Strengthening or Weakening? The Impact of Universal Health Insurance on Intergenerational Co-residence

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Abstract

In this paper, we exploit a unique natural experiment— the implementation of National Health Insurance (NHI) in Taiwan in 1995—to examine how the introduction of universal health insurance increases or decreases the likelihood of intergenerational co-residence. Five waves of surveys from the Survey of Health and Living Status of the Elderly in Taiwan between 1989 and 2003 are employed, and models with various specifications are estimated. Our results indicate a mixed relationship between the likelihood of co-residence and the enactment of NHI. While NHI on average reduces the probability for elderly parents to live with their adult children by approximately 6.6%, the likelihood of co-residence increases among families benefiting most from NHI, such as those with unhealthy elderly mothers and fewer children.

**JEL Codes** I10, I18, J14

**Keywords** Intergenerational co-residence, National health insurance, Post-retirement health insurance, Difference-in-differences
I. Introduction

As society around the world ages, a major challenge faced by every government is providing sustainable welfare to ensure the well-being of the elderly population. To cope with this challenge, many emerging industrialized countries have introduced and provided various social programs—such as old-age pensions, health insurance, and long-term care systems—in the process of modernization (Pallares-Miralles et al. 2012). However, to achieve the goal of improving the well-being of the elderly while maintaining the financial sustainability of public systems, it is imperative to understand the interaction between public and private arrangement in caring for the elderly population. How private care will be provided financially or nonfinancially, through either a formal or informal care system, is profoundly affected by the living arrangement of the older population. For example, co-residing with adult children may increase the use of informal care and decrease the probability of being institutionalized (i.e., the use of formal care). Living independently may increase the use of informal care provided by a spouse or increase the demand for formal care, such as home care in the short run and institutional care in the long run. Thus, an important, but not well-studied, question to ask is whether the introduction of a public program affects the living arrangement of the elderly.

The elderly’s living arrangement involves complicated and recursive interplays among a variety of factors. Determinants such as marital status, economic and financial situation, family size and structure, and social norms and traditions with regard to the value placed on independent living and co-residence are better studied in the literature. Less attention is paid to how the living

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1 To cite an example, in the East Asia and Pacific region, “… nearly all countries provide benefits for old age, disability and survivorship. Most countries provide coverage for work injury. Programs covering sickness, maternity benefits, family allowances, and unemployment benefits are not yet common. Access to health care varies considerably. Korea is notable in the region for providing insurance for long-term care. China, Indonesia, and Vietnam are examples of countries that, relatively recently, have begun the task of integrating social security reform initiatives” (Pallares-Miralles et al. 2012, pp. 56-57).
arrangement is affected by the availability and quality of public programs aiming to improve well-being in later life. Previous studies have shown that elderly living arrangement was affected by public policies that improved the elderly’s economic well-being, including Union Army pension programs (Costa 1997) and the Social Security program (McGarry and Schoeni 2000; Englehardt et al. 2005). However, the existing literature offers little evidence on the effect of a policy that aims to improve noneconomic well-being, such as health insurance. Takagi et al.’s (2007) study was an exception that presented evidence from Japan. Their results showed that the availability of public services targeted to older adults, which was measured by an index representing the utilization of welfare services (home care, day care, and short-stay services) in each prefecture, reduces the likelihood of co-residence.

We contribute to the literature by studying whether the implementation of one important social insurance program in the recent history of Taiwan, National Health Insurance (NHI), resulted in an increase or a decrease in the odds of co-residence of elderly parents with their adult children. Relative to Western societies, co-residence is a major option of living arrangement in Asian societies. For instance, in 1990, more than 60% of elderly parents in South Korea and Taiwan, and more than 50% in Japan, co-resided with their adult children (Park et al. 1999). This ratio was still above 60% in Taiwan in 2009 (Ministry of the Interior 2009). The Confucian ethic of filial piety remains strong in Taiwan. Therefore, the existing literature on living arrangements of the elderly in Taiwan often features this important part of traditional Chinese culture, as well as its influence on the extended family system (e.g. Lee et al.1994, Chen

2 It was found that the provision of the Union Army pension program (Costa 1997) or the Social Security program (McGarry and Schoeni 2000; Englehardt et al. 2005) reduced intergenerational co-residence in the U.S. However, Edmonds et al. (2005) found no evidence that social pension income is used to maintain the independence of black elders in South Africa.

3 Some papers studied the substitution effect between public and private care directly. For example, the Medicaid home care benefit (Ettner 1994) or publicly provided home care (Pezzin et al. 1996) substitutes for family care in the U.S. However, these papers do not study the effect of public care on living arrangements.
2005, Tseng et al. 2006). Chen and Lin (2010) document that the elderly’s life satisfaction is enhanced when their actual living arrangement matches their preferred living arrangement. The evidence of Chen and Chen (2012) shows that for some senior citizens in Taiwan high socioeconomic status (SES) is associated with a preference for independent living, whereas for others it is associated with a preference for intergenerational co-residence.

In theory, intergenerational co-residence could increase or decrease when NHI is implemented. On the one hand, the introduction of NHI may alleviate the burden of caregiving and reduce the necessity of co-residence that facilitates the care provision. On the other hand, the reduced burden may provoke a greater moral response or encourage provisions of complementary care that are facilitated by an increase in co-residence. Finally, the NHI may increase the elderly’s disposable income by decreasing their precautionary savings. With the expansion of available resources, family members may reconsider the “living arrangement concordance” that better matches the preference and the actual arrangement. Whether NHI will increase or decrease the probability of intergenerational co-residence is thus an empirical question.

NHI was launched in March 1995 in Taiwan. Before its introduction, employees in the private sector did not have post-retirement health insurance, while public-sector workers did. Therefore, the implementation of NHI provides cost savings among private workers. As shown by Kuznets (1978) and Michael et al. (1980), affluence is an important determinant of living arrangement. The birth of NHI should have an impact on workers in Taiwan’s private sector because their financial security in the post-retirement period is, ceteris paribus, higher after the enactment of NHI. On the contrary, the introduction of NHI does not influence people working in the public sector because the coverage of NHI is identical to the coverage of their post-
retirement health insurance prior to 1995. We follow the “difference-in-differences” (DID) strategy adopted by other studies (e.g. Chou et al. 2003; Chou and Staiger 2001; Kan and Lin 2009) to analyze the effect of NHI on intergenerational co-residence. To the best of our knowledge, this is the first study that directly examines the relationship between NHI and intergenerational co-residence.

II. Background

2.1 National Health Insurance in Taiwan

Taiwan’s NHI program took effect in March 1995. Prior to the inauguration of the NHI program, approximately 53% of the total population obtained health insurance through various social insurance programs: Government Employee’s Insurance (GEI) for public employees, retirees, and their dependents; Farmer’s Insurance (FI) for farmers; and Labor Insurance (LI) for employees in the private sector or government-owned enterprises. GEI was the only program that provided post-retirement health insurance coverage prior to 1995. Moreover, the health insurance coverage of each of these programs has been replaced by NHI since 1995.

The NHI program is designed to provide equal access to health care for all citizens. To achieve this goal, the insurance premium is shared among three parties: the enrollee, the employer, and the government. The premiums of low-income families are totally waived. NHI’s cost sharing is modest: there is a $5 copayment for each outpatient visit to a clinic, a $12 fee for every outpatient visit to a hospital, and a 5%–30% coinsurance rate for inpatient care capped at 10% of the national per capita income. In return, NHI provides multiple benefits, covering almost all medical services (including preventive care, medical care, prescription drugs, dental services, and Chinese medicine) except for long-term care. Furthermore, enrollees are free to
visit any doctor or hospital. With the generous package and modest cost-sharing system, the insured population increased from 53% to 92% throughout 1995 and has stayed above 97% since 1997. Medical care utilization also increased significantly among the newly insured and the elderly (Chen et al. 2007; Cheng and Chiang 1997).

2.2 NHI and Intergenerational Co-residence: Conceptual Framework

In theory, whether the implementation of NHI increases or decreases intergenerational co-residence is not clear a priori. The ambiguity of theoretical prediction is due to the assumptions imposed upon the model regarding preferences, motives of intergenerational transfers and/or the pathways through which the NHI may affect the living arrangement. It highlights the complexity of making decisions on the elderly’s living arrangement in the real world, as no single model can fit everyone well. Therefore, the purpose of this subsection is to provide a glimpse of a variety of theoretical discussions so that we can better conceptualize how the NHI may affect intergenerational co-residence. Nevertheless, we do not attempt to examine the fitness of theoretical models to our empirical results in this paper.

NHI may incentivize families to reconsider the living arrangement of the elderly, namely to live in an intergenerational household or to live independently, through three channels. First, the post-retirement health insurance provided through NHI reduces the need for precautionary savings among elderly citizens. Their disposable income could consequently increase. We term this the direct income effect of NHI. Second, unlike pension-type programs, in which income redistribution obviously occurs across generations, NHI is financed largely by premiums and redistributes income from those who are comparatively healthy to those who have a higher demand for health care. Therefore, we can think of NHI as forcing the younger generation to make a transfer to the older generation by paying premiums but not using medical resources as
much as the older generation does. We term this the income redistribution effect of NHI. Third, it is a great relief for children to know that their parents are protected against unexpected illness or emergency by NHI. When adult children do not have to bear the enormous medical cost for their parents, they obtain peace of mind and may be more willing to engage in intergenerational transfer or fulfill the caregiving responsibility imposed by social norms and expectations. Thus, NHI, by sharing the burden of medical care, may strengthen intergenerational relationships. We term this the complementary effect of NHI.

Through the direct income effect, the conventional economic model predicts that NHI increases the elderly’s likelihood of having the preferred living arrangement, no matter whether it is independent living or intergenerational co-residence. However, this model does not incorporate the income redistribution effect. How families respond to the income redistribution effect depends on the motives of intergenerational transfers. There are two theories of such motives in the economics literature: altruism and exchange (Barro 1974; Becker 1974, 1993; Cox 1987).4

In an altruistic model, each family member cares about the needs of other family members. Therefore, when the needy generation (for example, elderly parents) in an altruistically linked family becomes more financially sound due to a change in social programs, the intergenerational transfer from the richer generation (for example, adult children) to the needy generation (for example, elderly parents) may decrease.

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4 Despite a wide array of empirical literature on intergenerational transfers, no consensus has been reached on whether altruism (need-based; more need, more help; less need, less help) or exchange is the dominant motive. For instance, Lee et al. (1994) documented that an altruism model best portrays the intergenerational transfers from children to parents in Taiwan. Park (2003) found that intra-household transfers are the result of a mixture of altruism and exchange motives in Malaysia.
By contrast, the exchange motive assumes reciprocity in the structure of transfers. If giving is motivated by exchange, the substitution between public and family support does not necessarily happen (Bernheim et al. 1985; Cox 1987). In some situations, exchange-motivated transfers within a family can even be reinforced by public transfers (Cox and Jakubson 1995). The rationale is that when one generation (for example, elderly parents) has more resources because of public transfers, its members can provide more gifts/private transfers to another generation (for example, adult children) to exchange for a greater anticipated return, including nonmarket services within the family. In this case, public support strengthens and complements the family safety net.

Some sociology literature on giving and receiving across generations suggests that a “strengthening” effect is more plausible than “weakening” effect between public support and intergenerational transfer (Daatland and Herlofson 2003; Künemund and Rein 1999; Litwak et al. 2003). This line of research is based on three rationales: reciprocity, intimacy, and norms of responsibility (Doty 1986). When all types of support are considered, it is possible for the public sector and family to play different roles, specialize in different tasks, or share responsibilities in caring for the elderly (“mixed-responsibilities”). For example, with changing demographics, the so-called “sandwich generation” faces the double burden of caring not only for their children but also for their elderly parents. The pressure of these dual roles may lead to breakdowns in intergenerational relationships. Nevertheless, if some responsibilities, such as medical care, are shared through public systems, making the younger generation’s potential care obligation

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5 Several recent cross-European comparative studies support the hypothesis of “complement” or “mixed-responsibilities.” Motel-Klingebiel et al. (2005) found that senior citizens received the most help and support in generous welfare state regimes (the “complement” hypothesis), while there was relatively little total support in countries with the most pronounced family orientation. Brandt et al. (2009) found that public and family supports are complements, with each specializing in different tasks in order to provide the best quality and quantity of care for the elderly (“mixed-responsibilities” hypothesis).
feasible, then adult children may not shy away altogether from caring for frail parents (Esping-Andersen 2009). Instead, adult children may be more likely to engage in intergenerational transfer, especially in societies where giving and receiving across generations is stimulated by affection, exchange expectations, and norms of responsibilities.

In all these three models (altruism, exchange, and sociology), intergenerational co-residence can either be viewed as a type of intergenerational transfer or be considered a special form of private support. It may directly encompass and facilitate the provision of conventional forms of care, including emotional support, direct service provision, and mediation with formal organizations and providers of financial assistance (Horowitz, 1985). Thus, through the income redistribution effect, the altruistic model predicts that NHI will decrease the odds of co-residence, which functions as a type of intergenerational transfer or as a care facilitator. In contrast, the exchange model predicts that NHI will increase the odds of co-residence. Through the complementary effect, the sociology model also predicts that NHI will increase the odds of co-residence. Aside from these models, the general income effect will increase the elderly’s likelihood of having the preferred living arrangement.

III. Empirical Specification

3.1 Econometric Methods

To examine whether NHI increases or decreases intergenerational co-residence, the most straightforward way is to simply compare the difference in the proportions of private workers who lived with children before and after 1995 because they gained post-retirement health insurance coverage after the introduction of NHI in 1995. That is, we can compute the effect of NHI ($\Delta^{NHI}$) as:
\[ \Delta^{NHI} = Y^{After\ NHI}_{Private-sector\ workers} - Y^{Before\ NHI}_{Private-sector\ workers} \]  

where \( Y \) represents the proportion of the elderly living with children. \( \Delta^{NHI} \), in fact, can be estimated by running the following simple regression model, given the structure of our data:

\[ Y_{it} = \beta_0 + \beta_1 NHI_{it} + \beta_2 X_{it} + \tau_t + \epsilon_{it} \]  

In this setting, the dependent variable is the living arrangement of individual \( i \) in year \( t \). It equals 1 if an individual \( i \) chose to live with his or her children in year \( t \), and 0 otherwise. The variable \( NHI_{it} \) is a binary indicator, which can be viewed as an exogenous causal variable, equaling 1 for \( t \) after 1995. \( X_{it} \) is a vector of personal characteristics affecting the living arrangement decision, including gender, mainlander status, education, age, age squared, marital status, the number of living children, location of residence, an indicator of working, an indicator of owning assets, and a proxy variable for health status. \( \tau_t \) is a yearly dummy that is included to control for the fixed effect of the year, and \( \epsilon_{it} \) is a random-error term assumed to be independently and identically distributed over individuals and time. The estimate of \( \beta_1 \) will be used to approximate \( \Delta^{NHI} \).

However, estimating Eq. 2 can produce a misleading estimate of the effect of NHI on living arrangement because some omitted factors, such as social changes,\(^6\) may contribute to \( \Delta^{NHI} \), and an estimation of Eq. 2 is unable to take this fact into consideration. The most important confounding factor that needs to be taken into consideration when evaluating the impact of NHI on the probability of intergenerational co-residence is the rise of individualism in most Asian countries, including Taiwan, in recent years. This rise has been slow when compared to its dominance in Western societies. Still, despite the facts that traditional values are firmly in place in most Taiwanese families and that living with children is an ideal option for many senior...  

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\(^6\) Many studies document that living arrangement is influenced by cultural factors and traditional values (Cameron 2000; Chaudhuri and Roy 2009; Richards et al. 1987). Takagi and Silverstein (2006) indicated that the effect of social transformation cannot be ignored when studying the elderly’s living arrangement in Asia, especially in economically developed but traditional countries such as Japan, South Korea, and Taiwan.
citizens, it cannot be denied that there is a decreasing trend of intergenerational co-residence in Taiwan (Ruggles and Heggeness 2008). Therefore, we rely on the DID method to remove the effect of a common trend. With the DID method, the effect of NHI is measured by:

$$\Delta^{NHI} = \left( Y^{After\ NHI\ Treatment}_{Treatment} - Y^{Before\ NHI\ Treatment}_{Treatment} \right) - \left( Y^{After\ NHI\ Control}_{Control} - Y^{Before\ NHI\ Control}_{Control} \right)$$

$$= \Delta Y^{NHI\ Treatment} - \Delta Y^{NHI\ Control}$$

(3)

where $Y$ represents the proportion of the elderly living with children. Individuals from the private sector are defined as the treatment group, and individuals from the public sector are the control group. As shown in Eq. 3, $\Delta^{NHI}$ in this setting is equivalent to the comparison of the change in outcome of the treatment group ($\Delta Y^{NHI\ Treatment}$) to the change in outcome of the control group ($\Delta Y^{NHI\ Control}$). $\Delta Y^{NHI\ Treatment}$ measures the effects of NHI and social changes, such as increasing individualism, on living arrangement. $\Delta Y^{NHI\ Control}$ measures solely the effect of social changes, such as increasing individualism, on living arrangement. If social changes affect the control and treatment groups equally, then the difference between $\Delta Y^{NHI\ Treatment}$ and $\Delta Y^{NHI\ Control}$ will identify the effect of NHI on living arrangement by netting out social changes these two groups have experienced.

$\Delta^{NHI}$ in Eq. 3 can be estimated within a regression framework by pooling the control and treatment groups:

$$Y_{it} = \beta_0 + \beta_1 T_i + \beta_2 NHI_{it} + \beta_3 NHI_{it} \times T_i + \beta_4 X_{it} + \tau_t + \epsilon_{it}$$

(4)

All variables in Eq. 4 appear in Eq. 2, except for one variable, $T_i$. $T_i$ is a binary indicator of treatment status that is equal to 1 if individual $i$ is in the treatment group (private-sector workers); it equals 0 if individual $i$ is in the control group (public-sector workers). The treatment group did

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7 For example, 66.19% of interviewees in the first wave of the Survey of Health and Living Status of the Elderly in Taiwan stated that “living with children” was the ideal living arrangement.
not have access to post-retirement health insurance prior to the enactment of NHI in 1995, but the control group did through GEI before 1995. The treatment group indicator, $T_i$, does not vary over time.

Based on Eq. 4, the effect of NHI ($\Delta^{NHI}$) defined by Eq. 3 can be expressed as:

$$
\Delta^{NHI} = \Delta Y_{Treatment}^{NHI} - \Delta Y_{Control}^{NHI} = [(\beta_0 + \beta_1 + \beta_2 + \beta_3) - (\beta_0 + \beta_1)] - [(\beta_0 + \beta_2) - \beta_0]
$$

$$
= (\beta_2 + \beta_3) - \beta_2 = \beta_3
$$

Thus, the coefficient $\beta_3$ on the interaction between $NHI_{it}$ and the treatment group dummy $T_i$ in Eq. 4 measures the DID effect of NHI on living arrangement. If the estimate of the coefficient $\beta_3$ is greater than zero, the implementation of NHI increases the probability of co-residence. Otherwise, the implementation of NHI reduces the probability of co-residence.

One critical assumption underlying the derivation of the effect of NHI, which is demonstrated by Eq. 5, is that the effect of social changes on $Y_{it}$ (measured by $\beta_2$) is the same for both groups. That is, $\beta_2$ in $\Delta Y_{Control}^{NHI}$ cancels out $\beta_2$ in $\Delta Y_{Treatment}^{NHI}$ in Eq. 5. However, this assumption could be unrealistic. As Table 1 shows, our control group is, on average, more educated than the treatment group, and therefore it is possible that, for instance, individualism could arise faster among the control group and cause the control group to be more inclined to live independently. If this is true, $\beta_2$ in $\Delta Y_{Control}^{NHI}$ can be more negative compared to $\beta_2$ in $\Delta Y_{Treatment}^{NHI}$, and thus the difference between $\beta_2$ in $\Delta Y_{Treatment}^{NHI}$ and $\beta_2$ in $\Delta Y_{Control}^{NHI}$ in Eq. 5 will become positive. As a result, the estimation of Eq. 4 will yield a biased estimate of $\beta_3$ and a misleading conclusion that NHI increased co-residence. To provide a solution to this potential problem, we add a group-specific trend to Eq. 4 and estimate the following equation:

$$
Y_{it} = \beta_0 + \beta_1 T_i + \beta_2 NHI_{it} + \beta_3 NHI_{it} \times T_i + \beta_4 X_{it} + \beta_5 Trend_{it} \times T_i + \tau_t + \epsilon_{it}
$$
where Trend=Year-1988; Year=1989, 1993, 1996, 1999, and 2003.\(^8\) We will estimate equations (2), (4), and (6) and compare their results in section IV.

### 3.2 Demographic and Socioeconomic Determinants of Living Arrangement

The relationship between \(X_{it}\) and \(Y_{it}\) is worth further discussion. Some researchers, such as Tsuya and Martin (1992), found it more possible for older males than older females to have multigenerational co-residence, while others presented opposite evidence. Therefore, the influence of gender on the elderly’s living arrangement is indeterminate. Many government employees in Taiwan are mainlanders. They moved to Taiwan after the Kai-Shek Chiang administration lost the Chinese Civil War to the Chinese Communist Party in 1949. This group consists of relatively more males and more unmarried individuals than its counterparts. Hence, the explanatory variables in our regression models include an indicator for mainlanders. Elderly parents’ educational attainment is often associated with their degrees of exposure to modernity (Logan and Bian 1999). Therefore, elderly parents with higher educational attainment were less likely to live with adult children than their counterparts.

Past research indicates that older parents are more likely to live with their adult children (Atchley 1993). This higher possibility could be due to their stronger need for informal care. On the other hand, older parents could be less likely to live with adult children because their aged children are possibly too old to provide care. Hence, the influence of age on \(Y_{it}\) is inconclusive. Age squared is also included in \(X_{it}\) since the relationship between age and \(Y_{it}\) is expected to be non-linear (Lee et al. 1994).

The relationship between marital status, an important determinant of family resources, and the possibility of intergenerational co-residence has been investigated in many studies (e.g.,

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\(^8\) Details of the data set and its survey years will be provided in section 3.3.
Chen and Chen (2012), a research about preferred living arrangement of elderly people in Taiwan. Most studies found a higher likelihood for married elderly to live independently, possibly due to less need for emotional support from their children. More children form a stronger safety net for the elderly parents, and hence result in a higher likelihood of multigenerational co-residence. Since traditional family culture is, in general, more prevalent in rural areas, the tendency of intergenerational co-residence could be higher in rural areas (Takagi et al. 2007). Owning assets (assets other than the current house/residency) is included in $X_{it}$ as a proxy for the economic resources available to the elderly parents. Having an independent source of earned income is presumed to decrease their likelihood of co-residing with children, therefore work status is also included as one of the independent variables.

Health status obviously affects an elderly person’s need for informal care. As indicated by Pezzin and Schone (1997), “…With the increasing number of persons surviving to advanced ages, often with limited abilities to perform everyday activities, the informal support of families (particularly through intergenerational co-residence) represents a vital resource for maintaining frail elderly persons in the community.” Therefore, frail parents are more likely to co-reside with children. This phenomenon has been confirmed in various studies, such as those of Chen and Chen (2012), Logan and Bian (1999), and Takagi and Silverstein (2006).

In addition, to mitigate the concern that some observed characteristics (e.g., educational attainment) are different between the treatment and control groups, we not only control for various important explanatory variables in the estimation but also employ a sample that was matched by propensity scores to reduce the extent of potential bias.

3.3 Data
Our empirical research is based on data from the Survey of Health and Living Status of the Elderly in Taiwan (SHLSET), which contains detailed information about the living arrangement and socio-demographic background of the elderly. This survey was conducted by the Health Promotion Administration at the Ministry of Health and Welfare in Taiwan. The first wave of interviews was initiated in 1989 with a random sample of 4,049 individuals aged 60 or older. Respondents to this baseline survey were re-interviewed in later waves (the number of interviewees is shown in brackets): 1993 [3,155], 1996 [2,669], 1999 [2,310], and 2003 [1,743]. Our study uses all five waves of data: two waves were collected before and three waves after the implementation of NHI. Because very few senior citizens stay in nursing facilities in Taiwan, our analysis considers only two forms of living arrangement: independent living and co-residing with adult children. For the purpose of this research, our sample is restricted to non-institutionalized individuals with at least one living child in each year, so co-residing with children is an option for every individual in each year.

Our control group contains individuals who had access to post-retirement health insurance prior to 1995, while the treatment group comprises people who did not. Hence, individuals without any labor market experience (those who have never worked before) are excluded from the sample. The 1989 baseline survey does not have information about health

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9 This survey was originally conducted by the Taiwan Provincial Institute of Family Planning (renamed the Bureau of Health Promotion at the Department of Health in Taiwan in 2001, renamed again the Health Promotion Administration at the Ministry of Health and Welfare in Taiwan in 2013) and the Population Studies Center at the University of Michigan, Ann Arbor (PSC, UM) in 1989.

10 The SHLSET used a stratified three-stage sampling design without replacement at each stage to obtain a random sample of the elderly population in Taiwan.

11 The percentage of elderly citizens staying in nursing homes and other institutions is approximately 0.6% in the 1989 wave. Since quasi co-residence (parents and their children live separately but in close proximity) is a possible option of living arrangement for the elderly, we also run a regression using the indicator of quasi co-residence as the dependent variable (similar to Eq. 6). The result from the entire sample shows that the probability of quasi co-residence does not rise significantly relative to those of other living arrangements after the implementation of NHI.
insurance. Therefore, we use the categories of occupation (99 categories in total) to identify people working in the public sector and private sector.\textsuperscript{12}

The majority of data attrition comes from death or loss of contact. However, some interviewees who missed one survey (or more) due to loss of contact in earlier waves participated in surveys again in later waves. To evaluate the impact of data attrition on our analysis of NHI, we start with a sample including individuals with data in the pre-1995 waves and define a variable “after-NHI attrition” equal to 1 if an interviewee did not participate in any survey after 1995; it is equal to 0 if the interviewee participated in at least one survey after 1995. We then compute the rate of attrition for the treatment and control groups based on this dichotomous variable and perform a $t$-test on the equality of attrition rates between these two groups. The $t$-test produces a $t$-value of 1.29, meaning that there is no significant difference in the rate of attrition between control and treatment groups. Hence, data attrition should not impact the estimate of the coefficient on our main variable of interest ($NHI_{it} \times T_i$).

We generate three proxy variables for an individual’s health status. The first variable is the score of basic activities of daily living (BADLs). The second variable is the score of instrumental activities of daily living (IADLs). The third variable is the score of functional limitation. To obtain consistent measures of health status, we use identical question(s) across the five waves of SHLSET to compute three scores for each person. For example, basic ADLs include tasks related to personal care, such as bathing, dressing, eating, transferring, and toileting. However, because questions on dressing, eating, transferring, and toileting are lacking in the 1989 baseline wave of SHLSET, we use the question about the difficulty of bathing solely to calculate the basic ADL score across years. By the same token, we use four questions to measure

\textsuperscript{12} We use the other four waves’ information about insurance to do retrospective matching and make our definition of “the control group” as precise as possible.
the difficulty of doing instrumental activities of daily living (IADLs): shopping, handling finances, using a telephone, and traveling independently. The score of functional limitation is based on answers to six questions about the difficulty of walking, climbing stairs, stooping and squatting, reaching, grasping or twisting, and lifting or carrying heavy weights. Each interviewee of SHLSET answered questions about the difficulty of doing each activity, and the answers were coded as 0 to 3, where 0 denotes no difficulty, 1 represents a small magnitude of difficulty, 2 indicates a medium amount of difficulty, and 3 signifies the highest degree of difficulty in performing an activity.\(^{13}\) Based on this information, an average score (the arithmetic mean of the answers) for each proxy variable is constructed for each interviewee.

The SHLSET inquires about the income of the elderly. However, the income categories are inconsistent across years and the answers contain many missing values. Instead of utilizing this variable, we use a binary indicator of owning assets (assets other than the current house/residency) as proxy for economic status.

Table 1 presents the summary statistics of the sample by treatment/control group and before/after NHI. The average ages of the treatment and control groups were similar to each other, but other characteristics were not. Compared to the control group, the treatment group had fewer males, fewer mainlanders, a less educated population, fewer married people, one more child on average, a lower proportion residing in cities, more working population, fewer owners of assets, and more unhealthy individuals before the enactment of NHI. These differences were still in place after the implementation of NHI. Since the dissimilarities did not change

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\(^{13}\) A respondent has two additional options to choose in the 1989 survey: 4: I do not know the level of difficulty. 5: I have never done the task. These answers are coded as missing. To evaluate its impact on the results, we measure the percentage of missing values for each health indicator in each wave. Overall, the score of functional limitation has a better quality than the other two health indicators in terms of missing values and the question(s) used to construct the health indicator.
systematically across the sample periods, they strengthen the validity of our DID analysis once we control for these variables in our regression analysis.

Table 1 shows the change in the proportion of intergenerational co-residence for our treatment and control groups. This proportion decreased with the implementation of NHI for both groups. However, the magnitude of decline was smaller amid the treatment sample than amid the control sample: approximately –5.15% for the treatment group and –7.6% for the control group. Taking the difference between –5.15% and –7.6% yields a positive difference-in-differences coefficient, which is supportive of the hypothesis that NHI increases the likelihood of co-residence. But we cannot reach this conclusion without considering any confounding factors. We will present further analysis in the following section.

IV. Results

Table 2 presents estimates of the effect of NHI on living arrangement by estimating equations (2), (4), and (6) among the whole sample. The results are robust to three health indicators. Therefore, we only present the results with the score of functional limitation. Each regression is clustered by the identification number of the individual in the data set. The coefficient estimate on $NHI_{it}$ in column (a) is negative, meaning that the implementation of NHI reduces the likelihood for workers in the private sector to live with their adult children.

After introducing the control group to our analysis, the DID estimation of Eq. 4 shows that the implementation of NHI increases the likelihood of intergenerational co-residence. This is the estimate on the coefficient of $NHI_{it} \times T_i$ reported in column (b) of Table 2. However, this effect is not statistically significant. Since the estimation of Eq. 4 could generate a biased

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14 Results with the other two health indicators are available from the authors upon request.
estimate of the effect of NHI, we make an adjustment by adding $Trend_{it} \times T_i$ to the regression (Eq. 6). The estimation results of Eq. 6 are summarized in column (c) in Table 2. Based on the coefficient estimate on $NHI_{it} \times T_i$, the introduction of NHI significantly reduces the likelihood for the elderly to live with their adult children. These results are consistent with our expectation that if certain social changes impact the treatment and control in different ways in our sample periods due to inherent differences in their characteristics, our results from Eq. 4 will be biased toward finding a complementary (strengthening) effect.

As stated earlier, treatment and control groups differ substantially. While Eq. 6 has controlled for personal characteristics $X_{it}$, it is still arguable that the treatment and control groups are not comparable in our setting and our estimate of NHI’s policy effect is not precise. To test the robustness of our results, we take two approaches. First, we re-estimate Eq. 6 employing instrumental variable (IV) estimation using years of schooling of the respondent’s father and its interaction with NHI dummy as instrumental variables for $T_i$ and $NHI_{it} \times T_i$. Our results (not reported in the tables) suggest that treatment status and the interaction between NHI and treatment dummy are not endogenous—all the Durbin-Wu-Hausman tests are not rejected, regardless of the sample.\(^{15}\)

Second, we re-estimate Eq. 6 using a sample where public-sector workers are matched with private-sector workers using propensity scores. To reduce the difficulties of matching based on high dimensionality of the observable characteristics, we first estimate the propensity score using the logit model in which an elderly person belongs to the treatment group as a function of personal characteristics.\(^{16}\) Then we match each observation from the treatment group with an observation from the control group without replacement based on the nearest propensity scores.

\(^{15}\) Those results are available from the authors upon request.

\(^{16}\) Propensity scores are based on variables included in $X$ in Eq. 6 and years of schooling of the respondent’s father.
Results from estimation of Eq. 6 based on the matched sample are reported in column (d) in Table 2. The coefficient estimate on $NHI_{it} \times T_i$ is negative and has a similar magnitude to the estimate in column (c). Overall, results based on the matched sample are consistent with our previous findings. These findings, together with the Durbin-Wu-Hausman test results, suggest that our estimates are not biased due to the selection to the control and treatment groups. All in all, the elderly in Taiwan are approximately 6.6% less likely to live with children after the implementation of NHI. This effect is robust between specifications (c) and (d) in Table 2, and is robust across the three proxy measures for the senior citizen’s health status.

As discussed in the second section, NHI may decrease co-residence when the motive for giving is altruism. If instead the motive for giving is exchange, affection, or the norm of responsibility, NHI may increase co-residence by sharing some of the burden of care. Children facing more of a burden of care will feel more relieved after the introduction of NHI and be more willing to co-reside with their parents. We test this hypothesis by estimating Eq. 6 for different subgroups defined by the health status (healthy versus unhealthy parents), number of children (samples with a weaker safety net (three or fewer children) versus samples with a stronger safety net (more than three children)), and gender of the parent. We expect that the “complementary” effect of NHI on co-residence is more likely to occur among those families with heavier burdens of care, particularly for the elderly with poor health status and with fewer adult children.

The results in Table 3 present heterogeneous effects across different demographic groups. Regarding families with healthy fathers and three or fewer children (i.e., a weaker safety net), the probability of co-residence dropped significantly after the implementation of NHI. Cost savings due to the post-retirement health insurance offered through NHI could have made independent
living or quasi co-residence (parents and children live separately but in close proximity) more affordable among this subgroup.

However, for families with unhealthy mothers and fewer children (i.e., a weaker safety net), the strengthening effect is manifest. Based on the results in Table 3, the implementation of NHI increases the likelihood of intergenerational co-residence among those families with unhealthy mothers and three or fewer children. This complementary effect is statistically significant across matched and unmatched samples. It is consistent with the predictions of the exchange model, as well as the theories of affection and norms of responsibility in sociology. On the other hand, a significant weakening effect is revealed again among families with unhealthy mothers and more children. The diverse responses to NHI between families with aging fathers and families with aging mothers deserve more research in the future.

Thus far, our results suggest that on average the likelihood of co-residence decreased after the introduction of NHI. With this result in mind, the next question to ask is whether other forms of caregiving in a family safety net are affected as well. To answer this question, we create four alternative outcome variables from our data set. The first outcome variable is the monetary transfer from the family. It equals 1 if the monetary transfer from adult children or other relatives is one of the top two sources of income for a parent; otherwise it is 0. The second outcome variable is the level of reliability of children when parents are ill and in need of care. This variable is generated from the answer to the following question: “In general, how much can you count on your family or relatives to take care of you when you are ill?” The choices are: 1: not at all; 2: very little; 3: some; 4: quite a bit; 5: a great deal. The third outcome variable is the average number of phone calls or letter communications with children in other households per year. The

17 This question is absent in the 1993 wave. Moreover, the categories of answers are adjusted to reflect the slight difference in answers between the 1989 wave and other waves.
fourth outcome variable is the average number of visits between parents and children in other households per year. We present the results of regressions with these four alternative outcome variables in Table 4. In general, we find that the implementation of NHI reduces the likelihood for the elderly to receive cash income primarily from their adult children or other relatives. In addition, according to the estimation with the whole sample (unmatched), family members, including adult children, seem to become less reliable in terms of providing informal care after the implementation of NHI. These two findings are in accord with the evidence in Table 2 that NHI leads to a reduction in intergenerational co-residence. However, the other two proxies of intergenerational support, the number of phone calls/letters per year and the number of visits per year, are not impacted by the introduction of NHI.18

V. Conclusions

Ensuring the well-being of both the elderly and the younger generation in an aging society has been a challenge for many families and policy makers, especially when many countries are experiencing declines in fertility rates and acceleration of population aging (Grant et al. 2004). How the expansion of social programs reshapes intergenerational relations and shifts care responsibilities between the family and the public sector is always a central question in public policy debates. We contribute to the previous literature by examining the impact of the implementation of NHI on intergenerational co-residence in Taiwan.

This study takes advantage of a unique natural experiment created by the enactment of NHI in Taiwan in 1995. Our results suggest that the introduction of universal health insurance

18 To ensure the robustness of the results, we restrict the sample to people with at least one son and re-estimate the regressions in all tables. The results are qualitatively the same as those displayed in the paper.
decreases the likelihood of intergenerational co-residence in Taiwan by about 6.6% on average. However, the treatment effect differs substantially across subsamples. For families with unhealthy mothers and three or fewer children, the likelihood of co-residence is higher after the introduction of NHI. One explanation for the complementarities between this public program and co-residence is that both the elderly and their children are largely relieved by NHI, either financially or medically. As a result, adult children are more willing to stay with their elderly parents. In the long run, this kind of complementarity may bring additional benefits (such as stronger family ties, fewer emotional disorders, and fewer mental health problems) to society, especially in a culture in which parents prefer to co-reside with their adult children. Further investigation to evaluate the long-term policy effect could be conducted when additional waves of data are available in the future.

On the other hand, means of delivering support may have changed over time, especially among those who do not co-reside. For instance, elderly parents and adult children who do not live with each other in the post-NHI period may choose to live separately but in close proximity (i.e., quasi co-residence). In that case, adult children can still deliver various types of support and family care through more frequent visits or more in-kind transfers. Parents living far away from their children can also obtain financial support and in-kind transfers through mailing or electronic delivery. There are diverse ways for adult children to provide monetary transfers, in-kind transfers, family care, or emotional support for their parents. To what extent the intensity of family support is influenced by the decision of co-residence is another research question to be explored in the future.

Our results have some important policy implications. First, families do respond to changes in public policy by reallocating family resources, including intergenerational support
provided through intergenerational co-residence. These reactions should be taken into consideration when evaluating public policies. Particularly in our case, it will be important for policy makers to improve the existing long-term care system or enhance the elderly’s social networks to supplement reduction of some supports which were previously provided through co-residence with children. Second, families with weaker familial safety nets (measured by the number of children) and higher familial needs (measured by the health status of parents) are needy families usually targeted by social programs. When a social program like the NHI was introduced in Taiwan, needy families having a larger burden of caring for the elderly responded with a stronger tie between generations in terms of a higher probability of intergenerational co-residence. However, a significant weakening effect manifests among those families with unhealthy mothers and more children. Policy makers may need to be attentive to the impact of this phenomenon on the frail senior citizens in these families in the long run. The divergent responses to NHI between families with aging fathers and families with aging mothers deserve more research in the future. Third, our analysis demonstrates the importance of identifying the heterogeneous treatment effects among various demographic groups. The coexistence of weakening and strengthening policy effects could offset each other, resulting in a small but disguised average treatment effect. Our experience can be helpful to future studies aiming to uncover policy effects on elderly living arrangements.
References


Table 1. Summary statistics of the dependent and independent variables (mean and standard deviation)

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Treatment Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 if living with children, 0 otherwise.</td>
<td>74.77%</td>
<td>69.62%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Variables:</th>
<th>Treatment Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male*: 1 if male; 0 if female.</td>
<td>54.34%</td>
<td>50.56%</td>
</tr>
<tr>
<td>Mainlander*: 1 if Mainlanders; 0 otherwise.</td>
<td>5.70%</td>
<td>6.25%</td>
</tr>
<tr>
<td>Less-educated*: 1 if less than 6 years of education; 0 otherwise.</td>
<td>65.17%</td>
<td>62.80%</td>
</tr>
<tr>
<td>Age: age of the elderly person.</td>
<td>69.79</td>
<td>76.19</td>
</tr>
<tr>
<td>[6.54]</td>
<td>[5.66]</td>
<td>[5.72]</td>
</tr>
<tr>
<td>Age squared</td>
<td>4912.91</td>
<td>5837.54</td>
</tr>
<tr>
<td>[947.35]</td>
<td>[885.34]</td>
<td>[814.07]</td>
</tr>
<tr>
<td>Married: 1 if married; 0 if widowed or not married.</td>
<td>65.39%</td>
<td>53.94%</td>
</tr>
<tr>
<td>Number of Living Children</td>
<td>5.13</td>
<td>5.01</td>
</tr>
<tr>
<td>[2.07]</td>
<td>[1.97]</td>
<td>[2.04]</td>
</tr>
<tr>
<td>In City: 1 if living in a city; 0 otherwise.</td>
<td>35.97%</td>
<td>28.65%</td>
</tr>
<tr>
<td>Working: 1 if working; 0 otherwise.</td>
<td>27.23%</td>
<td>10.06%</td>
</tr>
<tr>
<td>Own Asset: 1 if yes; 0 otherwise.</td>
<td>59.62%</td>
<td>64.93%</td>
</tr>
<tr>
<td>Basic ADL Score</td>
<td>0.12</td>
<td>0.25</td>
</tr>
<tr>
<td>[0.53]</td>
<td>[0.75]</td>
<td>[0.42]</td>
</tr>
<tr>
<td>(N=4,466)</td>
<td>(N=4,223)</td>
<td>(N=1,590)</td>
</tr>
<tr>
<td>Instrumental ADL Score</td>
<td>0.35</td>
<td>0.54</td>
</tr>
<tr>
<td>[0.73]</td>
<td>[0.90]</td>
<td>[0.48]</td>
</tr>
<tr>
<td>(N=4,204)</td>
<td>(N=4,201)</td>
<td>(N=1,572)</td>
</tr>
<tr>
<td>Score of Functional Disability</td>
<td>0.40</td>
<td>0.65</td>
</tr>
<tr>
<td>[0.67]</td>
<td>[0.80]</td>
<td>[0.50]</td>
</tr>
<tr>
<td>Explanatory Variables:</td>
<td>Treatment Group Only (a)</td>
<td>The Whole Sample (b)</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>--------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>NHI×Treatment</td>
<td>0.014</td>
<td>0.060*</td>
</tr>
<tr>
<td></td>
<td>[0.018]</td>
<td>[0.025]</td>
</tr>
<tr>
<td>NHI</td>
<td>-0.040</td>
<td>-0.060*</td>
</tr>
<tr>
<td></td>
<td>[0.022]</td>
<td>[0.024]</td>
</tr>
<tr>
<td>Treatment</td>
<td>0.026</td>
<td>-0.0004</td>
</tr>
<tr>
<td></td>
<td>[0.020]</td>
<td>[0.022]</td>
</tr>
<tr>
<td>Functional Limitation Score</td>
<td>0.017*</td>
<td>0.028**</td>
</tr>
<tr>
<td></td>
<td>[0.008]</td>
<td>[0.008]</td>
</tr>
<tr>
<td>Trend×Treatment</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Year Dummies</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of Observations (N)</td>
<td>8,693</td>
<td>11,911</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.051</td>
<td>0.045</td>
</tr>
</tbody>
</table>

Notes: a. Standard errors are in brackets.  
b. *: significant at 5% level, **: significant at 1% level.  
c. The score of functional limitation is rated 0 to 3, where 0 denotes no difficulty and 3 denotes the highest degree of difficulty. Results with basic ADL score or instrumental ADL score are qualitatively the same as those reported in this table.
Table 3. The coefficient on NHI×Treatment -
Subgroups defined by functional limitation, number of children, and gender of the parent

<table>
<thead>
<tr>
<th>Dependent Variable: Living with Children</th>
<th>Without Functional Limitation</th>
<th>With Functional Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Children &lt;=3</td>
<td>Children &gt;3</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Table 2, Eq. 6, (c)</td>
<td>-0.357* [0.167]</td>
<td>-0.194* [0.084]</td>
</tr>
<tr>
<td></td>
<td>(N=305)</td>
<td>(N=1,306)</td>
</tr>
<tr>
<td>Table 2, Eq. 6, (d) Using Matched Sample Only</td>
<td>-0.361 [0.204]</td>
<td>-0.247* [0.102]</td>
</tr>
<tr>
<td></td>
<td>(N=164)</td>
<td>(N=1,048)</td>
</tr>
<tr>
<td>Table 2, Eq. 6, (c)</td>
<td>0.388** [0.125]</td>
<td>-0.024 [0.112]</td>
</tr>
<tr>
<td></td>
<td>(N=838)</td>
<td>(N=879)</td>
</tr>
<tr>
<td>Table 2, Eq. 6, (d) Using Matched Sample Only</td>
<td>0.455* [0.180]</td>
<td>-0.022 [0.148]</td>
</tr>
<tr>
<td></td>
<td>(N=310)</td>
<td>(N=604)</td>
</tr>
</tbody>
</table>

Notes: a. Standard errors are in brackets. Numbers of observations (N) are in parentheses.
   b. *: significant at 5% level. **: significant at 1% level.
   c. The indicator of health status is the score of functional limitation.
   d. Without functional limitation: score=0; with functional limitation: 0<score<=3.
Table 4. The coefficient of NHI×Treatment, with four alternative outcome variables

<table>
<thead>
<tr>
<th>Model</th>
<th>Monetary Transfer</th>
<th>Reliability of Providing Care</th>
<th>Phone or Letter</th>
<th>Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2, Eq. 6, (c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Whole Sample</td>
<td>-0.147**</td>
<td>-0.284**</td>
<td>-9.340</td>
<td>0.590</td>
</tr>
<tr>
<td></td>
<td>[0.030]</td>
<td>[0.102]</td>
<td>[6.882]</td>
<td>[5.555]</td>
</tr>
<tr>
<td></td>
<td>(N=11,904)</td>
<td>(N=8,370)</td>
<td>(N=10,808)</td>
<td>(N=11,091)</td>
</tr>
<tr>
<td>Table 2, Eq. 6, (d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using Matched Samples Only</td>
<td>-0.131**</td>
<td>-0.179</td>
<td>-3.373</td>
<td>8.310</td>
</tr>
<tr>
<td></td>
<td>[0.038]</td>
<td>[0.124]</td>
<td>[8.607]</td>
<td>[7.095]</td>
</tr>
<tr>
<td></td>
<td>(N=5,967)</td>
<td>(N=4,300)</td>
<td>(N=5,281)</td>
<td>(N=5,390)</td>
</tr>
</tbody>
</table>

Notes:  
 a. Due to missing values of the dependent variables, the number of observations (N) differs across regressions.  
 b. **: significant at 1% level.  
 c. The health indicator in the regressions is the score of functional limitation. Results with basic ADL score or instrumental ADL score as a health indicator are qualitatively the same as those reported in this table.  
 d. Monetary transfer is equal to 1 if either of the top two sources of income is from private transfers provided by children or other relatives; it is equal to 0 otherwise. Reliability of providing care is defined based on answers to the following question: “In general, how much can you count on your family or relatives to take care of you when you are ill? 1: Not at all, 2: Very little, 3: Some, 4: Quite a bit, 5: A great deal.” Phone or Letter: The number of phone calls or letter correspondence with children in other households per year. Visits: The number of visits between parents and children in other households per year.