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The Philippine Review of Economics

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Unpaid eldercare and its impact on the US labor supply

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Globally, the dependency ratio is rising due to increase in aging population. Individuals, especially women are challenged when choosing between participating in the labor market and providing care. Using 2011-2017 American Time Use Survey data for a subsample of individuals aged 25-61 years, we examine the effect of frequent eldercare provision on labor force participation in the US using bivariate probit instrumental variable approach. Our findings suggest that unpaid eldercare performed frequently reduces labor force participation. Female frequent providers are likely to have lower labor force participation compared to their male counterparts. Robustness and sensitivity checks confirm these findings.

JEL Classification: J14, J16, J22
Keywords: aging, eldercare, labor supply, United States

1. Introduction

The world is facing a demographic turn. The number of persons aged 65 and older is expected to rise from 703 million in 2019 to 1.5 billion in 2050, i.e., one in six people worldwide will be 65 and older by the year 2050, increasing from one in 11 in 2019 [United Nations 2019]. The rate of increase in the older population is highest in Eastern and Southeastern Asia, with the largest growth estimated to be in the Republic of Korea (23 percent). With the increase in the aging population and declining fertility, the old-age dependency ratio is projected to rise in all regions of the world, with Japan and Korea estimated to be having the highest old-age dependency ratio of 81 and 79 persons aged 65 years and older, depending on 100 persons aged 20-64 years by 2050, respectively.

The US will also follow—soon facing a significant demographic turn by the year 2035. The 2018 US Census Bureau report predicts that the elderly, aged 65 years and older, will outnumber children, aged 18 years and younger for the first time

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in the US history (78 million elderly vs. 76.4 million children) [US Census Bureau 2018]. Due to aging, the dependency ratio in the population is expected to increase to 41 percent by the year 2060, nearly four times the level in 1940 (11 percent) [Vespa et al. 2018]. This change in demographic composition poses a unique set of challenges for long-term care for frail elderly. Many low and middle-income countries either lack or have inadequate government support for long-term care services, and so the burden of eldercare largely falls upon family members (e.g., children, spouse, niece or nephew, and grandchildren).

In many low- and middle-income countries, family members (e.g., children, spouse, niece or nephew, and grandchildren) shoulder the heavy burden of caregiving. This is in large part due to the prevailing cultural norms involving filial piety or familial obligations to care for elderly parents. It is also due to the high cost of private long-term care insurance and of institutional forms of elder care such as nursing homes, given the weak or no government support for such services.

On the other hand, the increasing prevalence of nuclear families and urbanization in high-income countries and in some middle-income countries have weakened the ability of families to provide eldercare on their own. As a result, their governments are also increasingly providing support for long-term care insurance and are investing in eldercare supply. Not surprisingly, nursing homes, community-based eldercare services, and private residential care facilities have grown in these countries in the past few decades.

In the US, nursing homes care for nearly three million elderly persons each year, with government-funded Medicaid paying the majority of the USD 235 billion in annual cost. However, millions more Americans needing long-term care support largely rely on services provided by unpaid caregivers [Mitchell et al 2022].[1] This is because US government spending on long-term care is proportionally the lowest among high-income countries [Commonwealth Fund 2023]. There is, by now, a general consensus that inadequate prioritization of public investment in long-term care in the US has led to a highly variable quality of care, critical staff shortages, racial and ethnic disparities, and wasteful spending, all of which have become evident during the COVID-19 pandemic [Mitchell et al. 2022].

Eldercare has become a pressing issue given the increase in life expectancies and the fact that as population ages and the elderly live longer, many of the elderly will live with limited functionalities and disabilities, which increases the complexity and duration of care tasks (Hagen [2013]; National Alliance for Caregiving and AARP Public Policy Institute (2015); Reinhard et al. (2015)]. Care for older adults involves a wide range of activities—from assisting with daily living activities such as eating, bathing, getting dressed, continence, and moving

[1] In all states, US Medicaid gives health coverage to eligible individuals and families based on incomes and family size, including children, parents, pregnant women, and elderly persons below a certain income level, as well as people with disabilities. See: https://www.hhs.gov/answers/medicare-and-medicaid/who-is-eligible-for-medicaid/index.html.

around, performing medical and nursing tasks, to assistance with financial, housing, as well as legal issues. It also involves providing emotional support and companionship, which includes activities such as listening or taking the elderly out for a walk.

Studies by Arora and Wolf [2014], Zagheni et al. [2016], Hammersmith and Lin [2016], and Bott et al. [2017] point to the challenges and difficulties that many eldercare providers face in balancing care responsibilities with their employment. Other studies show that an increase in unpaid eldercare is likely to lead to withdrawal from the labor force or a shift from full-time to part-time employment, and decline in earnings (Butrica and Karamcheva [2015]; Chari et al. [2015]; Feinberg [2016]; Feinberg and Choula [2012]; Reinhard et al. [2015]; US Bureau of Labor Statistics [2017]). However, the impact on labor force participation is likely to be underestimated, for two reasons. First, several of these studies, e.g., Johnson and Lo Sasso [2006], Houtven et al. [2013], and Butrica and Karamcheva [2015] focus only on individuals 50 years and older, leaving out prime-aged adults who also provide unpaid eldercare. Second, these studies do not distinguish the effects on labor supply between those providing frequent (daily or several times a week) eldercare and those who perform infrequent eldercare (once a month or a few times a year), which results in a pooled average effect. The distinction is important since the frequency of care provision is closely related with the level and intensity of unpaid care provided and the extent to which caregiving poses a serious time constraint in performing other activities such as market work. On the other hand, the labor supply effect may be overestimated if the issues of selection bias and endogeneity are not addressed (Lam and Garcia-Roman [2017]; Yamashita et al. [2018]).

This study addresses the above methodological and data issues in our analysis of the impact of unpaid eldercare on labor supply. First, it examines the relationship between frequent eldercare and labor force participation using a subsample of individuals aged 25 to 61 years. Second, it makes a distinction between infrequent and frequent eldercare providers and focuses on the labor supply effect in the latter case, thus providing a more accurate, albeit nuanced assessment. The study is distinct from other studies in that it uses the eldercare module of the 2011-2017 American Time Use Survey (ATUS) dataset rather than special survey datasets, e.g., the Health and Retirement Study (HRS) or other time use surveys, which do not collect specific data on eldercare. ATUS's time diary approach along with an eldercare module allows for a more accurate measure of the amount of time spent on eldercare; and its design includes not just spouse and parents as care recipients but also other family members e.g., aunts, uncles, grandparents, friends, and neighbors. While Johnson and Lo Sasso [2006], Houtven et al. [2013], Skira [2015], and Butrica and Karamcheva [2015] used panel data to deal with the selection bias, in this paper we address the problem using a bivariate probit with instrumental variable (IV) approach. Our findings suggest that frequent eldercare provision reduces the labor force participation of

individuals aged 25 to 61 years old by nine percentage points. Interestingly, we also find that frequent male providers reduce their labor force participation more than frequent female providers. A series of robustness tests confirm our results.

2. Background

Most people nowadays provide care for an elderly family member, friend, or neighbor at some point in their lives. For a growing number of individuals, this occurs while they are still economically active and thus its provisioning can affect the labor supply, as demonstrated by studies in high-income countries such as the US. Using the HRS longitudinal data, Johnson and Lo Sasso [2006], Houtven et al. [2013], Skira [2015], and Butrica and Karamcheva [2015] show that providing eldercare leads to lower labor force participation of those aged 51 years and older in the US. Houtven et al. [2013] and Butrica and Karamcheva [2015] point out that the effect of providing eldercare on labor force participation varies by types and the intensity of care. Butrica and Karamcheva [2015] show that the likelihood of the labor force participation of women fall by 3.9 percent if women provide intensive care. Houtven et al. [2013] find that female caregivers are more likely to be retired, and male caregivers are more likely to reduce their labor force participation by around 2.4 percentage points.

Studies outside the US that explore the impact of caregiving on the paid work hours of elder caregivers show mixed results. Maurer-Fazio et al. [2011] find that an elderly living in the household increases the likelihood of market work of prime-aged married women in urban China. Leigh's [2010] and Nguyen and Connelly's [2014] research on Australian working-age population, and Crespo and Mira's [2014] study of European mature women, on the other hand, find a negative effect of eldercare on labor force participation. Jacobs et al. [2014] show that providing higher intensity eldercare in Canada increases the likelihood of retirement for the age 55-69 years. However, the studies by Schneider et al. [2013] (on working population in Austria) and Meng [2013] (on age 36-63 individuals in Germany) find that eldercare has no effect on labor force participation.

The ambiguous findings may be due to differences in the sample and methodology and the fact that there is great variation in the level and intensity of unpaid eldercare provisioning. It can be given infrequently, say a few times a year or during once a month visits, or on a daily (or near daily) basis by a household member. The latter is likely to take on a greater toll on the provider in terms of the amount of time spent in providing basic (e.g. dressing, feeding, giving bath, etc.), instrumental (shopping, cleaning house, doing laundry, answering phone calls, etc.) and emotional (talking and listening, etc.) support and therefore may have a different impact on labor supply. In our study, we take into account the heterogeneity in eldercare giving and distinguish between frequent and infrequent eldercare. We also consider whether the impact on labor supply is likely to differ between female and male providers.

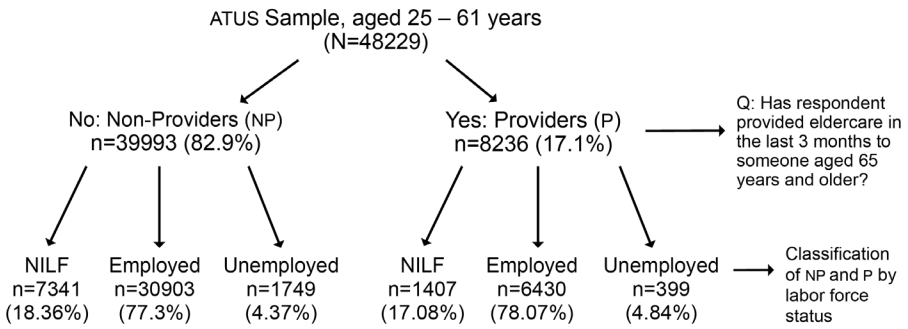
2.1. Data and sampling

This paper analyzes the 2011-2017 ATUS data collected by the US Census Bureau (US Bureau of Labor Statistics 2018a). ATUS interviews one randomly selected individual aged 15 years and older from a subset of households that have completed their eighth and final month of interviews with the Current Population Survey (CPS). The ATUS collects time diary and socio-demographic and labor market information. Since 2011, ATUS has collected information on eldercare using a supplementary module. ATUS defines eldercare as "not including financial assistance or help that one provided as part of her paid job, whether one has provided any other care or assistance in the last three to four months for an adult who needed help because of a condition related to aging" (US Bureau of Labor Statistics 2018a). The caregiver can be a family member or a non-family member. Eldercare includes activities such as assisting with grooming and feeding, preparing meals, arranging medical care, providing transportation, providing companionship, and being available ("on call") to assist whenever help is needed. The ATUS eldercare module also collects information on the care recipient including age, frequency of care provided by the respondent-caregiver, relationship with the caregiver, whether co-residing with the caregiver or not, and the length of time the respondent has provided for each activity.

We examine the impact of eldercare on labor force participation among adults in their prime working ages (25 to 61 years). We restrict the upper bound of the prime working age to 61 years because an individual in the US can retire with partial social security benefits starting at 62. Since the retirement eligibility for workers 62 years or older may lead to bias in our estimation of the impact on labor force participation, we exclude them from the analysis. We also consider the possibility that the labor supply effect of unpaid eldercare is more likely to occur when it is performed on a regular basis. The frequency in which individuals do eldercare, whether for a few days during the year or several days a week, matters since the caregivers have to adjust their daily routine schedule to accommodate their care work. Figure 1 presents the distribution of 48,229 ATUS sample respondents aged 25-61 years as to whether they provided eldercare or not, based on their response to the following question: "Has respondent provided care to an elderly person (aged 65 years or older) in the last three to four months?" It also shows the distribution of the elder care provider (P) and non-provider (NP) respondents according to their labor force status. About 8,236 respondents[2] (17.1 percent) are considered providers (P), i.e. individuals who have provided care to an elderly person (aged 65 years or older) in the last three to four months; out of which 1,407 (17.08 percent) are not in the labor force; 6,430 (78.07 percent) are employed and 399 (4.84 percent) are unemployed. A significant proportion (82.9 percent) of the sample consists of non-providers (NP), with 7,341 (18.36 percent) not in the labor force, while 30,903 or 77.3 percent employed and 1,749 (4.37 percent) unemployed.

[2] Respondents with inconsistent and missing responses are also excluded from the sample.

FIGURE 1. Distribution of 2011-17 ATUS respondents aged 25 to 61 years, by eldercare provision and labor force status



Eldercare providers (P) are further divided into two groups: frequent providers (FP) and infrequent providers (IP). FP provide care either on a daily basis or several times a week while those who provide care once a week, several times a month, once a month or several times a year are considered IP. Table 1 shows the distribution of P by frequency type and by labor force status. FP are more likely to be not in the labor force (22.6 percent) compared with IP (17.1 percent). IP on the other hand are more likely to be full-time employed (64.5 percent or higher) compared with the FP (58.1 percent).

TABLE 1. Distribution of eldercare providers (P), by frequency of eldercare and labor force status[a,b]

Labor Force Status/ Frequency	Not in Labor Force (NILF)	Employment		Unemployed		Subtotal
		Full-time	Part-time			
	Daily	362 (29.1)	627 (50.4)	171 (13.7)	84 (6.8)	1,244 (100.0)
Frequent Providers (FP)	Several times a week	385 (18.6)	1296 (62.7)	276 (13.4)	110 (5.3)	2,067 (100.0)
	Subtotal	**747 (22.6)**	**1923 (58.1)**	**447 (12.5)**	**194 (5.8)**	**3311 (100.0)**
	Once a week	218 (13.5)	1083 (67.3)	239 (14.8)	70 (4.3)	1,610 (100.0)
	Several times a month	240 (13.6)	1226 (69.6)	218 (12.4)	77 (4.4)	1,761 (100.0)
Infrequent Providers (IP)	Once a month	137 (13.9)	762 (67.8)	149 (13.9)	37 (4.5)	1,085 (100.0)
	Others[c]	65 (17.1)	318 (64.5)	65 (13.6)	21 (4.8)	469 (100.0)
	Subtotal	**1,407 (17.1)**	**5,312 (64.5)**	**1,118 (13.6)**	**3,99 (4.8)**	**8,236 (100.0)**

[a] Row percentages in parentheses.
[b] Not survey weight adjusted.
[c] Others refer to several times a year.

Table 1 indicates that as the frequency of eldercare increases, the likelihood of being in the labor force declines, implying that providing eldercare on a frequent basis can impose time constraints on the caregiver. FP and IP represent 40.1 percent and 59.9 percent respectively of P in the sample.

Table 2 provides the pertinent characteristics of the FP subsample. For comparison, we also include the characteristics of IP and non-providers (NP). Not surprisingly, the majority of P, whether FP or IP, are women. More than half of FP (58.8 percent) are women; they also constitute 53.9 percent of IP. Table 2 also shows that the likelihood of being an FP increases with age and then slightly falls as the FP gets older. The average age of FP (48.2 years) is higher compared to the NP (42.2 years) and IP (46.3 years). IP on the other hand have higher education level, with 43.1 percent having a bachelors' degree or higher compared with FP (34.3 percent) and NP (36.8 percent). More than half (58.9 percent) of FP are married, most of whom have their spouses present. Nearly half (49.3 percent) of FP and half (50 percent) of IP have annual family incomes below USD 60,000, compared to 39.7 percent of IP.[3] Other significant differences in the characteristics between FP and NP can be noted. Women are 8.8 percent more likely to be FP than NP. The average age of FP is higher than that of NP by six years. Around 4.1 percent of individuals who are widowed, divorced or separated are more likely to be FP than NP. Additionally, FP belong to households with more adult female members compared with NP.

Table 2 also shows the characteristics of the elderly cared for by frequent and infrequent providers. The majority of FP (70.1 percent) and IP (66.6 percent) care for only one elderly person; however, more than one-fifth (22.3 percent) of FP and one-fourth (25.8 percent) of IP provide care to two elderly and another 7.6 percent care for more than two persons, suggesting that a number of P may be subject to stress. A higher proportion of elderly persons live with the FP (26.0 percent), compared to 3.2 percent living with the IP. Nearly a quarter (73.4 percent) of FP care for their parents or in-laws, compared to 62.3 percent of IP.

TABLE 2. Characteristics of sample respondents aged 25-61 years, by occurrence of care provision (percent of total)

	Frequent Providers (FP)	Non - Providers (NP)	FP vs. NP (test)	Infrequent Providers (IP)
A. Characteristics of Respondents				
Sex				
Male	41.2	50.2	-8.8***	45.8
Female	58.8	49.8	8.8***	53.9

[3] The median family income in the US (in current dollars) ranged from USD 50,054 in 2011 to USD 61,372 in 2017 [US Census Bureau n.d.].

TABLE 2. Characteristics of sample respondents aged 25-61 years, (continued)

	Frequent Providers (FP)	Non - Providers (NP)	FP vs. NP (test)	Infrequent Providers (IP)
Age (in years)				
25 to 34	11.5	29.8	-18.3***	17.8
35 to 44	18.9	27.0	-8.1***	19.8
45 to 54	38.3	26.0	12.3***	37.7
55 to 61	31.1	17.1	14.0***	24.6
Mean Age	48.2	42.2	6.0***	46.3
Educational Level				
Less than grade 1	0.4	0.2	0.2	0.01
Grade 1 to 12	6.1	10.0	-4.0***	4.3
High school diploma	30.6	28.2	2.4**	25.7
Some college or associate degree[a]	28.6	24.9	3.8***	26.7
Bachelor degree and above	34.2	36.8	-2.4**	43.1
Disability				
Has disability	7.6	7.1	0.5	6.2
Race				
White only	70.4	63.2	7.2***	77.1
Black only	13.1	11.7	1.4**	10.6
Asian only	3.0	5.4	2.5***	2.6
Hispanic only	11.4	17.6	-6.2***	8.2
Mixed	1.9	1.9	0.02	1.5
Marital Status				
Married - spouse present	57.7	59.6	-0.2	66.31
Married – spouse absent	1.2	1.5	-0.4*	1.15
Widowed/divorced/separated	19.1	15.0	4.1***	14.88
Never married	21.9	23.9	-2.0*	17.52
Family Income (in USD)				
Below 25000	17.4	17.9	-0.4	12.2
25000 to below 35000	10.8	9.8	1.0	7.7
35000 to below 60000	21.1	22.3	-1.2	19.8
60000 to below 100000	26.1	24.9	1.2	27.8
100000 and above	24.4	25.0	-0.6	32.6
Average number of children under 6 in household	0.1	0.3	-0.2***	0.2
Average number of adult males aged 16 and older in household	1.1	1.1	0.0	1.1
Average number of adult females aged 16 and older in household	1.3	1.1	0.2***	1.1

TABLE 2. Characteristics of sample respondents aged 25-61 years, (continued)

	Frequent Providers (FP)	Non - Providers (NP)	FP vs. NP (test)	Infrequent Providers (IP)
B. Eldercare				
Number of Eldercare Recipients				
1	70.1			66.6
2	22.3			25.8
More than 2	7.6			7.4
Living Arrangement[b]				
Same household as caregiver	26.0			3.2
Not living with caregiver	76.3			97.3
Duration of Care Provision[b]				
0 to 5 months	18.4			19.6
6 to 11 months	9.5			9.0
1 year	10.5			15.1
More than 1 year	71.2			66.6
Relation to Elderly[b]				
Parents/ in-laws	73.4			62.3
Spouse / Partner	2.3			0.3
Other[c]	88.1			84.1
Number of observations	3,311	39,993	43,304	4,925
	(100.0)	(100.0)	(100.0)	(100.0)

[a] Some college or associate degree includes individuals with occupational/vocational and associate degree.
[b] Some caregivers have provided care to more than one individual. Hence, the column percentages for living arrangement of care recipients, relationship to the recipients and the duration of providing care are greater than 100.
[c] Refers to aunt/uncle, grandparent, neighbor, etc.
[d] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[e] Statistics are survey weight adjusted.

3. Empirical analysis

We test whether providing eldercare affects the probability of participating in the labor force using probit regression and bivariate probit methods. In the first approach, we estimate the impact of frequent eldercare provision on labor force participation for individual i with the following model (Model 1) specification:[4]

$$LF_i^* = \beta_0 + \beta_1 E_i + \beta_X X_i + \gamma + t + \varepsilon_1 \qquad LF_i = \mathbb{I}(LF_i^* > 0); \tag{1}$$

[4] In our study, we only compare the labor force participation of FP with those of NP. Results of similar analyses comparing the labor force participation between IP and NP indicate no statistical significance. They are provided in Table A1, Appendix A. The empirical model already controls for race, education, and age.

where,

LF_i^* refers to the latent variable labor force participation of an individual i taking the value of one if the individual participates in the labor force and zero otherwise;

E_i refers to frequent eldercare giving, taking the value of one if the individual is a frequent eldercare provider and zero if non-provider;

X_i is a vector containing individual and household level control variables;

γ is a vector of state fixed effects;

t is a vector of time fixed effects; and

ε_1 is the error term.

The vector X_i includes the following variables namely: lifecycle stage (age and age squared), sex (female=1), level of education categories, disability status (controls for health-related issues), race/ethnicity, marital status, annual family income categories, and household composition (number of children in the household aged six and younger, number of male adults 16 years and older, and number of female adults 16 years and older).

3.1. Endogeneity issue and bivariate probit model

The relationship between eldercare provision and labor force participation, however, is endogenous, as both are simultaneously determined. In other words, it is also possible that individuals not in the labor force are more likely to provide eldercare on a frequent basis. To address the endogeneity problem, we simultaneously estimate the LF Equation 1 with the probability of providing frequent eldercare as shown in the following specification (Model 2):

$$LF_i^* = \beta_0 + \beta_1 E_i + \beta_X X_i + \gamma + t + \varepsilon_2 \qquad LF_i = \mathbb{I}(LF_i^* > 0); \tag{2a}$$

$$E_i^* = \alpha_0 + \alpha_1 Z_i + \alpha_X X_i + \gamma + t + \varepsilon_3 \qquad E_i = \mathbb{I}(E_i^* > 0); \tag{2b}$$

$$\begin{pmatrix} \varepsilon_2 \\ \varepsilon_3 \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix} \cdot \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right]$$

where the error terms are ε_2 and ε_3.

Model 2 is estimated by a recursive bivariate probit model that allows a structural equation modeling of a binary outcome (labor force participation) as a function of a binary endogenous variable (frequent eldercare provision, E_i^*). The binary endogenous variable is, in turn, expressed in a set of reduced form equations. Although Equation 2a is similar to Equation 1, Equation 2b explicitly models the selection into eldercare provision. Identification of the model is achieved by excluding the Z_i variable from Equation 2a. The correlation coefficient ρ measures the correlation between disturbances in the equations. Disturbances in the equations capture the omitted factors. The recursive bivariate model is estimated by full information maximum likelihood.

We use the ATUS sample weights throughout our regression analyses. The ATUS weights take into account a) the issue of oversampling of some of the demographic groups, b) variation in the sampling of weekends and weekdays, and c) non-responses [US Bureau of Labor Statistics 2018b].

3.2. Selection of instrumental variable (IV)

In selecting the IV, we take into account the following conditions that the IV must satisfy: it is exogenous and not affected by other variables ($\text{Cov}(Z,\varepsilon) = 0$), and it is correlated with eldercare giving, which is the endogenous explanatory variable ($\text{Cov}(Z,E) \neq 0$).

Johnson and Lo Sasso [2006] use the age of parents as one of the instruments for identifying childcare obligation in the US. Alternatively, Meng [2013] uses parental residence, i.e., whether parents live in the household or not, as instrument for determining the likelihood of providing informal care in Germany. In the absence of information on parental residence or age in ATUS, we use parental birthplace as a proxy in deducing whether parents live nearby and thus may need care from the respondent. We use the parental birthplace (at least one of the parents is foreign-born versus both parents are US-born) as instrument to determine the selection into frequent eldercare provision.

Based on the parental birthplace information, FP and NP subsamples are sorted into the first, second and third-generation respondents living in the US. The first-generation (immigrants) are foreign-born themselves. The second-generation respondents are native-born with at least one foreign-born parent, while the third-generation respondents constitute the native-born with both US-born parents. The exclusion variable Z_i is equal to one for both first and second-generation respondents. More than 99 percent of foreign-born individuals in our sample have at least one foreign-born parent. The Z_i compares the frequent eldercare provision of the third-generation (Z=0) subsample with the combined first and second-generation subsample (Z=1).

In the US, the third generation mainly comprises Baby Boomers born from 1946 to 1964. The youngest boomers will turn 65 by the year 2030 [Passel and Cohn 2017]. The exogenous demographic shift in the US population (towards older age cohort) makes the third generation older than individuals in the first and second generations. As such, third-generation individuals are likely to have parents or families who are older and demand care. Additionally, foreign-born parents of the first generation are more likely to reside outside the US. As such, the instrument is expected to have a negative correlation with frequent eldercare provision. Individuals with at least one foreign-born parent are less likely to provide frequent eldercare.

The potential strength of the instrument is tested by the estimation of Equation 2b using the probit model with and without the control variables and the results are given in Table B2 in Appendix B. The sample distribution of the FP and NP

sample by the exclusion variable *Z* and the covariate balance statistics are given in Tables B1 and B3 of Appendix B. The marginal effects of the probit model with control variables show that individuals with at least one foreign-born parent are three percentage points less likely to be a frequent eldercare provider and these are statistically significant (see Table B2 in Appendix B).

In addition to the relevance of the instrument, it is essential that the instrument be exogenous. Parental birthplace satisfies the exogeneity condition of the instrument and therefore cannot be influenced by the labor force participation or frequent eldercare provision. It is also critical to argue that the instrument only affects the labor force participation through selection into frequent eldercare provision. Without the availability of a direct statistical technique to test whether the instrument only influences labor force participation through eldercare, it is difficult to establish such criteria. Instead, we review the literature for supporting evidence.

We examine whether there is any evidence of parental birthplace directly determining the labor force participation in the US. Trevelyan et al. [2016] show that the average labor force participation rate of the first and second generations in the US is 62.4 percent, whereas the labor force participation rate of the third generation is 63.2 percent. The very small gap in the labor force participation rates across generations negates the idea that the instrument has a direct influence on the outcome. Enchautegui [2014] argues that the difference in the labor force participation across generations is predominantly due to the exogenous demographic shift related to the aging of the Baby Boomers. The control variables namely age and age squared in Model 2 capture this impact of lifecycle on labor force participation.

Taking the above study findings into account, we then estimate a probit model that takes into account the effect of the IV on labor force participation. The results of our estimation with control variables are given in Appendix B, Table B2 and shows that parental birthplace does not influence the respondents' labor force participation.

We also examine other potential channels through which the instrument may determine labor force participation. The US Bureau of Labor Statistics [2018c], Trevelyan et al. [2016], Americans [2013], and Myers et al. [2013] studies show that first, second and third generation cohorts differ by race, age, marital status, educational attainment, household income, fertility, and household sizes. Model 2 controls for race, age, marital status, educational attainment, and annual family income. The number of children under six years in the model is used as proxy for fertility rate, and the number of adult males and females above 16 years for household size.

It is also possible that the nativity of the individual affects labor force participation and is highly correlated with parental birthplace. Non-natives are more likely to have at least one parent born outside the US. In 2017, the labor force participation of the foreign-born was 74 percent, and the native-born was 71.8 percent in the US (OECD [2017a], OECD [2017b]). According to the US Bureau of Labor Statistics (2018c) report, the gap in the labor force participation between the foreign-born and US-born (native) workers is mainly due to differences in

race, education, and age.[5] Except for Johnson and Lo Sasso [2006] study, none of the existing studies that examine the relationship between eldercare and labor force participation controlled for nativity. In fact, Johnson and Lo Sasso [2006] find no evidence of the effect of nativity on the working hours of respondents. Thus, the lack of correlation between the respondent's birthplace and labor force participation is indirectly confirmed by these study findings. Therefore, parents' nativity is also unlikely to be related to labor force participation.

Finally, whether or not the instrument influences labor force participation through other unobservables is examined. For instance, cultural differences across generations can be a potential channel through which the instrument can influence labor force participation. In this study, we use state fixed effects and race/ethnicity variables to control for any variation in cultures across states and ethnicity. The presence of a potential unobservable is also tested by examining the covariate balances and evaluating the standardized difference,[6] variance ratio,[7] and the overlap coefficient[8] between the two groups, i.e., individuals with at least one foreign-born parent and individuals with both US-born parents. The idea is to demonstrate that a balance in the covariates[9] by parental birthplace also suggests a balance in the unobservables. As such, the unobservables may not be an issue in the empirical analysis. Similar to what is suggested in the literature, the standardized difference test shows covariate imbalance for White, Asian, Hispanic and individuals with educational attainment of grade 1 to 12 (See Table B3 in Appendix B). For the other covariates, all three test results show a balance in the sample. Hence, we conclude that the exclusion variable, parental birthplace meets the IV criteria.

3.3. Gender dimensions of frequent eldercare impact on labor force participation

We next analyze the gendered impact of frequent eldercare on labor force participation by extending Models 1 and 2 in the previous section. The extended models take into account the gender differences in providing eldercare and in labor market participation. Gender norms around care responsibilities and household division of labor and persistence of gender-based occupational segregation in the labor market are likely to lead to different outcomes for women and men [Neumark 2018]. In particular, we expect women are less likely to be in the labor market and more likely to be frequent eldercare providers.

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[5] The empirical model already controls for race, education, and age.

[6] Standardized difference assesses differences of selection groups in the means.

[7] Variance ratio is the ratio of the variances of the characteristics by two groups determined by IV.

[8] Overlap coefficient is a measure of the closeness of the location of two distributions.

[9] We do not use *t*-test to examine the characteristics balance across the IV groups. In this paper, the observations across FP and NP are unbalanced. When distributions are sensitive to the variance differences between the groups, *t*-test with the assumption of equal variance or even unequal variance can be misleading. The sensitivity of the distributions is also evident in the estimated overlap coefficients provided in Table B3, Appendix B.

Models 1 and 2 are re-estimated by including two interaction variables: female dummy interacted with frequent elder caregiving and female dummy interacted with family income category. This is expressed as follows (Model 3):

$$LF_i^* = \beta_0 + \beta_1 E_i + \beta_2 F_i + \beta_3 (F_i \times E_i) + \beta_4 Y_i + \beta_5 (Y_i \times Fi) + \beta_x X_i + \gamma + t + \varepsilon_4$$

$$LF_i = \mathbb{I}(LF_i^* > 0); \tag{3}$$

whereby:

F_i refers to the sex of respondent, female takes the value of 1 and male is 0;

E_i refers to frequent eldercare provision (=1);

$F_i \times E_i$ refers to the interaction variable between sex and frequent eldercare provision;

Y_i refers to the dummies for family income ranges (in USD), e.g., below 25,000 (reference), 25,000 to below 35,000, 35,000 to below 60,000, 60,000 to below 100,000, and 100,000 and above;

$Y_i \times F_i$: interaction variable between sex and family income categories; and

X_i: is a vector containing other individual and household level control variables.

The coefficient of the interaction $F_i \times E_i$ helps identify whether or not frequent eldercare performed by women is associated with lower labor force participation, more so than among male frequent providers. The interaction variable $Y_i \times F_i$ is added in order to examine whether women are more likely to work in the labor market when they have to (belong to a lower income group) compared to men.[10] In other words, it captures the extent to which the economic necessity to earn income is greater for women compared to men. We expect that although caregiving is considered to be women's primary responsibility, female FP in lower income households may be more compelled to earn income in order to help meet basic needs even if they also provide eldercare, compared to men FP. Men on the other hand are socially expected to be breadwinners or economic providers, regardless of economic status. This gender norm is challenged, however, when men provide frequent eldercare, say to their spouse or a parent and so to ease their workload, they withdraw from the labor market.

As mentioned earlier, there is an endogeneity problem given that labor force participation and eldercare provision are simultaneously determined. To address this issue, we estimate a bivariate probit with IV model (Model 4), which is an extension of Model 2:

$$LF_i^* = \beta_0 + \beta_1 E_i + \beta_2 F_i + \beta_3 (F_i \times E_i) + \beta_4 Y_i + \beta_5 (Y_i \times Fi) + \beta_X X_i + \gamma + t + \varepsilon_5$$

$$LF_i = \mathbb{I}(LF_i^* > 0); \tag{4a}$$

[10] Bradbury and Katz [2008], Albanesi and Prados [2011], and Hua [2014] studies show that spousal or family income is an important determinant of labor force participation of married women in the US. However, the ATUS data does not include spousal income for married women; moreover, the sample includes respondents with different marital status, e.g., never married, separated, divorced, widowed, married with spouse absent and married with a spouse present.

$$E_i^* = \alpha_0 + \alpha_1 Z_i + \alpha_2 F_i + \alpha_3 (F_i \times Z_i) + \alpha_4 FY_i + \alpha_5 (Y_i \times Fi) + \alpha_X X_i + \gamma + t + \varepsilon_6$$

$$E_i = \mathbb{I}(E_i^* > 0); \qquad \begin{pmatrix} \varepsilon_5 \\ \varepsilon_6 \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix} \cdot \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right] \tag{4b}$$

Note that Model 4 includes an additional endogenous variable of interest namely the interaction variable ($F \times E$) along with the endogenous explanatory variable E. The exclusion variable Z in Equation 4b helps identify the impact of frequent eldercare giving on labor force participation. In the same way, the sex dummy interacted with the exclusion variable ($F \times Z$) allows for the effect of parental birthplace on eldercare provision to be different between men and women. Generally, the care burden falls on women. Hence, we expect, that when at least one of the parents of a female respondent is foreign-born, she is more likely to provide frequent eldercare than a male respondent.

4. Empirical result

The results for the probit and recursive bivariate probit models, which test Hypotheses 1 and 2, are given in Table 3. Columns 1 and 3 show the marginal effects estimates for both Model 1 probit (column 1) and Model 2 bivariate probit estimations (column 3) for the sample respondents who are either FP or NP. Separate models are estimated for the difference in the relationship between providing eldercare and (LFP) by gender. The results for Models 3 and 4 estimations are presented in columns 4-6, also with and without interaction variables.

TABLE 3. Probit and bivariate probit results: marginal effects of providing frequent eldercare on labor force participation, with and without interaction variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Frequent Provider	Labor Force Participation	Labor Force Participation	Frequent Provider	Labor Force Participation
At least one parent is foreign-born=1		-0.03*** (0.01)			-0.04*** (0.01)	
Frequent provider = 1	-0.04*** (0.01)		-0.09** (0.04)	-0.07*** (0.01)		-0.18*** (0.05)
Female	-0.15*** (0.01)	0.02*** (0.004)	-0.15*** (0.01)	-0.11*** (0.01)	-0.01 (0.01)	-0.11*** (0.01)
Female x At least one parent is foreign-born					0.02* (0.01)	

TABLE 3. Probit and bivariate probit results (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Frequent Provider	Labor Force Participation	Labor Force Participation	Frequent Provider	Labor Force Participation
Female x Frequent provider				0.05*** (0.02)		0.05*** (0.02)
Age	0.01*** (0.002)	0.01*** (0.002)	0.02*** (0.002)	0.01*** (0.002)	0.01*** (0.002)	0.02*** (0.002)
Age-squared	-0.0002*** (0.00002)	-0.0001** (0.00002)	-0.0002*** (0.00002)	-0.0002*** (0.00002)	-0.00005** (0.00002)	-0.0002*** (0.00002)
Ref: Less than grade 1						
Grade 1 to 12	-0.05 (0.05)	-0.07 (0.05)	-0.05 (0.05)	-0.05 (0.05)	-0.07 (0.05)	-0.06 (0.05)
High school diploma	-0.01 (0.05)	-0.04 (0.05)	-0.01 (0.05)	-0.02 (0.05)	-0.04 (0.05)	-0.02 (0.05)
Some college or associate degree	0.01 (0.05)	-0.03 (0.05)	0.01 (0.05)	0.01 (0.05)	-0.03 (0.05)	0.00 (0.05)
Bachelor's degree and above	0.04 (0.05)	-0.03 (0.05)	0.03 (0.05)	0.03 (0.05)	-0.03 (0.05)	0.03 (0.05)
Disability=1	-0.28*** (0.01)	-0.02*** (0.01)	-0.28*** (0.01)	-0.28*** (0.01)	-0.02*** (0.01)	-0.28*** (0.01)
Ref: White only						
Black only	0.01 (0.01)	-0.01* (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01* (0.01)	0.01 (0.01)
Asian only	-0.05*** (0.01)	-0.02 (0.01)	-0.05*** (0.01)	-0.05*** (0.01)	-0.02 (0.01)	-0.05*** (0.01)
Hispanic only	0.02** (0.01)	-0.004 (0.01)	0.02** (0.01)	0.02** (0.01)	-0.004 (0.01)	0.01** (0.01)
Mixed	0.01 (0.01)	-0.001 (0.01)	0.01 (0.01)	0.01 0.02**	-0.0002 (0.01)	0.01 (0.01)
Ref: Married – spouse present						
Married – spouse absent	0.05** (0.02)	0.01 (0.01)	0.05** (0.02)	0.05** (0.02)	0.01 (0.01)	0.05** (0.02)
Widowed/ divorced/ separated	0.06*** (0.01)	0.02*** (0.01)	0.06*** (0.01)	0.06*** (0.01)	0.01*** (0.004)	0.06*** (0.01)
Never married	0.04*** (0.01)	0.03*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.03*** (0.01)	0.04*** (0.01)
Ref (in USD): Below 25000						
25000 to below 35000	0.08*** (0.01)	0.01 (0.01)	0.08*** (0.01)	0.10*** (0.01)	-0.01 (0.01)	0.10*** (0.01)
35000 to below 60000	0.11*** (0.01)	-0.01** (0.01)	0.11*** (0.01)	0.14*** (0.01)	-0.02** (0.01)	0.14*** (0.01)
100000 and above	0.17*** (0.01)	-0.02*** (0.01)	0.17*** (0.01)	0.22*** (0.01)	-0.05*** (0.01)	0.21*** (0.01)

TABLE 3. Probit and bivariate probit results (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Frequent Provider	Labor Force Participation	Labor Force Participation	Frequent Provider	Labor Force Participation
Ref (in USD): Female x Below 25000						
Female x 25000 to below 35000				-0.03** (0.01)	0.02* (0.01)	-0.03** (0.01)
Female x 35000 to below 60000				-0.06*** (0.01)	0.02 (0.01)	-0.05*** (0.01)
Female x 60000 to below 100000				-0.06*** (0.01)	0.02 (0.01)	-0.06*** (0.01)
Female x 100000 and above				-0.09*** (0.02)	0.05*** (0.01)	-0.08*** (0.02)
Number of children under 6 in household	-0.05*** (0.003)	-0.02*** (0.004)	-0.05*** (0.003)	-0.05*** (0.003)	-0.02*** (0.004)	-0.05*** (0.003)
Number of adult males aged 16 and older in household	-0.03*** (0.004)	0.02*** (0.003)	-0.03*** (0.004)	-0.03*** (0.005)	0.01*** (0.003)	-0.03*** (0.01)
Number of adult females aged 16 and older in household	0.03*** (0.004)	0.03*** (0.003)	0.03*** (0.01)	0.02*** (0.004)	0.03*** (0.003)	0.03*** (0.01)
Number of observations	43,304	43,304	43,304	43,304	43,304	43,304
ρ			0.13 (0.10)			0.27** (0.13)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

[a] Standard errors are in parentheses.
[b] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[c] Estimates are survey weight adjusted.

Both the probit and the bivariate probit estimates with instrument confirm that providing frequent eldercare is associated with a decline in labor force participation. Specifically, the results in columns 1 and 3 indicate that the impact of frequent eldercare provision on labor force participation is statistically significant. In fact, our basic probit model (Model 1) estimate shows that frequent eldercare provision reduces labor force participation by four percentage points. After endogenizing the explanatory variable *E* by estimating the bivariate probit

model (Model 2), this effect is heightened to nine percentage points. This implies that there are economic consequences of frequent eldercare in terms of loss of earning and job benefits.

The results in Table 3 also indicate that gender significantly influences the probability of being an eldercare provider. Column 2 shows that after controlling for individual and household characteristics as well as state and time fixed effects, women tend to provide more frequent eldercare than men. More specifically, women are two percentage points more likely to be frequent providers compared to men, reinforcing the findings of other studies that women are more likely to shoulder the burden of care work. Not surprisingly, female frequent providers are likely to have lower labor force participation compared to their male counterparts.

Other individual and household characteristics significantly influence the labor force participation of the sample respondents. Both columns 1 and 3 show that the marginal effects of age, disability status, marital status, family income and the number of household members to be statistically significant. Being older, not disabled, being married with spouse absent/widowed/divorced/never married, belonging to higher income household increase the probability of labor force participation. Fewer male members and more female members in the household increase the likelihood of participating in the labor force by three percentage points, suggesting that additional female help in caregiving (or the presence of fewer male members) reduces the care burden, thus enabling the individual to participate in the labor market.

The results in columns 4 (Model 3 estimates) and 6 (Model 4 estimates) of Table 3 indicate that frequent eldercare by women is associated with higher labor force participation, more so than among male frequent providers, which is different from the predicted outcome. Among frequent providers, women are less likely to reduce their labor force participation compared to men, a difference of five percentage points.

The significance of ρ (=0.27) in the bivariate model confirms a slight selection effect. Table 3, column 6 shows that providing frequent eldercare (E=1) reduces male labor force participation by 18 percentage points; however, it reduces female labor force participation only by 13 percentage points. This finding implies that more women chose to stay in the labor market compared to men even when they are providing frequent care. One possible explanation is that providing unpaid care to an elderly and also working to earn income are both economic necessities for some women. Giving up her job to care for an elderly can put her and her household's needs at risk and at the same time, she is either unable to find another person to provide unpaid eldercare or is unable to pay for one.

The marginal effect of the interaction variable between family income and gender shown in column 6 of Table 3 helps illuminate the likely effect of economic necessity for women to have a job. The probability of labor force participation of women with a family income of USD 100,000 and above is eight percentage

points lower than the women with a family income below USD 25,000 and this is found to be statistically significant.

The higher labor force participation rate among female FP compared to male FP is consistent with the gender-based pattern in US labor force participation. Geiger and Parker [2018] show that the labor force participation of women in the US has risen in general from 33.9 percent to 57 percent over the period 1950 to 2017. However, over the same period, the labor force participation of men followed a downward path. Labor force participation of men has fallen from 86.4 percent to 69.1 percent from 1950 to 2017. The reasons for such a change in labor market composition is still less understood in the literature.

A more detailed analysis of the factors that account for higher labor force participation of female frequent providers in the US requires further research and is beyond the scope of this paper. Nevertheless, our results are consistent with the findings of other studies. For example, Albanesi and Şahin [2018] suggest that the growing labor market attachment of women as compared to men over time is also a part of the reason for the contrasting trend in labor force participation by men and women. The likelihood of women leaving employment has also reduced. However, the likelihood of men leaving the labor force, e.g., due to prolonged periods of unemployment has escalated. Once men exit the labor force, they are less likely to re-enter. Moreover, Geiger and Parker [2018] highlight the rise in the labor force participation of mothers with dependent children in the US. The growing number of working mothers indicates that many women choose to stay in the labor market, irrespective of their domestic obligations.

4.1. Robustness and sensitivity analysis

We perform robustness and sensitivity checks to validate the results in Table 3. The robustness of our findings is examined using different categories of regular eldercare providers. Specifically, we test whether our findings on the impact of frequent eldercare giving on their labor force participation, in comparison with NP, also hold for other categories of eldercare givers by changing the subsample. First, we increase the eldercare providers' subsample (Subsample A) by adding 'once a week providers' to the FP (daily and several times a week providers) subsample and therefore increasing the sample to 4,921 observations. The inclusion of "once a week providers' lowers the frequency (or intensity) threshold of regular eldercare giving. Next, we raise the frequency (or intensity) threshold of eldercare by focusing only on daily providers and excluding 'several times a week providers' (Subsample B). This yields a sample size of 1,244 observations for eldercare providers. The results presented in Table 3 are robust if the subsample (A) that includes "once a week providers," has a lower effect on labor force participation than that of FP subsample. Alternatively, the impact of providing daily eldercare subsample (B) on labor force participation is expected to be no less than the results for the FP subsample in Table 3.

Table 4 gives the summary results for the robustness and sensitivity checks. Columns 1 and 3 provide the marginal effects for probit (Model 1) and bivariate probit (Model 2) regressions without interaction variables. Columns 4 and 6 provide the marginal effects for Models 3 and 4 that include interaction variables. Focusing on bivariate results, Table 4 column 3 shows that providing eldercare, whether at lower frequency (Subsample A) leads to a decline of eight percentage points in labor force participation as compared to NP while FP shows a decline of nine percentage points (Table 3, column 3). The opposite is true when we compare the effect on labor force participation using the daily providers only subsample (Subsample B) with the frequent provider subsample. Table 4 column 3 shows a much higher reduction in LFP (15 percentage points) among the daily providers (Subsample B) compared to the nine percentage point reduction in labor force participation among frequent providers.

Table 4, columns 4 and 6 present the main results for the robustness checks using interactions in the empirical models (Models 3 and 4). The interaction coefficients of both Subsamples A and B probit regressions confirm the gender-differentiated impact of frequent eldercare on labor force participation to be robust. Similar to the results given in Table 3 (columns 4 and 6), the marginal effects in Table 4 show that the reduction in labor force participation for men is lower than that for women when providing eldercare. Focusing on the bivariate probit results, female eldercare providers in both Subsamples A and B are five percentage points more likely to participate in the labor market as compared to male eldercare providers. The results in columns 4 and 6 also confirm the results obtained without interaction variables in that eldercare reduces the probability of participating in the labor force as compared to the non-providers and that the magnitude of this effect increases (to 23 percentage points) as the frequency of providing care intensifies.

TABLE 4. Summary results of robustness tests: Marginal effects of eldercare on labor force participation, with and without interaction variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Frequent Provider	Labor Force Participation	Labor Force Participation	Frequent Provider	Labor Force Participation
A. Eldercare providers' sample that includes frequent providers and 'once a week' providers[a]						
At least one parent is foreign-born=1		-0.04*** (0.01)			-0.05***	
Eldercare provider= 1	-0.02*** (0.01)		-0.08* (0.04)	-0.04*** (0.01)		-0.16*** (0.05)
Female	-0.15*** (0.01)	0.02*** (0.01)	-0.15*** (0.01)	-0.11*** (0.01)	-0.01 (0.01)	-0.11*** (0.01)

TABLE 4. Summary results of robustness tests (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Frequent Provider	Labor Force Participation	Labor Force Participation	Frequent Provider	Labor Force Participation
Female x At least one parent is foreign-born					0.01 (0.01)	
Female x Eldercare provider				0.04*** (0.01)		0.05*** (0.01)
ρ			0.15 (0.10)			0.30** (0.13)
Number of observations	44,914	44,914	44,914	44,914	44,914	44,914
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
B. Eldercare providers' sample that includes daily providers only[b]						
At least one parent is foreign-born=1		-0.01*** (0.004)			-0.02*** (0.01)	
Daily provider = 1	-0.07*** (0.01)		-0.15** (0.06)	-0.10*** (0.02)		-0.23*** (0.07)
Female	-0.16*** (0.00)	0.01*** (0.003)	-0.15*** (0.004)	-0.11*** (0.01)	-0.01** (0.01)	-0.11*** (0.01)
Female x At least one parent is foreign-born					0.01 (0.01)	
Female x Daily provider				0.05** (0.02)		0.05** (0.02)
ρ			0.17 (0.13)			0.29** (0.15)
Number of observations	41,237	41,237	41,237	44,914	44,914	44,914
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes

[a] Full results are provided in Appendix C, Table C1.
[b] Full results are provided in Appendix C, Table C2.
[c] Standard errors are in parentheses.
[d] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[e] Estimates are survey weight adjusted.

5. Conclusion

The world is expected to encounter a major demographic turn in the next two decades: the elderly population will outnumber the number of younger people in almost all the world's regions. This demographic trend poses a unique set of challenges not only for the US but also for other countries throughout the world, especially those with a rapidly aging population including Japan, Korea, and China. Eldercare continues to be mainly provided by family caregivers, many of whom struggle to balance market work with care responsibilities.

This paper examines the effect of frequent eldercare provision on labor supply using the 2011-2017 ATUS with eldercare module data for individuals aged 25 to 61 years. We use a bivariate probit model with instrumental variable in order to address the endogeneity and selection bias problems. Our findings suggest that frequent eldercare provision is associated with a significantly lower labor supply of individuals aged 25 to 61 years old. This finding is consistent with the existing literature which show that providing eldercare has a negative effect on labor force participation and/or working hours (Johnson and Lo Sasso [2006]; Leigh [2010]; Houtven et al. [2013] Nguyen and Connelly [2014]; Jacobs et al. [2014]). We also find that frequent eldercare provision is associated with a much lower probability of labor force participation among men, compared to women. This may be explained by the fact that for some women, i.e., those in lower income households, withdrawing from the labor force while providing eldercare on a frequent basis is not an option. The robustness test results show that providing care with higher frequency only intensifies the negative effect of eldercare giving on labor supply.

Our study findings have important policy implications. Increasing old-age dependency and the negative economic impact on unpaid care providers suggest the importance and urgency of public investment in quality elder care services and long-term care insurance. Public policies that reduce unpaid care work can help address the adverse effect on labor supply as well as unpaid female carers' disadvantage in the labor market; at the same time, they can enhance the welfare of those receiving care [Addati et al. 2018]. Such policies are likely to produce demand-side effects that expand job opportunities and create employment [Addati et al. 2018].

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Annex

ANNEX A. Probit and bivariate probit results: marginal effects of providing infrequent eldercare (IP) on labor force participation

	(1)	(2)
	Bivariate Probit	
	Infrequent Provider	Labor Force Participation
At least one parent is foreign-born=1	-0.03***	
	(0.006)	
Infrequent Provider = 1		0.04
		(0.05)
Female	0.02***	-0.15***
	(0.004)	(0.005)
Age	0.01***	0.01***
	(0.002)	(0.002)
Age-squared	-0.00004**	-0.0002***
	(0.00002)	(0.00002)
Ref: Less than grade 1		
Grade 1 to 12	0.12**	-0.02
	(0.05)	(0.05)
High school diploma	0.16***	0.02
	(0.05)	(0.05)
Some college or associate degree	0.17***	0.04
	(0.05)	(0.05)
Bachelor degree and above	0.19***	0.06
	(0.05)	(0.05)
Disability=1	-0.02***	-0.27***
	(0.01)	(0.01)

ANNEX A. Probit and bivariate probit results (continued)

	(1)	(2)
	Bivariate Probit	
	Infrequent Provider	Labor Force Participation
Ref: White only		
Black only	-0.01**	0.01
	(0.01)	(0.01)
Asian only	-0.05***	-0.05***
	(0.01)	(0.01)
Hispanic only	-0.02***	0.02***
	(0.01)	(0.01)
Mixed	-0.01	0.01
	(0.02)	(0.01)
Ref: Married – spouse present		
Married – spouse absent	0.00	0.04**
	(0.01)	(0.02)
Widowed/divorced/separated	-0.01**	0.06***
	(0.01)	(0.01)
Never married	-0.00	0.04***
	(0.01)	(0.01)
Ref (in USD): Below 25000		
25000 to below 35000	0.01	0.08***
	(0.01)	(0.01)
35000 to below 60000	0.01	0.11***
	(0.01)	(0.01)
60000 to below 100000	0.02**	0.15***
	(0.01)	(0.01)
100000 and above	0.02***	0.16***
	(0.01)	(0.01)
Number of children under 6 in household	-0.01***	-0.05***
	(0.003)	(0.003)
Number of adult males aged 16 and older in household	0.002	-0.04***
	(0.004)	(0.002)
Number of adult females aged 16 and older in household	0.005	0.02***
	(0.004)	(0.004)
Number of observations	44918	44918
ρ		-0.02
(0.13)		
State FE	Yes	Yes
Time FE	Yes	Yes

[a] Standard errors are in parentheses.
[b] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[c] Estimates are survey weight adjusted

ANNEX B1. Distribution of the FP and NP sample, by parental birthplace (exclusion variable)

	Both the parents are US-born = 0	At least one parent is foreign born =1	*t*-test (At least one parent is foreign-born - both the parents are US-born)
Frequent Provider (FP)	8.55	5.10	- 3.45***
Non-providers (NP)	91.45	94.90	
Observations	31,917	11,387	43,304

[a] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.

ANNEX B2. Summary of probit estimates: marginal effects of the impact of the instrument on being a frequent eldercare provider and participating in the labor force

	Dependent Variable		
	Frequent Provider (FP)	Frequent Provider (FP)	Labor Force Participation
Effect of instrument			
At least one of the parents is foreign-born =1	-0.05*** (0.004)	-0.03*** (0.01)	0.01 (0.01)
Observations	43,304	43,304	43,304
State FE	No	Yes	Yes
Time FE	No	Yes	Yes
Other control variables?	No	Yes	Yes

[a] Standard errors are in parentheses.
[b] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[c] Estimates are survey weights adjusted.

ANNEX B3. Covariate balance statistics, by parental birthplace (exclusion variable)

	Both parents are US- born = 0		At least one parent is foreign-born = 1		Absolute Standardized Difference (Cohen d)	Variance Ratio Mean	Overlap Coefficient	
	Mean	Variance	Mean	Variance			Equal Variance	Unequal Variance
Female=1	0.54	0.25	0.54	0.25	0.00	1.00	100.0	100.0
Age	41.81	96.56	43.65	109.25	0.18	0.88	0.99	0.92
Less than grade 1	0.01	0.01	0.00	0.00	0.10	43.22	0.08	0.28
Grade 1 to 12	0.18	0.15	0.05	0.05	0.42	3.09	0.38	0.70
High school	0.21	0.17	0.25	0.19	0.08	0.90	0.92	0.96
Associate degree	0.20	0.16	0.30	0.21	0.24	0.76	0.77	0.89
Bachelor and above	0.40	0.24	0.40	0.24	0.00	1.00	100.0	100.0
Disability=1	0.04	0.04	0.09	0.08	0.18	0.52	0.67	0.83
White only	0.23	0.18	0.77	0.18	1.29	0.99	0.12	0.52
Black only	0.08	0.08	0.16	0.13	0.24	0.57	0.68	0.84
Asian only	0.18	0.15	0.00	0.00	0.64	45.51	0.03	0.26
Hispanic only	0.50	0.25	0.05	0.04	1.17	5.61	0.03	0.44
Mixed	0.01	0.01	0.02	0.02	0.04	0.75	0.88	0.93
Married - spouse present	0.60	0.24	0.53	0.25	0.13	0.97	0.89	0.95
Married – spouse absent	0.03	0.03	0.01	0.01	0.14	2.62	0.55	0.77
Widowed/Divorced/Separated	0.16	0.13	0.22	0.17	0.16	0.78	0.83	0.92
Never Married	0.21	0.17	0.23	0.18	0.06	0.92	0.94	0.97
Below 15000	0.23	0.18	0.19	0.15	0.10	1.16	0.90	0.95
15001 to 35000	0.12	0.11	0.09	0.08	0.10	1.29	0.86	0.93

ANNEX B3. Covariate balance statistics, by parental birthplace (continued)

	Both parents are US- born = 0		At least one parent is foreign-born = 1		Absolute Standardized Difference (Cohen d)	Variance Ratio Mean	Overlap Coefficient	
	Mean	Variance	Mean	Variance			Equal Variance	Unequal Variance
35001 to 60000	0.22	0.17	0.22	0.17	0.01	1.01	0.99	100.0
60001 to 100000	0.20	0.16	0.26	0.19	0.12	0.85	0.88	0.94
Above 100000	0.22	0.17	0.24	0.18	0.06	0.93	0.95	0.97
Number of children under 6	0.41	0.49	0.32	0.42	0.13	1.15	0.92	0.94
Number of adult male 16 and older	1.05	0.42	0.92	0.34	0.21	1.24	0.86	0.91
Number of adult female 16 and older	1.08	0.40	0.98	0.32	0.16	1.24	0.89	0.92

[a] For the standardized difference test, there is no fixed rule for the cut point to determine the imbalance. Normand et al. [2001], suggest that a standardized difference greater than 0.10 shows imbalance, whereas Rubin [2001] suggests a cut-off of 0.25 for imbalance. Alternatively, since the standardized difference is a version of Cohen's d statistic for effect size, one could also argue for a cut-off of 0.20 [Cohen 1988], which Cohen termed a "small" effect [Linden 2016]. Given the unbalance in the sample of frequent providers and non-providers, a standardized difference greater than 0.25 is considered to show imbalance.
[b] For the variance ratio, any statistic below 0.5 and above 2.0 shows imbalance [Linden 2016].
[c] For the overlap coefficient, the higher the overlap the better.

ANNEX C1. Marginal effects of providing eldercare (includes frequent providers and once a week providers) on labor force participation, with and without interaction variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
At least one parent is foreign-born=1		-0.04*** (0.01)			-0.05***	
Eldercare provider = 1	-0.02*** (0.01)		-0.08* (0.04)	-0.04*** (0.01)		-0.16*** (0.05)
Female	-0.15*** (0.01)	0.02*** (0.01)	-0.15*** (0.01)	-0.11*** (0.01)	-0.01 (0.01)	-0.11*** (0.01)
Female x at least one parent is foreign-born					0.01 (0.01)	
Female x Frequent provider				0.04*** (0.01)		0.05*** (0.01)
Age	0.01*** (0.002)	0.01*** (0.002)	0.02*** (0.002)	0.02*** (0.002)	0.01*** (0.002)	0.02*** (0.002)
Age-squared	-0.0002*** (0.00002)	-0.0001*** (0.00002)	-0.0002*** (0.00002)	-0.0002*** (0.00002)	-0.0001*** (0.00002)	-0.002*** (0.00002)
Ref: Less than grade 1						
Grade 1 to 12	-0.05 (0.05)	-0.08 (0.06)	-0.05 (0.05)	-0.05 (0.05)	-0.08 (0.06)	-0.06 (0.05)
High school diploma	-0.01 (0.05)	-0.04 (0.06)	-0.01 (0.05)	-0.01 (0.05)	-0.04 (0.06)	-0.02 (0.05)
Some college or associate degree[a]	0.01 (0.05)	-0.02 (0.06)	0.01 (0.05)	0.01 (0.05)	-0.02 (0.06)	0.00 (0.05)
Bachelor degree and above	0.03 (0.05)	-0.02 (0.06)	0.03 (0.05)	0.03 (0.05)	-0.02 (0.06)	0.03 (0.05)
Disability=1	-0.28*** (0.01)	-0.03*** (0.01)	-0.28*** (0.01)	-0.28*** (0.01)	-0.03*** (0.01)	-0.28*** (0.01)
Ref: White only						
Black only	0.01 (0.01)	-0.01* (0.01)	0.004 (0.01)	0.01 (0.01)	-0.01* (0.01)	0.003 (0.01)
Asian only	-0.05*** (0.01)	-0.04*** (0.01)	-0.05*** (0.01)	-0.05*** (0.01)	-0.04*** (0.01)	-0.05*** (0.01)
Hispanic only	0.02** (0.01)	-0.01* (0.01)	0.01** (0.01)	0.02** (0.01)	-0.01 (0.01)	0.01* (0.01)
Mixed	0.01 (0.01)	-0.001 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.0002 (0.01)	0.01 (0.01)

ANNEX C1. Marginal effects of providing eldercare (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
Ref: Married – spouse present						
Married – spouse absent	0.05*** (0.02)	0.01 (0.01)	0.05*** (0.02)	0.05*** (0.02)	0.01 (0.01)	0.05*** (0.02)
Widowed/ divorced/ separated	0.06*** (0.01)	0.01 (0.01)	0.06*** (0.01)	0.06*** (0.01)	0.01 (0.01)	0.06*** (0.01)
Never married	0.04*** (0.01)	0.03*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.03*** (0.01)	0.04*** (0.01)
Ref (in USD): Below 25000						
25000 to below 35000	0.08*** (0.01)	0.01 (0.01)	0.08*** (0.01)	0.09*** (0.01)	-0.01 (0.01)	0.09*** (0.01)
35000 to below 60000	0.11*** (0.01)	-0.01 (0.01)	0.11*** (0.01)	0.14*** (0.01)	-0.02* (0.01)	0.14*** (0.01)
60000 to below 100000	0.16*** (0.01)	-0.003 (0.01)	0.16*** (0.01)	0.19*** (0.01)	-0.01 (0.01)	0.19*** (0.01)
100000 and above	0.17*** (0.01)	-0.02** (0.01)	0.17*** (0.01)	0.22*** (0.01)	-0.04*** (0.01)	0.22*** (0.01)
Ref (in USD): Female x Below 25000						
Female x 25000 to below 35000				-0.03** (0.01)	0.04** (0.02)	-0.03* (0.01)
Female x 35000 to below 60000				-0.05*** (0.01)	0.02 (0.01)	-0.05*** (0.01)
Female x 60000 to below 100000				-0.06*** (0.01)	0.02 (0.01)	-0.06*** (0.01)
Female x 100000 and above				-0.09*** (0.02)	0.04*** (0.01)	-0.09*** (0.02)
Number of children under 6 in household	-0.05*** (0.003)	-0.02*** (0.004)	-0.05*** (0.003)	-0.05*** (0.003)	-0.02*** (0.004)	-0.05*** (0.003)
Number of adult males aged 16 and older in household	-0.03*** (0.004)	0.01*** (0.004)	-0.03*** (0.004)	-0.03*** (0.004)	0.01*** (0.004)	-0.03*** (0.004)
Number of adult females aged 16 and older in household	0.02*** (0.004)	0.03*** (0.004)	0.03*** (0.004)	0.02*** (0.004)	0.03*** (0.004)	0.02*** (0.004)

ANNEX C1. Marginal effects of providing eldercare (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
Number of observations	44,914	44,914	44,914	44,914	44,914	44,914
ρ			0.15			
(0.10)			0.30**			
(0.13)						
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

[a] Standard errors are in parentheses.
[b] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[c] Estimates are survey weight adjusted.

ANNEX C2. Marginal effects of providing frequent eldercare (excludes several times a week providers) on the labor force participation, with and without interaction variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
At least one parent is foreign-born=1		-0.01*** (0.004)			-0.02*** (0.01)	
Daily provider = 1	-0.07*** (0.01)		-0.15** (0.06)	-0.10*** (0.02)		-0.23*** (0.07)
Female	-0.16*** (0.00)	0.01*** (0.003)	-0.15*** (0.004)	-0.11*** (0.01)	-0.01** (0.01)	-0.11*** (0.01)
Female x At least one parent is foreign-born					0.01 (0.01)	
Female x Frequent provider				0.05** (0.02)		0.05** (0.02)
Age	0.01*** (0.002)	0.01*** (0.002)	0.01*** (0.002)	0.01*** (0.002)	0.01*** (0.001)	0.02*** (0.002)
Age-squared	-0.0002*** (0.00002)	-0.00003*** (0.00001)	-0.0002*** (0.00002)	-0.0002*** (0.00002)	-0.00003*** (0.00001)	-0.0002*** (0.00002)

ANNEX C2. Marginal effects of providing frequent eldercare (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
Ref: Less than grade 1						
Grade 1 to 12	-0.05 (0.05)	-0.05** (0.02)	-0.06 (0.05)	-0.06 (0.05)	-0.05** (0.02)	-0.07 (0.06)
High school diploma	-0.01 (0.05)	-0.03 (0.02)	-0.02 (0.05)	-0.02 (0.05)	-0.03 (0.02)	-0.03 (0.06)
Some college or associate degree[a]	0.01 (0.05)	-0.03 (0.02)	0.001 (0.05)	0.002 (0.05)	-0.03 (0.02)	-0.01 (0.06)
Bachelor degree and above	0.03 (0.05)	-0.03 (0.02)	0.03 (0.05)	0.03 (0.05)	-0.03 (0.02)	0.02 (0.06)
Disability=1	-0.28*** (0.01)	-0.01* (0.004)	-0.28*** (0.01)	-0.28*** (0.01)	-0.01* (0.004)	-0.28*** (0.01)
Ref: White only						
Black only	0.01 (0.01)	-0.01* (0.003)	0.01 (0.01)	0.01 (0.01)	-0.01* (0.003)	0.004 (0.01)
Asian only	-0.05*** (0.01)	0.001 (0.01)	-0.05*** (0.01)	-0.05*** (0.01)	0.0001 (0.01)	-0.05*** (0.01)
Hispanic only	0.02*** (0.01)	-0.001 (0.004)	0.02*** (0.01)	0.02*** (0.01)	-0.001 (0.004)	0.02** (0.01)
Mixed	0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)
Ref: Married – spouse present						
Married – spouse absent	0.04** (0.02)	-0.003 (0.01)	0.04** (0.02)	0.04** (0.02)	-0.003 (0.01)	0.04** (0.02)
Widowed/ divorced/ separated	0.06*** (0.01)	0.01*** (0.003)	0.06*** (0.01)	0.06*** (0.01)	0.01*** (0.003)	0.06*** (0.01)
Never married	0.04*** (0.01)	0.03*** (0.003)	0.04*** (0.01)	0.04*** (0.01)	0.03*** (0.003)	0.04*** (0.01)
Ref (in USD): Below 25000						
25000 to below 35000	0.07*** (0.01)	0.001 (0.004)	0.07*** (0.01)	0.09*** (0.01)	-0.01 (0.01)	0.09*** (0.01)
35000 to below 60000	0.11*** (0.01)	-0.01*** (0.004)	0.11*** (0.01)	0.14*** (0.01)	-0.03*** (0.01)	0.14*** (0.01)
60000 to below 100000	0.16*** (0.01)	-0.02*** (0.004)	0.15*** (0.01)	0.19*** (0.01)	-0.03*** (0.01)	0.19*** (0.01)
100000 and above	0.17*** (0.01)	-0.02*** (0.004)	0.16*** (0.01)	0.22*** (0.01)	-0.04*** (0.01)	0.21*** (0.01)

ANNEX C2. Marginal effects of providing frequent eldercare (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
Ref (in USD): Female x Below 25000						
Female x 25000 to below 35000				-0.03** (0.02)	0.01 (0.01)	-0.03** (0.02)
Female x 35000 to below 60000				-0.05*** (0.01)	0.02** (0.01)	-0.05*** (0.01)
Female x 60000 to below 100000				-0.06*** (0.02)	0.02*** (0.01)	-0.06*** (0.02)
Female x 100000 and above				-0.09*** (0.02)	0.04*** (0.01)	-0.08*** (0.02)
Number of children under 6 in household	-0.05*** (0.003)	-0.01*** (0.003)	-0.05*** (0.003)	-0.05*** (0.003)	-0.01*** (0.003)	-0.05*** (0.003)
Number of adult males aged 16 and older in household	-0.03*** (0.004)	0.01*** (0.002)	-0.03*** (0.01)	-0.03*** (0.004)	0.01*** (0.002)	-0.03*** (0.004)
Number of adult females aged 16 and older in household	0.03*** (0.004)	0.02*** (0.002)	0.03*** (0.01)	0.02*** (0.004)	0.02*** (0.002)	0.03*** (0.004)
Number of observations	41,237	41,237	41,237	41,237	41,237	41,237
ρ			0.17			
(0.13)			0.29**			
(0.13)						
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

[a] Standard errors are in parentheses.
[b] ***, ** and * denote level of significance at 1 percent, 5 percent and 10 percent respectively.
[c] Estimates are survey weight adjusted.