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DISCUSSION PAPER SERIES

IZA DP No. 15457

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Bruce Hollingsworth
Lancaster University

Asako Ohinata
University of Leicester

Matteo Picchio
Marche Polytechnic University, Ghent University and IZA

Ian Walker
IZA and Lancaster University

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Does It Matter Who Cares for You? The Effect of Substituting Informal with Formal Personal Care on the Care Recipients' Health*

We show that a Scottish policy reform, which introduced free formal personal home care for those aged 65 and above, reduced the probability and the hours of receiving informal personal care. Moreover, we find that the group of individuals that most benefited from the policy introduction, i.e. women aged 75 and above, experienced the largest fall in informal care. We go on to investigate whether such reductions in informal and increases in formal personal care impacted on the care recipients' health outcomes. Our results demonstrate that switching from informal to formal care does very little to the recipients' hospital usage and health outcomes.

JEL Classification: C21, D14, I18, J14

Keywords: long-term elderly care, ageing, financial support, difference-in-differences

Corresponding author:
Asako Ohinata
Department of Economics
Finance and Accounting
University of Leicester
Leicester, LE1 7RH
United Kingdom

E-mail: ao160@le.ac.uk

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1 Introduction

In 2013, approximately 65% of older individuals in OECD countries received care at home (OECD, 2015). Often, they rely on their own families to provide informal care. Alternatively, they can arrange for a formal care worker to visit the individual's own home.

In this paper we investigate the relative effectiveness of the two types of care. More specifically, we study the health outcomes of recipients that have experienced a switch in the type of care received as the result of the implementation of the 2002 Scottish Care and Community Health Act (CCHA). CCHA provides in-kind formal personal care without means-testing to Scottish individuals aged 65+ in need of care. See Table 1, for examples of "personal care". In contrast, individuals in the rest of UK have not been exposed to such a policy and largely continues to fund their care out of pocket. Using the 1998-2006 UK Family Resources Survey and the General Household Survey, we first present results demonstrating that the Scottish policy led individuals to switch from informal to formal care. We then study whether such a switch affected the care recipients' self-reported health outcomes and use of hospital care. We employ a difference-in-differences estimator and compare the various health outcomes of individuals in Scotland against those in the rest of Britain.

The existing literature has focused on the substitutability between informal and formal care by measuring how the probability of having informal care, and the hours of such care, change in response to the availability of formal care (e.g. Ettner, 1996; Bolin et al., 2008; Bonsang, 2009; Charles and Sevak, 2005; Bell et al., 2007; Costa-Font et al., 2018; Hollingsworth et al., 2022). Similarly, theoretical models that highlight the potential substitutability of these two types of care have often used a health production function, where health depends on the hours of both informal and formal care. The underlying assumption is that the quality of both types of care is similar to each other (e.g. Ettner, 1996; Pezzin et al., 1996).

More recent papers investigate the impacts of either public financed home care or long-term care health insurance policy changes on self-reported health (Stabile et al., 2006; McKnight, 2006; Tamiya et al., 2011; Lei et al., 2022) or mortality (McKnight, 2006; Kim and Lim, 2015; Sohn et al., 2020) and find mixed effects. Sohn finds that the introduction of a long-term care health insurance scheme in South Korea reduced mortality. However, Kim and Lim (2015) found that the same scheme had no effect on mortality. McKnight (2006) finds no adverse effect on neither the self-reported health nor mortality after the US Medicare home care coverage was significantly reduced in 1997. Tamiya et al. (2011) and Lei et al. (2022) each investigated the impacts of long-term care

health insurance introduction on self-reported health in Japan and China, respectively. Whilst Tamiya et al. (2011) found little effect on self-reported health, Lei et al. (2022) found significant and positive effects on the self-reported health and one-year mortality.

The past literature relied on the exogenous variations in the price of formal care caused due to the introduction of new health insurance schemes or changes in the coverage amount of public financed home care. These policies share two potential limitations. The first is that they typically involve selection of individuals that are eligible for the scheme either in the form of income threshold or because the insurance scheme is not universal. This means that the estimated results show the impacts among the selected individuals within a country. The second limitation is that they often change the coverage of both home care as well as care provided in the nursing care homes. This could lead those who suffer from worse health conditions to become more likely to seek institutional care. However, since the available household datasets only collect data individuals who live at home, their analyses are likely to only capture the impacts on those healthy enough to stay at home.[1][2]

Table 1: Types of formal personal care

Personal Hygiene	Bathing, showering, hair washing, shaving, oral hygiene, nail care
Continence Management	Toileting, catheter/stoma care, skin care, incontinence laundry, bed changing
Food and Diet	Assistance with the preparation of food and the fulfilment of special dietary needs
Problems with Immobility	Dealing with the consequences of being immobile or substantially immobile
Counselling and Support	Behaviour management, psychological support, reminding devices
Simple Treatments	Assistance with medication (e.g. eye drops, application of lotions), oxygen therapy
Personal Assistance	Assistance with dressing, surgical appliances, prostheses, mechanical and manual aids. Assistance to get up and go to bed.

Notes: "Free Personal and Nursing Care" (2017, May 03) retrieved from http://www.gov.scot/Topics/-Health/Support-Social-Care/Support/Older-People/Free-Personal-Nursing-Care.

[1] Several papers have focused on the increased availability of care rather than on comparing the quality of different types of care. Van Houtven and Norton (2004, 2008) studied the impact of informal care availability on medical health care usage and expenditures in the US. Barnay and Juin (2016) investigated how receiving either informal or formal care affected the recipients' mental health in France. Costa-Font et al. (2018) used a Spanish policy reform that increased the availability of informal care through a cash allowance that was used as a within-family cash transfer. The individuals could alternatively opt to receive an in-kind benefit, which was often given out to older female widows that did not have informal caretakers. They show that these increases in the availability of informal or formal care led to reductions in hospital admissions and healthcare utilisation.

[2] A recent paper by Bakx et al. (2020) looks at the impact of nursing home admissions and find that being looked after in a nursing care home setting reduces medical care usage and hospitalisation.

In contrast, the Scottish CCHA was offered without means-testing. Moreover, as demonstrated in our companion paper, Hollingsworth et al. (2022), the policy did not increase the financial support for the Scottish nursing home users relative to those in England or Wales. Therefore, not surprisingly, the policy did not create any additional incentives for the severely frail individuals to seek to enter nursing homes.

We find that the Scottish policy reduced the probability that individuals receive informal care at home by 2.8 percentage points, which is a reduction of about 18% with respect to the pre-treatment period. The impact on informal care was estimated to be a reduction of approximately 1.6 hours per week. We explore heterogeneity in the effect, and find that women aged 75 and above (the group most likely to receive formal care provided by the local authority (LA)) were the most likely to experience a reduction in the probability of receiving informal care and the hours of care) (Gillespie, 2006). We observe that the policy did not affect either the self-reported health outcomes or the use of hospital care. For selected outcomes, our estimates suggest a minor reduction in the usage of hospital care or improvements in health outcomes - particularly for women aged 75 and above.

The structure of our paper is as follows. Section 2 presents the details of the 2002 Scottish CCHA legislation. Section 3 describes the data, the sample construction, and the econometric model. Section 4 presents the estimation results. Section 5 discusses and concludes.

2 Context

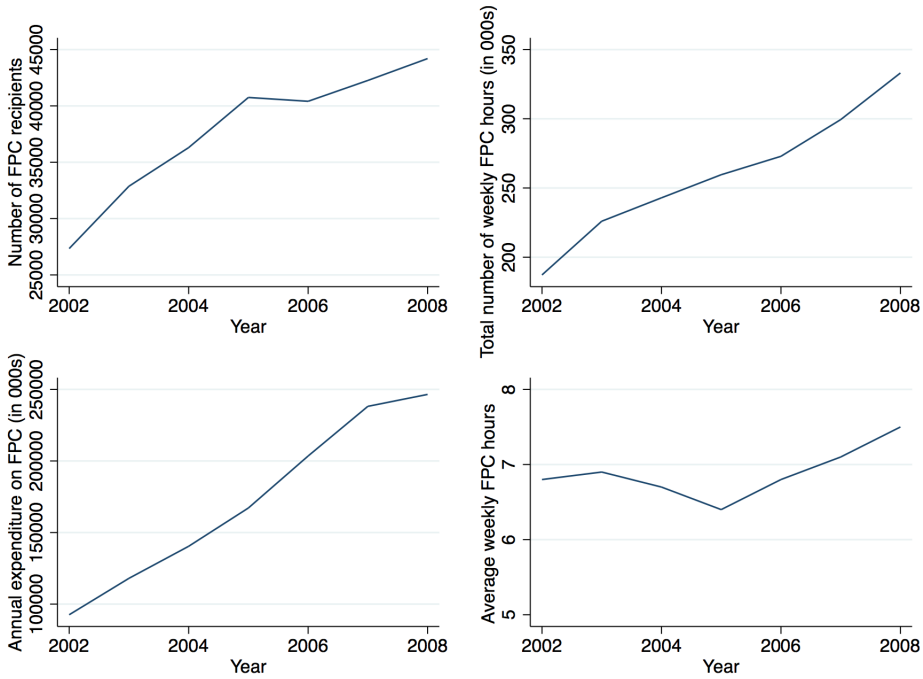
2.1 The 2002 Scottish Care and Community Health Act (CCHA)

The Royal Commission on Long-Term Care for the Elderly was set up in December 1997. The resulting 1999 Sutherland Report recommended all UK regions to offer formal personal care free of charge to those aged 65+ and that the amount of care be determined by a rigorous need-based assessment. This recommendation was taken up only by Scotland. The rest of UK decided not to adopt the recommendation and continued to charge for formal personal care. The divergence in the directions of these long-term elderly care policies stemmed from Scotland being able to set its health care policies as the result the transfer of some powers under Scottish devolution in 1999. The CCHA Bill passed in Scotland and received Royal Assent on 12 March 2002: it mandated local authorities to offer in-kind formal personal care. Although the cash amount to finance the in-kind support was not capped at a specific value, the average weekly amount spent per individual

in 2003 was £80 for those receiving care in their own homes (National Statistics, 2012).[3] Given that the average hourly home care cost in 2002 is £12 (National Statistics, 2002), the amount would cover approximately seven hours worth of care per week.

Figure 1 presents more details on the CCHA recipients. The left-bottom and left-top graphs show that from 2002 until 2008 the annual expenditure for the policy increased and the number of recipients in Scotland steadily rose from approximately 25,000 to close to 45,000. From the right-top graph, we see that the total number of weekly formal care hours for Scottish recipients increased. However, the average individual weekly hours remained fairly stable at around seven hours per week during the first three years (right-bottom graph), suggesting that the additional hours were offered to the new CCHA clients.

Figure 1: Number of CCHA recipients and weekly hours used



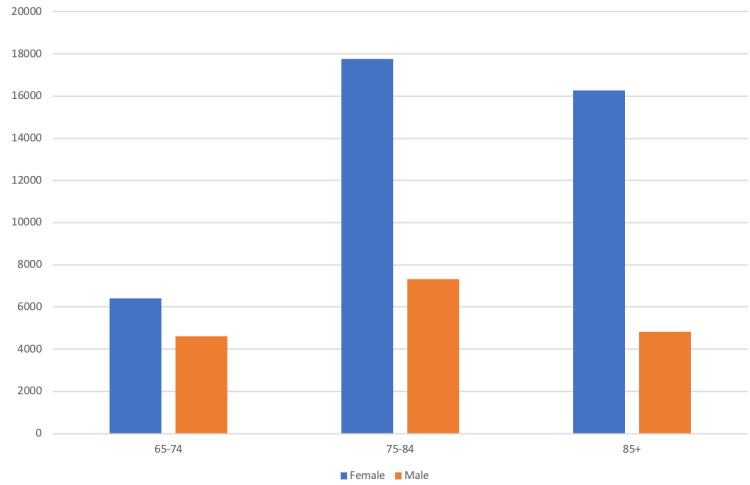
Sources: Gillespie (2007), Gillespie (2013)
Notes: We report the trends in the number of Scottish CCHA recipients at home and the total weekly hours used between 2002–2008.

Figure 2 shows the number of Scottish individuals receiving LA-provided formal home care by age and gender. Women are far more likely to receive LA-provided formal care at home, especially when they are 75 and above. As older women are more

[3]It also offers support to those in nursing care homes. However, we do not discuss the care home aspect of CCHA in this paper, since the focus of our paper is on those receiving care at home. Policy information for those in nursing care homes can be found in Ohinata and Picchio (2020).

likely to receive formal care, we will pay special attention to them in the econometric analysis below where we investigate the impact of the CCHA policy on the probability of receiving informal care and on the recipients' health outcomes.

Figure 2: Number of Scottish individuals receiving LA-provided home care by age and gender



Sources: Gillespie (2006).
Notes: This histogram shows the number of Scottish individuals that received LA-provided home care in 2006 by age and gender. Home care is formal care provided at home of the frail individuals. It is worth noting that home care also includes types of care other than personal care. However, by 2006, approximately 71% of home care recipients also received free personal care. Therefore, the presented numbers are likely to be closely related to those of the personal care recipients.

3 Method

3.1 Data, sample and variable definition

This study employs two UK repeated cross section datasets: the Family Resources Survey (FRS) and the General Household Survey (GHS). FRS has been collected annually by the Department for Work and Pension from 1992 and includes approximately 24,000 households and 45,000 individuals annually. GHS was collected by the Office for National Statistics between 1971 and 2007 and contains information from approximately 9,000 households and 20,000 individuals annually. They both contain variables at the household and individual levels. FRS includes detailed care-related information, such as whether and how many hours an individual received care from family members living in or out of the household. However, it does not have information on the health outcomes. Instead, GHS contains several health-related variables.

Our analysis spans from 1999 until 2006 since all the relevant dependent and independent variables are available during these years in both datasets. We exclude Northern Ireland from our analysis because FRS does not collect data for this country before the 2002/2003 survey. We further restrict the sample to only include observations aged 65 and above, as only this sub-sample of individuals qualified for the support provided by CCHA. After eliminating individuals with missing observations for some of the variables included in the econometric model, we obtain the final sample consisting of 77,556 observations in FRS and 24,979 observations in GHS.

We have several outcomes of interest. We use two care related outcome variables that are observed in FRS. One of them is an indicator variable equal to 1 if the individual was looked after by an adult (family members or friends/neighbours). The second is an interval-coded variable measuring the number of hours per week of informal care received from an adult.

When we study the impact on the hours of informal care received, the relevant dependent interval-coded variable is obtained from two underlying interval-coded variables. One variable reports the number of hours of informal care received from adults in the same household. The other one reports the hours of care received from adults outside of the care recipients' household. For both variables, the information on the numbers of weekly hours received is reported with an interval structure. We build the number of hours per week of informal care received by adults aged 65+ by assigning to each individual an interval whose lower bound is given by the sum of the lower bounds of the two underlying variables and whose upper bound is the sum of the two upper bounds. Therefore, the resulting variable is also an interval variable.

From GHS, we retrieve the following health related outcome variables: an indicator equal to 1 if the individual received inpatient care last year; the number of days inpatient care received last year; an indicator equal to 1 if the individual received outpatient care in the last three months; the number of days the individual received outpatient care in the last three months; dummy variables each equal to 1 if the individual suffered from a back problem, a skin problem, a stroke, other cardiac issues such as a heart attack, hypertension and high blood pressure, diabetes, or from bronchitis or other respiratory conditions.

The first four outcomes are related to the use of inpatient and outpatient care. Inpatient care refers to the type of hospital care that requires overnight treatments, whereas outpatient care is given out as a day visit to hospitals. These variables are chosen so as to investigate whether switching from informal to formal care led individuals to change their usage.

The last seven outcomes are the self-reported health outcomes constructed based on the long-standing illness codes (ICD codes) included in GHS. We chose these outcomes

for two reasons. First, individuals are likely to suffer from them at older ages and the quality of care may indirectly change the probability of the onset (i.e. the risks of diabetes or cardiac conditions such as stroke or heart attack that require close monitoring and dietary support). Second, the quality of care is likely to affect the outcomes through direct physical contacts with the frail individuals (i.e. back problems or skin conditions caused by physically supporting the frail individuals). Table 2 reports descriptive statistics of the outcome variables.

Table 2: Summary statistics of the dependent variables

Variable	FRS		GHS	
	Mean	Std. Dev.	Mean	Std. Dev.
1 if informal care received	0.134	0.341		
1 if outpatient care used			0.230	0.421
1 if inpatient care used			0.135	0.342
Number of days of outpatient care usage			0.424	1.063
Number of days of inpatient care usage			0.180	0.537
1 if suffers from back problem			0.038	0.191
1 suffers from skin problem			0.008	0.089
1 if suffered stroke			0.025	0.156
1 if suffered heart attack or other heart issues			0.147	0.354
1 if suffers from hypertension/high blood pressure			0.108	0.311
1 if suffers from diabetes			0.074	0.262
1 if suffered bronchitis and other respiratory conditions			0.042	0.200
Observations	77,556		24,974	

Notes: The mean and the standard deviation of the hours of informal care usage are not included in this table due to the categorical nature of the variable.

As independent variables, we include various characteristics such as the age and its square, ethnicity fixed effects, region of residence fixed effects, and year fixed effects. Age left education is reported in FRS, but no such information is available in GHS. In order to control for the socioeconomic characteristics of the GHS individuals, we instead include the social class indicators that classify individuals based on their professions when they were at work.

We also control for macroeconomic characteristics such as the Gross Value Added (GVA) or the Gross Disposable Household Income (GDHI) by region. To help control for region specific time-varying health and social care expenditures, we also add the corresponding capital and current spending. The capital spending refers to long-term expenditures used to maintain medical machines and hospital buildings, whereas the current spending measures short-term expenditures such as the wages for hospital staff. Table 3 displays summary statistics of these control variables.

Table 3: Summary statistics of the regressors

Variable	FRS		GHS	
	Mean	Std. Dev.	Mean	Std. Dev.
Age	73.281	5.200	74.122	6.655
1 if Female	0.552	0.497	0.532	0.499
1 if couple	0.575	0.494	0.590	0.492
Ethnicity				
White	0.946	0.226	0.976	0.152
Black	0.007	0.086	0.010	0.100
Asian	0.012	0.110	0.009	0.095
Region of residence				
North East	0.047	0.211	0.048	0.213
North West	0.111	0.314	0.118	0.323
Yorks and Humber	0.086	0.281	0.090	0.286
East Midlands	0.070	0.255	0.080	0.271
West midlands	0.086	0.281	0.091	0.288
Eastern	0.092	0.290	0.096	0.295
London	0.081	0.273	0.080	0.271
South East	0.134	0.341	0.145	0.352
South West	0.094	0.292	0.105	0.306
Wales	0.056	0.230	0.057	0.232
Scotland	0.141	0.348	0.090	0.287
Age left education				
0–12	0.007	0.085		
13–15	0.694	0.461		
16–18	0.229	0.420		
19–21	0.036	0.187		
22–23	0.019	0.136		
24–27	0.010	0.100		
28 and above	0.005	0.071		
Social class indicator				
Professional occupations			0.041	0.198
Managerial and Technical occupations			0.234	0.424
Skilled occupations:non-manual			0.236	0.425
Skilled occupations:manual			0.227	0.419
Partly-skilled occupations			0.176	0.380
Armed forces			0.086	0.280
Year of observation				
Year1999	0.117	0.322	0.030	0.171
Year2000	0.118	0.323	0.083	0.276
Year2001	0.121	0.326	0.127	0.333
Year2002	0.126	0.332	0.123	0.329
Year2003	0.132	0.338	0.137	0.343
Year2004	0.129	0.335	0.134	0.341
Year2005	0.133	0.340	0.216	0.411
Year2006	0.123	0.329	0.150	0.357
Regional gross value added per head (deviations from average)	-161.607	4,101.794	-67.662	4196.906
Regional gross disposable household income per head (deviations from average)	-49.407	1,739.466	128.375	1733.138
Health (capital spending) by region	247.095	133.365	274.764	131.103
Health (current spending) by region	6,328.269	2,237.385	6846.163	2339.576
Social protection (capital spending) by region	38.410	31.216	48.704	32.418
Social Protection (current spending) by region	13,520.930	3,680.619	14188.690	3832.151
Observations	77,556		24,974	

3.2 The econometric model

We employ a difference-in-differences (DD) estimator. Our aim is to identify the effects of the 2002 policy in Scotland (our treatment group) by comparing the outcomes to the rest of the UK (our control group). Using the month and the year of interview reported in both FRS and GHS, we define the after policy introduction period to be March 2002, which is the month that the bill passed. We specify the following model for a generic outcome variable y for individual i in region r and in tax year t:

$$y_{irt} = \mathbf{x}'_{irt}\boldsymbol{\beta} + \boldsymbol{\gamma}_r + \boldsymbol{\phi}_t + \delta_{DD} I_{rt} + \varepsilon_{irt}, \tag{1}$$

where $\mathbf{x}_{irt}$ is the $K \times 1$ vector of relevant individual characteristics and $\boldsymbol{\beta}$ is the conformable vector of coefficients. $\mathbf{x}_{irt}$ includes various regressors discussed in Section 3. $\boldsymbol{\gamma}_r$ is a set of regional fixed effects (regional dummies) and $\boldsymbol{\phi}_t$ is a set of time fixed effects. I_{rt} is the regressor of interest. It is an indicator variable equal to 1 if individual i resides in Scotland after the reform, i.e. after March 2002. The corresponding parameter δ_{DD} is the effect of the introduction of free personal care in Scotland. Finally, ε_{irt} is the error term.

Our dependent variables have limited supports. In most cases, the dependent variable is a binary indicator. When this is the case, the parameters of Equation (1) are estimated by Ordinary Least Squares (OLS), i.e. we estimate a linear probability model by OLS. The variable for the number of hours of informal care is instead interval-coded, and suffers from the right or left censoring for some observations, and presents a sizeable mass of observations at zero. We model this interval-coded variable using a generalisation of the type-I Tobit model, with Equation (1) representing the latent variable model: after imposing the normal distribution on the error term ε_{irt}, we estimate the interval-coded model by maximum likelihood (ML), as in our companion paper, Hollingsworth et al. (2022).

Finally, when we study the number of days individuals received outpatient/inpatient care, we use the linear double-hurdle model proposed by Cragg (1971). This is because we have large proportions of individuals who did not use either type of care (approximately 77% for outpatient care and 86% for inpatient care). The Cragg's double-hurdle model allows us to model the participation equation separately from the outcome equations.

Let y_{irt} be the observed value of the number of days inpatient/outpatient hospital care was used, s_{irt} be the selection indicator equal to one if the individual used a positive number of days of hospital care, and let y^*_{irt} be the continuous latent variable. Then we can write the relationship among these three variables as follows.

The outcome linear model for the latent variable is

$$y^*_{irt} = \mathbf{x}'_{irt}\boldsymbol{\beta} + \boldsymbol{\gamma}_r + \boldsymbol{\phi}_t + \delta_{DD} I_{rt} + \varepsilon_{irt}. \tag{2}$$

The selection model is

$$s_{irt} = \begin{cases} 1 & \text{if } \mathbf{x}'_{irt}\boldsymbol{\beta}^s + \boldsymbol{\gamma}^s_r + \boldsymbol{\phi}^s_t + \delta^s_{DD} I_{rt} + u_{irt} \\ 0 & \text{otherwise.} \end{cases} \tag{3}$$

While the observed corner solution dependent variable is

$$y_{irt} = s_{irt} y^*_{irt}. \tag{4}$$

The error terms ε_{irt} and u_{irt} have truncated normal and standard normal distribution, respectively. The type-I Tobit model is nested in the linear double-hurdle model, as in the type-I tobit model the same parameters enter Equations (2) and (3). As controls, we use the same variables for both the selection and the outcome equations. However, the choice of variables does not affect our estimates.

3.3 Identification assumptions

The difference-in-differences strategy is able to identify the causal effect of a policy change if certain assumptions are satisfied. The first requires that, conditional on observed characteristics, the individuals residing in Scotland experience similar trends in the outcome variable as those living in the rest of the UK if the 2002 reform hat not been implemented. We check the validity of this assumption by comparing the trends of our outcome variables for England & Wales and for Scotland by estimating the following equation, which regresses each outcome variable against all the covariates discussed earlier together with a set of time dummies whose coefficients are allowed to be different between Scotland and England & Wales:

$$y_{irt} = \mathbf{x}'_{irt}\boldsymbol{\omega} + \boldsymbol{\gamma}_r + \boldsymbol{\phi}^{EW}_t + \boldsymbol{\phi}^{Sc}_t + u_{irt}, \tag{5}$$

where $\boldsymbol{\phi}^{EW}_t$ are tax year dummies if individual i lives in England & Wales and $\boldsymbol{\phi}^{Sc}_t$ are tax year dummies if individual i lives in Scotland. We jointly test, for $t = 1999, 2000, 2001$, if $\boldsymbol{\phi}^{Sc}_t - \boldsymbol{\phi}^{UK}_t = k$, where $k \in \Re$ is some constant. If the null hypothesis cannot be rejected, the distance between the Scottish trend and the trend of the rest of the UK is constant over the sample period before the reform, i.e. the trends are parallel before the reform.

In Table 4, we report the p-values from these tests. They consistently confirm that the trends are statistically parallel prior to the reform.

Table 4: Identification tests of parallel trends

Dependent variables	p-values	Observations
a) Informal care usage		
1 if receiving informal care	0.875	77,556
Hours of receiving informal care	0.844	77,556
b) Inpatient/outpatient care usage		
1 if receiving outpatient care	0.611	24,974
1 if receiving inpatient care	0.353	24,974
Number of days outpatient care usage	0.525	24,974
Number of days inpatient care usage	0.717	24,974
c) Self-reported health outcomes		
1 if suffers back problem	0.643	24,974
1 if suffers skin condition	0.850	24,974
1 if suffered stroke	0.303	24,974
1 if suffered heart attack and other heart issues	0.325	24,974
1 if suffers hypertension/ high blood pressure	0.210	24,974
1 if suffers diabetes	0.914	24,974
1 if suffers bronchitis and other respiratory	0.599	24,974

Notes: The p-values are the result of the joint test $\phi_t^{Sc} - \phi_t^{UK} = k$, where $k \in \Re$ is some constant for $t = 1999, 2000, 2001$ after the regression $y_{irt} = \mathbf{x}'_{irt}\boldsymbol{\omega} + \gamma_r + \phi_t^{EW} + \phi_t^{Sc} + u_{irt}$, with $t = 1999, \ldots, 2006$, where ϕ_t^{EW} are tax year dummies if individual i lives in England-Wales and ϕ_t^{Sc} are tax year dummies if individual i lives in Scotland. The covariates in $\mathbf{x}_{irt}$ are: age and its squared term, gender, race, the level of education (for FRS) or the former occupational groups (for GHS), the region-specific economic indicators, and the current and capital health and social care expenditures. γ_r are regional dummies. The full set of estimation results of these auxiliary regressions are available upon request.

The second assumption requires that the Scottish individuals were not able to anticipate the introduction of the 2002 policy. Such anticipation may have changed the behaviour of the Scottish individuals prior to 2002, thus potentially biasing the estimates. Since the progression of the bill was closely followed by the UK media and received wide coverage (e.g. BBC, 2001; Inman, 2002), it is likely that households in Scotland were aware of the policy even before its approval in March 2002 and its implementation in July 2002. The Scottish individuals might then have faced the incentives to switch to formal personal care prior to March 2002. In order to test this assumption, we include a robustness check by eliminating all the observations collected in the 12 months preceding the post-policy period, i.e. from March 2001 until February 2002, and the results are discussed in Subsection 4.3.

The final assumption is related to the stable sample composition. In order for our estimates to be causal, we require that individuals were not incentivised to move to Scotland after CCHA to benefit from the cheaper formal care. Ohinata and Picchio (2020) conducted a test for this assumption using the 1999–2007 British Household Panel Survey. Their results indicates that the policy introduction did not modify the probability of the English and Welsh of moving to Scotland.

4 Estimation results

4.1 Policy effects on the usage of informal care

Table 5 reports the estimated policy effect on the probability of receiving informal care from families and friends and on the number of received hours of informal care. Panel (a) displays the results when the model is estimated without the demographic covariates. The policy reduced the probability of receiving informal care by 2.8 percentage points (pp). This is equivalent to an approximate reduction of 18.2% relatively to the fraction of those receiving informal care in Scotland before the reform (15.4%). This finding does not change when we include various covariates, as shown in panel (b).

In panel (c), we observe that the policy effect was heterogeneous across age. Compared to those aged below 75, individuals aged 75 and above experienced a larger reduction in the probability of receiving informal care from families and friends (-3.8 pp against -2.4 pp). The difference between these two parameters is statistically significant at 1%.

Similarly, in panel (d) we observe heterogeneous effects across gender: women experienced a larger reduction in the probability of receiving informal care (-3.4 pp against -2.3 pp). Again, the two estimates are statistically different at the 1% significance level.

Since in the UK life expectancy for women is higher than that for men (Morgan, 2019), it is not clear whether the heterogeneous results in panels (b) and (c) are driven by gender or age. Therefore, we present estimates of the reform effect by gender and age in panel (d): the negative policy effect is driven by women aged 75 and above, who experienced a 5.1 pp reduction in the probability of receiving informal care from families and friends.

Turning to the impact of the reform on the hours of informal care received by frail individuals, we find a very similar pattern to the effects on the probability of informal care. The interval regression estimate for received hours of informal care reveals that the reform significantly reduced the hours of informal care received by those aged 65+ by -8.9. Due to the interval-coded nature of the dependent variable and the consequent non-linearity in parameters of the model , we cannot directly interpret this number as the average partial effect of the policy change on the number of received hours of informal care. Therefore, we also estimate and report two average partial effects implied by the estimated model - with and without conditioning on the hours of receiving informal care being larger than zero.

In panel (a), without controlling for $\mathbf{x}$, we observe that the policy reduced the hours of informal care by 1.6 hours conditional on them being larger than zero, and by 1.07 unconditionally. Very similar partial effects are obtained (in panel (b) if we include control variables in the model specification).

Table 5: Policy effects on the probabilities and hours of receiving informal care

	Linear probability model for receiving informal care	Interval regression for hours of receiving informal care
a) Baseline without covariates		
After*Scotland (I_{rt})	-0.028***	-8.923***
	(0.008)	(2.995)
Average partial effect of the policy		
$\Delta \mathrm{E}\left(y\middle\vert z, y>0\right)$	–	-1.601
$\Delta \mathrm{E}\left(y\middle\vert z\right)$	–	-1.071
b) Baseline with covariates		
After*Scotland (I_{rt})	-0.028***	-8.980***
	(0.008)	(3.030)
Average partial effect of the policy		
$\Delta \mathrm{E}\left(y\middle\vert z, y>0\right)$	–	-1.578
$\Delta \mathrm{E}\left(y\middle\vert z\right)$	–	-1.064
c) By Age		
After*Scotland (Age $<$ 75)	-0.024**	-8.298*
	(0.009)	(4.367)
After*Scotland (Age $\geq$ 75)	-0.038***	-10.651***
	(0.015)	(4.111)
Test of equality (p-value)	0.002	0.007
d) By Gender		
After*Scotland (male)	-0.023*	-7.146
	(0.012)	(4.741)
After*Scotland (female)	-0.034***	-11.075***
	(0.011)	(3.908)
Test of equality (p-value)	0.002	0.006
e) By Age and Gender		
After*Scotland: male & Age$<$75	-0.016	-5.597
	(0.014)	(6.532)
After*Scotland: male & Age$\geq$75	-0.034	-8.774
	(0.022)	(6.791)
After*Scotland: female & Age$<$75	-0.022*	-8.379
	(0.013)	(5.833)
After*Scotland: female & Age$\geq$75	-0.051***	-13.366***
	(0.019)	(5.134)
Test of equality (p-value)	0.010	0.028
Observations	77,556	77,556

Notes: Standard errors (robust to heteroskedasticity in the linear probability model) are in parenthesis. For the estimation of Equation (1), the following regressors are included: age, squared age, gender, race, the level of education, the region-specific economic indicators, the current and capital health and social care expenditures, regional dummies, and fiscal year dummies. *** Significant at 1%; ** significant at 5%; * significant at 10%.

Subsequent results to unveil heterogeneity effects are in line with the corresponding results for the probability of receiving informal care. Individuals aged 75+, who were more likely to be impacted by the decline in the hours, experienced a larger and more significant decline in the hours of informal care received. Further interactions between age and gender again reveals that women aged 75+ were the most significantly affected by the decline in the hours of informal care received.

The findings presented in this section are consistent with the descriptive evidence discussed earlier in Section 2. The official statistics on CCHA indicated indeed that the group of individuals that was most likely to receive formal personal care included women aged 75+. Our results on receiving informal care show a mirror image to the findings from the official statistics: informal care was reduced for the demographic group that experienced the greatest increase in the amount of formal care received.

4.2 Policy effects on the health outcomes among care recipients

The previous section highlighted that the introduction of the 2002 Scottish CCHA was followed by the substitution of informal personal care provided by families and friends with formal care offered by LAs. We now investigate whether this substitution affected the recipients' health.

Table 6 presents evidence on how hospital usage changed in response to the policy introduction. More specifically, we show the impacts on the probabilities of inpatient and outpatient care usage.[4] The impacts on the probabilities of outpatient and inpatient care are estimated using linear regressions. The effects on the number of days of usage were instead estimated using a linear Cragg hurdle model as discussed in Section 3.2.

Panel (a) of Table 6 reports the raw estimates without controlling for covariates. These estimates show that neither the probability of using outpatient nor inpatient care were significantly affected by the policy introduction. Similarly, the frequencies of hospital care usage were not affected. For these latter effects, we need to evaluate the average partial effects rather than the raw parameter estimates directly, as the model is nonlinear in the estimated parameters. The estimates of the average partial effects tell us that the number of days of outpatient care usage increased by 0.084 (0.074) days, conditional (unconditional) on the number of days being greater than 0. The number of days of inpatient care not significantly decreased by 0.040 (0.069) days, condition (unconditional) on the number of days being greater than 0. These conclusions remain unchanged when we introduce the covariates $\mathbf{x}$ in our regressions (see panel (b)).

[4]GHS records outpatient care usage that occurred up to three months before the interview date. On the other hand, the inpatient care usage that happened up to one year prior to the interview date are included.

Table 6: Policy effects on the usage of inpatient and outpatient care

	1 if outpatient care used	1 if inpatient care used	Number of days outpatient care usage	Number of days inpatient care usage
a) Baseline without covariates				
After*Scotland (I_{rt})	-0.004	-0.024	0.321	-0.100
	(0.020)	(0.018)	(0.701)	(0.140)
Average partial effect of the policy				
$\Delta \mathrm{E}\left(y\|z, y>0\right)$	–	–	0.084	-0.040
$\Delta \mathrm{E}\left(y\|z\right)$	–	–	0.074	-0.069
b) Baseline with covariates				
After*Scotland (I_{rt})	0.000	-0.023	0.167	-0.109
	(0.021)	(0.018)	(0.709)	(0.144)
Average partial effect of the policy				
$\Delta \mathrm{E}\left(y\|z, y>0\right)$	–	–	0.044	-0.075
$\Delta \mathrm{E}\left(y\|z\right)$	–	–	0.006	-0.039
c) By Age				
After*Scotland (Age <75)	-0.017	-0.015	0.876	-0.248
	(0.026)	(0.022)	(0.907)	(0.189)
After*Scotland (Age ≥ 75)	0.021	-0.034	-0.920	-0.006
	(0.032)	(0.030)	(1.089)	(0.211)
Test of equality (p-value)	0.629	0.431	0.425	0.423
d) By Gender				
After*Scotland (male)	0.015	0.024	1.120	-0.151
	(0.030)	(0.027)	(1.085)	(0.212)
After*Scotland (female)	-0.018	-0.059**	-0.635	-0.120
	(0.027)	(0.024)	(0.925)	(0.195)
Test of equality (p-value)	0.708	0.033	0.455	0.651
e) By age and gender				
After*Scotland: male & Age$<$75	-0.0080	0.0220	0.402	0.090
	(0.038)	(0.032)	(1.298)	(0.289)
After*Scotland: male & Age$\geq$75	0.055	0.026	2.635	-0.413
	(0.047)	(0.047)	(2.030)	(0.305)
After*Scotland: female & Age$<$75	-0.024	-0.047	1.184	-0.447*
	(0.035)	(0.030)	(1.241)	(0.253)
After*Scotland: female & Age$\geq$75	-0.006	-0.075*	-3.044**	0.242
	(0.042)	(0.039)	(1.348)	(0.295)
Test of equality (p-value)	0.754	0.142	0.094	0.212
Observations	24,974	24,974	24,974	24,974

Notes: Standard errors (robust to heteroskedasticity in the linear probability model) are in parenthesis. The same set of control variables are included as those listed in the notes of Table 4. *** Significant at 1%; ** significant at 5%; * significant at 10%.

Turning to the potentially heterogeneous effects of the policy, we explore the effects by age (panel (c)) and by gender (panel (d)). In all but one case, we observe no heterogeneous policy effects across these dimensions; nor do we see significant differences across groups. The only exception is when we look at the probability of inpatient care. We see that women experienced a significant reduction in the probability of inpatient care usage and the difference between the estimates for males and females is significant at 5% level. When we further interact age and gender of care recipients, we observe that women aged 75 and above are marginally less likely to use inpatient care and the frequencies of outpatient care also significantly declined. This suggests that the group of individuals most likely to have been affected by the policy, and to substitute informal personal care with formal personal care, exhibited less reliance on hospital care.

We present estimates on the impact of the reform on the self-reported health outcomes in Table 7. These estimates are calculated by estimating linear probability models. Every column of the table shows a different health outcome. As in the previous tables, Table 7 is organised so that panels (a) and (b) list the estimates without and with the individual and macro-level covariates, respectively. Panels (c) and (d) include the heterogeneous estimates across age and gender. Finally, panel (e) contains the estimates after we include the further interactions between age and gender in the model specification.

Out of the seven health outcomes, we observe no policy effects on the following three health outcomes: back problem, stroke, and hypertension or high blood pressure. This is true regardless of whether we look at our baseline estimates with or without the covariates or when we break the effects down to different demographic groups. In contrast, we observe minor effects for the remaining four outcomes. Although the overall effect is insignifcant and small, those aged 75 and above, and particularly the women in this age group, experienced a reduction in the probability of suffering from skin conditions. Similarly, the older age group experienced a marginally lower likelihood of having heart related issues. We observe that the incidence of diabetes went up after the policy introduction in Scotland, but this is mainly driven by those aged younger than 75. Finally, the probability that individuals suffer from bronchitis and other respiratory conditions went up marginally for the those aged 75 and above. On further inspection, we see that this is driven mainly by males in this age category.

In summary, the substitution from informal care to formally provided care seems to have done very little to self-reported health outcomes. On the one hand, when we see any reduction in the incidents of illnesses, the effects are often driven by individuals aged older than 75 and women, the group of individuals that were most likely to have been affected by CCHA. On the other hand, when we see any marginally positive impact, this is often due to individuals aged younger than 75 or males.

Table 7: Policy effects on the self-reported health outcomes

	Back problem	Skin	Stroke	Heart attack and other heart issues	Hypertension/ High blood pressure	Diabetes	Bronchitis and other respiratory
a) Baseline without covariates							
After*Scotland (I_{rt})	0.009	0.000	0.009	0.003	0.010	0.017	0.001
	(0.009)	(0.003)	(0.007)	(0.018)	(0.014)	(0.010)	(0.011)
b) Baseline							
After*Scotland (I_{rt})	0.005	-0.000	0.007	-0.007	0.008	0.020*	0.001
	(0.009)	(0.003)	(0.007)	(0.018)	(0.014)	(0.011)	(0.011)
c) By Age							
After*Scotland (Age $<$ 75)	0.007	0.003	0.009	0.019	0.014	0.026*	-0.017
	(0.012)	(0.004)	(0.006)	(0.022)	(0.019)	(0.014)	(0.014)
After*Scotland (Age $\geq$ 75)	0.001	-0.005**	0.001	-0.051*	-0.002	0.015	0.027*
	(0.013)	(0.002)	(0.014)	(0.031)	(0.021)	(0.017)	(0.015)
Test of equality (p-value)	0.861	0.0524	0.399	0.161	0.758	0.141	0.088
d) By Gender							
After*Scotland (male)	0.024	-0.005	0.009	0.006	-0.019	0.029	-0.001
	(0.017)	(0.006)	(0.012)	(0.034)	(0.023)	(0.021)	(0.020)
After*Scotland (female)	0.011	-0.000	0.001	-0.027	0.000	0.033*	-0.016
	(0.015)	(0.004)	(0.011)	(0.028)	(0.025)	(0.018)	(0.016)
Test of equality (p-value)	0.337	0.707	0.752	0.599	0.712	0.958	0.622
e) By age and gender							
After*Scotland: male & Age$<$75	0.004	-0.005	0.011	0.024	0.039	0.041**	-0.006
	(0.019)	(0.008)	(0.010)	(0.034)	(0.025)	(0.021)	(0.022)
After*Scotland: male & Age$\geq$75	0.013	-0.001	0.016	-0.055	-0.013	0.020	0.052**
	(0.019)	(0.004)	(0.021)	(0.050)	(0.027)	(0.026)	(0.023)
After*Scotland: female & Age$<$75	0.011	0.009**	0.009	0.016	-0.009	0.015	-0.026
	(0.016)	(0.004)	(0.008)	(0.028)	(0.027)	(0.019)	(0.019)
After*Scotland: female & Age$\geq$75	-0.011	-0.005*	-0.014	-0.052	0.005	0.008	0.009
	(0.018)	(0.003)	(0.019)	(0.038)	(0.029)	(0.022)	(0.020)
Test of equality (p-value)	0.849	0.038	0.431	0.414	0.575	0.273	0.114
Observations	24,974	24,974	24,974	24,974	24,974	24,974	24,974

Notes: Standard errors robust to heteroskedasticity are in parenthesis. The same set of control variables are included as those listed in the notes of Table 4. *** Significant at 1%; ** significant at 5%; * significant at 10%.

A possible explanation for the younger or male groups experiencing slightly worse health outcomes may be as follows: these groups experienced a reduction in the level of informal care after the 2002 policy and the size of the reductions were similar to the magnitude to the females, or those older than 75 (as shown in Table 5). However, as shown in Figure 2, males or those aged between 65 and 74 are not the categories of individuals mainly offered the LA-provided home care. Therefore, the reduction in the informal care may not have been supplemented as much by formal care relative to the female recipients or those aged 75.

4.3 Robustness checks

We carry out various robustness checks in Table 8. As a point of comparison, the first column of Table 7 repeats our baseline estimates that were reported in Tables 5 and 6.

In the second column of Table 8, we present estimates when we exclude London from our control group. We do this because London is probably the least comparable region to Scotland in terms of demographic or economic characteristics. However, eliminating individuals residing in London does not affect our estimates. In the third column, we include results that compare Scotland to the North of England (i.e. North-West, North-East, and Yorkshire and the Humber), since the collated north region may share more common characteristics to Scotland. Again, we see that the estimates are very similar to our baseline results displayed in the first column.

Finally, we investigate whether there was any anticipation effect in the fourth column. As discussed in Section 3.3, identifying causal effects requires that individuals did not change their care usage behaviours prior to March 2002 in the anticipation of the policy introduction. Therefore, we remove the observations collected 12 months before the policy introduction to see whether our estimates are sensitive to such a change in our sample. However, we again see that this does not change the sizes or the directions of the estimates.

5 Conclusions

In this paper, we demonstrated that the Scottish Care and Health Act 2002 reduced both the probability and the hours of receiving informal care between 2002 and 2006. Since the frail Scottish individuals were more likely to receive LA-provided formal care during the observation period, the policy is likely to have led individuals to substitute informal care with formal personal care. We then studied how this substitution affected the Scottish individuals' health outcomes.

Table 8: Robustness checks: Alternative control groups

Dependent variables	Baseline	Without London	Comparison with North England	Baseline without 2001
Informal care usage				
(a) Pr(receiving informal care)	-0.028***	-0.030***	-0.023**	-0.034***
	(0.008)	(0.009)	(0.010)	(0.010)
(b) Hours of informal care received	-8.980***	-9.622***	-9.896***	-10.724***
	(3.030)	(3.161)	(3.744)	(3.663)
Sample size	77,556	71,246	29,892	68,164
Probabilities and hours of inpatient/outpatient care usage				
(c) Pr(Outpatient care)	0.000	-0.006	0.014	-0.014
	(0.021)	(0.782)	(0.584)	(0.023)
(d) Pr(Inpatient care)	-0.023	-0.025	-0.009	-0.023
	(0.018)	(0.179)	(0.710)	(0.020)
(e) Number of days outpatient care usage	0.167	0.175	0.163	0.338
	(0.709)	(0.703)	(0.706)	(0.806)
(f) Number of days inpatient care usage	-0.109	-0.135	-0.084	-0.156
	(0.144)	(0.147)	(0.169)	(0.160)
Probabilities of suffering from self-reported health conditions				
(g) 1 if suffers from back problem	0.009	0.007	0.018	0.008
	(0.009)	(0.010)	(0.012)	(0.010)
(h) 1 suffers from skin problem	0.000	-0.000	-0.002	-0.001
	(0.003)	(0.003)	(0.004)	(0.003)
(i) 1 if suffered stroke	0.009	0.006	0.004	0.008
	(0.007)	(0.007)	(0.009)	(0.008)
(j) 1 if suffered heart attack or other heart issues	0.003	-0.009	-0.009	-0.005
	(0.018)	(0.019)	(0.023)	(0.020)
(k) 1 if suffers from hypertension/high blood pressure	0.01	0.004	-0.007	0.001
	(0.014)	(0.015)	(0.018)	(0.015)
(l) 1 if suffers from diabetes	0.017	0.016	0.029**	0.024**
	(0.010)	(0.011)	(0.014)	(0.012)
(m) 1 if suffered bronchitis and other respiratory conditions	0.001	0.006	-0.009	0.006
	(0.011)	(0.011)	(0.013)	(0.012)
Observations	24,974	22,983	8,627	22,118

Notes: Standard errors (robust to heteroskedasticity in the linear probability model) are in parenthesis. The same set of control variables are included as those listed in the notes of Table 4. *** Significant at 1%; ** significant at 5%; * significant at 10%.

Using difference-in-differences estimators, comparing the various outcomes of those in England and Wales with those in Scotland, we find that the Scottish policy reduced the probability of receiving informal care by 2.8 percentage points, which amounts to a decrease of about 18.2% relative to the pre-treatment period. Regarding the impact on the number of hours per week of informal care, the estimated reduction is approximately 1.6 hours per week. We found the policy effects to be heterogeneous. In particular, women and those aged 75 and above were more likely to experience a reduction in the amount of informal care received, both at the intensive and extensive margins.

Our subsequent analysis shows that, despite the substitution of the types of personal care from informal to formal care, the various health outcomes of those that are likely to be receiving care did not change significantly. We, on occasion, find an improvement in the health outcomes for female recipients aged 75 and above, i.e. the group of individuals most likely to have experienced the switching. Therefore, our results suggest that informal and formal personal home care are at least comparable to each other on average. However, in some instance the latter improves the health outcomes of the care recipients.

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