Foreign-Born Care Workers and Their Care Recipients' Health Outcomes*

Su-Yuan Chan† Kuan-Ming Chen‡

December 4, 2024

Abstract

We causally estimate how hiring a home-based, foreign-born care worker impacts the care recipient's healthcare utilization and health outcomes. Utilizing unique policy reforms as a quasi-experiment, we analyze data from the Taiwan Longitudinal Study on Aging (TLSA). Our findings reveal that hiring foreign-born care workers statistically significantly reduces healthcare utilization, including inpatient, outpatient, and emergency room use. This reduction likely results from improvements in health outcomes, as we observe a decrease in overall healthcare use and in the probability of falls. Further analysis shows that foreign-born caregivers complement family caregivers, and their substantial training may contribute to these positive effects.

Keywords: Foreign-Born Care Worker; Long-Term Care; Health Outcomes; Healthcare Utilization; Home- and Community-based Services

JEL Codes: J14, J61

*We thank Yu-Chang Chen, Maxwell Kellogg, Ming-Jen Lin, Kuan-Ju Tseng, and seminar participants at NTU for valuable inputs and comments. Chen-An Lien, Wei-Lun Lo, and NTU C2L2 lab provided excellent research assistance. The IRB at NTU approves this study. The data is kindly provided by the Health and Welfare Data Science Center and the Ministry of Health and Welfare in Taiwan. Kuan-Ming Chen acknowledges the support from the National Science and Technology Council grant NSTC 111-2628-H-002-019 and the Yushan Fellow Program by the Ministry of Education, Taiwan (MOE-112-YSFSL-0003-001-P1).

†Indiana University Indianapolis. Email: suychan@iu.edu.

‡National Taiwan University. Email: kuanmingchen@ntu.edu.tw.

1 Introduction

The aging population is a prevalent phenomenon in global demography, leading to significant long-term care (LTC) needs worldwide. Among those over age 60, more than 14% are currently unable to meet all their basic daily needs and require LTC (World Health Organization and others, 2021). These LTC needs are commonly addressed by family caregivers, nursing homes, or home-based paid care workers (Colombo et al., 2011; Gruber and McGarry, 2023; Gruber, McGarry and Hanzel, 2023; OECD, 2023). Notably, 28.5% of home-based hired caregivers are foreign-born (Merçay, Dumont and Lafortune, 2015). This is particularly true for East Asia and Southern Europe, where countries like Spain, Italy, and Greece have more than 65% of their caregivers being foreign-born (Merçay, Dumont and Lafortune, 2015).

The large number of foreign-born care workers has made their role central to policy debates. Traditionally, these caregivers are employed to address labor shortages in the LTC workforce (Colombo et al., 2011; Gruber and McGarry, 2023; Jun and Grabowski, 2024; Rapp and Sicsic, 2020). However, many countries are concerned that the growing number of foreign-born care workers may crowd out domestic care workers, as the former increases while the latter decreases (Merçay, Dumont and Lafortune, 2015; Jun and Grabowski, 2024). Additionally, the quality of care provided by foreign-born care workers remains controversial. On one hand, they may lack the necessary language and communication skills required to handle the complexities of LTC work (Colombo et al., 2011; Jun and Grabowski, 2024). On the other hand, foreign-born caregivers' willingness to work longer and stronger incentives to keep their jobs may make them a viable option (Jun and Grabowski, 2024). Understanding the quality of care provided by foreign-born care workers and their effects on care recipients' health is essential for policymakers to weigh the costs and benefits.

Despite the importance of understanding the effects of foreign-born care workers on care recipients' health, large-scale causal evidence remains scarce. The main challenge lies in establishing a causal relationship between the care arrangement and the health outcomes of the care recipient. For instance, if care from foreign-born care workers is

associated with worse health outcomes for the care recipient compared to care from family members, this could be interpreted as a causal effect of foreign-born care workers. Alternatively, it might be that those in worse health status tend to choose foreign-born care workers due to the more intensive care they can provide. This potential selection mechanism complicates the establishment of a clear causal relationship.

Previous studies mainly discussed the relationship between immigrant care workers and nursing home residents' outcomes. One observational study found that nursing homes with a higher percent of foreign-born certified nursing assistants were associated with more caregiving hours, improved quality performance, and better residents' health outcomes (Jun and Grabowski, 2024). Some quasi-experimental studies further found that the increase of immigrant care workers improved the quality of care, such as lower institutionalization risks, fewer falls, reduction in restraints, as well as reduced rehospitalization in institutional settings (Butcher, Moran and Watson, 2022; Furtado and Ortega, 2023; Grabowski, Gruber and McGarry, 2023). However, it is still unknown whether foreign-born care workers also lead to better health outcomes of older adults in home- and community- based settings.

Our paper aims to bridge this gap by providing causal estimates on the impact of caregiver choices on the health of care recipients. We evaluate whether care recipients reduce healthcare utilization and experience better health outcomes with home-based foreign-born care workers compared to other options. We focus on the context of Taiwan, where the population aged over 65 has reached 4.3 million, constituting 18.6 percent of the total population (Department of Household Registration, 2024). According to government estimates, the population in need of LTC was approximately 738 thousand in 2017 (Ministry of Health and Welfare, 2017). Foreign-born caregivers are also very popular, with their number reaching 234 thousand in 2023, accounting for one percent of the total population (Ministry of Labor, 2023).

We leverage the unique policy rules governing the eligibility for hiring foreign-born caregivers in Taiwan. As an island country, Taiwan enforces strict controls over the number of foreign-born care workers. Anyone wishing to hire a foreign-born care worker must first apply through the government, demonstrating that they meet a certain threshold of

LTC needs. The criteria for eligibility were relaxed in both 2012 and 2015. These reforms serve as a quasi-experiment, exogenously shifting some individuals towards hiring a foreign-born care worker (Department of Health, 2012; Ministry of Labor, 2015).

We employ an instrumental variable (IV) approach that utilizes the eligibility reforms to estimate the causal effect of hiring a foreign-born care worker on health outcomes. Our IV is an indicator of whether an individual is eligible to hire a foreign-born care worker. Conditioning on age and health status measured by the government-defined Barthel Index, the eligibility varies only due to the exogenous policy reform.

The data utilized in this paper come from the Taiwan Longitudinal Study on Aging (TLSA), a longitudinal dataset that draws a representative sample of the older population in Taiwan. Crucially for our study, it collects information on demographics, health status, health care utilization, family structure, and LTC arrangements, making it the Taiwanese counterpart to the Health and Retirement Study. The sample we constructed uses data spanning from 1996 to 2019 (Department of Health, 2015).

Our empirical findings indicate that hiring foreign-born care workers who provide home-based care has statistically reduced their care recipients' healthcare utilization. Our robust first-stage estimates reveal a pronounced inclination among individuals to employ a foreign-born care worker upon becoming eligible. While the OLS estimates exhibit a negative association between care recipients' health status and hiring a foreign-born caregiver, the IV estimates demonstrate the opposite sign.

The IV estimates show a substantial reduction in inpatient, outpatient, and emergency room (ER) utilization. The magnitude of these effects is considerable. For example, hiring a foreign-born care worker decreases the probability of an ER visit by 0.51. The difference between the OLS and IV estimates suggests a strong negative selection effect, underscoring the need to correct for selection bias. Despite the strong effects, we do not detect statistically significant effects on mortality. Our robustness checks show that the results are robust against different measures of LTC needs or restricting to a balanced panel.

We interpret the reduction in overall healthcare utilization as potential improvements in health outcomes, as the effects are not only seen in outpatient use but also in hospitalization and ER use. We also find a marginally significant decrease in the probability of

falls.

To further understand the source of improvement in health care, we first follow Abadie (2003) to estimate the counterfactual care arrangements for compliers. We find that, without hiring a foreign-born caregiver, more than 70% of care recipients would rely on their family members. Next, using an auxiliary caregiving survey, we find that foreign-born workers are more often a complement rather than a substitute for family caregivers—more than half of the families that hired foreign-born care workers still list family members as secondary caregivers. Lastly, the substantial training received by these foreign-born caregivers may contribute to their impact. On average, they receive 240 hours of training related to caregiving.

Our paper contributes to a vast and expanding body of literature on LTC. Economists have extensively explored the far-reaching effects of LTC on the care recipient's family (Bauer and Sousa-Poza, 2015). Previous studies have focused on the healthcare utilization, financial costs and implications for family members (Chan et al., 2022). However, the effects of different care options on the care recipients themselves have been less studied. There is a substantial amount of research focused on measuring nursing home quality (Bostick et al., 2006; Castle and Ferguson, 2010; Grabowski, 2001; Jun and Grabowski, 2024). Nevertheless, much of this literature does not tackle the issue of selection on unobservables. To the best of our knowledge, our study is the first to establish a causal link between the choice of caregivers and health outcomes. This study is also the first to demonstrate the causal effect of foreign-born caregivers providing in-home care on the care recipients' health outcomes. In addition to examining health outcomes the most likely to be directly impacted by the direct care, such as falls, we also assess care recipients' healthcare utilization to investigate further impacts.

Additionally, our work connects to a broad discourse on immigrant workers by examining their impact on local populations beyond labor market implications. Within the LTC workforce, our study provides evidence of one of the benefits of introducing foreign care workers. We also propose that foreign-born caregivers are more likely to serve as a complement, instead of a substitute, for family caregivers. Given previous findings showing that caregiving responsibilities affect the employment and earnings of family

caregivers (Maestas, Messel and Truskinovsky, 2023), it is essential for future research to explore whether the immigrant workforce can alleviate the caregiving burden and positively impact family caregivers' labor supply.

2 Background

2.1 Overall Care Arrangement in Taiwan

Informal care provided primarily by family caregivers is the majority of LTC worldwide (Gruber, McGarry and Hanzel, 2023; OECD, 2023). In order to support family caregivers and their care recipients, formal care programs, such as home- and community-based services (HCBS) and institutional care, are provided by public or private sectors (Gruber, McGarry and Hanzel, 2023; OECD, 2023).

Unlike the United States, where LTC relies more heavily on institutional care, HCBS are the primary setting assisting with LTC in Taiwan (Ministry of Health and Welfare, n.d.; Colombo et al., 2011). On one hand, the Taiwanese government introduced the LTC 1.0 and the LTC 2.0 national policies in 2007 and 2017, respectively, to provide HCBS. On the other hand, foreign-born care workers were also brought into to address workforce shortages in the home-based care setting.

During our study period, LTC policies remained limited and developed slowly due to budget constraints. The LTC budget in 2016 was 4.58 billion New Taiwan Dollars (NTD), accounting for 0.026% of the nominal GDP (Executive Yuan, 2022; National Statistics, 2016). Compared to the OECD countries' average of 1.6% (OECD, 2015), the amount of LTC services that the Taiwanese government provided was quite limited. As a result, foreign-born care workers have played, and continue to play, a vital role in meeting Taiwan's growing LTC needs.

Figure 1 shows the choice of caregivers in TLSA 2015. The landscape of care arrangements in Taiwan has evolved over time. We categorize caregiving into three main types: family caregivers, nursing homes, and paid foreign caregivers. Traditionally, informal family caregivers have been the most crucial source of care. However, foreign-born care

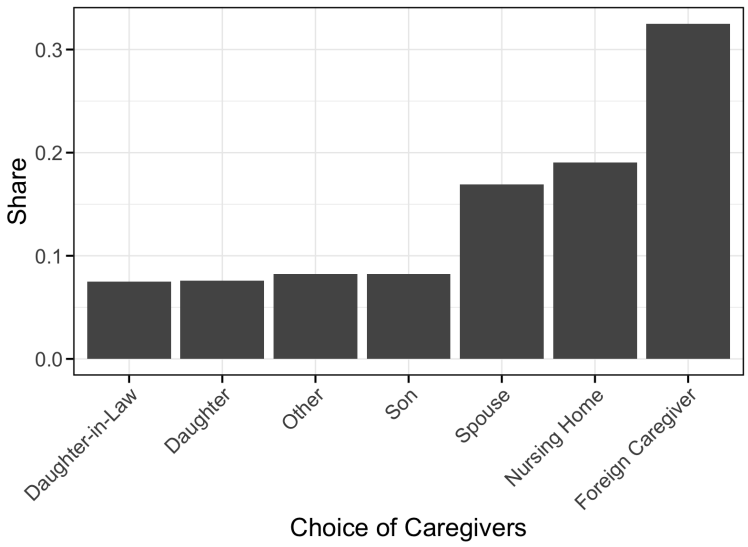


Figure 1: TLSA 2015, among all caregivers

workers assisting with in-home care grow fast. Nursing homes have never been a popular option in Taiwan, in stark contrast to some Western societies where nursing homes are the predominant source of care (Ministry of Health and Welfare, n.d.; Colombo et al., 2011).

2.2 Foreign-born Care Workers

Among the paid caregivers, the most important part is the foreign-born care worker. The foreign-born care workers are typically 24-7 caregivers that live with the care recipients. The number of foreign-born care workers increases from virtually zero to 234,305 as of 2023. The caregivers are mostly from Indonesia (76.4%), Vietnam (11.8%), and the Philippines (11.6%). 99.2% of these caregivers are female. The caregivers are also overwhelming young, with 43.0% between age 35-44, 31.2% age 25-34 (Ministry of Labor, 2023).

A majority of these caregivers are on a short-term visa that requires them to renew every three years. Due to visa regulations, few caregivers stay or migrate permanently after finishing the term.

The source countries typically require some training sessions before they enter Taiwan. Take Indonesia for example, they require the foreign-born care workers to receive

600 hours of nurse training. Overall, 98.7% received some training. Among these trainings, a typically 469 hours are on Chinese and Taiwanese. Approximately 240 hours are spent on safety, health, and housekeeping training. The Taiwanese government also provides on-the-job training programs to increase the ability of the foreign-born care workers' caregiving abilities (Ministry of Labor, 2013).

In addition to the caring skills that the foreign-born caregivers have, the popularity of the foreign-born caregivers results from the cheap price. The minimum monthly wage for a foreign care worker is 15,840 NTD in 1997 and 17,000 NTD in 2015, and then 20,000 NTD starting from 2022 (Ministry of Labor, 2022). Despite the almost around-the-clock care provided, the monthly price that the care-receiving family paid for a foreign care worker is 20,209 NTD in 2021 (Ministry of Labor, 2021). The mean salary for a Taiwanese worker population as of 2021 is 60,954 NTD. The cost of hiring a foreign-born caregiver is roughly 20% of the mean gross household income. To compare, a domestic care worker would cost 32,000 to 70,000 NTD per month[1]. The foreign-born care worker is, in fact, one of the few categories that the minimum wage law does not apply.

Due to their low cost, demand for foreign-born care workers is high. However, the application process is heavily regulated. Individuals wishing to hire a foreign-born care worker must first obtain an evaluation from a doctor. The evaluation records the doctor-certified Barthel Index (BI), which maps functional limitations to a score ranging from 0 to 100. The individuals will then take this evaluation and apply to the government. The government enforces strict BI criteria, allowing only those with severe functional limitations to apply for permission to hire a foreign-born care worker (Department of Health, 2012; Ministry of Labor, 2015). Once permission is obtained, individuals will then be granted a recruitment permit. Then they could go to an intermediary or to the governmental website to hire a caregiver.

Given the significant benefits and legal barriers associated with hiring foreign-born care workers, individuals have sought ways to circumvent these challenges. Some have attempted to forge BI certificates with the help of doctors, a practice that has led to numerous indictments and decreased incentives due to the heavy penalties involved. Another

[1]Source: https://www.mohw.gov.tw/cp-16-41021-1.html

method is hiring foreign-born care workers through the black market. Given Taiwan's status as an island with strict border control, the government can accurately estimate the number of foreign-born care workers working illegally. As of December 2021, the estimated number of foreign-born care workers in the black market is roughly 29,293 (National Immigration Agency, 2024). Considering these rules and regulations, underground hiring should not pose a significant problem.

2.3 Reform Details

Due to the growing LTC needs, the rule for hiring a foreign-born care worker has been changing over time. Before September 2012, only those with a BI of less than 35 is eligible to hire a foreign-born care worker. A reform in September 2012 relaxed the threshold for those above age 80 to also be eligible if the BI is less than 60 (Department of Health, 2012)[2]. In August 2015, the government further relaxed the BI threshold for those above 85 so that everyone beyond that age with any functional limitation is eligible to hire a foreign-born care worker (Ministry of Labor, 2015). Both of these reforms were adopted shortly after the announcement.

3 Empirical Strategy

The goal of our paper is to estimate the differential healthcare utilization and health outcomes based on whether an individual hires a foreign-born care worker. The ideal experiment would randomly assign LTC needers into two groups: one receiving a foreign caregiver and the other not, and then compare the outcomes of the two groups.

Our empirical strategy is to exploit the reform in eligibility. The reform serves as a quasi-experiment that shifts certain individuals around the eligibility threshold, leading some to become eligible and hire a foreign care worker. Since the eligibility rule is a function of the BI and age, eligibility is determined solely by the reforms once we condition on these variables. Motivated by this institutional feature, we use eligibility as an instrument and employ an IV strategy to identify the effect of hiring a foreign-born care worker.

[2]Age does not directly factor into the measurement of the BI.

As there are two reforms that share the same structure but differ in their thresholds, the IV strategy better leverages the exogenous variation created by the reforms compared to a difference-in-differences approach.

Formally, we have the following model:

$$Y_{it} = \beta^{\text{IV}} D_{it} + \gamma X_{it} + \epsilon_{it}, \tag{1}$$

$$D_{it} = \delta Z_{it} + \eta X_{it} + \nu_{it}, \tag{2}$$

where Y_{it} is healthcare utilization or health outcome, D_{it} is the treatment indicator (whether one hires a foreign-born caregiver), X_{it} denotes the covariates, including individual and calendar time fixed effects, and importantly, the individual's BI measure fixed effect. Z_{it} is the instrument variable, representing the eligibility for hiring a foreign-born care worker.

According to standard econometric results, our IV strategy can identify the causal effect of hiring a foreign-born care worker when (1) the instrument is relevant ($\delta \neq 0$) and (2) the exclusion restriction holds ($Z_{it} \perp \epsilon_{it} | X_{it}$ and Z_{it} affects Y_{it} only through D_{it}). The relevance condition requires a large and statistically significant first stage coefficient in Equation 2. The institutional setup makes the relevance plausible, and the F-statistic of approximately 33 supports this assumption.

The exclusion restriction cannot be verified directly from the data; therefore, we rely on institutional details. Eligibility is determined by the individual's age and LTC needs, measured by BI. Greater care needs typically indicate worse health outcomes. However, given individual BI and other characteristics, eligibility variation stems solely from the reform. This nationwide policy change provides an exogenous source of variation. To validate that the reform is indeed an exogenous source of variation, we conduct a balance test using the outcome in the previous period as the outcome variable instead. Reassuringly, the results shown in Appendix C suggest that our instrumental variable does not affect the pre-period outcomes. Taken together, the exclusion condition should hold in our setup.

4 Data

4.1 Data Source

We use the Taiwan Longitudinal Study on Aging (TLSA) in this paper. The TLSA is the counterpart of the Health and Retirement Study (HRS) in Taiwan. The goal of the survey is to construct a representative sample of individuals aged above 50. It is a panel data survey conducted every 3 to 4 years. Starting in 1989, the most up-to-date data in 2019 provides nine waves of data. The TLSA records detailed demographic, health, labor market, and household information. Importantly for our study, the TLSA provides information regarding LTC needs and caregiving. We use data from 1996 onwards since this is when the LTC needs data become more reliable and consistent (Department of Health, 2015).

One important variable in our study is the BI. The BI is not directly provided by the TLSA questionnaire. However, since 1996, the TLSA questionnaire includes most of the information needed to construct the BI. Some items and the exact intensity are still missing from the TLSA, so we rely on the external resource constructed by Chen et al. (2021). Chen et al. (2021) includes the joint distribution of all BI items, allowing us to extrapolate the missing items by using the mean value conditioned on other items. We also show robustness checks in Appendix D using alternative measures corresponding to the BI. The results and conclusions remain unchanged.

4.2 Summary Statistics

We present the summary statistics of our study population in Table 1, stratifying individuals based on their eligibility to hire a foreign-born care worker and their actual hiring of such caregivers. Our analysis reveals significant disparities in health status and care utilization between eligible and non-eligible individuals, as well as between those with and without foreign-born care workers.

In our sample, the majority of individuals are not eligible to hire a foreign-born care worker. However, among those who are eligible, a substantial portion chooses to hire a

Table 1: Summary Statistics

	All	Eligibility		Caregiver	
		Yes	No	Yes	No
Age	68.35	81.92	67.67	82.58	67.91
Barthel Index	90.87	17.79	94.52	35.13	92.39
N. of ADL	0.45	5.50	0.20	4.81	0.33
Any ADL	0.11	1.00	0.06	0.97	0.08
N. of IADL	0.86	6.53	0.58	6.20	0.70
Any IADL	0.23	1.00	0.19	0.98	0.20
Any Outpatient	0.62	0.69	0.61	0.77	0.61
Any Inpatient	0.17	0.53	0.15	0.49	0.16
Any Fall	0.19	0.29	0.18	0.33	0.18
Any ER	0.17	0.49	0.15	0.47	0.16
N. Outpatient	2.06	2.18	2.05	2.06	1.96
N. Inpatient	0.27	1.14	0.23	1.01	0.25
N. Fall	0.50	1.39	0.45	1.32	0.48
N. ER	0.29	1.12	0.25	1.11	0.27
Death Next Wave	0.11	0.50	0.09	0.44	0.10
N. Individual	12,238	1,429	11,958	754	12,039
N	37,989	1,805	36,184	993	36,572

Notes: The summary statistics are calculated from the sample constructed from TLSA 1996 - 2019. "Eligibility" stands for the eligibility for hiring a foreign-born care worker, and "Caregiver" indicates whether an individual hires a foreign-born care worker. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month.

foreign-born care worker, indicating a pressing need for additional support. Our findings underscore the severe functional impairments among eligible individuals, with average scores indicating substantial needs in both Activities of Daily Living (ADLs, approximately 5.50) and Instrumental Activities of Daily Living (IADLs, approximately 6.53). These scores reflect serious levels of dependency and the need for comprehensive care and assistance.

Health service use is markedly higher among eligible individuals, pointing to their greater healthcare needs. A majority of the sample reported visiting a doctor in the past month. The contrast is stark when examining any hospitalization and ER use; about half of the eligible population experienced these events, compared to only about 15% of those not eligible. This disparity highlights the vulnerable health status of eligible individuals. When considering the frequency of healthcare utilization, the data on outpatient visits do not exhibit significant variance between groups, suggesting that the necessity for routine medical attention does not differ markedly across the sample. However, the higher incidence rates of inpatient stays, falls, and ER visits among eligible individuals emphasize their critical healthcare needs.

About half of the care recipients' eligible to hire a foreign-born care worker passed away before the subsequent survey wave. This high mortality rate underscores the critical health conditions of this group. Notably, the decision to hire a caregiver does not solely align with the most severe cases based on eligibility and functional status. Some individuals who may not meet the eligibility criteria still opt for foreign-born care worker support, potentially due to limitations in accurately assessing needs through conventional measures like the Barthel Index. In Appendix D, we demonstrate that our main findings are robust, even considering potential discrepancies in need assessment.

This analysis reveals the profound impact of eligibility for foreign-born care worker support on individuals' functional status, healthcare utilization, and mortality, highlighting the critical role of caregiver support in addressing the needs of the most vulnerable populations.

5 Results

5.1 First Stage

In light of our IV strategy, we first present the first stage estimates in Table 2. The first stage estimates correspond to the estimates from Equation 2. From columns (1) to (4), we gradually add covariates. The key parameter of interest is the coefficient of eligibility. The coefficient remains similar even after adding individual fixed effects. Since eligibility depends on the Barthel Index, adding the Barthel Index fixed effect reduces the coefficient by half. However, even with the inclusion of the Barthel Index fixed effect, the coefficient remains strongly statistically significant. This result suggests that the eligibility satisfies the relevance condition.

5.2 Reduced Form

We next present the reduced form estimates in Table 3 and 4. In Table 3, we build up to our full specification gradually by presenting different model specifications. Similar to the results from the first stage estimates, Columns (1) and (2) show similar estimates. Even when controlling for individual fixed effects, eligibility is strongly positively associated with ER entry. Specifically, those who are eligible to hire a foreign caregiver are 32.17 percentage points more likely to enter the ER during the past year. However, when we include the Barthel Index in the control variables, the sign of eligibility flips, becoming negative and statistically significant. This is again due to the fact that eligibility is heavily influenced by the Barthel Index. The difference in these estimates also highlights the substantial selection effect into hiring a foreign caregiver, suggesting that our approach of controlling for unobserved heterogeneity is necessary. Column (4), where the remaining variation of eligibility is driven by the reforms, indicates that being eligible to hire a foreign caregiver causes a statistically significant reduction in the likelihood of ER use.

To put the effect size into context and compare across different health outcomes, we estimate the specification of Column (4) on various measures in Table 4. First, the probability of hospitalization and ER is reduced and statistically significant. We note that their

Table 2: First Stage Estimates

Dependent Variable:	Hiring a Foreign Caregiver			
Model:	(1)	(2)	(3)	(4)
Variables				
Constant	0.0098***			
	(0.0008)			
Eligibility	0.3480***	0.3446***	0.1796***	0.1748***
	(0.0034)	(0.0144)	(0.0304)	(0.0304)
Fixed-effects				
Individual		Yes	Yes	Yes
Barthel Index			Yes	Yes
Year				Yes
Fit statistics				
Observations	37,565	37,565	37,558	37,558
R^2	0.21470	0.55872	0.63266	0.63333

Notes: The first stage estimates are calculated from the sample constructed from TLSA 1996 - 2019. Standard errors clustered at the individual level are reported in the parentheses. The statistically significant level is as follows: ***: 0.01, **: 0.05, *: 0.1.

Table 3: Reduced Form Estimates – Emergency Room Entry

Dependent Variable:	Emergency Room (ER) Use			
Model:	(1)	(2)	(3)	(4)
Variables				
Constant	0.1515***			
	(0.0019)			
Eligibility	0.3379***	0.3217***	-0.0715**	-0.0835**
	(0.0088)	(0.0153)	(0.0346)	(0.0350)
Fixed-effects				
Individual		Yes	Yes	Yes
Barthel Index			Yes	Yes
Year				Yes
Fit statistics				
Observations	37,951	37,951	37,944	37,944
R^2	0.03706	0.42553	0.44833	0.45567

Notes: The reduced form estimates are calculated from the sample constructed from TLSA 1996 - 2019. The dependent variable is the indicator of whether one entered the ER in the past year. Standard errors clustered at the individual level are reported in the parentheses. The statistically significant level is as follows: ***: 0.01, **: 0.05, *: 0.1.

Table 4: Reduced Form Estimates

	ER	Inpatient	Outpatient	Fall
Probability of Event	-0.0835**	-0.0977***	-0.1660***	-0.0650*
	(0.0350)	(0.0352)	(0.0362)	(0.0378)
Mean	0.1676	0.1724	0.6163	0.1860

Notes: The reduced form estimates are calculated from the sample constructed from TLSA 1996 - 2019. The numbers reported are estimated as the specification (4) in Table 3. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month. "Mean" refers to the mean value of the dependent variables. The statistically significant level is as follows: ***: 0.01, **: 0.05, *: 0.1.

Table 5: IV Estimates

	ER	Inpatient	Outpatient	Fall
Probability of Event	-0.5100**	-0.5688**	-0.9398***	-0.3947*
	(0.2171)	(0.2282)	(0.2696)	(0.2299)
Mean	0.1676	0.1724	0.6163	0.1860

Notes: The IV estimates are calculated from the sample constructed from TLSA 1996 - 2019. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month. "Mean" refers to the mean value of the dependent variables. The statistically significant level is as follows: ***: 0.01, **: 0.05, *: 0.1.

reduced form estimates are very large, with the decrease being almost half of the mean. For outpatient use, although there is a statistically significant decrease in probability, the magnitude is much smaller. This suggests that the results are not solely driven by a decrease in health utilization but also reflect improvements in health. The same message is reflected in the probability of a fall, which is a self-reported measure and hence not directly related to health utilization, yet we still observe a large decrease in its probability. A similar pattern is shown in the count of the event.

5.3 IV Results

Table 5 presents the main results of this paper. Consistent with the reduced form estimates, the IV estimates indicate a large and statistically significant decrease in the probabilities of utilizing ER, inpatient, and outpatient utilization. Although the probability

of having a fall is only marginally significant, the negative magnitude is still substantial. We observe the same direction in the number of events of these measures reported in Appendix Table 6.

To contextualize these results, the magnitude of the decrease is several times greater than the baseline mean of the control group. As shown in Table 1, individuals who are eligible are less healthy at the outset, providing more room for improvement in their health outcomes.

The set of compliers identified through our IV estimates may also explain the large estimates. The compliers of the eligibility instrument are those who would hire a foreign-born care worker whenever eligible. This group of people is likely to benefit the most from having a foreign-born care worker.

Two potential concerns remain regarding our findings. The first is the composition of the sample changing over time, which can be due to newly drawn samples, non-response attrition, or the death of individuals. We present estimates with data restricted to a balanced panel in Appendix B. Although the sample size drops significantly, the estimates remain similar in magnitude.

The second concern is the selection on survivors. It might be the case that foreign-born care workers make care receivers more likely to die, leading to better health outcomes among those who survive. We examine this in Appendix E, and the results do not support the notion that hiring foreign-born care workers increases the likelihood of death.

6 Discussion

We find a significant decrease in healthcare utilization. Two key questions arise: (1) What are the implications for health outcomes? (2) What mechanisms explain the observed decrease in healthcare utilization?

6.1 Implications for Health Outcomes

One alternative explanation for the observed reduction in healthcare utilization is that health does not actually improve; rather, the foreign-born care worker substitutes for the

need for healthcare services. Two pieces of evidence suggest that health does improve. First, the probability of falls also seems to decrease (and are statistically significant at the conventional level if we use an alternative BI measure in Appendix D). Second, if we observe a decrease only in primary care settings (e.g., outpatient services) but not in ER or inpatient utilization, it could indicate that care recipients are not regularly seeing doctors, which does not necessarily mean their health is improving. If outpatient use decreases but ER or inpatient use increases, it could be that individuals use more severe ER or inpatient services as substitutes for regular outpatient services, indicating a worsening of health. However, our findings show a significant decrease not only in outpatient use but also in both ER and hospitalization use. This result suggests that the reduction in overall healthcare reduction is likely due to health improvements, so that care recipients who are taken care by foreign care workers have less need in all aspects of healthcare utilization.

6.2 Mechanism

The next question is: What mechanisms underlie the improved health outcomes and reduced healthcare utilization after hiring a foreign-born care worker? To investigate this, we examine counterfactual care arrangements and the impact on family caregiving behavior.

Counterfactual Care Arrangements. The estimated effects reflect the local average treatment effect for compliers. To understand these effects, we ask: What care arrangements would have existed without foreign-born caregivers? Figure 1 shows that nursing homes accounted for roughly 20%, foreign caregivers for 30%, and family members (spouses, children, daughter-in-law) for 40%. Using Abadie (2003)'s method detailed in Appendix G, we estimate the counterfactual care arrangements without foreign caregivers: 72% of care would have been provided by family members, 5.4% by nursing homes, and 22.8% by others. This suggests that without foreign caregivers, compliers would have relied heavily on family members for care.

Substitutes or Complements. Next, we assess how hiring foreign caregivers affects overall care arrangements. Foreign care workers may complement rather than substitute family caregiving. To examine the time use and quality of care provided by family caregivers, we turn to another survey, the Senior Citizen Condition Survey (SCCS). The SCCS is a cross-sectional dataset from 2017, surveying 6,920 older individuals about their health conditions, caregivers, and the hours of care provided by caregivers.

In the SCCS survey, even when care recipients report that their primary caregiver is a foreign-born care worker, more than half (51.9%) specify that they have family caregivers as secondary caregivers. Regarding caregiving hours, for those in the worst health conditions (with a zero BI), it takes family caregivers an average of 16 hours per day to care for the care recipient. An increase of 10 BI points is associated with approximately a half-hour reduction in family caregiving time.

To further analyze the relationship between the use of foreign-born care workers and the caregiving hours provided by family caregivers, we regress the hours that a family caregiver spends providing care on an indicator of whether one hires a foreign-born care worker (Appendix Table 19). We find no detectable association between hiring a foreign care worker and the caregiving hours provided by a family caregiver, even after controlling for BI. The total hours spent on family caregiving do not significantly decrease even when a hired foreign-born caregiver is present. This result suggests that foreign-born care workers act more as complements than substitutes to family caregivers in a home-based care setting. Our findings from Taiwan shift the focus from the previously broadly discussed institutional care setting to the home-based care setting, and add empirical evidence to the discussion on whether informal care and formal care appear to be complements or substitutes in the economic literature (Van Houtven and Norton, 2004).

Training and Caregiving Skills. The substantial estimated effects may also stem from the higher training levels of foreign caregivers compared to family members. Foreign-born care workers receive approximately 240 hours of training in safety, health, and housekeeping, with additional on-the-job training provided by the Taiwanese government (Ministry of Labor, 2013). Small-scale randomized trials indicate that such training

can be effective (Huei-Ling and Yea-Ing, 2003; Huei-Ling et al., 2003).

Summary. In summary, the observed effects appear to arise from comparing two alternatives: one relying predominantly on family caregiving, and the other involving an additional trained foreign caregiver who complements family members. This distinction helps explain the significant improvements in health outcomes and reduced healthcare utilization.

7 Conclusion

In conclusion, the challenges of providing LTC for aging populations demand a comprehensive understanding of the impacts of various care arrangements on health outcomes. Our study contributes insights into this issue by focusing on the effects of care provided by foreign-born care workers compared to other forms of care. Given the significant reliance on foreign-born care workers in regions like Southern Europe and East Asia—particularly in Taiwan, where they constitute a notable fraction of care solutions—our findings are timely and relevant.

Despite the empirical challenges associated with causal studies in this area, our use of the Taiwanese government's BI threshold reforms as an instrumental variable has allowed us to uncover meaningful effects of hiring foreign-born care workers on care recipients' health outcomes. Notably, our analysis reveals that although the presence of foreign-born care workers does not statistically significantly influence mortality rates, it is associated with tangible benefits in terms of reduced outpatient, hospitalization, and ER utilization. These findings underscore the importance of foreign-born care workers in the broader LTC landscape, highlighting their role in mitigating some of the healthcare utilization pressures associated with care recipient needs.

We interpret the decrease in healthcare utilization as an improvement in health outcomes, supported by evidence of a simultaneous decrease in overall healthcare use and a reduction in falls. We also suggest that the large effects we observed may be due to the training received by the foreign-born caregivers and the complementary roles they

play in the household, whereas households without foreign-born caregivers rely solely on family members. As the demand for LTC continues to grow alongside aging populations, our research provides policymakers with important insights when evaluating LTC and immigration policies related to foreign-born care workers.

References

Abadie, Alberto. 2003. "Semiparametric instrumental variable estimation of treatment response models." *Journal of econometrics*, 113(2): 231–263.

Bauer, Jan Michael, and Alfonso Sousa-Poza. 2015. "Impacts of Informal Caregiving on Caregiver Employment, Health, and Family." *Journal of Population Ageing*, 8(3): 113–145.

Bostick, Jane E, Marilyn J Rantz, Marcia K Flesner, and C Jo Riggs. 2006. "Systematic review of studies of staffing and quality in nursing homes." *Journal of the American Medical Directors Association*, 7(6): 366–376.

Butcher, Kristin F., Kelsey Moran, and Tara Watson. 2022. "Immigrant labor and the institutionalization of the U.S.-born elderly." *Review of International Economics*, 30(5): 1375–1413.

Castle, Nicholas G, and Jamie C Ferguson. 2010. "What is nursing home quality and how is it measured?" *The Gerontologist*, 50(4): 426–442.

Chan, Su-Yuan, Hsiao-Wei Yu, Ming-Ching Yang, Yue-Chune Lee, and Ya-Mei Chen. 2022. "The Impact of Multiple Long-Term Care Services Use on Dementia and Nondementia Caregivers' Health Care Utilization and Costs." *Journal of Applied Gerontology*, 41(11): 2341–2352. PMID: 35815742.

Chen, Kuan-Ming, Chen-Wei Hsiang, Shiau-Fang Chao, Ming-Jen Lin, Kuan-Ju Tseng, Yu-Hsuan Chou, Ji-Lung Hsieh, and Ya-Mei Chen. 2021. "Using Taiwanese Universal Health Insurance Data to Estimate LTC Needs with Machine Learning." *Innov. Aging*, 5: 1019.

Colombo, Francesca, Ana Llena-Nozal, Jérôme Mercier, and Frits Tjadens. 2011. *Help Wanted?*

Department of Health. 2012. "Older adults aged over 80 who have been assessed as having severe disabilities by medical institutions can apply to hire foreign caregivers starting from September 24."

Department of Health. 2015. "Taiwan Longitudinal Study on Aging (TLSA)."

Department of Household Registration. 2024. "Demographic data."

Executive Yuan. 2022. "Long-Term Care Services 2.0 Policy Outcomes."

Furtado, Delia, and Francesc Ortega. 2023. "Does Immigration Improve Quality of Care in Nursing Homes?" *Journal of Human Resources*.

Grabowski, David C. 2001. "Medicaid reimbursement and the quality of nursing home care." *Journal of health economics*, 20(4): 549–569.

Grabowski, David C, Jonathan Gruber, and Brian McGarry. 2023. "Immigration, The Long-Term Care Workforce, and Elder Outcomes in the U.S." National Bureau of Economic Research Working Paper 30960.

Gruber, Jonathan, and Kathleen M McGarry. 2023. "Long-term Care in the United States." National Bureau of Economic Research Working Paper 31881.

Gruber, Jonathan, Kathleen M McGarry, and Charles Hanzel. 2023. "Long-term Care Around the World." National Bureau of Economic Research Working Paper 31882.

Huei-Ling, Huang, and Shyu Yea-Ing. 2003. "The Effectiveness of a Community-based Caregiver Training Program for Improving the Caregiver's Competence of Elders with Dementia." *The Journal of Long-Term Care*, 7(2): 121–134.

Huei-Ling, Huang, Shyu Yea-Ing Lotus, Chen Min-Chi, Chen Sien-Tsong, and Lin Li-Chan. 2003. "The Effectiveness of a Community-based Caregiver Training Program for Improving the Caregiver's Preparedness of Elders with Dementia." *Chang Gung Nursing*, 14(1): 1–10.

Jun, Hankyung, and David C. Grabowski. 2024. "Nursing Home Staffing: Share Of Immigrant Certified Nursing Assistants Grew As US-Born Staff Numbers Fell, 2010â€"21." *Health Affairs*, 43(1): 108–117. PMID: 38190591.

Katz, Sidney, and C. Amechi Akpom. 1976. "A Measure of Primary Sociobiological Functions." *International Journal of Health Services*, 6(3): 493–508. PMID: 133997.

Maestas, Nicole, Matt Messel, and Yulya Truskinovsky. 2023. "Caregiving and Labor Supply: New Evidence from Administrative Data." National Bureau of Economic Research Working Paper 31450.

Merçay, C, J-Ch Dumont, and G Lafortune. 2015. "Changing patterns in the international migration of doctors and nurses to OECD countries." *International migration outlook*, 105–176.

Ministry of Health and Welfare. 2017. "Long-term Care Services 2.0." *https://1966.gov.tw/LTC/cp-6572-69919-207.html*.

Ministry of Health and Welfare. n.d.. "Long-Term Care Services."

Ministry of Labor. 2013. "Survey on Work and Life of Foreign Workers."

Ministry of Labor. 2015. "Older adults aged over 85 who have been assessed as having mild disabilities by medical institutions can apply to hire foreign caregivers starting from August 8."

Ministry of Labor. 2021. "Survey on Foreign Workers Management and Utilization."

Ministry of Labor. 2022. "The Monthly Salary for Newly Hired and Renewed Household Caregivers Is Adjusted to 20,000." *https://www.mol.gov.tw/1607/1632/1640/54530/post*.

Ministry of Labor. 2023. "Number of industrial and social welfare foreign workers."

National Immigration Agency. 2024. "Statistics of Missing Migrant Workers." *https://www.immigration.gov.tw/5385/7344/7350/8943/?alias=settledown*.

National Statistics. 2016. "Nominal GDP."

OECD. 2015. "OECD Data Explorer."

OECD. 2023. *Health at a Glance 2023.*

Rapp, Thomas, and Jonathan Sicsic. 2020. "The contribution of the immigrant population to the U.S. long-term care workforce." *Social Science Medicine*, 263: 113305.

Van Houtven, Courtney Harold, and Edward C. Norton. 2004. "Informal care and health care use of older adults." *Journal of Health Economics*, 23(6): 1159–1180.

World Health Organization and others. 2021. *Decade of healthy ageing: baseline report.* World Health Organization.

Appendix A Results for the Number of Events

We present the results for the number of events in Table 6.

Appendix B Balanced Panel

We present the results restricting on a balanced panel in Table 7, 9, 8, 10, and 11.

Appendix C Balance Check

We present the balance check in Table 13 and 12 to validate our IV design.

Appendix D Alternative Barthel Definition

We present our main estimates with alternative Barthel Index measures in Table 14, 15, 16, and 17. We present two alternative measures, ADL_1H and ADL_2L, according to the behavioral levels of ADL items. Generally, bathing is the first function lost when individuals gradually develop disabilities, while feeding is the last (Katz and Akpom, 1976). Hence, to construct a care recipient's highest ADL score, ADL_1H, we identify the missing ADL items based on this care recipient's feeding level, in order to get the potential best function level. Conversely, the lowest score, ADL_2L, is determined by the bathing function level.

Appendix E Death Outcomes

We present the death IV outcomes in Table 18.

Table 6: Results for the Number of Events

	ER	Inpatient	Outpatient	Fall
Reduced Form	-0.1609*	-0.2281***	-0.5139	-0.6499*
	(0.0919)	(0.0730)	(0.3852)	(0.3333)
Mean	0.2908	0.2734	2.0610	0.5020
IV	-1.064*	-1.3730***	-2.702	-3.963*
	(0.5554)	(0.4915)	(2.115)	(2.093)
Mean	0.2908	0.2734	2.0610	0.5020

Notes: The estimates are calculated from the sample constructed from TLSA 1996 - 2019. The numbers reported are estimated as the specification (4) in Table 3. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month. "Mean" refers to the mean value of the dependent variables. The statistically significant level is as follows: ***: 0.01, **: 0.05, *: 0.1.

Table 7: First Stage Results – Balanced Panel

Dependent Variable:	Hiring Foreign Caregiver			
Model:	(1)	(2)	(3)	(4)
Variables				
Constant	0.0075***			
	(0.0016)			
Eligibility	0.4780***	0.4470***	0.1831***	0.1838***
	(0.0077)	(0.0321)	(0.0471)	(0.0473)
Fixed-effects				
Individual		Yes	Yes	Yes
Barthel Index			Yes	Yes
Year				Yes
Fit statistics				
Observations	7,401	7,401	7,400	7,400
R^2	0.34262	0.50333	0.64584	0.64591

Notes: The first stage estimates are calculated from the sample constructed from TLSA 1996 - 2019. Standard errors clustered at the individual level are reported in the parentheses. The statistically significant level is as follows: ***: 0.01, **: 0.05, *: 0.1. The estimates in this table are restricted to a balanced panel.

Table 8: Reduced Form Results - Y - Balanced Panel

Dependent Variables:	Fall	Inpatient	ER	Outpatient
Model:	(1)	(2)	(3)	(4)
Variables				
Eligibility	-0.0915	-0.1233**	-0.1233**	-0.2775***
	(0.0593)	(0.0533)	(0.0590)	(0.0585)
Fixed-effects				
Individual	Yes	Yes	Yes	Yes
Barthel Index	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	6,364	7,425	7,415	7,425
R^2	0.30150	0.25756	0.29439	0.31302

Notes: The reduced form estimates are calculated from the sample constructed from TLSA 1996 - 2019. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. The dependent variables are binary indicators of the events. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month. "Mean" refers to the mean value of the dependent variables. The estimates in this table are restricted to a balanced panel.

Table 9: Reduced Form Results - N - Balanced Panel

Dependent Variables:	Fall	Inpatient	ER	Outpatient
Model:	(1)	(2)	(3)	(4)
Variables				
Eligibility	-0.3330	-0.0637	0.0327	-0.8058*
	(0.3965)	(0.1122)	(0.1551)	(0.4437)
Fixed-effects				
Individual	Yes	Yes	Yes	Yes
Barthel Index	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	6,344	7,425	7,409	7,396
R^2	0.25613	0.28942	0.28938	0.19743

Notes: The reduced form estimates are calculated from the sample constructed from TLSA 1996 - 2019. The numbers reported are estimated as the specification (4) in Table 3. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. The dependent variables are the numbers of the events. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month. "Mean" refers to the mean value of the dependent variables. The estimates in this table are restricted to a balanced panel.

Table 10: IV Results - N - Balanced Panel

Dependent Variables:	Fall	Inpatient	ER	Outpatient
Model:	(1)	(2)	(3)	(4)
Variables				
Hiring Foreign Caregiver	-1.887	-0.3389	0.1754	-5.603**
	(2.262)	(0.6201)	(0.8504)	(2.725)
Fixed-effects				
Individual	Yes	Yes	Yes	Yes
Barthel Index	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	6,344	7,399	7,383	7,370
R^2	0.25468	0.28272	0.28923	0.18753

Notes: The IV estimates are calculated from the sample constructed from TLSA 1996 - 2019. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. The dependent variables are the numbers of the events. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month. "Mean" refers to the mean value of the dependent variables. The estimates in this table are restricted to a balanced panel.

Table 11: IV Results - Y - Balanced Panel

Dependent Variables:	Fall	Inpatient	ER	Outpatient
Model:	(1)	(2)	(3)	(4)
Variables				
Hiring Foreign Caregiver	-0.5065	-0.6592*	-0.6610*	-1.495***
	(0.3341)	(0.3456)	(0.3633)	(0.5022)
Fixed-effects				
Individual	Yes	Yes	Yes	Yes
Barthel Index	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	6,364	7,399	7,389	7,399
R^2	0.28824	0.21546	0.25757	0.21827

Notes: The IV estimates are calculated from the sample constructed from TLSA 1996 - 2019. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. The dependent variables are binary indicators of the events. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month. "Mean" refers to the mean value of the dependent variables. The estimates in this table are restricted to a balanced panel.

Table 12: Balance Check - Y

Dependent Variables:	Fall	Inpatient	ER	Outpatient
Model:	(1)	(2)	(3)	(4)
Variables				
Eligibility	-0.0171	0.0068	0.0353	0.0185
	(0.0440)	(0.0345)	(0.0346)	(0.0377)
Fixed-effects				
Individual	Yes	Yes	Yes	Yes
Barthel Index	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	11,726	15,463	15,437	15,456
R^2	0.47898	0.42159	0.42198	0.51240

Notes: The balance check estimates the lagged outcomes on the eligibility dummy and control variables. The estimates are similar to the reduced form and are calculated from the sample constructed from TLSA 1996 - 2019. The numbers reported are estimated as the specification (4) in Table 3. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. The dependent variables are binary indicators of the events. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month. "Mean" refers to the mean value of the dependent variables.

Table 13: Balance Check - N

Dependent Variables:	Fall	Inpatient	ER	Outpatient
Model:	(1)	(2)	(3)	(4)
Variables				
Eligibility	0.8599	-0.0286	0.1287	0.8240
	(0.7539)	(0.0523)	(0.0907)	(0.6365)
Fixed-effects				
Individual	Yes	Yes	Yes	Yes
Barthel Index	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	11,701	15,462	15,426	15,410
R^2	0.39888	0.46823	0.41265	0.52758

Notes: The balance check estimates the lagged outcomes on the eligibility dummy and control variables. The estimates are similar to the reduced form and are calculated from the sample constructed from TLSA 1996 - 2019. The numbers reported are estimated as the specification (4) in Table 3. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. The dependent variables are the numbers of the events. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month. "Mean" refers to the mean value of the dependent variables.

Table 14: First Stage Results – ADL_1H

Dependent Variable:	Hiring a Foreign Caregiver			
Model:	(1)	(2)	(3)	(4)
Variables				
Constant	0.0112***			
	(0.0008)			
Eligibility	0.3567***	0.3489***	0.1530***	0.1476***
	(0.0037)	(0.0152)	(0.0290)	(0.0290)
Fixed-effects				
Individual		Yes	Yes	Yes
Barthel Index			Yes	Yes
Year				Yes
Fit statistics				
Observations	37,565	37,565	37,560	37,560
R^2	0.20169	0.55111	0.59855	0.59947

Notes: The first stage estimates are calculated from the sample constructed from TLSA 1996 - 2019. Standard errors clustered at the individual level are reported in the parentheses. The statistically significant level is as follows: ***: 0.01, **: 0.05, *: 0.1.

Table 15: First Stage Results – ADL_2L

Dependent Variable:	Hiring a Foreign Caregiver			
Model:	(1)	(2)	(3)	(4)
Variables				
Constant	0.0076***			
	(0.0007)			
Eligibility	0.3375***	0.3449***	0.1619***	0.1558***
	(0.0032)	(0.0138)	(0.0310)	(0.0309)
Fixed-effects				
Individual		Yes	Yes	Yes
Barthel Index			Yes	Yes
Year				Yes
Fit statistics				
Observations	37,565	37,565	37,560	37,560
R^2	0.23373	0.57194	0.60311	0.60394

Notes: The first stage estimates are calculated from the sample constructed from TLSA 1996 - 2019. Standard errors clustered at the individual level are reported in the parentheses. The statistically significant level is as follows: ***: 0.01, **: 0.05, *: 0.1.

Table 16: Reduced Form Results

Dependent Variables:	Fall		Inpatient		ER		Outpatient	
	N	Y	N	Y	N	Y	N	Y
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADL_1H								
Variables								
Eligibility	-0.4876**	-0.0763**	-0.1525**	-0.0738**	-0.1396	-0.0494	-0.4863	-0.1139***
	(0.2460)	(0.0351)	(0.0712)	(0.0321)	(0.0852)	(0.0334)	(0.3178)	(0.0332)
Fixed-effects								
Individual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Barthel Index	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics								
Observations	32,741	32,853	37,948	37,980	37,875	37,946	37,811	37,964
R^2	0.56379	0.44272	0.49815	0.44087	0.41836	0.44718	0.48661	0.48316
ADL_2L								
Variables								
Eligibility	-0.5823*	-0.1079***	-0.2148***	-0.1130***	-0.1727*	-0.0930***	-0.3181	-0.1900***
	(0.3441)	(0.0390)	(0.0725)	(0.0336)	(0.0891)	(0.0352)	(0.3700)	(0.0354)
Fixed-effects								
Individual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Barthel Index	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics								
Observations	32,741	32,853	37,948	37,980	37,875	37,946	37,811	37,964
R^2	0.56341	0.44316	0.49722	0.44062	0.41809	0.44757	0.48666	0.48334

Notes: The reduced form estimates are calculated from the sample constructed from TLSA 1996 - 2019. The numbers reported are estimated as the specification (4) in Table 3. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. "N" refers to the estimates where the dependent variables are the numbers of the events. "Y" refers to the estimates where the dependent variables are the binary indicators of the events. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month.

Table 17: IV Results

Dependent Variables:	Fall		Inpatient		ER		Outpatient	
	N	Y	N	Y	N	Y	N	Y
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ADL_1H								
Variables								
Hiring a Foreign Caregiver	-2.012	-0.5033*	-0.2435	-0.4552*	0.4871	-0.3603	-3.432	-0.9434***
	(1.375)	(0.2645)	(0.4803)	(0.2551)	(0.7325)	(0.2586)	(2.111)	(0.3281)
Fixed-effects								
Individual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Barthel Index	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics								
Observations	6,345	6,365	7,400	7,400	7,384	7,390	7,371	7,400
R^2	0.24302	0.26432	0.25147	0.21058	0.25369	0.26020	0.18774	0.25723
ADL_2L								
Variables								
Hiring a Foreign Caregiver	-3.093	-0.6269**	-0.6821	-0.6793**	-0.5851	-0.7819**	-3.854*	-1.263***
	(2.639)	(0.3102)	(0.5898)	(0.3079)	(0.7689)	(0.3237)	(2.268)	(0.4010)
Fixed-effects								
Individual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Barthel Index	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics								
Observations	6,345	6,365	7,400	7,400	7,384	7,390	7,371	7,400
R^2	0.23575	0.25405	0.23264	0.18586	0.25079	0.21789	0.18755	0.22090

Notes: The IV estimates are calculated from the sample constructed from TLSA 1996 - 2019. "ER" refers to emergency room use. "Inpatient" and "Outpatient" refer to inpatient and outpatient use. "N" refers to the estimates where the dependent variables are the numbers of the events. "Y" refers to the estimates where the dependent variables are the binary indicators of the events. Standard errors clustered at the individual level are reported in the parentheses. Inpatient, ER, and Falls are measured as the frequency in the past year. Outpatient is measured as the frequency of the past month.

Table 18: Death Outcomes

Dependent Variable:	Death		
Model:	(1)	(2)	(3)
Variables			
Hiring Foreign Caregiver	2.104***	1.310	1.135
	(0.1266)	(0.7974)	(0.7764)
Fixed-effects			
Individual	Yes	Yes	Yes
Barthel Index		Yes	Yes
Year			Yes
Fit statistics			
Observations	30,957	30,951	30,951
R^2	0.19723	0.43533	0.50976

Notes: The IV estimates are calculated from the sample constructed from TLSA 1996 - 2019. The dependent variable is whether the individual is dead in the next wave of the survey.

Appendix F Caring Hours

Table 19: Caring Hours

Dependent Variable:	Hours Providing Care	
Model:	(1)	(2)
Variables		
Constant	13.216***	
	(0.580)	
Hiring a Foreign Caregiver	3.222	2.330
	(2.298)	(2.330)
Fixed-effects		
Barthel Index		Yes
Fit statistics		
Observations	214	214
R^2	0.0091	0.0940

Notes: The estimates are constructed with the 2017 Senior Citizen Condition Survey. Samples are restricted to the individuals with at least 1 ADL need. The statistically significant level is as follows: ***: 0.01, **: 0.05, *: 0.1.

Appendix G Profiling Compliers

We follow Abadie (2003) to estimate the expected outcome for compliers by first estimating the κ_0 and then estimating the expected care arrangement weighted by κ_0. κ_0 is defined as:

$$\kappa_0 = (1-D)\frac{(1-Z)-(1-p(X))}{p(X)(1-p(X))},$$

where $p(X)$ is the instrument propensity score ($p(X) \equiv P(Z = 1|X)$). We estimate $p(X)$ using a logistic regression with the eligibility as the outcome variable. The counterfactual of care-needers' care arrangement is then estimated with using the fact that $E[Y_0|D_1 > D_0] = \frac{1}{P(D_1>D_0)}E[\kappa_0 Y]$, where D_1 and D_0 are the potential treatment status when the instrument does and does not turn on.