment and control groups were calculated using monthly birth count for each group, divided by the respective population of treatment or control respondents in the 1990 WMFES survey for the pre-NHI period, and in the 2000 WMFES survey for the post-NHI period. The resultant figures were multiplied by 1000 to proxy birthrate for these groups in analysis. The pre-treatment period (t = 0) applies to births before December 1995, and the treatment period applies to births thereafter (t = 1). The treatment group of non-government women (T = 1) and control group of government-insured women (T = 0) remain the same as in part 1 of the DID approach, and observation unit is group-month, with data covering five years before and after the 1995 cutting point, from December 1990 to December 2000.

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5. Results

5.1 Multivariate Regression

In the following OLS regression of Taiwanese fertility, we dummy NHI implementation and regress the natural log of completed fertility as reported in the WMFES surveys to account for skew. The estimate in the first column of Table 4 shows a negative correlation between NHI implementation and fertility in in the sample—that is, the regression coefficient for the NHI dummy is -2.43. Fertility is also negatively associated with educational attainment in the overall sample (higher educational attainment is correlated with declining fertility), and is positively associated with respondent age and child sex (son) preference. Thus, older respondents and those expressing unequal preference for sons over daughters tend to exhibit higher fertility, and have more children. Given the rising average age of childbearing in Taiwan over the last four decades, this result is unsurprising; in addition, son preference may even lead to increased childbearing if the first child born is a daughter. The magnitude of the coefficient for respondent age is comparatively small, however, and unlikely to significantly influence fertility decision making. The coefficients in column 1 are all statistically significant at the 1% level, and the model may explain up to 50% of the variation in completed fertility for the sample.

Stratification by marital status in columns 2 and 3 (where the unmarried category also includes respondents who have never married, have divorced, or who have been widowed) complicates these results. When we examine fertility by marital status, the explanatory power of the model increases to 79% for unmarried women, and decreases to just 10% for married women. For the unmarried sample in column 2, the NHI dummy is negatively correlated with fertility, with a coefficient of just -0.06. For married women (column 3), the NHI dummy coefficient of -0.94 is nearer to that of the overall regression. Both married and unmarried

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samples evince a negative association between educational attainment (intermediate or high) and fertility, and a positive correlation between both respondent age or sex preference and fertility. In general, respondents' educational attainment remain strongest correlates of fertility in the model regardless of marital status. That regression results for unmarried women show a negative correlation, even one of low magnitude, between fertility and NHI contradicts the Medicaid analysis by Zavodny and Bitler (2010), insofar as they found that Medicaid eligibility expansions stimulated fertility more among unmarried women than married. The extremely low extramarital birth rate in Taiwan may explain this disparity. For example, if extramarital birth in Taiwan is largely unplanned, NHI implementation would be less likely to affect long-term fertility planning, though it may affect the viability of unplanned pregnancies.

The correlation between the NHI dummy variable and fertility differs in magnitude across educational attainment. In all three education categories, the NHI dummy is negatively associated with childbearing. This negative correlation is strongest at the lowest level of educational attainment, for women with up to an elementary education, with a regression coefficient of -6.42. Among women with an intermediate (column 5) or postgraduate education (in column 6), the coefficient on the NHI dummy ranges between just -1.86 and -0.72, respectively. While Taiwan today has very high levels of educational attainment among women and men, the mean birth year of the original sample was 1953 (ranging between 1870 and 2001). Although we limited the sample to women born after 1945 to increase comparability, the large cohort of older women may explain the high number of respondents with minimal education that remain in the sample, as seen in column 4.

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Table 4: Ordinary Least Squares Results

	(1)	(2)	(3)	(4)	(5)	(6)
	All	Unmarried	Married	(1) None-elementary education	(2) Middle-high school education	(3) Postgraduate education
NHI dummy	-2.43*** (.044)	-0.06* (.033)	-0.94*** (.046)	-6.42*** (.090)	-1.86*** (.064)	-0.72*** (.119)
Educational attainment (Omitted: None-elementary education)						
Middle-high school education	-1.54*** (.016)	-1.84*** (.017)	-0.42*** (.014)			
Postgraduate education	-2.72*** (.021)	-2.80*** (.020)	-1.02*** (.020)			
Respondent age	0.28*** (.001)	0.16*** (.000)	0.08*** (.001)	0.26*** (.002)	0.32*** (.001)	0.31*** (.001)
Son preference	0.74*** (.016)	0.26*** (.014)	0.23*** (.014)	0.21*** (.023)	0.86*** (.023)	1.32*** (.050)
Constant	-11.04*** (.042)	-10.57*** (.034)	-2.51*** (.044)	-9.08*** (.065)	-14.31*** (.056)	-15.92*** (.122)
R^2	0.50	0.79	0.10	0.27	0.49	0.43
N	339,767	196,882	184,802	90,920	178,741	70,106

Notes: The dependent variable is the natural log of completed fertility, with standard errors in parenthesis below coefficient estimates. All columns include year fixed effects and geographic (county level) fixed effects. **p* < .1, ***p* <.05, ****p* < .01

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The findings of Zavodny and Bitler (2010) also help contextualize these OLS results. Firstly, they found that the pronatal effects of Medicaid expansion were significant and positive for white women with lower educational attainment. The strong negative correlation between the NHI dummy and fertility in our least educated sample (column 4) contradicts that finding. The results here imply the correlation between improved healthcare and reduced childbearing is particularly strong for less-educated women in Taiwan, strengthening the argument that improved health outcomes led to lowered fertility in Taiwan via the child quality/quantity tradeoff, and contradicting our hypothesis. The NHI coefficients in columns 5 and 6 of this paper are also negative despite their smaller magnitude. This echoes the Medicaid results of Zavodny and Bitler (2010), which showed a negative association between insurance expansion and birthrate for women with a high school education or beyond. Notably, the correlation between fertility and both respondent age and sex preference generally increased along with level of educational attainment. The larger coefficients on NHI, respondent age, and son preference in columns 5 supports the popular hypothesis that higher education delays women's childbearing, but in this regression, this effect is indistinguishable from time trends of decreasing fertility during this period.

In sum, the OLS regression shows relatively consistent results across marital and educational groups in the overall sample, with both the NHI dummy and women's education reliably associated with lower fertility. These results can only indicate a correlative relationship between childbearing and NHI, however, and not a causative one. It is possible that the NHI dummy variable used in this OLS analysis captures an overall demographic trend of decreasing ideal fertility, instead of significant differences in childbearing directly due to NHI policy changes. To examine the relationship between NHI and Taiwanese fertility further, the following

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section of the paper uses a difference-in-differences approach estimate the differential effects of NHI implementation on women of different ages and in different treatment groups.

5.2 DID Approach 1: Maternal Age

Results of the difference-in-differences estimators for regression using maternal age to create a cutting point are reported in Table 5. For the latest 2016 WMFES survey wave, respondents born in 1971 would have reached age 45 and likely completed childbearing, therefore we have limited the sample to women born between 1948 and 1971, aged 24 to 47 years in 1995 during NHI implementation. The government group is comprised of all women where either the respondent or her husband (or both) are a government employee, and conferring the increased childbirth and child healthcare benefits of state sponsored insurance to the respondent prior to NHI implementation. The non-government treatment group includes all other women in the sample. The pre-treatment group is born at or before the cutoff age, and the post-treatment group born afterwards. We first test 35 years old as the maternal cutoff age, under the logic that women 35 or older were less likely to have future fertility decisions affected by NHI implementation, since 35 years is the minimum age for advanced age maternal benefits under

Table 5: Difference in Differences Estimation

	35 year old cutoff	40 year old cutoff	45 year old cutoff
DID estimator (δ)	-0.79*** (.017)	-0.75*** (.018)	-0.65*** (.033)
Treated (β_1)	0.32*** (.010)	0.44*** (.014)	0.43*** (.032)
Time (β_2)	-0.69*** (.016)	-0.84*** (.016)	-0.94*** (.031)
R^2	0.23	0.21	0.07
N = 250,878			

Notes: All figures are significant at the 1% level, $p < .01$, coefficients from Eqn. 2.

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NHI. We further use 40 years and 45 years as additional cutoff points to test the robustness of regression results.

Prior to NHI intervention, we expect to see higher fertility in the group covered by government insurance, or if fertility is higher in the non-government group initially, to see a larger positive percentage change in fertility after NHI. Regression results in Table 6 for the 35-year-old cutoff group show that prior to NHI intervention, we see 17.01% higher fertility in the non-government group than the government group. After NHI intervention, however, expected fertility of the non-government group is 37.30% lower than that of the government group. This finding contradicts our hypothesis that NHI intervention would have stimulated childbearing in the newly insured non-government respondents, and actually shows the opposite effect since after NHI the state-insured group had higher fertility than the non-government group.

Table 6: DID Results for 3 Cutoff Ages (35, 40, and 45 years old)

	Pre-treatment			**Post-treatment**		
Variable	Government	Non-government	Percentage difference	Government	Non-government	Percentage difference
Cutoff age: 35 years old						
Fertility	1.94	2.27	17.01%	1.26	0.79	-37.30%
Sample size	17,139	105,947		10,051	117,741	
Cutoff age: 40 years old						
Fertility	2.24	2.68	19.64%	1.40	1.09	-22.14%
Sample size	9,492	56,500		17,698	167,188	
Cutoff age: 45 years old						
Fertility	2.55	2.99	17.25%	1.61	1.39	-13.66%
Sample size	2,311	13,648		24,879	210,040	

Notes: All figures are significant at the 1% level, $p < .01$

After NHI implementation, regressions for all three cutoff ages (35, 40, and 45) reveal lower fertility in the non-government respondents in comparison to the government group

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(22.14% lower for the 40 year old cutoff, and 13.66% lower for the 45 year old cutoff), though the magnitude of the percentage change is slightly different. These results contradict the hypothesis that NHI implementation may been seen as a successful pronatal policy that stimulated fertility by lowering cost barriers to childbearing. That the percentage change decreases as the cutoff age is raised, on the other hand, indicates the wider the range of potential childbearing years, the lesser the difference between the government and non-government groups. Between the 35 and 45 years cutoff age regressions, the percentage change between government and non-government changes decreases by 23.64%. However, the R-squared value also drops from 0.23 in the 35 years old cutoff regression to 0.07 in the 45 years old regression, exhibiting negligible explanatory power when the broadest estimation parameters are used.

DID results using the 35-year old cutoff point, and controlling for income and education (and without limiting respondent birth years), are presented in Table 7. As in the OLS regression, education was stratified into three groups, (1) no formal education to elementary school, (2) some middle to high school, and (3) a post-secondary or post-graduate education level. Similarly, income was bracketed into three groups. The lowest monthly income was 0 - 39,999 NT, the middle income group was 40,000 – 69,999 NT, and the highest group had a monthly income of more than 70,000 NT. The highest magnitude DID estimators were in the low education group models, in the low monthly income (-0.94) and high monthly income (-1.32) cells. Both of these cells evidenced statistically significant, negative relationship across the time and treatment groups, yet the explanatory power of the regressions were fairly low, at only 7% and 14%, respectively. The lowest magnitude estimator was in the low education, middle income cell; this was also the only model that showed a nonnegative DID coefficient in regression, at 0.03. This

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result was not found to be statistically significant at the 10% level, however, possible due to a low sample size of only 3,077 observations.

Generally speaking, the DID estimators for those with the highest level of educational attainment were less negative/smaller in magnitude than those for other education groups. This result may indicate that both pre- and post-treatment, both non-government treatment and government control groups who were highly educated were more likely to restrict their fertility, so that the new NHI had less of an effect on childbearing decisions. The low income, high education cell had the strongest explanatory power of all groups ($R^2 = 0.45$), yet the DID coefficient did not differ significantly from zero. In sum, the results of DID regression stratified by income-education cell support the DID results from Table 5. Although the DID coefficients

Table 7: Difference in Differences Results by Income-education Cell

		Low monthly income (0 - 39,999 元)	Middle monthly income (40,000 元 - 69,999 元)	High monthly income (70,000 元+)
Low education (none to elementary)		-0.94*** (.161)	0.03 (.155)	-1.32*** (.155)
	R^2	0.07	0.05	0.14
	N	76,565	3,077	143,295
Intermediate education (middle to high school)		-0.72*** (.037)	-0.15*** (.049)	-0.39*** (.027)
	R^2	0.32	0.03	0.30
	N	74,690	15,053	102,656
High education (postgraduate)		-0.06*** (.023)	-0.08 (.078)	-0.18*** (.015)
	R^2	0.45	0.04	0.12
	N	37,628	5,280	30,108

Notes: The above results use the 35 year old cutoff point for t_i , * $p < .1$, ** $p < .05$, *** $p < .01$.

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were smaller in magnitude than those found in the collapsed income/education groups for the 35, 40, and 45 year cutoff regressions, the direction of relationship seems consistently negative robust to controlling for income and education.

5.3 DID Approach 2: Monthly Birthrate

Finally, results of the difference-in-differences estimation using monthly birthrate as the outcome variable and the 1995 NHI implementation date to set a cutting point are reported in Table 8, with graphical representation featured in Figure 4.

Table 8: Difference in Differences Estimation (Birthrate)

DID estimator (δ)	-24.54*** (8.165)
Treated (β_1)	-44.32*** (5.797)
Time (β_2)	2.21 (5.773)
Constant	154.87*** (4.099)
R^2	0.47
N = 242	

Notes: * $p < .1$, ** $p < .05$, *** $p < .01$, birthrate per thousand, coefficients from Eqn. 2.

These regression results are based on the monthly birthrates for the treatment and control groups from December 1990 to December 2000, covering 5 years on either side of the 1995 cutting point for a total of 10 years of data. The DID coefficient, -24.54, shows a negative difference in differences between the government-insured control group and treatment group before and after the December 1995 cutting point, and is highly statistically significant. These results further support evidence that NHI implementation did not stimulate childbearing in the sample for the treatment group. Figure 4 shows similar birthrate trends for the treatment and

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control groups prior to NHI implementation, and that the birthrate decline appears to accelerate faster for the control group than the treatment group after NHI.

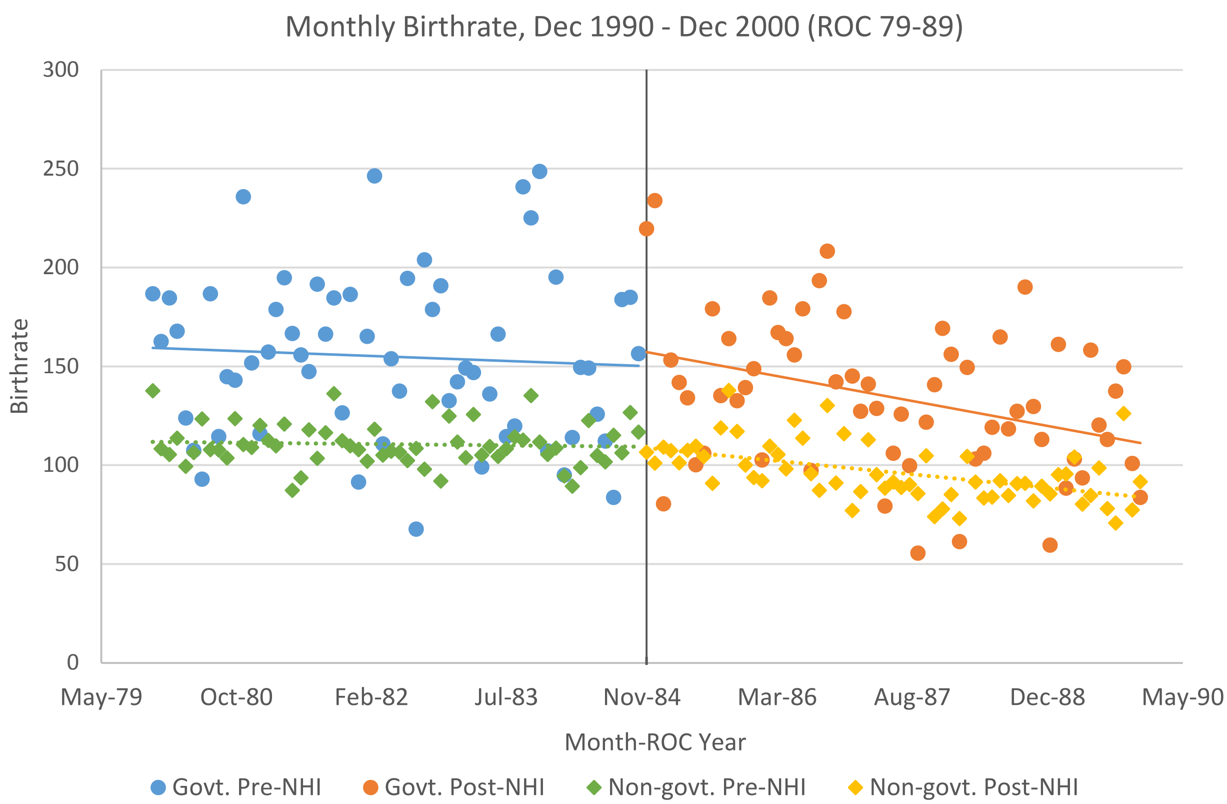

Figure 4: Monthly Birthrate DID

The DID results described in this and the previous section support OLS findings, which showed NHI implementation was not associated with increased Taiwanese childbearing after its 1995 implementation. In this paper, use of multivariate regression shows what association long-term Taiwanese survey data reveals between NHI implementation and Taiwanese fertility decisions on an individual level. Follow-up DID analysis first examines the effect of NHI on younger and older Taiwanese women, utilizing government employment status as reported in the WMFES survey to proxy for an insurance control group in the sample. DID analysis instead using monthly birthrate and a conception date cutoff, with the same treatment and control

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groups, reinforces the results of the paper: Taiwanese NHI is not associated with any significant increase in childbearing, and in fact a negative correlation exists in all regressions.

That both methodological approaches consistently find a negative association between NHI and childbearing supports evidence that national health insurance has failed to stimulate fertility in Taiwan, robust to controlling for government insurance eligibility, average monthly income, and educational attainment. It is possible that initial increases in childbearing caused by NHI were only short-term, and became negligible further from the implementation point; in this case, in light of long-term declining fertility trends, OLS and DID regression used in this study would mask any stimulating effect of NHI.

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6. Conclusion

This study uses the 1979-2016 waves of the Women's Marriage, Fertility, and Employment Survey conducted by the Statistical Department of the Taiwanese Ministry of the Interior survey data to estimate the effect of national health insurance implementation in 1995 on Taiwanese fertility decisions. Evidence from multivariate and difference-in-differences analysis refutes the initial hypothesis that NHI would stimulate fertility by universally lowering the cost of childbirth and child healthcare in Taiwan. After NHI, the newly covered non-government respondents showed lower completed fertility than state-insured control group when regressed according to three maternal cutoff points at 35, 40, and 45 years old, and when stratified by education and income level. Moreover, when the outcome variable was changed to monthly birthrate among the treatment and control groups, with a cutoff point dictated by the March 1995 NHI implementation rate, difference-in-differences analysis again supported the finding that NHI failed to increase Taiwanese childbearing. The small magnitude of OLS and DID coefficients is in line with previous literature on the effect of Medicaid eligibility expansion and other healthcare policy changes on fertility, although the negative nature of them may be surprising. Though the magnitudes of the NHI dummy coefficients in OLS regression are small, due to the richness of available survey data the results have high statistical significance; this is echoed in the DID analysis.

The results of this study largely contradict the "cost of children" hypothesis, which indicates that lowering the cost of having or raising children will increase childbearing. Instead, these findings support the child quantity/quality tradeoff, and insinuate that increased health of children due to increased prenatal/postnatal care access might cause parents to have fewer births overall. This explanation is consistent with trends indicating the "yang er fang lao" principle is

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decreasing in importance for Taiwanese households, consistent with the precautionary savings findings of Chou et al. (2003) and elderly consumption results found by Lai and Tung (2015). Guaranteeing state sponsored health insurance to the population essentially reduces income uncertainty in a unilateral fashion, which may secondarily reduce motivation for childbearing.

Alternatively, the combination of increasing housing prices and wage stagnation in the private sector in Taiwan in the 1990s may also explain why our results contradict the hypothesis that NHI stimulated domestic fertility. Average housing prices in Taiwan rose 70% between 2005 and 2014, while monthly salaries stagnated during the same period (rising only 12.25%, less even than the inflation rate). If adult children are increasingly unable to afford to run their own households, this may further delay marriage and childbearing (Y. Chen, 2015). As shown previously in figure 1, average maternal age at birth has indeed been rising in Taiwan since the 1970s. Wage stagnation in the private sector potentially explains higher fertility in the government control group of this study, as well, given that the higher job security and overall benefits of state employment may have facilitated higher fertility rates for that sector.

Limitations of this study include incomplete information on employment status for some respondent and incomplete household income information, which was only available in surveys after 1988. Using completed fertility as the outcome variable in the OLS regression relies on the assumption that if NHI was successful, it would push women to increase childbearing; a more precise dependent variable might be whether or not NHI increases their incentives for childbearing. In the absence of a specific survey question on this topic, national level analysis using national fertility rate would lend support to this study. In addition, lack of direct access to NHI and other insurance records represents a significant limitation in this paper, and inclusion of those records would allow for a more accurate division of the sample into treatment and control

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groups. Future research into the effects of pronatal policy on Taiwanese fertility would benefit from access to insurance records and birth certificate data to improve the accuracy of statistical modeling.

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