Understanding Adult Children's Labor Supply Responses to Parents' Long-Term Care Needs

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Abstract

How do adult children trade-off working and providing long-term care (LTC) to parents? How do international caregivers help with this trade-off? What are the effects of allowing international caregivers compared with other commonly implemented LTC policies? Using data from Taiwan, we first document that children are 4 percentage points less likely to participate in the labor market when parents' LTC needs arise, with daughters, the less educated, and older children having the largest decreases in labor supply. We also find that a 2012 reform that allows more international caregivers significantly increases children's labor supply. Motivated by these findings, We then build and estimate a dynamic labor supply model, combining the descriptive evidence with an exogenous variation in caregivers' prices from a policy reform in Taiwan. The model features costs of returning to work, endogenous health processes, and unobserved heterogeneity in care and labor market skills. Model-based results suggest large costs of returning to work, especially for daughters and the less educated. By relaxing the current international caregiver regulations, permanent leaves from the labor market due to LTC is cut down by half and the welfare gain is 4 times larger than the currently implemented LTC tax deduction program.

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1 Introduction

How do adult children trade-off working and providing long-term care (LTC) to parents? How do international caregivers help with this trade-off? Compared to international caregivers' eligibility regulations, how do commonly implemented LTC policies, such as tax deductions, and in-kind transfers, affect such trade-offs? What are the welfare effects of these policies? These questions have become increasingly important due to the increasing number of people with LTC needs, the costs adult children incur, and the share of international caregivers. More than 10% of those aged 65 and over have LTC needs worldwide. With a global trend of aging population, the number of people with LTC needs will grow substantially. Responding to these needs, governments in OECD countries have been spending 0.3% to 3.5% of GDP on LTC policies annually, and that number is expected to grow with the aging population.[1] Among the LTC policies, international caregivers are an essential part. The average share of foreign-born caregivers in OECD and the U.S. is approximately 25%. In Southern Europe and East Asian countries, the share is as high as 75%.[2]

This paper addresses the questions above empirically using a dynamic labor supply framework. We study the Taiwanese context, in which children are expected to be responsible for their parents' care arrangements, a characteristic typical in East Asian countries. Many developed countries rely heavily on international caregivers and implement the policies we analyze, but Taiwan offers several advantages to studying this topic. One of these advantages is clear and strict regulations on international caregivers and major reforms on hiring eligibility. The reform provides exogenous variation which can be used to identify the opportunity cost of hiring a caregiver. Another advantage is that we can combine multiple data sources, including the Taiwan Longitudinal Study in Aging (TLSA) and link them with the National Health Insurance Research Database (NHIRD) during empirical analysis.

We begin with several descriptive analyses and a reform analysis. We estimate dy-

[1] Source for LTC needs in OECD countries: Colombo et al. (2011)

[2] Source: Colombo et al. (2011) and Peng (2017).

namic labor supply responses of children when parents' LTC needs arise and when LTC-needing parents pass away. Findings from these analyses guide subsequent modeling choices. Effects of the reform and other data moments recover model primitives. We then use the estimated model to calculate labor supply elasticities and reservation wages, and conduct various counterfactual analyses that quantify disparities in labor supply paths due to parents' LTC needs. Finally, we calculate fiscal costs, compensating variations, and labor supply responses of typical LTC policies to address the research questions.

In Section 2, we introduce the definition, scale, and arrangements of LTC needs. In Section 3, we present data, summary statistics, and four findings. The first is that adult children's labor supply drops significantly when parents' LTC needs arise. Compared with those having LTC needs later and with those without LTC needs, the labor market participation decreases by 4 percentage points when parents' LTC needs arise. The drops are persistent and increasingly negative over time. Furthermore, the labor supply starts decreasing before the onset of LTC needs, consistent with a smoothly decaying health process of the parents.

The second finding is substantial heterogeneity in children's labor supply responses when LTC needs arise. Daughters are 300% more likely to leave the labor market than sons are, and 30% more likely than children-in-law. Heterogeneity also exists along education and age dimension. Lower-educated children reduce their labor supply more when parents' LTC needs arise, consistent with the lower opportunity cost of providing care themselves. Younger children decrease their labor supply less in response to the parents' LTC needs. The costs of returning to the labor market might explain this age pattern. Since younger children expect a longer period before retirement and after their parents' deaths, the cost of returning to the labor market more significantly deters younger children from leaving the labor market.

The third finding is that children return to the labor market after their LTC-needing parents pass away, but the probability of returning is 25% smaller in comparison to the drop at the onset of LTC needs. This finding is consistent with costs of returning to work, motivating the choice of a dynamic model that features adjustment costs of entering the labor market. In a static model without such costs, children's labor supply would return

to the same level after their LTC-needing parents pass away, as if their parents have never experienced LTC needs.

The fourth finding is that being eligible to hire an international caregiver increases children's labor supply in comparison to those ineligible. Exploiting the reform regarding such eligibility, we find that hiring eligibility increases the labor supply by 6 percentage points immediately. This estimate serves as a key data moment in the model to identify opportunity costs of hiring a caregiver.

The estimates of labor supply effects discussed above are informative of how individuals respond to parents' LTC needs, but they are insufficient for understanding the welfare effects of LTC policies. To understand the policy effects, we build a dynamic labor supply model in Section 4 that is informed by the empirical evidence on labor supply effects. In the model, an adult child chooses whether to work and hire a caregiver or not work and provide care herself. The parent's health evolves endogenously according to the care arrangements that the child makes. The key trade-offs that the child faces include the cost of hiring a caregiver, the payoff from the labor market, the parent's health evolution, and the potential costs of returning to the labor market. The model features both observed and unobserved heterogeneity. Sons, daughters, and children-in-law behave differently when dealing with LTC needs. Conditional on the relationship with the care-receiver, individuals vary regarding their abilities in the labor market and providing care to their parents.

We adapt Arcidiacono and Miller (2011) to estimate the model. Beginning with an initial guess of unobserved type distribution, we estimate the selection corrected health and wage processes. Next, we estimate the full model by simulated method of moments. Targeted moments include the share of working individuals conditional on education, parental health, lagged work status for each unobserved type, as well as effects of the eligibility reform. Section 5 discusses the estimation procedure and shows that the model replicates critical patterns in the data well. Besides the in-sample model fits, we study an eligibility reform in 2015 and show that the model replicates the out-of-sample reform effects closely.

The model delivers two key insights through counterfactual analyses, discussed in

Section 6 and 7. The first is that LTC needs drive a large share of children out of the labor market, and only some children return after their parents' deaths. Furthermore, these effects from LTC needs show considerable heterogeneity. We begin by comparing two counterfactual scenarios—(i) healthy parents dying immediately without experiencing LTC needs and (ii) parents having LTC needs before their deaths. This comparison shows how much parents' LTC needs change children's career paths. We find that sons and daughters are 5% and 19%, respectively, less likely to participate in the labor market in scenario (ii) than scenario (i). Moving beyond scenarios (i) and (ii), we aggregate the parental health sequences in the data and find a similar pattern, with a 9% decrease for daughters. This magnitude is comparable to fertility effects on female labor supply in the Taiwanese literature.

The second insight from the model is the large responses and welfare gains from relaxing eligibility criterion of hiring international caregivers. In a counterfactual exercise that allows all children whose parents have moderate ADL to hire an international caregiver, permanent leaves from the labor market due to LTC needs decreases by more than half. The labor supply increases approximately 4% for those whose parents have LTC needs. This policy disproportionally benefits the less educated children. These children have lower wages in the labor market and are more inclined to leave once parents' LTC needs arise. This cheaper option that international caregivers provide keeps these children in the labor market. The welfare gains of this policy for the beneficiary, measured by compensating variation, is 4 times as large as the currently implemented LTC tax deduction program. Considering the fiscal costs of other programs, the advantage of allowing international caregivers is even larger.

This paper relates to a growing literature that addresses the economics of LTC. The key questions and findings have been summarized in Norton (2000) and Norton (2016). Three strands of the literature are most relevant to the current study. The first strand studies the treatment effects of LTC needs on caregivers, which corresponds to the descriptive analyses in the current paper. Bauer and Sousa-Poza (2015) survey papers regarding how LTC provision affects informal caregivers' employment and health. Consistent with our findings, most papers find negative labor supply effects of such provision.

Frimmel et al. (2020) is the closest to our descriptive analysis. They employ an event study approach similar to our paper. Using Austrian data, they find large negative labor supply responses to unexpected parental health shocks, such as stroke and heart attack. Our analyses further complement these results by examining children's labor supply patterns after parents' deaths. Whether children return to the labor market under various policies suggests different career costs of caregiving. Some papers in the literature focus on the determination of the major caregiver and within-household bargaining, such as Hiedemann, Sovinsky and Stern (2018). In the context we study, we simplify this margin of choice since LTC arrangement is considered as children's responsibility.[3]

The second strand of the literature evaluates LTC policies using a treatment effect framework. For example, Løken, Riise and Lundberg (2017) assess the expansion of formal LTC in Norway in 1998. They find that government-provided LTC services substituted for informal care provision. Another example is Frimmel et al. (2020), they find that a reform legalizing migrant LTC workers in Austria in 2007 generated positive labor supply responses from informal caregivers. The reform we study changes rules with explicit health and age criteria, and thus offers suitable control groups to the treated individuals.

The last strand of the LTC literature uses model-based approaches to evaluate LTC policies, and such studies have diverse foci. Barczyk and Kredler (2018) build an equilibrium model with intra-family bargaining to study LTC subsidies. Consistent with the current paper, they find that demographics of those affected by the policy are essential to determining the welfare effects of LTC policies, such as informal care subsidies. Mommaerts (2020) assesses substitution between informal care and LTC insurance. She also finds that families place a large value on cash benefits over in-kind transfers. More closely linked to our setup, Skira (2015) builds a dynamic discrete choice model to investigate long-term career costs for daughter caregivers. The author focuses on job search dynamics and directly models the persistence in care provision as a part of the preferences. Similar to current findings, she finds a considerable value in staying in the labor market, in comparison to leaving and returning.

[3]According to 2006 Taiwan Social Change Survey, the majority of respondents answered that taking care of the elderly is the responsibility of all children.

We contribute to the LTC literature in several ways. First, we deliver novel causal estimates from a reform on international caregivers – an essential worldwide LTC arrangement. This natural experiment from the reform provides key information in studying how families respond to LTC policies. Second, we bring multiple strands of LTC literature together. We integrate descriptive analyses, a reform, and the dynamic model for policy analyses. The descriptive analyses connect tightly to the model we construct. The eligibility reform we exploit is directly informative for policy evaluations and useful for recovering structural model parameters. Guided by the descriptive and reform evidence, the model addresses pressing policy issues that widely apply to many contexts. Compared to reduced form evidence alone, this approach enables rich policy counterfactual analyses. Our method also provides more credible estimates than pure structural model calibration. Lastly, the East Asian context we study is important and mostly unexplored. Besides the large population, traditional norms on care arrangements make children's responses to parents' LTC needs much more salient than in other contexts.

This paper also contributes to an extensive literature on immigrant workers. Debates over the costs and benefits of the immigrant workers attract a wide attention in the literature. (For example, Borjas, 2014 and Card and Peri, 2016.) Although the cost of increasing foreign workers to a destination country has been studied extensively, the benefits of doing so are difficult to measure. Cortés and Pan (2013) and Cortés and Pan (2019) provide examples in which foreign workers provide childcare and induce young women to participate in the labor market. The current paper similarly shows that foreign workers allow domestic workers to substitute labor market participation for time-consuming LTC provision, especially among female workers.

This paper also contributes to the literature on female labor supply and traditional norms, with recent studies investigating how policies affect cultural practices. Bau (2019) assesses matrilocality and patrilocality, finding that pension policies reduce the practice of these traditions. The current finding that daughters have the largest labor supply responses to parents' LTC needs reflects traditional social norms in East Asia (see Chu and Yu, 2010 for a discussion). One prominent topic in such literature is whether policies narrow gender gaps in labor force participation. This paper contributes to the literature

by suggesting that LTC policies, such as relaxing caregiver hiring criteria and tax deductions, increase female labor market participation.

2 Background

Definition of LTC Needs. We follow the definition of LTC needs in the literature, which defines it as the assistance necessary to perform at least one Activity of Daily Living (ADL). ADLs refer to the most basic functions of living, such as grooming, toilet use, and walking.[4] ADL difficulty is commonly used as a major eligibility criterion for LTC insurance and government LTC programs.[5]

Scales and Costs of LTC Needs. The importance of LTC has been documented in the literature. Comparable to other countries, the Taiwanese government estimates that 12.7% of those over 65 have LTC needs. The Taiwanese government spends about 0.3% of GDP on LTC policies, which is lower than that in many other countries, but it is expected to grow rapidly.

Who Provides Care? We divide care provision into hired care service and non-hired care service. The most common hired care service in Taiwan is live-in caregivers. One-third of the LTC-needing families hire live-in caregivers to provide 24/7 LTC service. Nearly all of these live-in caregivers are international caregivers, an arrangement common in East Asia. Another common form of hired caregiver is LTC institutions, such as nursing homes. Approximately one-quarter of LTC is provided by institutions.

Among the non-hired, or informal, caregivers, the majority are spouses, sons, daughters, and children-in-law. The distribution of caregivers' relationships with care-receivers is similar across countries. Spouses and children account for similar shares of informal

[4]Standard ADL items include fecal incontinence, urinary incontinence, grooming, toilet use, feeding, transfers, walking, dressing, climbing stairs, and bathing. Difficulties with these activities are highly correlated. See Appendix A.1 for more details on ADL measures.

[5]In the United States, many Medicaid programs link eligibility to the number of ADLs. Most LTC-related policies in Taiwan, including those analyzed in this paper, also use ADL difficulties as part of eligibility criteria.

caregivers. Since care-receivers' spouses are usually older and retired, children are the main focuses of LTC needs' labor supply effects.

LTC Policies. We focus on three common LTC policies—(i) expanding or limiting the eligibility of hiring international caregivers, (ii) in-kind transfers, and (iii) tax deductions for LTC. Among hired caregivers, foreign-born caregivers constitute an essential part of LTC workers, especially in East Asia and Southern Europe. How much they substitute for informal care provision is essential to evaluating benefits of international caregivers, but the topic remains largely unanswered in the literature. In Taiwan, international caregivers are not subject to the minimum wage law or the Labor Standards Act. Most are 24/7, live-in caregivers, and they at least 3 times cheaper than their domestic counterparts.

In-kind transfers and tax deductions for LTC have also been implemented broadly in developed countries. Governments generally provide in-kind transfers by hiring caregivers and assigning them to those who do not hire live-in caregivers. On the other hand, tax deductions usually benefit those who have wage income and do not provide care themselves. Salient policy questions include who benefits from such policies, how the policies (dis)incentivize the labor supply, and whether targeting a specific population increases welfare gains. Taiwan launched an in-kind transfer and a tax deduction program during 2017 and 2020, respectively, with their policy details still being debated. We base counterfactual analyses on these policies and address current discussions.

3 Descriptive and Reform Evidence

To analyze the effects of the LTC policies, it is essential to understand how children trade-off work and care provision decisions in response to parental health statuses. In this section, we describe our data and present empirical findings on (i) dynamics of children's labor supply around the onset of their parents' LTC needs, (ii) dynamics of children's labor supply after the death of LTC-needing parents, and (iii) effects of the eligibility reform regarding hiring international caregivers.

3.1 Data

Main Dataset. This paper's primary dataset is the Taiwan Longitudinal Study in Aging (TLSA), a nationally representative sample of adult residents aged 60 and over from 1989 to 2011. The TLSA is a longitudinal dataset, surveying respondents approximately every three years and representing the Taiwanese counterpart to the Health and Retirement Study (HRS) in the United States.

The TLSA offers detailed information on health, ADL status, and household structure. Notably, it includes detail information of the respondents' family members. All children and co-residing children-in-law's ages, marital statuses, education, and employment statuses, and such information is repeatedly collected during each wave. Importantly, this information allows me to investigate the effects of LTC needs on family members.

Auxiliary Dataset. We link the TLSA with the National Health Insurance Research Database (NHIRD) from 2007 to 2014. The NHIRD is the administrative record of the universal health insurance system, providing information on basic demographics, death records, and the employment statuses of the population. Importantly, the database can be linked with the TLSA using unique national identification numbers.[6]

The link is useful to this paper in two ways. First, an important reform to eligibility for hiring international caregivers occurred during 2012. Since the TLSA ended in 2011, the link with NHIRD extends data available to 2014 to cover the reform. Second, the TLSA stops collecting information from a respondent after her death. However, the NHIRD allows me to continue tracking her family members' information, an advantage of this linked dataset over the HRS. In HRS, it is difficult to track a family member's information after the respondent's death.

Unit of Observation. We construct our sample so that child-year is the unit of analysis. We divide the adult children into sons, daughters, and children-in-law.[7] For example, if

[6] We describe this link in more detail in Appendix A.2.

[7] For children-in-law, only those who co-reside with the elderly will be in the data. The majority of them are daughters-in-law. However, according to the tradition norms, these co-residing sons-in-law in our data also play very similar roles as the daughters-in-law, so we choose to include them in our sample.

a respondent to TLSA has two children, they enter the sample as separate observations while sharing the same parental information. Since the goal is to assess children's labor supply decisions, we restrict the sample to those aged 25 to 65.

3.2 Summary Statistics

Table 1: Summary Statistics

		(1) All Children		(2) LTC Children	
	Relationship	Mean	SD	Mean	SD
Education	Daughter	9.68	4.20	8.54	4.22
	Son	11.01	3.82	10.03	3.78
	Children-In-Law	10.06	3.80	9.26	3.77
Work	Daughter	0.51	0.50	0.44	0.50
	Son	0.90	0.30	0.84	0.37
	Children-In-Law	0.60	0.49	0.51	0.50
Age	Daughter	44.26	8.04	48.03	7.91
	Son	44.26	8.06	47.87	8.07
	Children-In-Law	40.90	8.40	44.33	9.01
N	Daughter	7,085		2,344	
	Son	7,209		2,340	
	Children-In-Law	2,128		546	

Notes: "LTC Children" includes those whose parents have LTC needs.

Table 1 reports summary statistics for the sample. Column (1) shows descriptive statistics for the full sample, and Column (2) restricts the sample to those whose parents have at least one ADL difficulty. The "Work" reported in this table as well as the results throughout the paper refers to full-time work dummy.[8]

On average, sons have the highest education and work the most. The share of those who work varies considerably between sons and daughters. Approximately half of daughters and 90% of sons are working. The average age of the children is 43 years, and sons

[8]We focus on full-time work since the part-time employment rate in Taiwan is only 3.70%, much lower than other countries. The average of the OECD countries is 16.5% of the total employment. Source: https://statdb.mol.gov.tw/html/svy08/0821all.pdf and https://data.oecd.org/emp/part-time-employment-rate.htm

received 1.3 years more education than daughters did. Children-in-law are generally younger but otherwise similar to daughters.

In the sample of parents with LTC needs, both the education and the share of working individuals are lower. The difference in education is about a year, and the share of working individuals is about 4 to 7 percentage points lower. The ages are higher for these people, likely because parents with ADL difficulties are older than those without them.

3.3 Research Design for Descriptive Labor Supply Dynamics

3.3.1 Overview of Design

In the empirical analysis, we follow Fadlon and Nielsen (2017)'s design to analyze the dynamic labor supply pattern around the onset of parents' LTC needs and deaths. The goal is to compare patterns among adult children who experienced parental health status changes to comparable adult children who did not.

In the discussion that follows, we use labor supply dynamics when parents' LTC needs arise as the example of an outcome to help explain the research design. We refer to those whose parents experienced LTC needs as the "affected group." The effects of such health events on labor supply cannot be read off directly from the affected group because many observed and unobserved variables, such as aggregate time trends and children's age profiles of labor supply, might confound parents' health processes. We therefore construct two baseline groups that have not experienced these health events but are otherwise similar to those in the affected group.

The first baseline group comprises those whose parents have never experienced LTC needs. Guided by the summary statistics, we reweigh the children's age distribution such that the affected and baseline groups share the same children's age distribution. Therefore, the age profile of the labor supply is no longer a concern.

The second baseline group comprises those who would also experience parental LTC needs, but later in the sample. By comparing the affected group with the second baseline group, we alleviate the concern that unobserved factors of parental health and children's labor supply correlate with and confound the effects of LTC needs. Since parents even-

tually also have LTC needs in the second baseline group, unobserved factors of parental health are thus similar to those in the affected group.

Our main results employ both baseline groups. We show the results with distinct baseline groups in Section B.

We use the term "baseline group" and "affected group" as opposed to the "control group" and "treatment group" to emphasize the descriptive nature of the current analyses. As will be clear in the following results, the LTC needs events illustrate smooth trends on outcome variables.

3.3.2 Formal Description

In estimation, we follow Callaway and Sant'Anna (2021) and describe the key ideas in our context below. Formally, the comparison we discuss in this section is a set of difference-in-differences (DiD) estimates, consisting of two steps. The first is to construct the proper affected and baseline groups to avoid comparing two already affected observations, and the second is to conduct the standard difference-in-differences procedure period by period.[9] When reporting labor supply dynamics, including Figures 1, 2, 3, 4, and 6, each point in the figures represents a θ_t in estimation equation:

$$\theta_t = (y_t^T - y_t^C) - (y_b^T - y_b^C), \tag{1}$$

where y_t^T is the mean labor supply of the LTC-needing group, or the affected group, at time t, and y_t^C is the mean labor supply of the baseline groups at time t, and b the baseline period for comparison. t is the relative time period, where $t = 0$ denotes the period when LTC needs arise. We compare labor supply responses with the period just before LTC needs arose, setting $b = -1$. We also reweigh the children's age distribution such that the affected and baseline groups share the same children's age distribution. The composition of the baseline group changes across t since once a child's parent's LTC needs arise, the child is removed from the baseline group. By dropping such children from the baseline

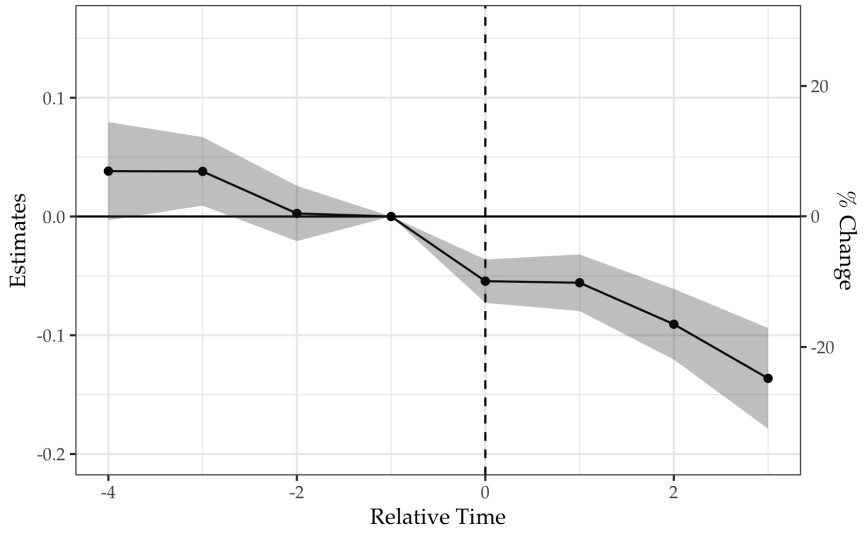
[9]The first step, as discussed in Callaway and Sant'Anna (2021), is to ensure that there is no bias from the traditional staggered design.

group, we avoid comparing two individuals whose parents have both had LTC needs already.[10]

After reporting the dynamic patterns, we also show how labor supply responses vary depending on education and age. To focus on heterogeneity and report results compactly, we pool all the post-event periods and the pre-event periods respectively and intersect with heterogeneous characteristics. We report the interacted coefficients in Table 9.

3.4 Labor Supply Dynamics When LTC Needs Arise

Figure 1: Labor Supply Responses for Daughters When LTC Needs Arise



Notes: The event is when parents first report any ADL. The outcome variable is the binary variable of whether a child works. The right y-axis represents the percent change relative to the baseline group mean of the baseline period. The baseline period is -1. Each event time corresponds to a wave of the TLSA. The shaded area represents the 90% confidence interval. Standard errors are clustered at the individual level. The sample includes daughters aged 25 to 65. The baseline group includes those who never have LTC needs and those who had LTC needs later. The samples are reweighed by the propensity score estimated by their age in the estimation.

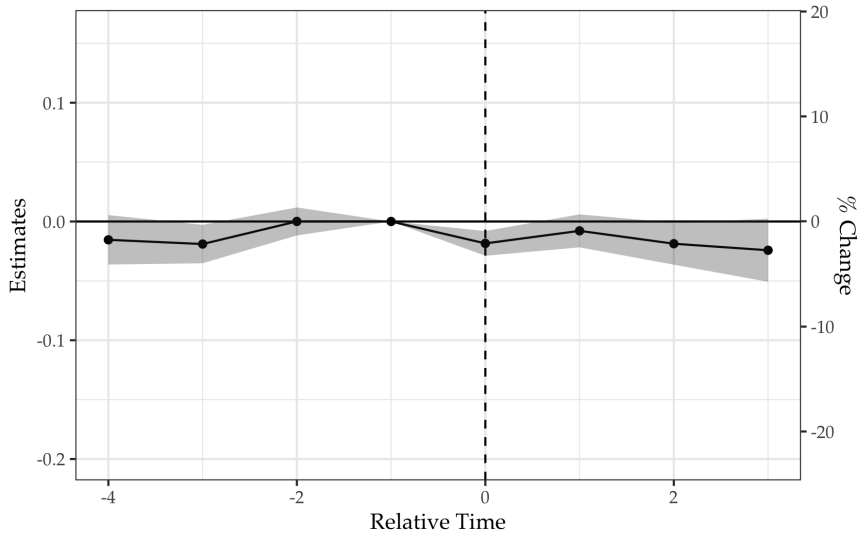
We first investigate children's dynamic labor supply when parents' LTC needs arise. The magnitude of the responses, whether the responses persist, and whether there are an-

[10]Equivalent, for a given event, let D_i^c denote an indicator that individual i is first treated at calendar time c. Let Y_{it}^c denote the outcome of individual i, t periods after time c. The estimating equations for each cohort c can be written as

$$Y_{it}^c = \beta^c \text{Treated}_i^c + \alpha_t^c + \delta_l^c D_i^c + \epsilon_{it}^c,$$

where α_t^c are calendar time effects. The coefficients δ_t^c are cohort-specific estimates. We obtain θ_t by averaging the δ_t^c across cohorts.

Figure 2: Labor Supply Responses for Sons When LTC Needs Arise



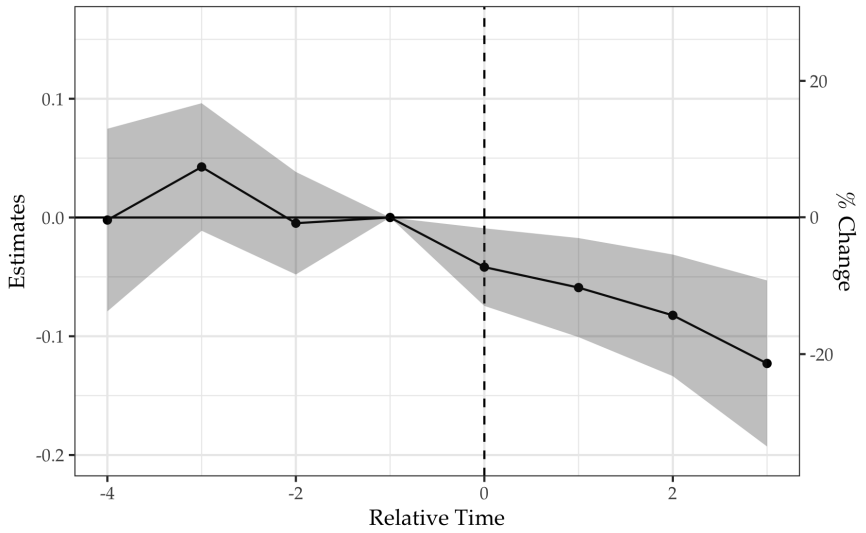
Notes: The event is when parents first report any ADL. The outcome variable is the binary variable of whether a child works. The right y-axis represents the percent change relative to the baseline group mean of the baseline period. The baseline period is -1. Each event time corresponds to a wave of the TLSA. The shaded area represents the 90% confidence interval. Standard errors are clustered at the individual level. The sample includes daughters aged 25 to 65. The baseline group includes those who never have LTC needs and those who had LTC needs later. The samples are reweighed by the propensity score estimated by their age in the estimation.

ticipatory effects are important to understanding policy effects. As described previously, we compare the affected group, whose parents experienced LTC needs, with the two baseline groups. We start directly with reporting results by relationship with care-receivers and report the average effects in Appendix B.

Figure 1 suggests a significant drop in ADL onset, followed by further decreases. The decrease is about 5 percentage points at ADL onset, or 10% in daughters' labor supply. The decrease in the labor supply is more than 20% in the long run.

There is also a modest decrease in the labor supply before LTC needs arose. A smoothly decaying health process might generate this pattern. Even before a parent's health status being categorized as LTC-needing, some children have started to respond to this health decay by adjusting labor market participation. This finding guides a modeling of health process that replicates the early adjustments. Note that these effects are not driven by age effect. By reweighing the age distribution and comparing with the baseline groups, age effects alone will not generate this pattern.

Figure 3: Labor Supply Responses for Children-In-Law When LTC Needs Arise



Notes: The event is when parents-in-law first report any ADL. The outcome variable is the binary variable of whether a child works. The right y-axis represents the percent change relative to the baseline group mean of the baseline period. The baseline period is -1. Each event time corresponds to a wave of the TLSA. The shaded area represents the 90% confidence interval. Standard errors are clustered at the individual level. The sample includes daughters aged 25 to 65. The baseline group includes those who never have LTC needs and those who had LTC needs later. The samples are reweighed by the propensity score estimated by their age in the estimation.

Heterogeneity in Labor Supply Responses. In Figures 2 and 3, we present patterns for sons and children-in-law, respectively, in addition to labor supply responses among daughters. In comparison to daughters, nearly no response from sons is evident, and children-in-law show a large decrease in the labor supply, although the estimates are less precise. This heterogeneity in responses suggests the importance of analyzing LTC-related behavior separately for each relationship with care-receivers.

We also present heterogeneous effects by other characteristics. Table 9 shows these effects interacting with various children's characteristics. Column (1) indicates that those with greater education are 3 percentage points less likely to drop out of the labor market. Column (2) shows that younger children are less likely to drop out of the labor market. These results suggest that those who are older and less educated are more likely to leave the labor market in response to the parent's LTC needs.

Heterogeneous responses suggest important features that a structural model should capture. Heterogeneity in education is consistent with individuals trading off labor mar-

ket payoffs for provision of care. Those with less education would have earned less in the labor market and hence have greater chances of providing care to parents when they have LTC needs.

Individuals tending to drop out of the labor market later in their careers more than those in their early careers suggests a model with costs of returning to work. For those in their early careers, it is likely that their parents with LTC needs will not survive until they reach retirement age. If they need to pay a cost to return to the labor market, they are less likely to leave the labor market in the first place. Nevertheless, for those late in their career, they simply retire early to provide care and do not expect to return to the labor market, and hence no returning cost is incurred.

In summary, children reduce their labor market participation when parents' LTC needs arise. The average response is 4 percentage points, but the average masks large heterogeneity. Children who are daughters, less educated, and older are more likely to reduce labor supply. Children who obtained more education or are in their early careers still decrease their labor supply in response to their parents' LTC needs, but on a smaller scale in comparison to groups with opposite characteristics.

3.5 Death of the LTC-Needing Parents

In the previous section, we report decreases to children's labor supply when parents have LTC needs. The next question is whether a child returns to the labor market after LTC parents' deaths. This exercise is important to recover the true costs of LTC provision if individuals are prevented from returning to the labor market due to costs of returning to work. We analyze the effect of LTC-needing parents' deaths on children's labor supply to examine whether they return to the labor market after the care provision responsibility ends.

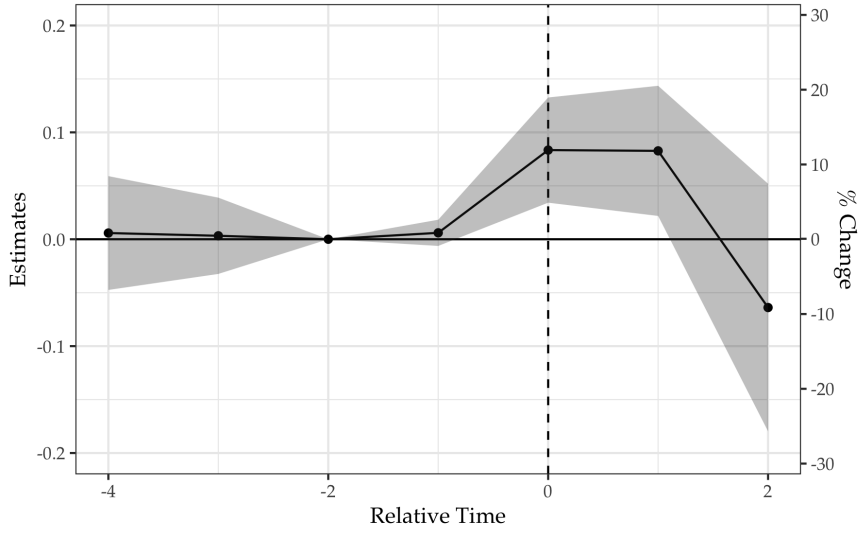
Results. Figure 4 shows the labor supply effect after a parent's death. Estimates in a table format appear in Appendix B. We restrict the sample to those whose parents have LTC needs. Similar to analyses on the onset of LTC needs, we construct a baseline group to include those whose LTC-needing parents survive throughout the sample, or those who

died later.

In the short run, an increase to the labor supply following LTC-needing parents' deaths is evident, but the increase is not persistent. One explanation is the difficulty of finding permanent employment after leaving for LTC responsibilities. The increase in labor supply is also much smaller than labor supply responses when LTC needs arise.

This pattern is again consistent with a cost of returning to the labor market. Without the cost, the increase should be comparable to the decrease when LTC needs arise. However, the much smaller increase in labor supply response suggests the opposite scenario, in which a high cost of returning to work exists.

Figure 4: Parent Death for Daughter and Work



Notes: The event is when parents with LTC needs pass away. The outcome variable is the binary variable of whether a child works. The right y-axis represents the percent change relative to the control group mean of the baseline period. The baseline period is -2. Each event time corresponds to six months. The shaded area represents the 90% confidence interval. Standard errors are clustered at the individual level. The sample includes daughters aged 25 to 65 whose parents have LTC needs. The baseline group includes those whose parents pass away later. The samples are reweighed by the propensity score estimated by their age in the estimation.

Alternative Explanation: Bequest. In addition to the costs of returning to work, wealth effects from bequest should accord with this labor supply pattern. If children inherit a large amount of money from LTC-needing parents, even without the costs of returning to work, they would choose not to participate in the labor market.

However, the parents have few assets. 17.92% of parents reported that they own the

houses in which they currently live. Other than the house, only 5.58% of parents with LTC needs reported having total assets of more than 500,000 NTD (or 17,500 USD), approximately the same amount of median annual earning in Taiwan.[11] Bequests thus cannot explain the pattern after parents' deaths.

Alternative Explanation: Grandchild. Another explanation for not returning to work is childcare. If the elderly are taking care of their grandchildren, their deaths might simply mean losing a free nanny, but this is not supported by the data. Only 14.23% of the elderly population report that they help take care of their grandchildren.[12] The number is even smaller for LTC-needing elderly people. Therefore, the childcare cannot explain the labor supply patterns either.

3.6 Reform in Eligibility for Hiring International Caregivers

Background. The Taiwanese context provides an opportunity to examine how an exogenous change to caregiver hiring prices affects the children's labor supply. We study the effects of a reform to the eligibility for hiring international caregivers on children's labor supply.

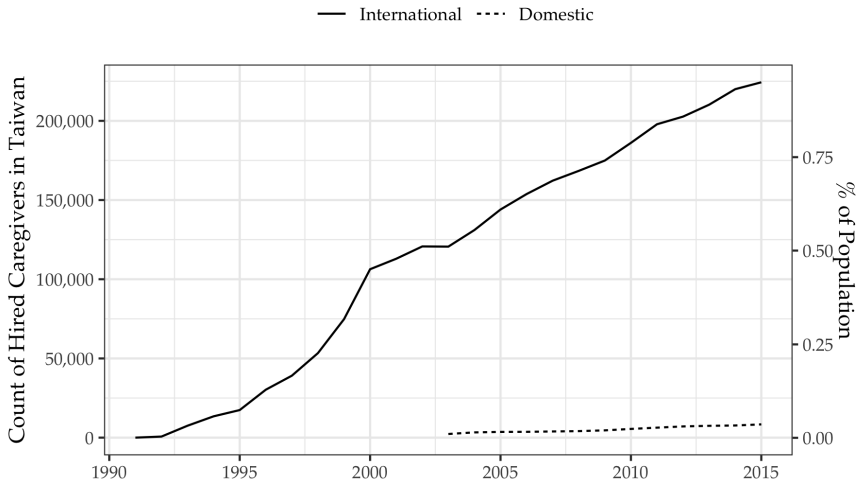
In Taiwan, international caregivers play crucial roles in the LTC system. The number of international caregivers grew from nearly none to 259,660, or more than 1% of Taiwan's population, in 2020. Figure 5 shows this trend.[13] The vast difference between the number of the international versus domestic caregivers results from their prices. International caregivers are not subject to the minimum wage law or the Labor Standards Act. Most are 24/7, live-in caregivers, and they are approximately 3 times cheaper than domestic caregivers.

[11] Source: TLSA 2007 wave.

[12] Source: 2006 Taiwan Social Change Survey.

[13] The source of Taiwan's international caregivers are different from those in the United States, where such caregivers are immigrants who already resided in the country before they were hired. International caregivers in Taiwan mostly work on short-term visas and return to their home countries after the contract ends. The black market is also less of a concern in Taiwan. According to records of the National Immigration Agency, illegal international caregivers who stay in Taiwan comprise approximately 10% of the total stock, much less than the number of undocumented immigrants in the United States.

Figure 5: Number of International Caregivers in Taiwan



Notes: The left axis represents the number of hired caregivers. The right y-axis represents the number of hired caregivers divided by 2015 total population. Source of data on domestic hired caregivers: Chen (2014). Source of data on international caregivers: Ministry of Labor (2020)

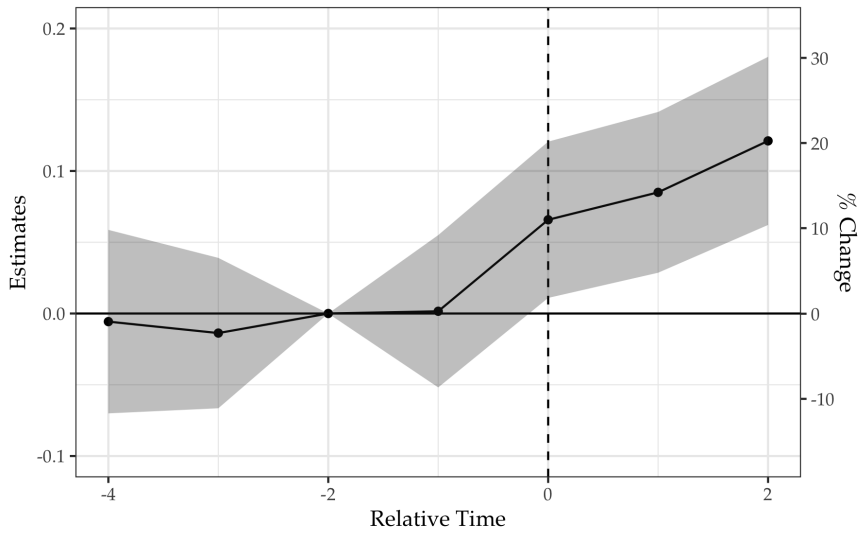
Reform Details. The Taiwanese government heavily regulates hiring and international caregiver. Unlike immigrant workers in the United States, nearly all international caregivers in Taiwan enter the country on a short-term visa and return to their home countries after the end of the contracts. Strict border control also limits the scope of undocumented international caregivers.

Eligibility for hiring a caregiver is a function of the care-receiver's age and health status, but criteria have relaxed over time. The reform we study occurred in September 2012. Before the reform, a care-receiver needed to have severe ADL needs to be eligible to hire an international caregiver. After the reform, the criteria relaxed for the older population. For those over age 80, care-receivers with moderate ADL needs are now eligible to hire international caregivers. This new criterion is much more lenient than the previous one.[14]

We restrict our samples to children whose parents are over age 80. The research design remains the DiD design in Equation 1. The treatment group is those who became eligible

[14]The official measure of ADL needs is the Barthel index. Severe ADL corresponds to an index lower than 35, and moderate ADL corresponds to an index of lower than 60 but higher than 35. Details are in Appendix A.1.

Figure 6: Labor Supply Effect of the Reform in Eligibility of Hiring International Caregivers



Notes: The event is the 2012 reform in the eligibility of hiring. The outcome variable is the binary variable of whether one works. The right y-axis presents the percent change relative to the control group mean of the baseline period. The baseline period is -2. Each event time corresponds to six months. The shaded area represents the 90% confidence interval. The standard errors are clustered at the individual level. The sample includes children aged 25 to 65. The control group consists of those over age 80 and who were already eligible to hire an international caregiver before the reform. The treatment group consists of those over age 80 and who are only eligible to hire an international caregiver after the reform. The samples are re-weighted by the propensity score estimated by their age in the estimation.

to hire only after the reform, and the control group is those who were already eligible. In contrast to the descriptive results in the previous sections, we interpret the reform effects causally, as these reforms are unexpected exogenous shocks.

Results. Figure 6 shows results. Being eligible to hire international caregivers has a large, positive effect on children's labor supply. In comparison to those who were already eligible, children whose parents are newly eligible have a share of working that is 12 percentage points higher due to the reform. The large effect of the reform again suggests the key trade-off that individuals make between labor market participation and care provision. When hiring a caregiver becomes cheaper, children are less likely to provide care themselves, instead participating in the labor market. No evidence suggests anticipation of the reform, and this unexpected nature is incorporated in the model.

3.7 How Descriptive and Reform Evidence Informs Modeling Choices

In the above analysis, we present children's labor supply dynamics in responses to (i) LTC needs of their parents, (ii) the death of LTC-needing parents, and (iii) the reform to eligibility of hiring an international caregiver. There are four main findings. The first is that children's labor supply drops significantly when parents' LTC needs arise. Compared with those having LTC needs later and without LTC needs, the labor supply decreased by 4 percentage points when their parents' LTC needs arose. The effects are persistent and increasingly negative over time. This suggests us to model LTC needs to crowd out adult children's time endowment so that the model displays such trade-offs. Furthermore, the labor supply started decreasing even before the onset of LTC needs. To fit this pattern, we propose a smooth decaying health process.

The second finding is substantial heterogeneity in labor supply responses when LTC needs arose. Daughters are 300% more likely to drop out of the labor market than sons are, and 30% more likely than the children-in-law. The differential responses motivates us to estimate the model separately by the identity of adult children. Lower-educated children reduce their labor supply more when parents' LTC needs arise, consistent with lower opportunity costs of providing care themselves. We also observe that older children decrease their labor supply more in response to parents' LTC needs. The costs of returning to the labor market could explain this age pattern since younger children expect a longer period before retirement after parents' deaths.

The third finding is that children return to the labor market after their LTC-needing parents pass away, but the probability of returning is 25% smaller in comparison to the drop at the onset of LTC needs. This finding is consistent with costs of returning to work, motivating the choice of a dynamic model that features adjustment costs of entering the labor market. In a static model without such costs, children's labor supply would return to the same level after their LTC-needing parents pass away, as if their parents have never experienced LTC needs.

The fourth finding is that being eligible to hire an international caregiver increases children's labor supply in comparison to those ineligible. Exploiting the reform regarding

such eligibility, we find that hiring eligibility increases the labor supply by 6 percentage points immediately. The large effect justifies our choice of modeling eligibility directly. This estimate serves as a key data moment in the model to identify opportunity costs of hiring a caregiver.

4 Model and Identification

Motivated by the previous findings in Section 3, we build a dynamic labor supply model to understand the policy effects and to conduct counterfactual analyses. Although the estimates above of the labor supply effects are informative for how individuals respond to parents' LTC needs, they do not apply directly to quantifying the effects of typical LTC policies. To assess policy effects, we model key trade-offs individuals face, including consumption, leisure, and parent's health. The model disciplines how individuals value these components under resource constraints. Based on this framework, we can infer behavioral responses and welfare implications of policy experiments by shifting these resource allocations. We present the model and discuss identification in this section.

4.1 Individual Problem

We consider an adult child i who maximizes the sum of expected utility in any period t:

$$\max_{D_{it}} V_{it} = \sum_{s=t}^{T} \beta^{s-t} E[u_{is}(C_{is}, L_{is}, H_{is}, D_{is}, D_{is-1}) | D_{it}],$$

where u_{it} is the flow utility during period t, β the discount rate, C_{it} consumption, L_{it} leisure, D_{it} choice, and D_{it-1} lagged choice. Individual i has a parent whose health at

time t is H_{it}.[15][16]

During each period, individual i chooses whether to work and hire a caregiver ($D_{it} = 1$), or not work and provide LTC by herself ($D_{it} = 0$).[17] When individual i chooses, she considers both the current period payoff u_{it} and how her choice will affect future payoffs. Each period is a year. The model ends at $T = 65$ when individual i retires and the working decision is no longer relevant.

The individual faces following constraints:

$$
\begin{aligned}
C_{it} &= D_{it}(W_{it} - P^*_{it}\mathbf{1}\{H_{it} \in \{\text{Any ADL}\}\}),\\
L_{it} &= 1 - aD_{it} - b(H_{it})(1 - D_{it}),\\
P^*_{it} &= \theta_P - \theta_{PE}E_{it},\\
E_{it} &= E_{it}(H_{it}, X_{H,it}, \text{Reform}_t).
\end{aligned}
$$

Consumption C_{it} is earnings minus the expenditure of hiring a caregiver. If a child with an LTC-needing parent chooses to work and hire, her consumption is $W_{it} - P^*_{it}$. If she decides to provide care by herself, then $C_{it} = 0$. Leisure, L_{it}, is the time endowment minus the time needed to spend at work or providing care. a and $b(H_{it})$ are time spent on work and providing care, respectively. P^*_{it} denotes the shadow price of hiring a caregiver. Price is a function of eligibility, E_{it}. E_{it} is a function of parent's health H_{it}, age $X_{H,it}$, and the reform in hiring eligibility described in Section 3.6. There is no savings or borrowing in the model. Two types of savings could be considered in this context: parents' saving and children's saving. Some papers in the LTC and retirement literature consider how

[15] Individual's problem can alternatively be written as

$$\max_{C_{it}, L_{it}, D_{it}} V_{it} = \sum_{s=t}^{T} \beta^{s-t} E[u_{is}(C_{is}, L_{is}, H_{is}, D_{is}, D_{is-1}) | C_{it}, L_{it}, D_{it}],$$

and specify individuals' choices as choosing C_{it}, L_{it}, and D_{it}. However, the model structure implies that C_{it} and L_{it} are determined when D_{it} is decided, and thus we write the problem the way above.

[16] Since most people would have been dead at the end of period T, there is no difference in the value in the terminal period. Moreover, as discussed earlier, few people leave bequest, especially the elderly with LTC needs, so we do not include it as part of the terminal value.

[17] We discuss alternative specification of individuals' choices, including the possibility of entering a nursing home, in Appendix C.1.

the elderly save against future LTC shocks. However, the most significant asset for these people in our context is their children. Other than that, they have few assets to begin with. Among those who have LTC needs, only 5.58% of the elderly report having a total assets more than 500,000 NTD (or 17,500 USD).[18] As for children's saving, the concern is that those wealthier finance caregiving differently and hence affect the estimates of labor supply responses. Previous paper in the literature suggests that this channel might not be prevalent. (e.g., Byrne et al. (2009)) Due to data restrictions on children's asset, we build a stylized two-period model that includes saving decisions in Appendix C.2. With this simplified setup, it is possible to infer in which direction would savings shift results. By allowing for savings in the model, it is more likely to observe children with low wages to leave the labor market due to parents' LTC needs. This amplifies the effects that this paper emphasizes.

4.2 Preference Specification

An individual cares about her consumption, leisure, and parent's health status. For each individual, i, we specify her flow utility as:

$$u_{it} = \underbrace{\theta_C C_{it}}_{\text{consumption}} + \underbrace{\theta_L L_{it}}_{\text{leisure}} + \underbrace{\sum_h \theta_h \mathbf{1}\{H_{it} = h\}}_{\text{parent's health}} - \underbrace{\theta_F D_{it} \mathbf{1}\{D_{it-1} = 0\}}_{\text{cost of returning to work}} + \epsilon_{u,it}(D_{it}).$$

The flow utility is assumed linear. This assumption is consistent with the model without savings and borrowing as discussed earlier.

The model corresponds to a unitary household. Parents do not make decisions in the model. There are two reasons for this modeling choice. First, LTC is nearly always expected to be children's responsibility in this context.[19] Second, 37.2% of elderly people with LTC needs have ADL difficulties that resulted from dementia, and thus they are less likely to make economic decisions. Discussions regarding other family members are included in Appendix C.3.

[18] Source: TLSA 2007 wave.

[19] According to Fu (2017), more than 80% of people indicated that children are "responsible for taking care of the elderly."

There is a cost of returning to work in the model, motivated by the previous descriptive results. An individual incurs an adjustment cost, θ_F losses in utility, if she does not work during the previous period and begins working this period. $\epsilon_{u,it}(D_{it})$ denotes the idiosyncratic preference shocks. For example, if an adult child gets sick herself and working becomes undesirable, she has a small $\epsilon_{u,it}(D_{it}=1)$ in comparison to $\epsilon_{u,it}(D_{it}=0)$. We follow the literature and assume $\epsilon_{u,it}(D_{it})$ follows the type one extreme value distribution. Potential experience effects and how they affect results are discussed in Appendix C.4.

4.3 Health Process

A latent parental health index, H^*_{it}, evolves, and health during the next period depends on the choice of care provision, current health, and demographics $X_{H,it}$. Formally, the health process is:

$$H^*_{it+1}(D_{it}) = \begin{cases} \sum_h \gamma_{L,h}(D_{it})\mathbf{1}\{H_{it}=h\} + \gamma_X(D_{it})X_{H,it} + \xi_{H,j(i)}(D_{it}) + \epsilon_{H,it+1}(D_{it}) & \text{if } H_{it} \neq \text{Dead} \\ -\infty & \text{if } H_{it} = \text{Dead.} \end{cases}$$

$X_{H,it}$ includes a parent's gender and age. $\xi_{H,j(i)}(D_{it})$ captures permanent unobserved heterogeneity. The permanent unobserved heterogeneity is type specific, and $j(i)$ denotes individual i's unobserved type. For example, a child of a high ability type will have high $\xi_{H,j(i)}(D_{it})$ in her parent's health process. All parameters are choice specific. $\epsilon_{H,it}(D_{it})$ denotes idiosyncratic health shocks and is assumed to follow a normal distribution. For example, a serious fall injury is represented by a small $\epsilon_{H,it}(D_{it})$.

To bring the model to the data, we further specify parental health using an ordered dependent variable structure. Observed parental health status H_{it} takes one of five possible values. The best to the worst health conditions are (i) healthy, (ii) mild ADL, (iii) moderate ADL, (iv) severe ADL, and (v) dead. Death is an absorbing state. The three levels of ADL correspond to the cutoff of eligibility for hiring an international caregiver.

$$H_{it} = \begin{cases} \text{Healthy}, & \text{for } m_4 < H_{it}^* \\ \text{Mild ADL}, & \text{for } m_3 < H_{it}^* \leq m_4 \\ \text{Moderate ADL}, & \text{for } m_2 < H_{it}^* \leq m_3 \\ \text{Severe ADL}, & \text{for } m_1 < H_{it}^* \leq m_2 \\ \text{Dead}, & \text{for } H_{it}^* \leq m_1. \end{cases}$$

4.4 Wage Process

The wage process is a standard AR(1) process with covariates:

$$\log W_{it+1} = \omega_L \log W_{it} + \omega_X X_{W,it} + \xi_{W,j(i)} + \epsilon_{W,it+1}.$$

The next period's wage depends on the current period wage W_{it}, individual demographics $X_{W,it}$, unobserved type $\xi_{W,j(i)}$, and idiosyncratic wage shocks $\epsilon_{W,it}$. $X_{W,it}$ includes age, gender, and education. $\xi_{W,j(i)}$ can be interpreted as labor market skill for type $j(i)$. $\epsilon_{W,it}$ denotes idiosyncratic wage shocks, such as an unexpected promotion. $\epsilon_{W,it}$ is assumed to follow a normal distribution. In contrast to the health process, the wage is a continuous variable in this process. To estimate the full model, I discretize wage into grids after the wage process is estimated.

4.5 Timeline and Information Set

Timeline. At the beginning of period t, idiosyncratic preference, health, and wage shocks—$\epsilon_t = (\epsilon_{u,it}(D_{it}), \epsilon_{H,it}(D_{it}), \epsilon_{W,it})$—are realized. Agent i learns her current state variables, $(W_{it}, E_{it}, H_{it}, X_{H,it}, X_{W,it})$. Importantly, she learns the realized wages, eligibility, and parental health for this period. She then forms expectations of future values, $E_t[V_{it+1}]$, where expectation is taken over the distribution of idiosyncratic shocks. She then chooses whether $D_{it} = 1$ or $D_{it} = 0$. The current period ends, and the individual enters the next period.

Information Set. An individual knows her current observable state variables, such as age, gender, parental health status, and wage. She also knows her unobserved type and the value of unobserved permanent heterogeneity, $\xi = (\xi_{H,j(i)}(D), \xi_{W,j(i)})$.

At time t, an individual does not know the exact values of future idiosyncratic shocks, and neither does she foresee any upcoming reforms. However, she knows the health and wage processes, and she also knows the distribution of idiosyncratic shocks, F_ϵ. Therefore, when she makes decisions, she forms correct expectations of future parental health statuses and wages.

4.6 Identification of Model Parameters

Identification of Health and Wage Processes. We experience the common identification challenges for the wage process that the literature commonly discusses; we observe wages only when a person works. Furthermore, we allow the health process to evolve differently according to whether a child provides care by herself. Thus, merely regressing observed wages or health statuses on covariates does not recover the underlying processes.

We illustrate how this fits into a standard Roy model. To avoid relying on identification from parametric assumptions we need shifters of decisions that are excluded from the wage and health equations. We use the parents' health as the shifter for the wage equation, and we use the lagged wage as the shifter for the health equation. The assumption is that lagged parent health does not affect wages directly, and the lagged wage does not affect current parental health directly. We specify the identification details in Appendix D.1.

Identification of the Preference Parameters We follow the dynamic discrete choice literature for identification of preference parameters in the model. In particular, Magnac and Thesmar (2002) and Kasahara and Shimotsu (2009) discuss general identification results for dynamic discrete choice models with unobserved heterogeneity under assumptions of idiosyncratic preference shocks and finite mixtures. Magnac and Thesmar (2002) explain why non-parametric identification is impossible in dynamic discrete

choices models and that parametric assumptions regarding idiosyncratic preference shocks identify model parameters. Kasahara and Shimotsu (2009) show that repeated observations from panel data and information from covariates provide identifying restrictions in finite mixture models. We discuss how the key assumptions specified in the literature link to our settings in Appendix D.2.

5 Estimation

5.1 Variable Construction

The sample we use for model estimation is the same as the one used in the descriptive analysis described in Section 3.1. $D_{it} = 1$ if one works full-time. W_{it} is the annual wage earning divided by 52 weeks $\times a$. a and $b(H_{it})$, time spent on work and caregiving, are calibrated due to data limitation. a is calibrated to 45 hours per week, the mean hours of a full-time job. b(mild ADL), b(moderate ADL), and b(severe ADL) are calibrated to 100, 87, and 60 hours per week. These numbers are based on data from Directorate-General of Budget, Accounting and Statistics, Executive Yuan (1989-2011) and Department of Health (2013), respectively. Parental health status, H_{it}, is taken directly from the data, where "Severe ADL" corresponds to those with a Barthel Index of 0 to 35, "Moderate ADL" corresponds to 35 to 60, and "Mild ADL" corresponds to 60 to 95. Eligibility of hiring an international caregiver $E_{it} = 1$ if $\{H_{it} = \text{Severe ADL}\}$ or $\{H_{it} = \text{Moderate ADL} \cap \text{Parent Age}_{it} \geq 80 \cap t > 2012\}$.

5.2 Estimation Procedure

We adapt Arcidiacono and Miller (2011) to estimate the model. We first predict the type for each individual according to the prior distribution.[20] Given the type, we estimate the selection corrected health and wage processes. We then estimate the full model by simulated method of moments, where the moments are conditional on types. We describe

[20]For the initial guess of the type distribution, we use K-means clustering on individual mean labor supply and the mean wage.

the moments targeted in Section 5.3. The model is solved by backward induction. With these estimated parameters, we update the posterior probability of belonging to a specific type. With the posterior distribution of types, we predict the type for each individual according to the posterior distribution. We then iterate the procedure until the parameters estimated converge.

We assume two unobserved types of children. As summarized in Aguirregabiria and Mira (2010), permanent unobserved heterogeneity poses an issue for the initial value. We take the standard solution by allowing the probability of being a type to correlate with the initial distribution of the state variables in the model. The estimation details of types are in Appendix E.1.

5.3 Results

We report the preference estimates by first discussing target moments and model fit. Since the parameters estimated are themselves difficult to interpret, we report model fit and key economic quantities implied by the model, such as labor supply elasticities and the reservation wages. A table of estimated parameters appears in Appendix E.3. Other estimation results, including the health processes, are discussed in Appendix E.2.

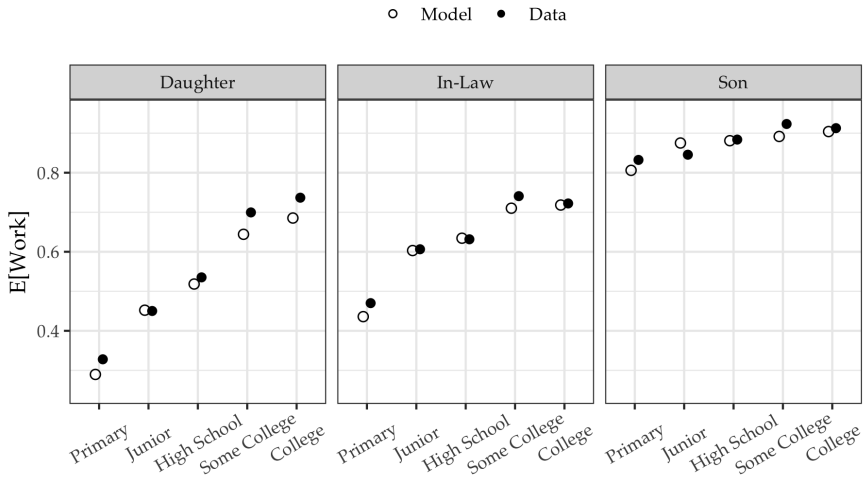
When estimating preference parameters, we choose three sets of target moments. These target moments include (i) the share of individuals working conditional on education, (ii) the share of individuals working conditional on parental health status, and (iii) the share of individuals working conditional on lagged work choices and effects of hiring eligibility. We discuss the choice of these target moments and their fits.

Fit of Education. The first set of target moments is the share of children working conditional on education. This set of moments is important since education is a key determinant of a child's wage. A higher-educated individual has greater potential wages, and thus, she is more likely to participate in the labor market and hire a caregiver. Intuitively, this variation provides information on the trade-offs between consumption and care provision.

The model closely replicates data in the share of children working conditional on

education. This is shown in Figure 7, where white points represent model simulations and black points represent data. In both the model and the data, the share of working children increases as educational attainment increases.

Figure 7: Fit of Moment: E[Work|Education]



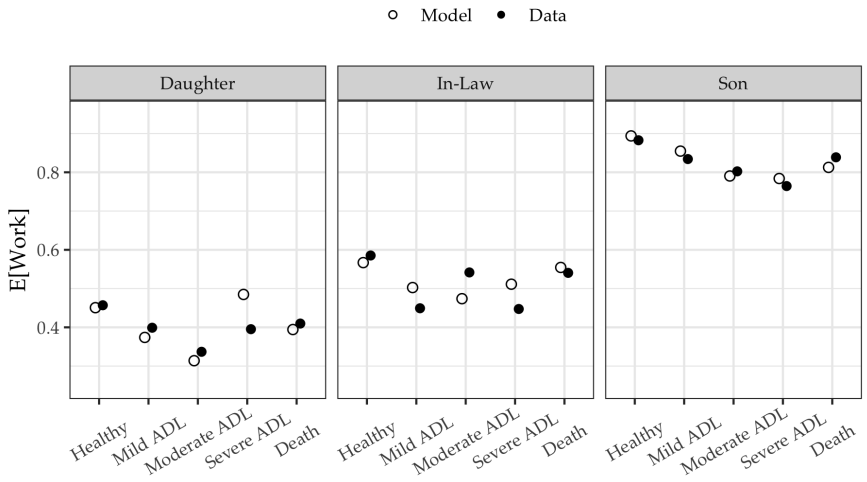
Notes: White points represent the data; black points represent the model simulation.

Fit of Health. The second set of target moments is the share of children working conditional on parental health status. Since the model assesses various policy counterfactuals regarding LTC needs, it is essential for it to replicate work decisions conditional on various parental health statuses.

The model captures the relative share of working children conditional on parental health in the data, as shown in Figure 8. Consistent with the data, the model predicts that when parents have LTC needs, the share of children who are working is smaller.

Fit of Persistence and Eligibility. The third set includes moments that capture persistence in the model and effects of eligibility of hiring international caregivers. The share of people working conditional on lagged choices is important to fitting the dynamics of working, and informative for adjustment of the cost parameter, θ_F, in the model. We also target the DiD estimate of the eligibility effect. This moment is important to estimating shadow prices of hiring caregivers and the counterfactual effects of other eligibility

Figure 8: Fit of Moment: E[Work|Health]



Notes: White points represent the data; black points represent the model simulation.

criteria.

These moments fit the data reasonably well, as shown in Table 2. The model replicates closely the probability of working conditional on working during the last period. The model under-predicts the probability of working conditional on not working last period. However, the predicted probabilities conditional on not working are still much smaller than the predicted probabilities conditional on working. The model also captures effects of being eligible for hiring international caregivers.

Table 2: Fit of Other Targeted Moments

	Daughter		Children-In-Law		Son	
Moment	Data	Model	Data	Model	Data	Model
$E[\text{Work}_{it}\|\text{Work}_{it-1}]$	0.855	0.918	0.885	0.925	0.954	0.949
$E[\text{Work}_{it}\|\text{Not Work}_{it-1}]$	0.084	0.058	0.091	0.018	0.146	0.123
DiD Eligibility Effect	0.119	0.056	0.119	0.127	0.119	0.080

Notes: $E[\text{Work}_{it}|\text{Work}_{it-1}]$ and $E[\text{Work}_{it}|\text{Not Work}_{it-1}]$ are estimated by empirical probabilities. "DID Eligibility Effect" in the data corresponds to the estimates in Section 3.6. The corresponding moment in the model is calculated using the same criteria of eligibility reforms.

5.4 Model Validation with Untargeted Moments from 2015 Reform in Eligibility

In addition to the reform in 2012 that we use to estimate the model, there is another reform to eligibility of hiring international caregivers implemented in August 2015. The 2012 reform granted those over age 80 with moderate ADL the permission to hire international caregivers. After the 2015 reform, those over age 85 with mild ADL are also eligible.

This reform provides an opportunity to test the model's performance in predicting policy effects. We assemble a new and independent sample, linking the new 2015 wave of TLSA with NHIRD from 2015 to 2018.[21] As a validation exerciese, this sample is not used elsewhere in the current study.

We use the same DiD design as in Section 3.6. For this reform, treatment group is those over age 85 and are eligible after the reform, and control group is those over age 85 and are eligible even before the reform. Results are shown in Table 3, with a graphical illustration in Appendix E.4. The difference in difference estimates suggest a 0.019 increase in children's labor market participation.

Table 3: Effects of Reform in 2015

	Reform 2015
Treatment × Post	0.019
	(0.043)
Treatment	0.003
	(0.090)
Post	−0.059
	(0.028)
Intercept	0.528
	(0.059)

Notes: The outcome variable is the binary variable of whether a child works. Standard errors are in the parentheses and are clustered at the individual level. The sample includes children aged 25 to 65.

The estimated effects are considerably smaller than the 2012 reform. The first reason

[21] The sample is constructed in the same way as the main sample.

is that health criteria are different. In the 2012 reform, those whose parents have moderate ADL are benefited, while in the 2015 reform, parents with mild ADL are benefited. For the less severe ADL condition, the substitution between working care providing is smaller. Another reason is the age effect. Children whose parents are over age 85 are older than those whose parents' ages over 80. Baseline labor market participation is smaller for children affected by the 2015 reform.

We simulate the model for the same reform, and compare labor market participation under two different policy. The effect we estimated from our model suggest an average effect of 0.025, and this coincides the estimates from the 2015 reform in the data. Although the estimates from 2015 is less precise due to a smaller number of parents over age 85, the results suggest that the model replicate the out-of-sample effects of reform closely.

In addition to the reform estimates, we also assess the age profiles of labor supply, which we do not target explicitly. By comparing the data moment with the model prediction, we provide an additional validity check of the estimated model in Appendix F.

6 Economic Mechanism

Before we conduct counterfactual analyses on policies, we examine the behavioral responses and welfare effects of LTC needs through the lens of our estimated model. We also study the model implied labor supply elasticities and reservation wages in Appendix G.1 and G.2. These analyses form the building blocks for policy counterfactual analyses in Section 7.

We assess how many people leave the labor market and do not return due to LTC provision. We consider two scenarios across three periods. In scenario (i), parents are healthy during period one, have moderate ADL needs during period two, and die during period three. In scenario (ii), parents are healthy during period one, die during period two, and die during period three.[22] We then calculate the difference in their labor supply during period three between the scenarios. The difference suggests how much more a

[22]Since health processes are endogenous, the counterfactual analysis is conducted through changing potential health outcomes for both choices.

person will work, were it not for LTC responsibilities.

Table 4: Difference in Labor Supply After Parent's Death

	Sequence: Healthy, ADL, Dead		Sequence: Aggregate Sequence in Data			
			Short-Run		Long-Run	
	(1)	(2)	(3)	(4)	(5)	(6)
Name	Baseline	$\theta_F = 0$	Baseline	$\theta_F = 0$	Baseline	$\theta_F = 0$
Daughter	-19.4	-0.7	-9.3	-0.8	-4.0	-0.1
Children-In-Law	-4.1	-1.1	-1.7	0.3	1.6	-0.6
Son	-5.2	0.1	-6.8	0.6	-2.8	0.6
Primary	-18.1	-1.4	-10.2	-1.3	-5.4	-0.7
Junior	-6.3	-0.3	-7.3	0.5	-3.3	0.5
High School	-6.8	-0.1	-6.8	0.8	-3.1	0.2
Some College	-3.2	-0.7	-6.3	0.8	-4.2	-0.1
College	-3.5	0.4	-5.4	-0.3	-1.9	0.9

Notes: In "Sequence: Healthy, ADL, Dead," we compare two sequences of parental health outcomes: (i) healthy, moderate ADL, dead, and (ii) healthy, dead, dead. In "Sequence: Aggregate Sequence in Data," we average the differences between pairs of parental health sequences. Each pair of sequence includes (i) healthy at $t = 0$, s periods of ADLs starting from time $t = 1$, and then dead at $t = s + 1$, and (ii) healthy at $t = 0$, and then dead at $t > 0$. "Short-Run" reports the comparison of labor supply at time $t = s + 1$, and "Long-Run" reports the average of difference for $t \geq s + 1$. "$\theta_F = 0$" corresponds to results from simulations with $\theta_F = 0$ in the model.

Results. We report results in Table 4. Column (1) shows the result of counterfactual analysis. The reduction in labor supply is significant for daughters, but also non-trivial for sons and children-in-law. If a daughter experiences parental LTC needs, she participates in the labor market nearly 20% less than in the LTC-free scenario. The difference in labor supply is decreasing in education since the higher educated people do not leave the labor market in the first place. Column (2) shows that these patterns result from the adjustment costs in the model. If we remove adjustment costs θ_F, nearly no difference is evident between the two counterfactual sequences. This shows that adjustment cost plays an important role in the model. Data on the individual experience, occupation, industry, and even job searching process in the labor market is needed to further understand the mechanism that generates the adjustment costs. Due to limitation on data, we explore the role of experience in Appendix C.4 and leave other mechanisms for future investigation.

Next, we present results using the distribution of parental health sequences in the data. In Column (3) to Column (6), we examine the evolution of parental health. As for the comparison sequence, we again construct counterfactual scenarios in which parents pass away immediately instead of incurring LTC needs. Column (3) shows that during the period in which a parent passes away, daughters whose parents had LTC needs have a 9.3% less probability of working than those whose parents never had LTC needs. Although results are less extreme compared to Column (1), similar heterogeneity is evident for this case. By ways of comparison, this magnitude is similar to fertility effects on female labor supply in the Taiwanese literature. For example, Ebenstein (2007) finds a 10% decrease in mother's probability of working when having a third child in Taiwan.

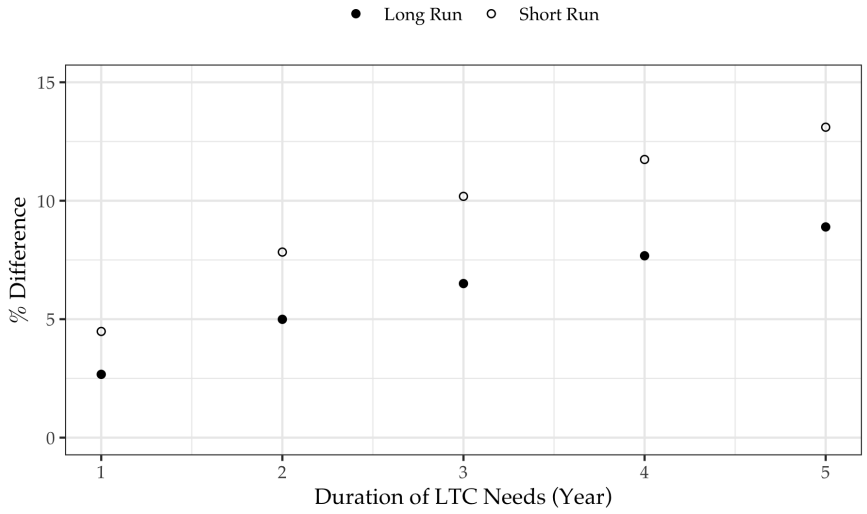
Instead of investigating the period subsequent to parents' deaths, Column (5) shows the long-run effects. Overall, the effects are smaller in the long run, since preference and wage shocks dilute effects from previous LTC needs. However, we still find a 4% smaller labor supply for the daughters in the long run, suggesting how profoundly parents' LTC needs affect careers.

Visualization. Figure 9 reports results of the counterfactual analysis. We plot the average decrease found in the short run and in the long run, with the x-axis representing the duration that children experience LTC responsibilities. Consistent with the pattern in Table 4, the differences are smaller in the long run than in the short run.

The difference is also increasing in the duration of LTC needs. If LTC needs last for only a year, the difference is about 5% in the short run. However, if LTC needs last for 5 years, the difference is approximately 13%. This difference results from expectations the children have regarding their parents' health. Consider a case in which an old parent experiences a severe fall and her health status changes suddenly from healthy to severe ADL. Her son expects that she might pass away in a short time, and thus he likely stays in the labor market and hires a caregiver to avoid the costs of returning to work.

Compensating Variation. We also calculate CV between these two scenarios. The detailed definition is in Appendix E.6. We find that daughters, sons, and children-in-law

Figure 9: Difference in Labor Supply After Parents' Deaths and LTC Duration



Notes: The x-axis represents the duration that parents have LTC needs before death. The y-axis represents how much lower children's labor supply would be after parents' deaths, comparing cases with and without parents' LTC needs. A detailed construction appears in Section 6.

demand 11.3%, 3.4%, and 4.1% of mean annual wage to move from the immediate death scenario to the LTC-needing scenario, respectively. Since we compare periods after parents' deaths, the source of these CVs is the difference of the cost of returning to work. Many children stopped working to provide care, and they would need to pay a cost to return to the labor market. Therefore, we observe a positive CV to switch to the immediate death scenario.

7 Policy Counterfactuals

We now analyze three sets of common LTC policies—(i) reforms to eligibility for hiring international caregivers, (ii) LTC tax deductions, and (iii) in-kind transfers for care-receivers. These policies were all implemented in Taiwan recently, and our goal here is to understand their impacts. We first describe the background, controversy, and debates for each policy. We then revisit how parents' LTC needs affect the long-term labor supply paths of children and assess various policies' implications for this exercise. We then calculate the compensating variation (CV) for each policy and estimate their fiscal costs.[23]

[23]We also analyze policies' overall labor supply responses under current LTC needs in Appendix H

7.1 Policy Backgrounds

7.1.1 Reforms on International Caregivers Hiring Eligibility

Foreign-born caregivers constitute an essential part of LTC workers. Hiring international caregivers is regulated strictly. Those who want to hire an international caregiver must meet eligibility criteria and apply through the Ministry of Labor.[24] Eligibility criterion is a function of a care-receiver's age, ADL, and disability status. The criterion has relaxed over time, allowing more people to hire international caregivers.

From an economic point of view, allowing international caregivers to enter the country is essentially opening up the international labor market. Caregiving is a labor-intensive job. Given the vast worldwide difference in the wage rate, eligibility reform creates considerable gains from trade. As many other trade related policies, whether the eligibility criterion should be further relaxed and who would benefit from such reform remain actively debated. [25]

In this section, we simulate two counterfactual reforms. In "Relaxed Eligibility," we analyze a reform that allows everyone with moderate ADL to be eligible, and in "Limited Eligibility," we allow only those with severe ADL to be eligible, even for those over age 80 who were also eligible with only moderate ADL previously. More radical reforms that grant eligibility to everyone or forbid international caregivers are analyzed in Appendix I.

7.1.2 Tax Deductions

Tax deductions and credits for LTC are also common worldwide, including in Belgium, Canada, France, Germany, and Ireland. The Taiwanese government initiated an LTC tax deduction program in 2020, providing a means-tested tax deduction for those with a

[24]The Ministry of Labor issues visa application permissions to those applying for an international caregiver, and then permission is taken to recruitment agencies to hire an international caregiver.

[25]These are active debates in Parliament. One parliament member stated, *"Japan is now importing international labor ... Our source countries are similar ... How do we compete with Japan in this market?"* The Director of Workforce Development Agency said, *"We still want them to be complementary...We don't want them to affect domestic labor. Most importantly, we want to build our own LTC system since only that would be a stable source of LTC."* Legislative Yuan (2019*a*)

family member who has LTC needs. Each year, depending on the tax bracket, a person can deduct approximately $200 to $500 (or 25% to 61% of minimum monthly wage). This tax deduction is estimated to benefit 0.3 million people, with a tax revenue loss of 2 billion NT dollars, or 0.1% of total tax revenue (Legislative Yuan, 2019*b*). As a tax deduction, this policy benefits only those with a job and income. Work incentives and the distribution of benefits are primary topics during discussions of the policy.[26]

The tax deductions we analyze in this section are the same as what the Taiwanese government implemented in 2020. Children who work and hire caregivers could benefit from tax deductions subject to means tests.

7.1.3 In-Kind Transfers

In-kind transfers are common among developed countries, including Canada, Japan, and Portugal (Colombo et al., 2011). In Taiwan, the in-kind transfer program is part of the LTC 2.0 program, launched in 2017. The program is a means-tested policy that provides in-kind subsidies with broad availability for those with LTC needs.[27] People with disabilities, over age 50 with dementia, or anyone over age 65 with LTC needs are eligible for this program. Importantly, those in nursing homes or who hire caregivers can claim only a minimal amount of transfer. Whether to provide transfers and how to distribute them are central to policy debates.

The in-kind transfers we analyze are similar to the one implemented in 2017. Children who provide care themselves are eligible for in-kind transfers. The transfers for severe, moderate, and mild ADL are 90, 50, and 25 hours of care per month, respectively. We assume that an hour of care provided by a child is equivalent to an hour of care from in-kind transfer.

[26]Family members of people with LTC needs are eligible for the deduction. The debate on this policy lies in its scale and how applicable it is. In the form of tax deduction, "those who stay at home and provide care without income will not benefit." Legislative Yuan (2019*c*)

[27]Items subsidized include (i) personal and professional care, (ii) transportation to hospitals, (iii) assisted devices purchases and rentals, and (iv) respite care for family caregivers. See Hsu and Chen (2019) for an introduction to the program.

7.2 LTC Responsibility and Returning to Work

Table 5: Difference in Labor Supply After Parents' Deaths Under Various Policies

Specification	(1) Status Quo	(2) Relaxed Eligibility	(3) Limited Eligibility	(4) Tax Deduction	(5) In-Kind Transfer
Daughter	-9.3	-4.7	-9.2	-6.5	-12.0
Children-In-Law	-1.7	7.7	-2.2	-0.4	-5.7
Son	-6.8	-3.7	-6.8	-3.1	-10.6
Primary	-10.2	-4.6	-9.5	-6.5	-13.9
Junior	-7.3	-2.9	-6.9	-3.4	-10.4
High School	-6.8	-3.1	-7.6	-3.9	-10.5
Some College	-6.3	-3.8	-6.8	-3.7	-9.2
College	-5.4	-3.1	-6.0	-2.6	-8.9

Notes: This table reports short-run returning to work comparisons using the data health sequence under various policies. The details are the same as in Table 4. In particular, Column (1) replicates Column (3) in Table 4.

Results Under Different Policies. The comparisons among parental health sequences in Section 6 have vastly different results if different LTC policies are implemented. Table 5 reports the comparison in the short run. Column (2) shows that, when eligibility criterion is relaxed, the differences in labor supply after parents' deaths are smaller, resulting from a cheap source of caregivers.[28] A tax reduction also reduces the tendency in which one leaves and returns to the labor market, as shown in Column (4).

Column (3) and Column (5) show that both limiting the international caregivers hiring eligibility and providing in-kind transfers increase labor-market leaving. An individual must provide care herself to be eligible for in-kind transfers, so the program discourages working and hiring.

[28]The positive number of children-in-law results from their high labor supply elasticity. They are willing to work and pay for the international caregiver so much that the probability of work is even higher than the case without LTC needs.

7.3 Compensating Variation

Another important aspect is how much people value the policies. We simulate the scenarios that implement the policies above, focusing on those whose parents have LTC needs at the first period of the simulated data. We report the average compensation that individuals require during the first period if we remove the policy. We thus report the CV for each policy. We normalize the CVs to the mean annual earnings to ease comparison.

The CV decomposes into two parts for each subgroup. The first is the share of individuals affected by the policy in the subgroup, and the second is how an affected individual value the policy. Taking the tax deduction as an example, the CV for those who benefit from the policy is similar. However, since more sons are working, they have higher overall CV for the policy. Table 6 reports total CV, the share of affected individuals, and the CV for affected individuals. Each policy is shown in its own column.

Reforms on International Caregivers Hiring Eligibility. The table shows that daughters and children-in-law value eligibility for hiring more than sons do. Although more sons are working, overall CVs are higher for daughters and children-in-law. The CV of affected individuals is not monotonic in children's education. For the higher-educated people, eligibility to hire an international caregiver prevents them from sacrificing higher wages if they ever decide to leave the labor market. For the lower-educated people, although the wages they sacrifice are smaller, they are more likely to leave the labor market and return at the first place. Therefore, we find non-monotonic effects in children's education.

Tax Deductions. The scale of CVs is small for a tax deduction policy. Since tax deductions are monetary transfers, CVs are similar across individuals. Small discrepancies are caused by the means-testing design and the tax bracket to which an individual belongs. Variance in the CVs results almost entirely from the share of people affected. For example, since more sons are working, they benefit most from tax deductions.

In-Kind Transfer. Unlike with tax deductions, individuals value in-kind transfers differently. Daughters and children-in-law value the policy more than sons do, and since few sons are benefiting from in-kind transfers, the contrast is more prevalent.

In addition to the heterogeneity of the relationship with care-receivers, in-kind transfers also benefit lower-educated people and those with severe ADL needs more. Total CV of in-kind transfers is monotonically decreasing in education. Since more severe ADL gets more hours of in-kind transfers, total CV increases with LTC needs. Groups that benefit more from in-kind transfers link with economically disadvantaged groups, and this redistributive property could represent the government's argument for this LTC policy.

Table 6: Compensating Variation

Name	Relaxed Eligibility			Limited Eligibility			Tax Deduction			In-Kind Transfer		
	Total CV	Affected Share	Affected CV	Total CV	Affected Share	Affected CV	Total CV	Affected Share	Affected CV	Total CV	Affected Share	Affected CV
Daughter	0.017	0.038	0.457	-0.011	0.024	-0.470	0.038	0.437	0.087	0.051	0.534	0.096
Children-In-Law	0.057	0.045	1.282	-0.095	0.068	-1.399	0.037	0.442	0.084	0.075	0.527	0.143
Son	0.010	0.067	0.145	-0.011	0.080	-0.142	0.095	0.824	0.115	0.002	0.047	0.048
Primary.	0.014	0.044	0.324	-0.017	0.035	-0.471	0.048	0.514	0.094	0.049	0.486	0.101
Junior	0.033	0.059	0.560	-0.034	0.053	-0.640	0.081	0.738	0.109	0.029	0.262	0.109
High School	0.020	0.060	0.336	-0.019	0.065	-0.301	0.081	0.745	0.109	0.021	0.207	0.102
Some College	0.008	0.052	0.147	-0.013	0.066	-0.204	0.070	0.629	0.112	0.009	0.106	0.087
College	0.012	0.047	0.261	-0.030	0.105	-0.286	0.044	0.410	0.107	0.008	0.086	0.093
Mild ADL							0.066	0.617	0.107	0.031	0.332	0.094
Moderate ADL	0.133	0.360	0.368	-0.153	0.377	-0.405	0.059	0.587	0.100	0.034	0.292	0.117
Severe ADL							0.054	0.591	0.092	0.038	0.281	0.135

Notes: "Total CV" and "Affected CV" are normalized by mean annual wage. For example, a daughter's total CV for relaxed eligibility, 0.017, means that she requires 1.7% of the mean annual wage to accept removal of this policy. "Affected Share" represents the share of those affected by the policy among children whose parents have ADL needs.

7.4 Fiscal Costs

Description of Comparison Exercise. By allowing more international caregivers to enter the country, eligibility reforms create gain of trade and are pure efficiency gains without fiscal costs. In contrast, tax deductions and in-kind transfers are costly for the government to implement. In Table 7, we compare both policies' fiscal costs when they are implemented. The calculation does not include administrative costs, and we assume full take-up for both policies.

Results. Column (1) shows average spending on those benefited. Spending on tax deductions is more than twice as large as on in-kind transfers per beneficiary. Since more

Table 7: Costs and Benefits

Policy	Costs			Benefits	
	(1) Per Beneficiary Spending ($USD/Year)	(2) Normalized Total Spending	(3) Tax Revenue from Behavior Changes	(4) Beneficiary Mean CV	(5) % Benefited Among ADL
(a) In-Kind Transfer	149.71	0.240	-0.00067	0.079	0.324
(b) LTC Tax Deduction	330.13	1.000	0.00059	0.099	0.612
(a)/(b)	0.453	0.240	-1.136	0.899	0.529

Notes: "Normalized Total Spending" sets the total spending on LTC tax deduction to 1.

people are working and hiring, total spending on in-kind transfers is only a quarter of that on tax deductions, as Column (2) shows.

One might argue that tax deduction could incentivize work, and hence the real cost will be smaller due to increased tax revenue. However, additional tax revenues from labor supply responses is only 0.00059 times total spending on the policy, as shown in Column (3). Similarly, additional tax losses from discouraging work by an in-kind transfer policy are negligible. The CV generated by the in-kind transfer policy is about 89.9% of the one generated by tax deductions for an average beneficiary. The cost of the in-kind transfer program per beneficiary is only 45.3% of the tax deduction policy, suggesting that in-kind transfer represent the more cost-effective program. However, compared to the mean beneficiary CV of reforms on eligibility, 0.399, the in-kind transfer program is far from the best.

8 Conclusion

We assess the children's labor supply responses to elderly's LTC needs, analyzing the effects of LTC policies on such responses. Using data from Taiwan, we first document that children are 4 percentage points less likely to participate in the labor market when parents' LTC needs arise, with daughters, the less educated, and older children having the largest decreases in labor supply. Only a small share of children return to the labor market if their LTC-needing parents pass away.

Motivated by the descriptive findings, we then build and estimate a dynamic labor supply model, combining the descriptive evidence with an exogenous variation in care-

givers' prices from a policy reform in Taiwan. The model features costs of returning to work, endogenous health processes, and unobserved heterogeneity in care and labor market skills. Model-based results suggest large costs of returning to work, especially for daughters and the less educated.

By simulating commonly implemented LTC policies, including changing eligibility criteria for hiring international caregivers, LTC tax deduction, and in-kind transfers, we find vastly different labor supply responses to LTC needs and welfare implications. Relaxing or restricting eligibility of hiring international caregivers will have huge impacts on LTC arrangements and children's welfare. Tax deductions and in-kind transfers have different effects, appearing in whether children stay in the labor market when parents experience LTC needs and the set of children benefited from the policies. However, compared to relaxing LTC eligibility, both tax deductions and in-kind transfers are less cost-effective.

In this paper we quantify how international caregivers are an essential part of the LTC system. The international aging trend is expected to increase the demand for international caregivers. Preparing for increasing costs and understand alternative options are important. The Taiwanese government recently began expanding community-based LTC institutions, trying to provide more diverse and flexible LTC services that focus on professional and preventive care. If these services could be accessed easily, labor-intensive and low-skilled focused care could change in the future. The potential effects are beyond the scope of this paper, but they would be interesting and important issues for future studies.

For Online Publication

Appendix A Data Construction Details

A.1 ADL Measure Construction

We construct our ADL measure using the TSLA that is consistent with the eligibility rules for hiring international caregivers. The eligibility rule uses the Barthel Index as a measure of ADLs. The index maps the performance of ten ADL items to a scale between 0 and 100; the lower the index, the more severe the health condition.

The ten items that the Barthel Index considers include grooming, feeding, transfers, toilet use, walking, dressing, climbing stairs, bathing, urinary incontinence, and fecal incontinence. The index considers each of these ten items separately and sums them up. For example, if a person is capable of climbing stairs by herself, she gets 10 points from that item. If she needs supports from someone to climb stairs, she gets 5 points, and if she cannot climb stairs even with support, she gets 0 points.

Severe ADL corresponds to those with a Barthel Index of 0 to 35. Moderate ADL corresponds to 35 to 60, and mild ADL corresponds to 60 to 95. The TLSA includes questions regarding feeding, transfers, toilet use, walking, dressing, climbing stairs, and bathing. On average, the correlation between ADL items is approximately 0.7. Since all ADL items are highly correlated, we assume that individuals have difficulties with grooming, urinary, and fecal incontinence whenever they report any other ADL difficulties. The assumption does not create an issue for descriptive analysis. One concern is the eligibility criteria, and we tend to overstate the severity of an individual's health if bias exists in the measurement. In that case, estimates of the effects of eligibility represent a lower bound, since some of those labeled as treatment groups are in fact control groups.

A.2 NHIRD Construction

The NHIRD provides a link to TLSA data. The link is created using parents' national identification number in TLSA data. Since the national identification number is unique

for each individual, parents' information can be linked perfectly.

The NHIRD also provides information on the family structure. Due to the design of the National Health Insurance, a person becomes a dependent of one of her family members if she does not have a job. We can thus infer the family relationship from this dependent structure. When we track children's information after parents pass away, we rely on the dependent structure to infer children's information.

Under this structure, one concern may is that the set of children we track is incomplete, and hence estimation of labor supply effects after parents pass away is biased. However, a child identified through a parent is more likely to bear LTC responsibility, and thus, if this set of children leads to biased estimates, we would overestimate returning to work given that these children are more responsive to LTC-related events. This means that the cost of returning to work would play an even more important role than analyses currently suggest.

Appendix B Additional Descriptive Results

In Section 3, we provide descriptive evidence visually, and we present estimations in Table 8. These estimates are equivalent to an average of estimates before and after corresponding events.

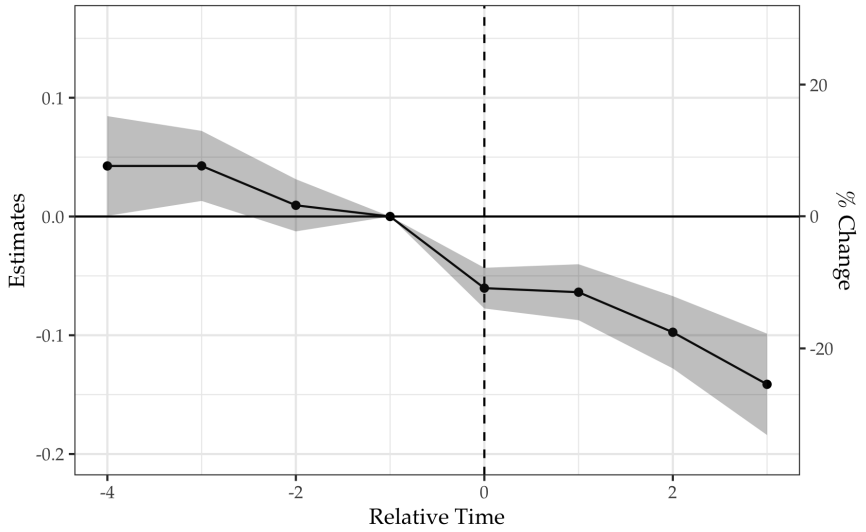
We report results when LTC needs arise, using both baselines in Section 3. We report results for the two baselines separately in Figures 10 and 11.

Table 8: Average Effects

	ADL Needs	Death	Reform
Affected Group × Post	−0.04	−0.03	0.12
	(0.01)	(0.04)	(0.05)
Affected Group	−0.02	0.10	−0.08
	(0.01)	(0.05)	(0.09)
Post	0.01	−0.00	−0.07
	(0.00)	(0.00)	(0.04)
Intercept	0.70	0.73	0.66
	(0.00)	(0.02)	(0.07)
N	928,044	566,286	4,835
R^2	0.00	0.00	0.00

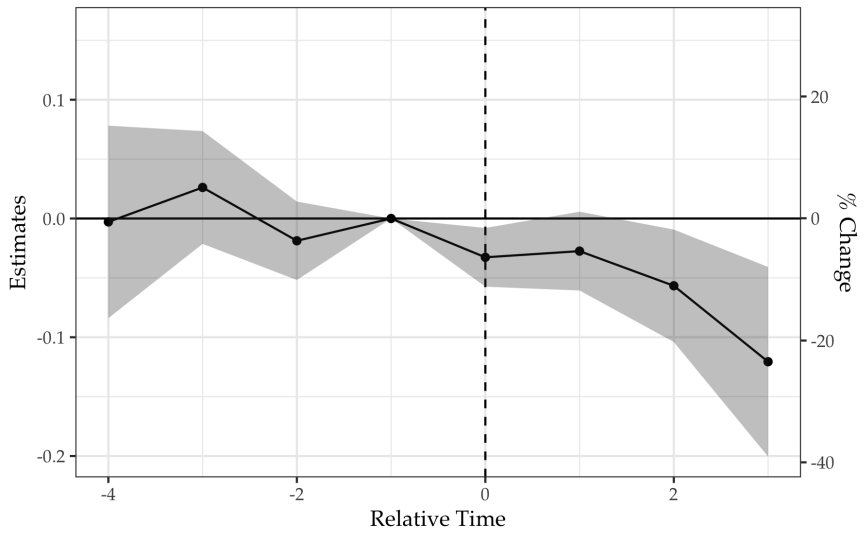
Notes: The outcome variable is the binary variable of whether a child works. Standard errors are in the parentheses and are clustered at the individual level. The sample includes sons, daughters, and children-in-law aged 25 to 65. The samples are reweighed by the propensity score estimated by their age in the estimation.

Figure 10: Labor Supply Responses for Daughters When LTC Needs Arise (First Baseline)



Notes: The event is when parents first report any ADL in the data. The outcome variable is the binary variable of whether a child works. The right y-axis represents the percent change relative to the baseline group mean of the baseline period. The baseline period is -1. Each event time corresponds to a wave of the TLSA. The shaded area represents the 90% confidence interval. Standard errors are clustered at the individual level. The sample includes daughters aged 25 to 65. The baseline group consists of those whose parents never have LTC needs. The samples are reweighed by the propensity score estimated by their age in the estimation.

Figure 11: Labor Supply Responses for Daughters When LTC Needs Arise (Second Baseline)



Notes: The event is when parents first report any ADL in the data. The outcome variable is the binary variable of whether a child works. The right y-axis represents the percent change relative to the baseline group mean of the baseline period. The baseline period is -1. Each event time corresponds to a wave of the TLSA. The shaded area represents the 90% confidence interval. Standard errors are clustered at the individual level. The sample includes daughters aged 25 to 65. The baseline group consists of those whose parents have LTC needs later. The samples are reweighed by the propensity score estimated by their age in the estimation.

B.1 Heterogeneity Results

Table 9: Labor Supply Responses When LTC Needs Arise

	$X_i =$	
	(1) High School	(2) Young
LTC Need × Post × $\mathbf{1}\{X_i = x\}$	0.03	0.03
	(0.01)	(0.01)
LTC Need × Post	−0.05	−0.05
	(0.01)	(0.01)
Post	0.00	0.01
	(0.00)	(0.00)
LTC Need	0.00	−0.02
	(0.01)	(0.01)
$\mathbf{1}\{X_i = x\}$	0.17	0.03
	(0.01)	(0.01)
Intercept	0.61	0.69
	(0.00)	(0.01)
N	928,044	928,044
R^2	0.04	0.00

Notes: The outcome variable is the binary variable of whether a child works. Standard errors are reported in parentheses and are clustered at the individual level. The sample includes sons, daughters, and children-in-law aged from 25 to 65. The baseline group includes those who never have LTC needs and those who had LTC needs later. The samples are reweighed by the propensity score estimated by their age in the estimation. "Young" represents children aged 25 to 40.

Appendix C Alternative Model Specification

C.1 Choice Specification

The choice is assumed to be binary in our model. This vastly simplifies the model identification. This simplification rules out the case in which one hires a caregiver but does not work. In the data, approximately 10.8% of the children report that they hire a caregiver but do not work.

There are 32.9% of children who work but do not report hiring a caregiver. However, the average time one needs to take care of their parent for mild ADL is 60 hours per week. It is hard for those people to have a full-time job and take care of their parents simultaneously. Most likely, these children ask relatives or other siblings to provide a certain amount of care. Sending the parents to nursing home belongs to this category.[29] The model is consistent with these possibilities since the price of hiring a caregiver is interpreted as a shadow price. The rationale of this choice specification is to capture the trade-off between the time endowment and the costs of care provision.

C.2 Savings

In the LTC literature, most papers that include savings in their model focus on how parents save to insure against future ADL shocks. (For example, Mommaerts, 2020 and Barczyk and Kredler, 2018.) In the current study, the focus is on children's decisions. In addition, as discussed in Section 3.5, most parents have few assets in the data, and thus parents' savings should be less concerning.

Similar to the current study, some papers in the literature that also focus on children abstract away from saving decisions. (For example, Skira, 2015.) The main reason that we do not include savings in the model is data limitation; there is no good asset information for children in our data. To address this concern, we build a stylized two-period model that includes saving decisions. With this simplified setup, it is possible to infer in which direction would savings shift results.

[29] However, staying in nursing homes is less common due to social stigma.

C.2.1 A Stylized Model with Saving Decision

Consider a two-period model for individual i. Individual i's problem is to maximize the lifetime utility:

$$U_i = C_{i0}^{\alpha} L_{i0}^{1-\alpha} + \beta C_{i1}^{\alpha} L_{i1}^{1-\alpha},$$

where C_{i0} denotes i's consumption at period 0, L denotes leisure, and β denotes discount factor. Individual i faces the following constraints:

$$\begin{aligned} W(D_{i1} + rD_{i0}) &= C_{i1} + rC_{i0} + PD_{i1}H_{i1} + rPD_{i0}H_{i0}, \\ L_{i0} &= 1 - aD_{i0} - b(1 - D_{i0})H_{i0}, \\ L_{i1} &= 1 - aD_{i1} - b(1 - D_{i1})H_{i1}, \end{aligned}$$

where W denotes wage, r denotes interest rate, D denotes individual's work decision, H_{i0} and H_{i1} denote indicator of parents' LTC needs, and P denotes the price of a hiring caregiver. The first constraint links total spending and total earnings in both periods, and the rest constraints specify time usages as in the main model.

We show that when parents have LTC needs, children work less in the world allowing savings than in the world not allowing savings. For simplicity, we assume that individuals know that $H_{i0} = 0$ and $H_{i1} = 1$.

First consider the world with savings. Children must have positive savings, since in the second period their parents need LTC. Due to the curvature in the utility function, children smooth consumption by saving in the first period. Denote the amount an individual saves as S.

Next, consider the world without savings. Since the only decision is whether $D_i = 0$ or $D_i = 1$, we write the consumption under $D_i = 1$ as C_{Work} and the consumption under $D_i = 0$ as $C_{\text{Not Work}}$. The utility comparison an individual makes in the second period is then $C_{\text{Work}}^{\alpha}(1-a)^{1-\alpha}$ versus $C_{\text{Not Work}}^{\alpha}(1-b)^{1-\alpha}$. She will work if and only if $C_{\text{Work}}^{\alpha}(1-a)^{1-\alpha} \geq C_{\text{Not Work}}^{\alpha}(1-b)^{1-\alpha}$. Similarly, for an individual in the world with savings, she will work if and only if $(C_{\text{Work}} + rS)^{\alpha}(1-a)^{1-\alpha} \geq (C_{\text{Not Work}} + rS)^{\alpha}(1-b)^{1-\alpha}$.

With the decision rules above, we discuss the implications of savings in the model.

We focus on the decisions in period two. Consider a case where an individual works in a world with savings but does not work in a world without saving. Then the following conditions must be satisfied:

$$(C_{\text{Work}} + rS)^{\alpha}(1-a)^{1-\alpha} \geq (C_{\text{Not Work}} + rS)^{\alpha}(1-b)^{1-\alpha},$$
$$(C_{\text{Work}})^{\alpha}(1-a)^{1-\alpha} \leq (C_{\text{Not Work}})^{\alpha}(1-b)^{1-\alpha},$$

which implies that

$$\frac{C_{\text{Work}}}{C_{\text{Not Work}}} \leq \frac{C_{\text{Work}} + rS}{C_{\text{Not Work}} + rS},$$

and thus $C_{\text{Work}} \leq C_{\text{Not Work}}$. If a child's wage is higher than the price to hire an caregiver, then this condition is not satisfied. On the other hand, if we consider a case where a child works when not allowed to save but does not work when allowed to, then we have the opposite implication.

In summary, analyses above suggest that by allowing for savings in the model, it is more likely to observe children with low wages to leave the labor market due to parents' LTC needs.

C.3 Alternative Household Structure

C.3.1 Motivation

Our model has a unitary household. In the main model, there is only a child making all the decisions and a parent whose only role is to be taken care of. In the LTC context, it is reasonable to have the elderly parent not participating in the decision process. However, one may argue that there are potentially other members in the household. The main model is compatible with this setup, since the price of hiring a caregiver is an estimated shadow price, that includes the possibility of hiring another household member.

Nevertheless, it is still interesting to uncover the heterogeneity in household structures and explore its implication for the counterfactual analysis. This might also be useful for interpreting the model. For example, we have seen daughters and children-in-law

having the largest responses to parents' LTC needs. An implication is to think of the model as a model for secondary earners.

C.3.2 Setup

The extended model we consider is as follows:

$$u_{it} = \theta_C C_{it} + \theta_L L_{it} + \sum\nolimits_h \theta_h \mathbf{1}\{H_{it} = h\} - \theta_F D_{it} \mathbf{1}\{D_{it-1} = 0\} + \epsilon_{u,it}(D_{it}),$$

subject to the following constraints:

$$\begin{aligned}
C_{it} &= D_{it}(W_{it} - P^*_{it}\mathbf{1}\{H_{it} \in \{\text{Any ADL}\}\}),\\
L_{it} &= 1 - aD_{it} - b(H_{it})(1 - D_{it})(1 - \theta_{LM} M_{it}),\\
P^*_{it} &= \theta_P - \theta_{PE} E_{it} - \theta_{PM} M_{it},\\
E_{it} &= E_{it}(H_{it}, X_{H,it}, \text{Reform}_t).
\end{aligned}$$

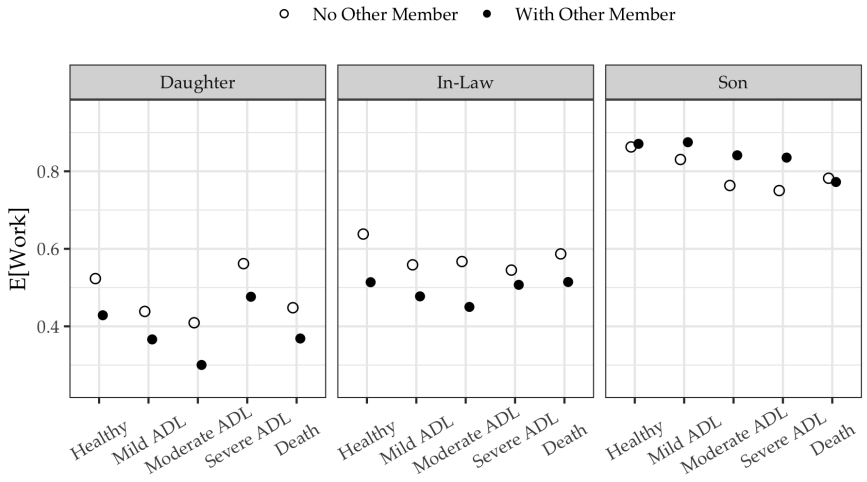
The flow utility remains unchanged from the main model in the paper. In the constraints individual faces, M_{it} is an indicator of whether this household has people other than the child and the parent. $M_{it} = 1$ if the child or the parent's spouse is also in the household. $M_{it} = 0$ if neither the child or the parent has a spouse living in the same household.

This additional member enters the model as a potential helping hand. First, suppose one decides to provide LTC by oneself. The amount of time that a child needs to spend on providing LTC depends on whether there are other members. With a helping hand, the amount of time needed to provide care by oneself drops from $b(H_{it})$ to $b(H_{it})(1 - \theta_{LM})$. Second, the shadow price of hiring a caregiver also changes in this extension. As described in the previous section, the shadow price can also be interpreted as the price of hiring a relative or friend. In this case, the shadow price would be θ_{PM} less since there is an additional household member that one can potentially hire.

C.3.3 Results

We estimate this version of model and highlight the difference between $M_{it} = 1$ versus $M_{it} = 0$. The share of children working conditional on parents' health and whether there is an additional member is shown in Figure 12.

Figure 12: Share of Children Working Conditional on Parental Health and Additional Member



Notes: The white points plot the case without other member ($M_{it} = 0$), while the black points plot the case with other member ($M_{it=1}$).

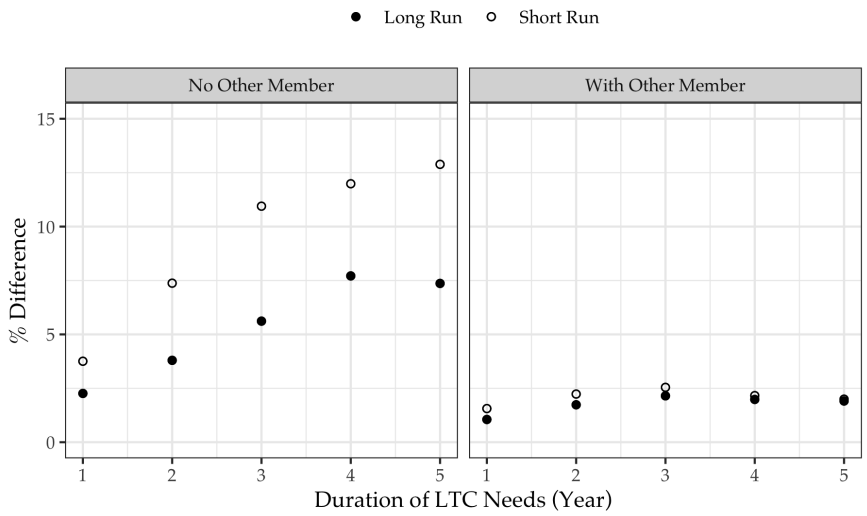
As shown in the figure, the effect of an additional member is mostly a parallel shift in share of individuals working conditional on different parental health statuses. Interesting patterns lie in the different relationships with the care-receivers. For daughters and children-in-law, the presence of an additional member decreases the share of individuals working for any parental health status. In contrast, for sons the effect of additional members goes the opposite direction.

The result is consistent with the interpretation that daughters and the children-in-law are the secondary earners in a household. When there are no other members, they act more alike as primary earners. However, when there are other members, their behavior diverges.

Next, we explore this extension's implication to our counterfactual analysis. Figure 13 presents the results. We observe that the most differences are generated from those without other members. In the case with other household members, there are much fewer

people who leave the labor market and do not return due to parents' LTC needs. As discussed in the previous section, our main specification presents an average effect. This extension further shows the large burdens and huge effects for those without additional helping hands.

Figure 13: Difference in Labor Supply After Parent's Death and LTC Duration



Notes: The x-axis plots the duration that the parents have LTC needs before death. The y-axis plots how much lower the children's labor supply would be after parents' death, comparing the cases with and without parents' LTC needs. "No Other Member" corresponds to those without other member in the household ($M_{it} = 0$), while the "With Other Member" corresponds to those with other member in the household ($M_{it} = 1$). The detailed construction is described in Section 6.

C.4 Experience and Human Capital

C.4.1 Motivation

One possible extension of our model is to add the human capital and experience aspects. The effects of experience in the labor market has been studied in classical papers in labor economics, such as Keane and Wolpin (1997).

In the context of our paper, experience in the labor market may play a role in the returning to work decision after experiencing parents' LTC needs. Conditional on the lagged choice, are the experienced more likely to keep participating in the labor market? Or would it be other case that the more experience is less likely to keep supplying labor? One way of the other, the experience effect would affect the pattern of returning to work.

Our current main model corresponds to a special case in which experienced or not is binary. The experience is fully depreciated after one stops working for one period. All the possible experience effects and human capital accumulation are loaded into the adjustment cost term in the model. In this extension, we explore how individuals with different experiences may respond to parents' LTC needs.

One major limitation in extending the model to incorporate the experience aspect is data. We do not observe the full work history, nor do the TLSA collect information on children's labor market experiences. The only proxy to the labor market experience is to use the observed work duration in the panel data.

In addition to the data limitation, this extension is going to increase the size of the state space. Currently, the state variable related to experience is whether one worked in the last period. To record the experience in the labor market, the size of the state variable will increase accordingly.

C.4.2 Setup

In response to these limitations, we take a calibration approach and extend our model to explore the possible experience effects.[30] The model we consider is as follows:

$$u_{it} = \theta_C C_{it} + \theta_L L_{it} + \sum\nolimits_h \theta_h \mathbf{1}\{H_{it} = h\} - \theta_F D_{it} \mathbf{1}\{D_{it-1} = 0\} + \underbrace{\theta_{Exp} D_{it} Exp_{it}}_{\text{experience effect}} + \epsilon_{u,it}(D_{it}),$$

where Exp_{it} denotes individual i's labor market experience at time t. This labor market experience follows a deterministic accumulation process:

$$Exp_{it+1} = Exp_{it} + D_{it} - (1 - D_{it}).$$

The flow utility is similar to the main specification. However, there is an additional experience term $\theta_{Exp} D_{it} Exp_{it}$ entering the flow utility. One interpretation of θ_{Exp} is simply

[30] We take a calibration approach instead of fully estimate the model due to state space constraint. Adding the experience state variable would increase the size of the state space dramatically and forbid the current backward induction solution method.

the wage return to labor market experience. However, by allowing the experience term to enter directly in the utility function, we allow for a more general return to experience, such as job amenity or flexible work arrangements.

The experience process is simple. By working for an additional period, one's experience increases by one. If one does not work this period, then her experience depreciates by one. A possible further extension is to allow for asymmetry in accumulating and depreciating experience stocks, but we stick to the above specification for simplicity.

C.4.3 Results

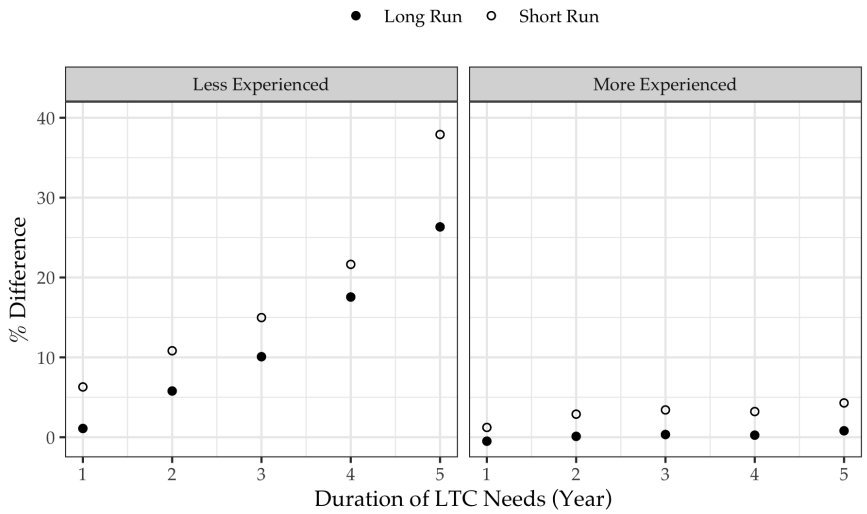
We take the parameter estimates from the main model, and then calibrate θ_{Exp} to the expectation of work conditional on the experience constructed from the observed duration of the data, Exp_{it}.

By calibrating the model to daughters' results, we find the Exp_{it} to be 0.140. First, the positive sign suggests that the more experience one has in the labor market, the more like she chooses to work. This is true even conditional on whether she worked in the last period. Second, the magnitude is large. According to the consumption parameter, θ_C, an additional year of experience translates into approximately 10% of wage increase.

To further understand the implication of experience effects to our model, we conduct the main counterfactual analysis in Section 6. The results are shown in Figure 14. For the less experienced, they have much smaller probability of being in the labor market compared with the scenario without parental LTC needs. On the other hand, for the more experienced, the differences are much smaller. The different patterns for these two groups of individuals result from the high return of labor market experiences.

While the main results in our paper present the average pattern for all experience levels, this exercise informs us of more potential heterogeneity. If the policymakers aim at preventing the permanent leave of labor market due to LTC needs, one aspect they could consider is to target those with less experience.

Figure 14: Difference in Labor Supply After Parent's Death and LTC Duration



Notes: The x-axis plots the duration that the parents have LTC needs before death. The y-axis plots how much lower the children's labor supply would be after parents' death, comparing the cases with and without parents' LTC needs. "Less Experienced" corresponds to those with experience level smaller than the mean experience level, while the "More Experienced" corresponds to those with experience level larger than the mean experience level. The detailed construction is described in Section 6.

Appendix D Identification Details

D.1 Identification of Health and Wage Processes

Roy Model Illustration. We use a two-sector Roy model framework and a simplified static model to illustrate the identification challenges and solutions. In this simplified model, there exists labor market ($D_i = 1$) and care provision ($D_i = 0$) sectors. Individuals sort into these sectors according to both observable and unobservable characteristics. Observable characteristics include gender, age, and education, and unobservable characteristics include skills in the labor market, skills with care provision, and access to other care provision support.

To illustrate, we write a static version of the model as:

$$\begin{aligned}
u_i(D_i = 1) &= W_i + H_i(D_i = 1), \\
u_i(D_i = 0) &= H_i(D_i = 0), \\
W_i &= \omega_X \mathbf{X}_{W,i} + \epsilon_{W,i}, \\
H_i(D_i = 1) &= \gamma_X(D_i = 1)\mathbf{X}_{H,i} + \epsilon_{H,i}(D_i = 1), \\
H_i(D_i = 0) &= \gamma_X(D_i = 0)\mathbf{X}_{H,i} + \epsilon_{H,i}(D_i = 0),
\end{aligned}$$

The moment conditions that can be derived from the model are:

$$E[W_i|D_i = 1, \mathbf{X}_{W,i}, \mathbf{X}_{H,i}] = \omega_X \mathbf{X}_{W,i} + E[\epsilon_{W,i}|D_i = 1, \mathbf{X}_{W,i}, \mathbf{X}_{H,i}], \quad (2)$$

$$E[H_i(D_i = 1)|D_i = 1, \mathbf{X}_{W,i}, \mathbf{X}_{H,i}] = \gamma_X(D_i = 1)\mathbf{X}_{H,i} + E[\epsilon_{H,i}(D_i = 1)|D_i = 1, \mathbf{X}_{W,i}, \mathbf{X}_{H,i}], \quad (3)$$

$$E[H_i(D_i = 0)|D_i = 0, \mathbf{X}_{W,i}, \mathbf{X}_{H,i}] = \gamma_X(D_i = 0)\mathbf{X}_{H,i} + E[\epsilon_{H,i}(D_i = 0)|D_i = 0, \mathbf{X}_{W,i}, \mathbf{X}_{H,i}]. \quad (4)$$

The choice equation is:

$$D_i = \mathbf{1}\{\omega_X \mathbf{X}_{W,i} + \gamma_X(D_i = 1)\mathbf{X}_{H,i} + \epsilon_{W,i} + \epsilon_{H,i}(D_i = 1) \geq \gamma_X(D_i = 0)\mathbf{X}_{H,i} + \epsilon_{H,i}(D_i = 0)\}.$$

To identify the parameters, the standard Heckman selection procedure applies to this context. Using the choice equation expression, $E[\epsilon_{W,i}|D_i = 1, \mathbf{X}_{W,i}, \mathbf{X}_{H,i}]$, $E[\epsilon_{H,i}(D_i = 1)|D_i = 1, \mathbf{X}_{W,i}, \mathbf{X}_{H,i}]$, and $E[\epsilon_{H,i}(D_i = 0)|D_i = 0, \mathbf{X}_{W,i}, \mathbf{X}_{H,i}]$ can be re-written as inverse Mill ratios. These ratios are functions of $\mathbf{X}_{W,i}$ and $\mathbf{X}_{H,i}$. Controlling for these, the parameters ω_X, $\gamma_X(D_i = 1)$, and $\gamma_X(D_i = 0)$ can be identified.

Excluded Shifters. To avoid relying on identification from parametric assumptions on the ϵ terms, we need shifters of decisions that are excluded from the wage and health equations. For example, in Equation 2, variables that shift $E[\epsilon_{W,i}|D_i = 1, \mathbf{X}_{W,i}, \mathbf{X}_{H,i}]$ but do not enter $\mathbf{X}_{W,i}$ are needed. Similarly, in Equation 3 and 4, shifters that affect decisions but does not enter $\mathbf{X}_{H,i}$ are needed.

We use the parents' health as the shifter for the wage equation, and we use the lagged

wage as the shifter for the health equation. The assumption is that lagged parent health does not affect wages directly, and the lagged wage does not affect current parental health directly.

Full Model Implementation. Most of the arguments above go through in the full version of our model, with only two exceptions. First, health status has an ordinal dependent variable structure. However, it is straightforward to accommodate selection correction in this case. Second, the choice equation in the dynamic model has no closed-form solution, but there are semi-parametric approaches that can be used in this context (Ahn and Powell, 1993).

D.2 Identification of the Preference Parameters

Linking to results in the literature, we follow the discussion in Aguirregabiria and Mira (2010) and list additional formal assumptions for model identification.

Formal Assumptions.

Assumption 1 (IID) *Idiosyncratic preference, health, and wage shocks,* $(\epsilon_{u,it}, \epsilon_{H,it}, \epsilon_{W,it})$*, are independent across individuals, over time, and across one another.*

Assumption 2 (DISTR) *Idiosyncratic preference, health, and wage shocks,* $(\epsilon_{u,it}, \epsilon_{H,it}, \epsilon_{W,it})$*, follow a known distribution.*

Assumption 3 (DISCOUNT) *The discount rate,* β*, is known.*

Assumption 4 (NTYPE) *The number of unobserved types is known and small.*

Assumption (IID) rules out time-varying unobserved types in the model. For example, suppose children have heterogeneous rates when accumulating care provision experience. This generates varying $\epsilon_{H,it}$, correlates over time and violates the assumption. However, the assumption does not rule out persistent shocks in the health or wage process, since there are lagged values included in both processes. Note that the model allows

for permanent unobserved types, and Assumption (IID) does not rule out the possibility of constant unobserved labor market and care provision skills.

Assumption (DISCOUNT) and Assumption (DISTR) are common in the literature. We assume the discount factor to be 0.95 per year, as commonly assumed.[31] For computational simplicity, we assume $\epsilon_{u,it}$ follows the type one extreme value distribution, and that $\epsilon_{H,it}$ and $\epsilon_{W,it}$ follow the normal distribution. Assumption (NTYPE) requires the number of unobserved types to be known and small. We assume two unobserved types.

Other standard assumptions that are discussed in the literature directly follow from the model's structure. For example, the model satisfies the additive separability assumption, since the idiosyncratic preference shock, $\epsilon_{u,it}$, is additively separable from the observable components in the flow utility. Conditional independence is also satisfied, given the specification of the wage and the health processes. Discussed in Kasahara and Shimotsu (2009), the number of absorbing versus non-absorbing state variables limits the number of unobserved types in identification. In the current model, only death is an absorbing state. Because all other state variables are non-absorbing, identification conditions are satisfied.

Appendix E Estimation Details

E.1 Estimation of Unobserved Types

We describe the procedure of unobserved type estimation in depth. Recall that in the model, $j(i)$ denotes individual i's unobserved type. Let $\pi^{(m)}(j|X_{i1})$ be the probability of being type j conditional on the initial state variable vector X_{i1} at the m-th iteration of the estimation procedure. We predict each individual's type using $\pi^{(m)}(j|X_{i1})$. Conditional on the predicted types, we estimate the health and wage processes as if types were observed. With the processes estimated, we estimate the model parameters with simulated method of moments, where moments are conditional on type j.

[31] Abbring and Daljord (2020) discuss recent progress on discount factors and dynamic discrete choice models.

Let $\theta^{(m)}$ denote the obtained estimates in the m-th iteration. After obtaining $\theta^{(m)}$ we update the type distribution according to:

$$q^{(m+1)}(j|D_i, X_i) = \frac{\pi^{(m)}(j|X_{i1}) \prod_{t=1}^{T} \mathcal{L}_t[D_{it}, X_{it+1}|X_{it}, j; \theta^{(m)}]}{\sum_{j'} \pi^{(m)}(j'|X_{i1}) \prod_{t=1}^{T} \mathcal{L}_t[D_{it}, X_{it+1}|X_{it}, j'; \theta^{(m)}]},$$

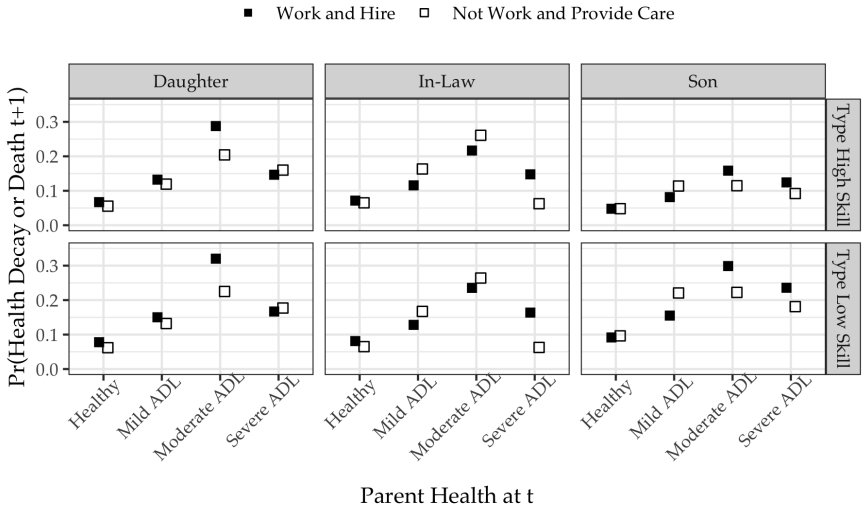
where $\mathcal{L}$ denotes the likelihood function. The updated probability, or the posterior probability, given values of initial state variables is then:

$$\pi^{(m+1)}(j|X_1) = \frac{\sum_i q^{(m+1)}(j|D_i, X_i) \mathbf{1}\{X_{i1} = X_1\}}{\mathbf{1}\{\sum_i X_{i1} = X_1\}}.$$

E.2 Estimation of Health Process

We report the estimated health process by plotting the probability of a health decay or death in Figure 15.

Figure 15: Estimates of the Health Process



Notes: The figure plots the probability of parents' health decaying or death, conditional on current health, choice, and demographic groups. Types correspond to various $j(i)$ in the model. Health processes are estimated through selection correction described in Section 4.6. The probability of health decay or death is then estimated by simulating data from the estimated health process and calculating the empirical probability.

Figure Setup Explanation. The x-axis represents current parental health status, and the y-axis plots the probability of health decay. The black points show the patterns when

a child works and hire a caregiver, and the white points show the patterns when a child does not work and provides care by herself. We plot estimates for various relationships and unobserved types separately.

For example, the first black point in the upper left panel shows that conditional on the parent being healthy and the high type daughter working this period, the probability that the parent has ADL needs or dies during the next period is approximately 0.07. The third white point in the upper left shows that for a high type daughter who does not work and provides care herself for her moderate ADL parent during this period, the probability of her parent having severe ADL or dying during the next period is approximately 0.2.

Probability of Health Decay. We now compare across current health status. For healthy parents without ADL needs, the probability of health decay is consistently 0.07 across all demographic groups. Once a parent has a mild ADL need, the probability of health decay doubles. The probabilities peak at moderate ADL and then drop at severe ADL, since for that condition, the only worse case is death.

The black versus white points denote the patterns of working and hiring versus not working and providing care, respectively. In most cases with moderate and severe ADL, working and hiring leads to worse parental health than not working and providing care. It is reassuring that little difference exists in the estimated probability of health decaying when a parent is healthy. Since no care is needed when a parent is healthy, the probability of a health decay should be similar across the child's choice.

We now focus on demographic patterns. Children-in-law have a different pattern than sons and daughters have. The care provision method shows little difference for mild and moderate ADL, and care provision leads to a very small probability of health decay. The unobserved type also shows a different pattern. In particular, for low-skilled type people, the difference is larger between working and hiring versus not working and providing care.

E.3 Parameters Estimated

Estimates for preference parameters in the model appear in Table 10. Standard errors in parentheses are calculated following Low and Pistaferri (2015) and Gourieroux, Monfort and Renault (1993).

Table 10: Preference Parameter Estimates

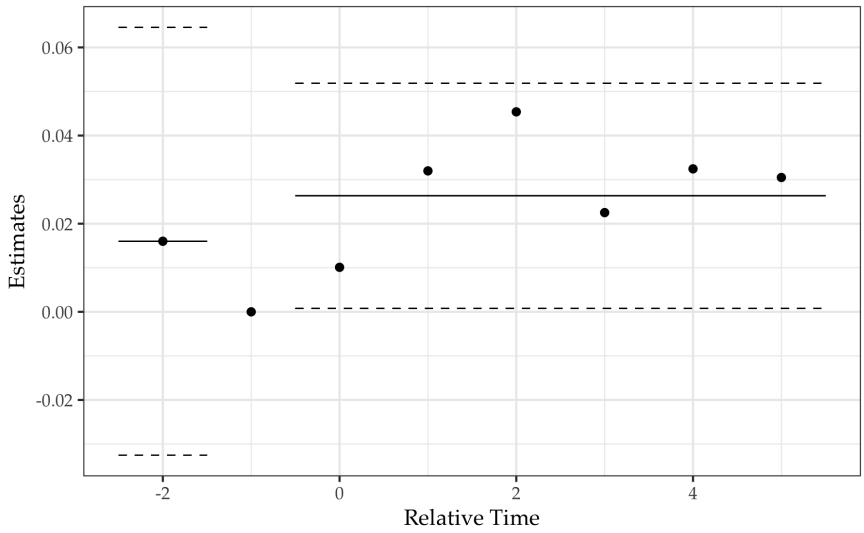
	Daughter	Son	Children-In-Law
θ_C	1.21	4.18	1.78
	(0.02)	(0.04)	(0.09)
θ_L	2.00	4.54	4.15
	(0.06)	(0.09)	(0.10)
$\theta_{h=\text{Death}}$	−1.27	16.04	4.14
	(0.09)	(0.15)	(0.08)
$\theta_{h=\text{Severe ADL}}$	3.09	12.84	0.71
	(0.04)	(0.06)	(0.09)
$\theta_{h=\text{Moderate ADL}}$	10.71	10.85	5.81
	(0.12)	(0.13)	(0.11)
$\theta_{h=\text{Mild ADL}}$	7.79	14.12	16.52
	(0.08)	(0.19)	(0.10)
θ_P	1.70	2.52	3.56
	(0.11)	(0.12)	(0.05)
θ_{PE}	1.66	1.39	6.01
	(0.18)	(0.23)	(0.11)
Intercept	−3.84	−9.47	−5.55
	(0.09)	(0.04)	(0.13)
θ_F	25.65	18.47	24.57
	(0.04)	(0.31)	(0.11)

Notes: Standard errors appear in parentheses. The definition and calculation follows Low and Pistaferri (2015) and Gourieroux, Monfort and Renault (1993).

E.4 Graphical Illustration of 2015 Reform

The point estimates and the magnitude from the reform are close to the prediction from model, although the reform effects of 2015 are less precise compared to the 2012 one due to a smaller affected population and the health requirement of the reform. Figure 16 shows the estimates from the data.

Figure 16: Effect of the Reform in Eligibility



Notes: The event is the 2015 reform in the eligibility of hiring. The outcome variable is the binary variable of whether one works. The baseline period is -1. Each event time corresponds to six months. Solid lines represent mean of estimates before and after the reform. Dashed lines represents the 90% confidence interval. The standard errors are clustered at the individual level. The sample includes children aged 25 to 65. The control group consists of those over age 85 and who were already eligible to hire an international caregiver before the reform. The treatment group consists of those over age 85 and who are only eligible to hire an international caregiver after the reform.

E.5 Reservation Wages

In the model, reservation wage is calculated as the wage needed such that working and hiring a caregiver is indifferent from not working and providing care. To formally define reservation wages, recall the individual problem:

$$\max_{D_{it}} V_{it} = \sum_{s=t}^{T} \beta^{s-t} E[u_{is}(C_{is}, L_{is}, H_{is}, D_{is}, D_{is-1}) | D_{it}],$$

and the expression can be also written as follows:

$$\max_{D_{it}} u_{it}(D_{it}) + V_{it+1}(D_{it}),$$

and if we expand u_{it} and replace C_{it} with budget constraints, we have:

$$\max_{D_{it}} \theta_C D_{it}(W_{it} - P^*_{it}\mathbf{1}\{H_{it} \in \{\text{Any ADL}\}\}) + \theta_L L_{it} + \sum_h \theta_h \mathbf{1}\{H_{it} = h\} + \theta_F D_{it}\mathbf{1}\{D_{it-1} = 0\} + \epsilon_{u,it}(D_{it}) + V_{it+1}(D_{it}).$$

Consider the case when $D_{it} = 1$ and $D_{it} = 0$ separately. If $D_{it} = 1$, then individual's value is:

$$\theta_C(W_{it} - P^*_{it}\mathbf{1}\{H_{it} \in \{\text{Any ADL}\}\}) + \theta_L(1-a) + \sum_h \theta_h \mathbf{1}\{H_{it} = h\} + \theta_F \mathbf{1}\{D_{it-1} = 0\} + \epsilon_{u,it}(D_{it} = 1) + V_{it+1}(D_{it} = 1).$$

If $D_{it} = 1$, then individual's value is:

$$\theta_L(1 - b(H_{it})) + \sum_h \theta_h \mathbf{1}\{H_{it} = h\} + \epsilon_{u,it}(D_{it} = 0) + V_{it+1}(D_{it} = 0).$$

Reservation wage is defined as the wage such that an individual is indifferent between $D_{it} = 1$ and $D_{it} = 0$. That is, reservation RW_{it} is defined as the RW_{it} that satisfies the following:

$$\begin{aligned}&\theta_C(RW_{it} - P^*_{it}\mathbf{1}\{H_{it} \in \{\text{Any ADL}\}\}) + \theta_L(1-a) + \\ &\sum_h \theta_h \mathbf{1}\{H_{it} = h\} + \theta_F \mathbf{1}\{D_{it-1} = 0\} + \epsilon_{u,it}(D_{it} = 1) + V_{it+1}(D_{it} = 1) \\ &= \theta_L(1 - b(H_{it})) + \sum_h \theta_h \mathbf{1}\{H_{it} = h\} + \epsilon_{u,it}(D_{it} = 0) + V_{it+1}(D_{it} = 0).\end{aligned}$$

The reservation wage defined does not involve future wages, and hence it does not affect values of V_{it+1} in the above equation. The only place RW_{it} term shows up is in the very first part of the equation. As a result, reservation wage RW_{it} is well-defined.

E.6 Compensating Variation

CV for a policy is defined as the compensation needed for an individual to reach her initial utility after we remove the policy. Formally, consider the following expression of

an individual's problem with certain policy at the first period:

$$\tilde{v}_{i1} = \max_{D_{i1}} \tilde{u}_{i1}(D_{i1}) + \tilde{V}_{i2}(D_{i1}),$$

where $\tilde{v}_{i1}$ is the optimized value, and we use tilde to represent flow utility and values under the policy. The counterpart value where no policy is in effect is:

$$v_{i1} = \max_{D_{i1}} u_{i1}(D_{i1}) + V_{i2}(D_{i1}).$$

Given the linear flow utility specification in the model CV is simply:

$$CV_i = \frac{\tilde{v}_{i1} - v_{i1}}{\theta_C},$$

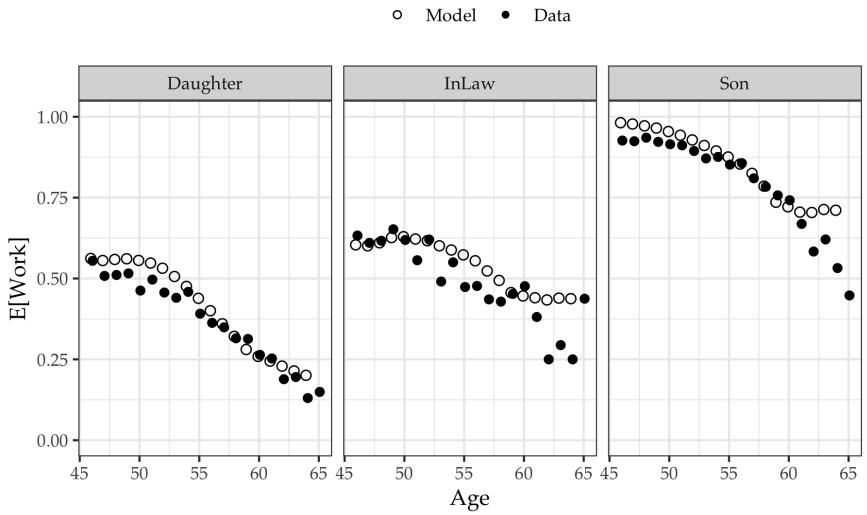
where θ_C is in the denominator because that translate utility into monetary unit.

Appendix F Additional Model Validation

Untargeted Moments: Age Profile of Labor Supply In addition to the reform estimates, we also assess the age profiles of labor supply, which we do not target explicitly. By comparing the data moment with the model prediction, we provide an additional validity check of the estimated model.

Figure 17 shows the comparison between the data and model prediction of the life-cycle profile. The predictions fit well, especially for the earlier pattern. For sons and children-in-law, the model over-predicts the share of working individuals near retirement. One explanation for over-predictions is that we do not model savings, pensions, and retirement benefits. When interpreting results from this model, caution is warranted regarding behaviors near retirement. The overall pattern is, nonetheless, close as a set of untargeted moments.

Figure 17: Un-targeted Moment: E[Work|Age]



Notes: The x-axis represents the age of the children. White points represent the data; black points represent the model simulation.

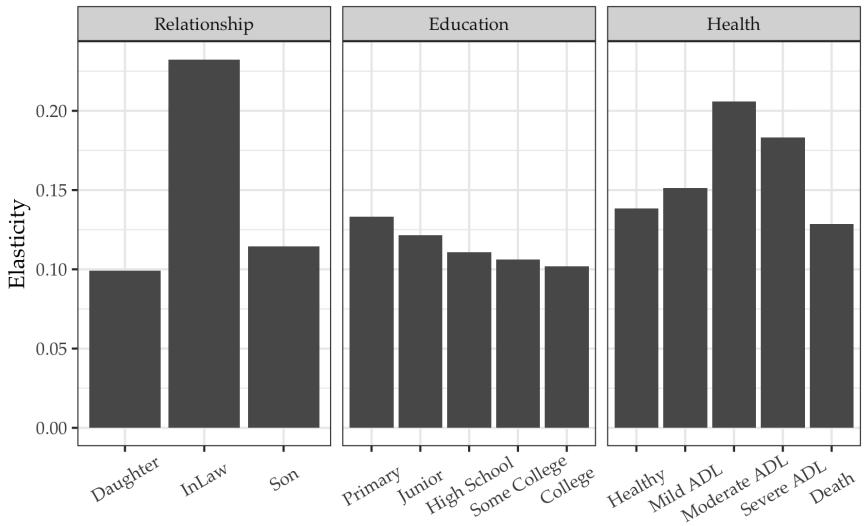
Appendix G Additional Economic Mechanisms

G.1 Labor Supply Elasticities

Labor supply elasticities from the model are useful in two ways. First, since an extensive literature studies the wage elasticity of labor supply, the elasticity allows us to compare current estimates with those in the literature. Second, many LTC policies are tax reductions or cash subsidies, and thus, labor supply elasticity informs labor supply responses when given these subsidies. For example, if the labor supply elasticity is high when parents have LTC needs, a small wage increase induces individuals to switch from care provision to labor market participation. However, if the labor supply elasticity is low when parents have LTC needs, labor supply responses to wages are small. In this case, policymakers might be less concerned about LTC policies' distortion effects in the labor market.

Results. We follow Dagsvik (2020) and calculate extensive margin wage elasticities of labor supply. Results are reported in Figure 18. Both daughters and sons have a labor supply elasticity of approximately 0.1, but children-in-law are twice as elastic, likely be-

Figure 18: Labor Supply Elasticities



Notes: Elasticities are calculated using simulated data.

cause they are secondary earners in families and are thus more sensitive to wage changes. A slight downward slope in education exists. The higher educated people have low elasticities. As for heterogeneity in parental health status, an inverted V shape is found, consistent with the level effect—fewer people work when parents have moderate ADL.

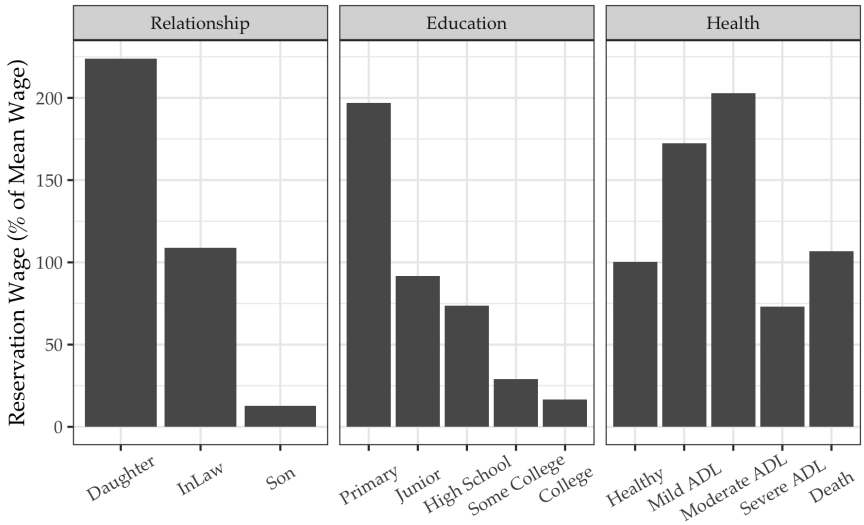
These elasticities are comparable to the findings in the Taiwanese literature. Chuang and Lin (2006) find that female labor supply elasticities lie between 0.026 and 0.158. The labor supply elasticity for males is similar to that for females.[32]

G.2 Reservation Wage

Reservation wages inform of the wages needed to participate in the labor market. In the model, reservation wage is calculated as the wage needed such that working and hiring a caregiver is indifferent from not working and providing care. The detailed definition is in Appendix E.5.

[32] In the U.S. literature, male labor supply elasticities at the participation margin are approximately 0.2. Less consensus has been achieved regarding female labor supply elasticity, but it is generally estimated to be larger than that for males.

Figure 19: Mean Reservation Wage



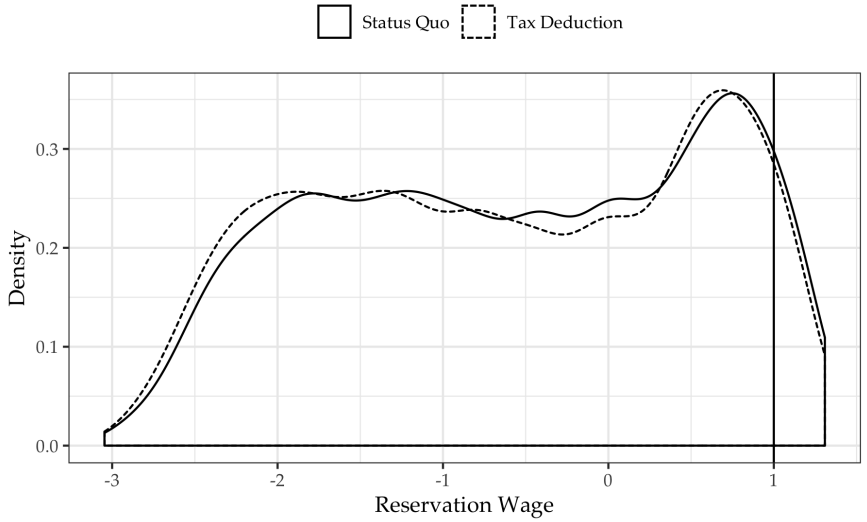
Notes: The reservation wage is the minimum wage a person requires to make work $D_{it} = 1$ and not work $D_{it} = 0$ indifferent in the model. We normalize the reservation wages reported by the mean wage.

Results. We report mean reservation wages in Figure 19. Reservation wages track closely the share of individuals who work. The higher the reservation wages, the smaller the share of individuals who work. Highest to lowest are daughters, children-in-law, and sons. The mean reservation wage is monotonically decreasing in education. For parents with severe ADL, reservation wages are low. This is consistent with the fact that all parents with severe ADL are eligible to hire an international caregiver, and hence many children choose to hire one and do not provide care themselves.

Reservation Wage and Policy Effects Illustration. The distribution of reservation wages is also useful for understanding the model. Figure 20 and 21 show daughters' reservation wage distribution conditional on lagged working statuses, normalized by the mean annual wage. If each person gets the mean wage when participating in the labor market, the area below the curve and left of the vertical line will represent the share of people who are working. The state variables in the model determine where a person is in the distribution. For example, a child worked last period is much more likely to work this period than who did not, and thus the distribution in Figure 20 has much smaller reservation wages than the distribution in Figure 21

This illustration is also useful for understanding policy effects. In the figures, solid curves represent the distribution of the status quo. In contrast, dashed curves represent the distribution under a tax deduction policy that allows working children with LTC-needing parents to deduct income taxes. The policy shifts the reservation wage distribution to the left, pushing more daughters to participate in the labor market.

Figure 20: Reservation Wage Distribution for Daughters (Worked Last Period)



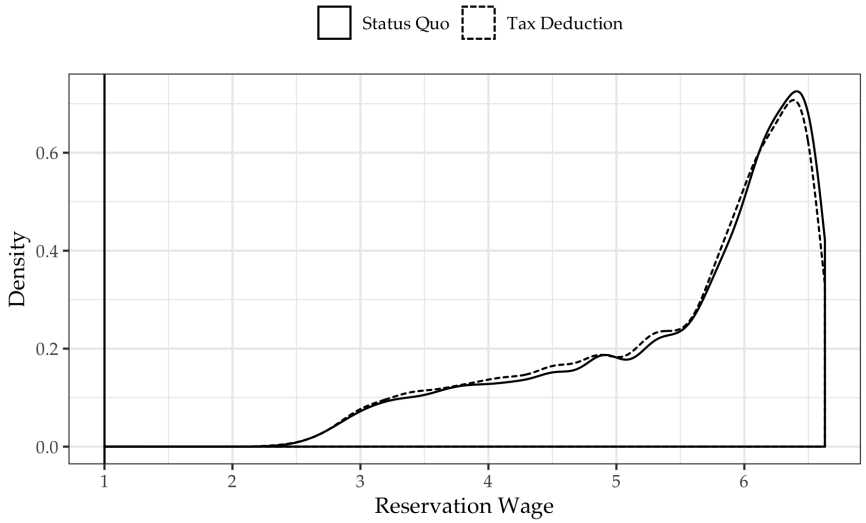
Notes: The x-axis represents reservation wages, normalized by the mean wage. The black vertical line indicates the mean wage.

Appendix H Labor Supply Responses of Policy Counterfactuals

We analyze labor supply responses under these policies in comparison to the status quo for children whose parents have LTC needs. By examining how responses differ as a function of observable characteristics, this analysis also identifies the marginal people affected by the various policies.

Reforms on International Caregivers Hiring Eligibility. Labor supply responses to this policy are shown in Column (1) and (2) in Table 11. Labor supply responses to an relaxed eligibility are large. When the eligibility is relaxed, sons' labor supply increases

Figure 21: Reservation Wage Distribution for Daughters (Not Worked Last Period)



Notes: The x-axis represents reservation wages, normalized by the mean wage. The black vertical line indicates the mean wage.

by 3.9%, on average. For children-in-law, the number is even higher. Results also vary vastly by education. Higher educated people are less responsive to these policies because they are likely to participate in the labor market under any parental health condition. In contrast, lower-educated children are at the margin. Opposite and almost equally large effects are found when eligibility is limited. In Appendix I, we show that completely open or closed eligibility leads to massive labor supply responses, suggesting that given the current situation, a reform that completely opens or closes the international caregiver market has enormous influences.

Tax Deductions. We report labor supply responses to tax deductions in Column (3) of Table 11. A tax deduction has positive effects on the labor supply. However, responses are much smaller in comparison to eligibility reforms. For those whose parents have LTC needs, the labor supply response to this policy is, on average, less than 5%. Sons have larger responses in comparison to daughters and children-in-law, and no clear pattern is evident for education.

In-Kind Transfer. Labor supply responses to in-kind transfers are shown in Column (4) of Table 11. In-kind transfers generate negative labor supply responses since they benefit

only children who provide care themselves. Negative responses are again larger for lower-educated people. There is also considerable variation in parental health status. Since the program provides many more hours of care services for parents with more severe ADL, responses are larger.

Summary. In addition to the number of international caregivers, analyses above demonstrate large labor supply responses when eligibility criterion is changed. This suggests that international caregivers have already been an essential part of LTC. A second finding is that lower-educated individuals lie at the margin and are responsive to such policies. Elasticity estimates corroborate this finding, but this analysis suggests that the pattern is prevalent under various policies.

Table 11: Labor Supply Responses

Characteristics	(1) Relaxed Eligibility	(2) Limited Eligibility	(3) Tax Deduction	(4) In-Kind Transfer
Daughter	3.6	-8.5	2.9	-4.0
Children-In-Law	7.7	-18.0	2.5	-4.3
Son	3.9	-6.8	5.2	-3.6
Primary	7.8	-10.6	7.1	-4.2
Junior	1.9	-7.1	2.9	-3.3
High School	6.2	-9.2	2.8	-3.5
Some College	6.1	-7.5	4.8	-4.0
College	-0.4	-8.6	3.4	-2.7
Mild ADL			3.4	-2.7
Moderate ADL	4.7	-9.0	6.4	-4.8
Severe ADL			5.6	-5.3

Notes: The unit is percent change to the probability of working in comparison to the status quo. The labor supply responses reported are conditional on parents having LTC needs.

Appendix I Additional Policy Counterfactuals

In this section, we consider the counterfactual analysis which (i) allows everyone with LTC needs to hire an international caregiver (open eligibility), and (ii) forbids anyone

to hire an international caregiver (no eligibility). These extreme eligibility rules might induce general equilibrium effects. In the analyses we abstract from the potential general equilibrium effects and show results for differences in labor supply after parents' deaths, labor supply responses, and compensating variation.

As shown in tables below, completely open or closed eligibility leads to massive labor supply responses, suggesting that given the current situation, a reform that completely opens or closes the international caregiver market has enormous influences.

Table 12: Difference in Labor Supply After Parents' Deaths Under Various Policies

Specification	(1) Status Quo	(2) Open Eligibility	(3) No Eligibility	(4) Relaxed Eligibility	(5) Limited Eligibility
Daughter	-9.3	10.2	-20.1	-4.7	-9.2
Children-In-Law	-1.7	24.6	-16.5	7.7	-2.2
Son	-6.8	-2.0	-12.0	-3.7	-6.8
Primary	-10.2	6.5	-19.3	-4.6	-9.5
Junior	-7.3	3.5	-13.6	-2.9	-6.9
High School	-6.8	3.0	-14.7	-3.1	-7.6
Some College	-6.3	0.1	-12.1	-3.8	-6.8
College	-5.4	1.8	-12.2	-3.1	-6.0

Notes: This table reports short-run returning to work comparisons using the data health sequence under various policies. The details are the same as in Table 4. In particular, Column (1) replicates Column (3) in Table 4.

Table 13: Labor Supply Responses

Characteristics	(1) Open Eligibility	(2) No Eligibility	(3) Relaxed Eligibility	(4) Limited Eligibility
Daughter	44.1	-20.4	3.6	-8.5
Children-In-Law	50.3	-44.9	7.7	-18.0
Son	7.7	-12.3	3.9	-6.8
Primary	31.8	-24.9	7.8	-10.6
Junior	18.1	-17.1	1.9	-7.1
High School	17.1	-15.6	6.2	-9.2
Some College	13.4	-15.2	6.1	-7.5
College	11.5	-13.4	-0.4	-8.6
Mild ADL	21.1			
Moderate ADL	18.0	-15.9	4.7	-9.0
Severe ADL		-18.3		

Notes: The unit is percent change to the probability of working in comparison to the status quo. The labor supply responses reported are conditional on parents having LTC needs.

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Table 14: Compensating Variation

Name	Open Eligibility			No Eligibility			Relaxed Eligibility			Limited Eligibility		
	Total CV	Affected Share	Affected CV	Total CV	Affected Share	Affected CV	Total CV	Affected Share	Affected CV	Total CV	Affected Share	Affected CV
Daughter	0.358	0.373	0.959	-0.082	0.111	-0.742	0.017	0.038	0.457	-0.011	0.024	-0.470
Children-In-Law	1.103	0.457	2.412	-0.254	0.138	-1.837	0.057	0.045	1.282	-0.095	0.068	-1.399
Son.	0.212	0.737	0.287	-0.043	0.223	-0.194	0.010	0.067	0.145	-0.011	0.080	-0.142
Primary.	0.326	0.471	0.691	-0.049	0.081	-0.604	0.014	0.044	0.324	-0.017	0.035	-0.471
Junior	0.428	0.556	0.769	-0.140	0.207	-0.673	0.033	0.059	0.560	-0.034	0.053	-0.640
High School	0.432	0.597	0.723	-0.084	0.207	-0.405	0.020	0.060	0.336	-0.019	0.065	-0.301
Some College	0.466	0.617	0.756	-0.083	0.281	-0.294	0.008	0.052	0.147	-0.013	0.066	-0.204
College	0.428	0.669	0.639	-0.150	0.270	-0.555	0.012	0.047	0.261	-0.030	0.105	-0.286
Mild ADL	0.504	0.703	0.717									
Moderate ADL	0.244	0.369	0.661	-0.218	0.374	-0.581	0.133	0.360	0.368	-0.153	0.377	-0.405
Severe ADL				-0.355	0.701	-0.506						

Notes: "Total CV" and "Affected CV" are normalized by mean annual wage. For example, a daughter's total CV for open eligibility, 0.358, means that she requires 35.8% of the mean annual wage to accept removal of this policy. "Affected Share" represents the share of those affected by the policy among children whose parents have ADL needs.

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