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Magdalena A. Stroka

The Mental and Physical Burden of Caregiving

Evidence from Administrative Data

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Technische Universität Dortmund, Department of Economic and Social Sciences
Vogelpothsweg 87, 44227 Dortmund, Germany

Universität Duisburg-Essen, Department of Economics
Universitätsstr. 12, 45117 Essen, Germany

Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI)
Hohenzollernstr. 1-3, 45128 Essen, Germany

Editors

Prof. Dr. Thomas K. Bauer
RUB, Department of Economics, Empirical Economics
Phone: +49 (0) 234/3 22 83 41, e-mail: thomas.bauer@rub.de

Prof. Dr. Wolfgang Leininger
Technische Universität Dortmund, Department of Economic and Social Sciences
Economics – Microeconomics
Phone: +49 (0) 231/7 55-3297, email: W.Leininger@wiso.uni-dortmund.de

Prof. Dr. Volker Clausen
University of Duisburg-Essen, Department of Economics
International Economics
Phone: +49 (0) 201/1 83-3655, e-mail: vclausen@vwl.uni-due.de

Prof. Dr. Christoph M. Schmidt
RWI, Phone: +49 (0) 201/81 49-227, e-mail: christoph.schmidt@rwi-essen.de

Editorial Office

Sabine Weiler
RWI, Phone: +49 (0) 201/81 49-213, e-mail: sabine.weiler@rwi-essen.de

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Magdalena A. Stroka[1]

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Abstract

This study evaluates the mental and physical strain experienced by informal caregivers. Econometric problems due to individuals selecting themselves into informal care provision are tackled by using informative and detailed data from the largest sickness fund in Germany and applying propensity score matching techniques. The findings suggest that carers take more psychoactive drugs as well as analgesics and gastrointestinal agents. Thus, informal caregiving appears to be a burdensome task with implications for both mental and physical health.

JEL Classification: I10

Keywords: Informal care; burden; drugs; propensity score matching

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1 Introduction and Literature Review

Because of rapid developments in medicine and medical technology, chronically, physically and mentally impaired elderly live longer after the onset of illness. The rising life expectancy in general cause an increasing old-age dependency ratio which contributes to rising care prevalence rates (OECD, 1998). These developments are socially and economically challenging. Apart from the ongoing discussions on the need to improve the quality of formal care and to undertake efforts to avoid dramatic increases of public spendings on long-term care services, the role of informal carers is also receiving significant public attention.

The vast majority of long-term care required by impaired people is provided by family and friends. In Germany, 45.6% of all 2.3 million people in need of care were solely attended by informal caregivers in 2009. Another 23.7% of the dependent persons received out-patient care by formal care services partly combined with care services provided by family and friends (Statistisches Bundesamt, 2011). As informal care is the relatively cheaper way of care provision for long-term insurance systems, legal care regulations emphasize the importance of informal caregivers to relieve public budgets (Jenson and Jacobzone, 2000). Even though informal caregivers can receive financial compensations for the provision of care services, care laws usually do not consider the opportunity costs resulting from forgone earnings due to decreased working hours or termination of labour supply, as well as decreased productivity, forgone pension entitlements and loss of specific human capital due to the provision of care. Another disregarded cost aspect results from the health effects due to the strain in providing informal care as the carers' burden can lead to mental and physical morbidity.

While there is strong consensus in the medical and epidemiological literature that the provision of informal care is burdensome and stressful to the caregivers and contributes to mental as well as physical morbidity with potentially detrimental consequences,[1] there appears to be less evidence in the economic literature. However, the economic

[1] Examples for evidence of the mental burden are given e.g. in Schulz et al. (1995); Becker and Ichino (2002); Stephens et al. (2001). Especially depression and other symptoms of psychological distress are considered as major consequences of care giving (Gallicchio et al., 2002; Tennstedt, Cafferata, and Sullivan, 1992; Beach et al., 2000). Furthermore, recent studies indicate that informal care provision is associated with poor physical health outcomes in addition to the adverse mental health (Ho et al., 2009). It has been shown that caregivers are at increased risk for developing hypertension (Yip, 1998) and cardiovascular diseases (Lindley et al., 1992). However, the empirical strategy of the existing studies is limited to descriptive comparisons and multivariate regressions.

perspective is important as a comprehensive discussion about efficiency in long-term care requires knowledge of the full costs of informal caregiving. Therefore, this paper analyses the question whether there are some costs so far inadequately discussed in the public debate that render informal care provision not as economic as often expected. This could be the case if, e.g. informal care provision goes along with mental or physical health impairments of the informal carers. Other costs include forgone income or human capital for those who leave the labour force in order to provide informal care. However, the latter costs are not considered in this paper.

The growing economic interest on the health effects of care provision is documented by Bobinac et al. (2010), Leigh (2010), Coe and Van Houtven (2009), Van den Berg and Ferrer-i-Carbonell (2007), Van Houtven, Wilson, and Clipp (2005), Do et al. (2013), Schmitz and Stroka (2013) as well as Schmitz and Westphal (2013). While Bobinac et al. (2010) provide evidence on a negative effect of informal caregiving on well-being, Leigh (2010) confirms the negative effect of caregiving on life satisfaction only when using cross-sectional data but does not find any significant effects in a panel data analysis. Coe and Van Houtven (2009) report negative effects on carers' mental health and predominantly insignificant results regarding physical health outcomes. This result is confirmed by Schmitz and Westphal (2013), who analyse the short- and long-term health effects of caregiving and suggest that there are short-term effects on mental health which, however, fade out over time. In contrast, Do et al. (2013) suggest that there is an increased probability of worsened physical health for caregivers caused by the provision of informal care. Van den Berg and Ferrer-i-Carbonell (2007) estimate the monetary value of informal care based on the impact that providing care has on individual well-being. According to their calculations, an extra hour of informal care should be compensated by about € 10 to maintain the same level of well-being. Van Houtven, Wilson, and Clipp (2005) assess the impact of caring on the intake of drugs. One finding is that the extesive care margin is an important factor determining drug intake. This result is confirmed by Schmitz and Stroka (2013). They focus on the double burden resulting from working full-time and the provision of informal care and find evidence for an impaired mental health and a rising health impairment in case of higher care intensity. This paper goes beyond the focus on the working population and considers the carer's burden in all population groups.

Identification of the health effects of care provision, however, comes with particular challenges. The first challenge is the data, which should provide individual information on reliable health outcomes, care responsibilities as well as socio-economic characteristics. It is argued below that the administrative data from the Techniker Krankenkasse (TK), with very detailed information on more than 5.2 million person-year observations from 2007 to 2009, can be used for such an analysis. The second challenge comes from individual self-selection into informal care provision. For example, if individuals in good health conditions choose to provide care for their family and friends, then a comparison of the health outcomes of individuals with and without care responsibilities will not be informative about the casual care effect. The fact that selection into caregiving is not random causes selection bias, which is intended to be solved by conditioning on observable variables that represent the confounding factors, i.e. propensity score matching techniques are employed to make carers and non-carers comparable.

Given the underlying research question and identification strategy, this paper intends to make a twofold contribution to the literature. The first goal is to learn more about the care burden using administrative data from the TK with its wealth of information. There are three important aspects of the data. First, the analysis is based on claims data generated by experts of health such as physicians. This goes along with obvious advantages of this data set resulting from its accuracy and reliability (i.e. compared to self-reported measures of individuals' health). Because the data generation results from billing processes, there is little measurement error both with respect to health outcomes and socio-economic characteristics. Second, in contrast to all previous studies, the data set is very large. Hence, the estimates are more precise. Finally, this study builds on prior research by using more recent data.

The second and main goal of the study is to uncover the mental and physical health effects of care provision while controlling for selection bias. The mental and physical health status is measured in prescribed amounts of certain drugs while differentiating between the care provision for dependent persons with certain levels of care severity. Particularly, this analysis aims at quantifying the effect of caregiving for dependent persons in certain care levels on the amount of prescribed antidepressants,

tranquilizers,[2] analgesics, cardiac and gastrointestinal agents in the course of a year. While the consumption of antidepressants and tranquilizers reflects mental well-being, the other drugs shed light on the physical health status. Considering the precisely measured amounts of prescribed drugs instead of diagnoses allows me to account for the severity of certain diagnoses. Apart from the study by Schmitz and Westphal (2013), propensity score techniques were not applied so far in analyses of the health effect of informal care provision.

The findings from the empirical analysis suggest that caregiving has a negative health effect on both the mental and physical health. What is more, the impact on the carers' mental health increases with the severity of impairment of the cared person measured by care levels.

In the following, Section 2 describes the data set and reports the relevant descriptive statistics for carers and non-carers. Following the empirical strategy of constructing a balanced sample of carers and comparison individuals without care responsibilities, Section 3 discusses the estimation of a propensity score equation, before the results of a variety of matching algorithms are presented in Section 4. Section 5 provides a sensitivity analysis. The paper concludes in Section 6. The appendix documents some data related issues.

2 Data

The empirical analysis is based on data for the period 2007-2009 provided by the TK, which is the largest statutory sickness fund in Germany with more than eight million insured. Like all other sickness funds, the TK collects administrative and claims data on their insured persons. From the large pool of these data, the underlying sample is based on the basic claims data with general socio-economic information as well as detailed information on prescriptions, diagnoses, care dependency and informal care provision.

The available data include, among others, very detailed information on ascertained diagnoses and prescribed drugs. The latter are measured in daily defined doses (DDDs) and are identified using the anatomical therapeutic chemical (ATC) classification. Five different types of drug consumption are considered in this paper, i.e. the yearly sums of

[2] Specifically, this group is "tranquilizers, sedatives and hypnotics", but in the following it is referred to as tranquilizers for brevity.

prescribed DDDs of antidepressants (ATC: N06A), tranquilizers (ATC: N05B, N05C), analgesics (ATC: N02), cardiac (ATC: C01, C10) and gastrointestinal (ATC: A02-A07, A09) agents.

The information on certain diagnoses is measured dichotomously and equals one if an International Classification of Diseases (ICD-10) code indicating a certain disease is diagnosed at least once either in the out-patient or in-patient health service field in the considered year. The analysis includes diseases of the liver (ICD-10: K70-K77), disorders of thyroid gland (ICD-10: E00-E07), stroke (ICD-10: I61, I63, I64), invasive neoplasms (ICD-10: C00-C97), diseases of the digestive system (ICD-10: K00-K93) and Parkinson's disease (ICD-10: G20-G22).

These disease variables control on the one hand for the general health status of the individuals. On the other hand they also control for diseases that go along with certain drug consumption as diseases of the liver and disorders of thyroid gland can cause depressive symptoms and might lead to prescriptions of antidepressants (Berkman et al., 1986; Gulseren et al., 2006). Further control variables include the number of hospitalizations, achieved education degree, work position and general socio-economic outcomes like gender, age and information on employment.

The variable of primary interest is the carer variable, indicating whether a person provides informal care services to an impaired person or not. This information is available in the data since sickness funds act as both health and long-term care insurance at once and pay legally determined care allowances to informal caregivers. Hence, caregivers have to be reported to the sickness fund to get the allowances that are supposed to compensate their care efforts. This makes it possible to identify informal caregivers in the data and link them to further individual information of these persons as well as to information regarding the care recipients.

This paper does not only concentrate on carers of elderly impaired people but also on people caring for dependent persons of all ages as the burden might occur regardless of the dependent person's age. While parents usually provide care services to their young dependent children, adult children are likely to care for their frail elder parents. People in the middle and old ages are also likely to be the caregivers of their high-maintenance partners or spouses. As the data also includes information on the care level of the dependent person, the variable on the care provision can be broken down in variables

indicating care provision for a person in a certain care level. In Germany, care recipients are classified into three care levels by the Medical Review Board of the Statutory Health Insurance Funds. While care level 1 goes along with nursing needs of on average at least 90 minutes per day, care level 2 includes on average at least 180 minutes of daily nursing needs. Care level 3 is the most severe care level, indicating average daily care exceeding 300 minutes. Since the care level of some care recipients are missing in the data, a variable indicating care provision to dependent persons with an unknown care level is also included.

One issue in the data is that individuals are identified as caregivers only if they provide care to family members who are also insured by the TK. However, it is possible that members of one family are insured by different health insurance companies. In fact, only 0.25% of the individuals in the underlying sample are identified as caregivers while one would expect a higher number, since about 1.25% of the German population receive informal care (Statistisches Bundesamt, 2011). Thus, a considerable amount of individuals is potentially assigned into the control group "no care provision" although they are informal caregivers. This is considered to be a minor problem only as the relative number of caregivers that is mistakenly put into the control group is negligible small compared to those who indeed do not provide informal care services. Hence, the caregivers mistakenly included in the control group should not affect the obtained results. If it does affect the results and if care provision goes along with worse health, this would lead to a possible underestimation of the true relation (in absolute values). The total number of 7,634 identifiable caregivers is still much larger than in studies that rely on data obtained in interviews.

The analysis is based on adult individuals who are at least 35 years old and live in Germany since younger individuals usually do not provide care in Germany and the prescriptions as well as diagnoses information on insured persons living abroad might suffer from incompletion.[3] As a further restriction, observations above the 99th percentile of the dependent variable are excluded in order to reduce the risk that outliers drive the results.[4] After applying the mentioned restrictions, the data covers

[3] Due to the fact that the outcome variables are measured on a yearly basis, observations on individuals not observed throughout a complete year are excluded to avoid any measurement bias.
[4] However, the results are robust to not trimming the data.

5,224,552 person-year observations resulting from 2,049,624 individuals observed for a maximum of three years.

Table 1 displays some descriptive statistics for carers and non-carers of the pooled sample including all variables used in the empirical analysis. Detailed definitions of all variables used are provided in Table 7 in the appendix. Overall, individuals who care for an impaired person take on average more DDDs of all considered drugs compared to individuals without care responsibility es. Noteable differences of the means can be observed regarding the pensioner status as well as unemployment and part-time employment. The higher share of part-time employees in the group of carers is not surprising given that care responsibilities are limited by the individuals' time and energy. In this regard, part-time jobs obviously can be better combined with care tasks. Furthermore, caregivers in general show slightly worse health outcomes concerning certain diseases.

Table 1 about here.

3 Empirical Strategy

This paper seeks to estimate the average effect of treatment on the treated (ATT), i.e. the average effect on mental and physical health, measured using drug consumption among those who care for an impaired person. The ATT indicates how treated persons (i.e. carers) have fared relative to a counterfactual situation in which these individuals would have not been treated. It is defined as:

$$E\,(Y_1 - Y_0 | T = 1) \tag{1}$$

where T indicates a binary variable describing the treatment status: specifically T = 1 if the subject is an informal caregiver in the considered year, and T = 0 otherwise.

Because care provision histories are not subject to random assignment, the analysis rests primarily on the conditional independence assumption (CIA) also referred to as "selection-on-observables" (Heckman and Robb, 1985). This assumption states that:

$$Y_0 \perp T \,|W \tag{2}$$

where W is a set of observable variables. It corresponds to the assumption that after conditioning on a set of observable covariates, potential health outcomes would be the same for those who care and those who do not care for impaired persons. The extensive information on personal characteristics included in the underlying data set covers the necessary range of observables to render this empirical strategy viable.

The overlap or common support assumption is given by:

$$Pr\,(\mathrm{T} = 1|\mathrm{W}) < 1. \tag{3}$$

This assumption requires that, for each treated unit, there are control units with the same W. Hence, under the CIA and overlap condition, the ATT can be identified as:

$$\begin{aligned} E\,(\mathrm{Y}_1 - \mathrm{Y}_0|\mathrm{T} = 1) &= E\,(E(\mathrm{Y}_1 - \mathrm{Y}_0|\mathrm{T} = 1, \mathrm{W})) \\ &= E\,(E(\mathrm{Y}_1|\mathrm{T} = 1, \mathrm{W}) - E\,(\mathrm{Y}_0|\mathrm{T} = 0, \mathrm{W})|\mathrm{T} = 1). \end{aligned} \tag{4}$$

In order to identify the ATT, a relatively small number of observations of carers (13,466 person-year observations) is compared to a much larger number of observations of non-carers (5,211,086 person-year observations) by applying the propensity score method. This methods extracts a control group from the whole sample of non-carers in which the distribution of covariates is similar to the distribution in the treatment group. This selection of the group of controls is done through a two-step procedure. In the first stage, a logit model is used to estimate the conditional probability of being a caregiver given a vector of observed covariates which may affect the probability of being a caregiver. The estimated conditional probability is the propensity score, which is used in the second step, where each carer is matched to a non-carer that has the closest propensity score. This matching procedure can be performed using different matching algorithms, i.e. the kernel, radius and nearest-neighbor matching with and without replacement, with an emphasis on their ability to ascertain the desired balancing.

While in small samples the choice of the matching approach may be important (Heckman, Ichimura, and Todd, 1997), with growing sample sizes all matching approaches become closer to exact matching and should yield asymptotically the same result (Smith, 2000). A caliper of width 0.00001 is used in the nearest-neighbor and radius matching, and a bandwidth of 0.000001 in the kernel matching algorithm. With the fairly strict caliper and bandwidth, it is possible to require a high degree of

observational similarity between treatment and control cases and still find matching control cases for the treatment cases. Nevertheless, all other variations on these themes (regarding the caliper and bandwidth) generate very similar results.[5] Since the literature suggests gender differences in the provision of informal care (see e.g. Szinovacz and Davey, 2004) separate regressions are carried out for women and men. The underlying samples used in the matching approach are trimmed to those observations that lie on the common support.

To shed light on the question whether the mental and physical impact on the caregivers increases with the severity of impairment of the cared person, the ATT for carers of individuals in certain care levels are estimated in separate models (i.e. including only individuals caring for persons in either care level 1, 2 or 3 in the treatment and non-carers in the control groups). The estimation procedure is the same as in the basic model described above taking observable covariate differences into account. However, since only carers of dependent persons in a certain care level are considered and compared with non-carers, the sample sizes vary due to the exclusion of the carers of dependent persons in other care levels.

As an extension of the analysis, difference-in-differences propensity score matching is applied. This strategy eliminates any time-invariant differences between the treatment and the control group and thereby allows for selection on both observed characteristics as well as unobserved characteristics that are constant over time (Heckman, Ichimura, and Todd, 1998). However, as care-giving episodes often extend over a long period of a person's life (see e.g. Henz, 2004) difference-in-differences comparisons are not appropriate in case of the underlying data of a relatively short period of time (2007-2009) as they measure only the short-run effects after the take-up of care provision. In the underlying data the majority of carers (about 40%) are observed as such in all of the considered three years. Hence, the majority of long-term carers – that nurse their relatives already for years – is excluded and disregarded in this kind of analysis. Due to these limitations of the difference-in-differences propensity score matching given the underlying question, this method is not considered as the main empirical strategy. Instead, it is regarded as an additional analysis of the health effects at the beginning of

[5] In particular, smaller values (from 0.001 onwards) of caliper and bandwidth, respectively, were considered.

caring episodes (as it identifies the effects only at the take-up of care responsibilities). In addition, it serves as a robustness check.

In case of the difference-in-differences propensity score matching, the estimation procedure of the ATT is analogous to the simple propensity score matching. However, instead of considering the pooled data from 2007 to 2009, the years 2008 and 2009 are considered and outcomes that represent differences of the prescribed DDDs in 2009 and 2008 are included in the analysis. While 2008 serves as the "pre-treatment year", 2009 serves as the "treatment year" and the estimation of the propensity scores is based on the conditional probability of being a caregiver in 2009 given the characteristics in 2008. All included individuals are non-carers in the pre-treatment period 2008.

4 Results

Matching Quality

As the propensity score matching can only lead to credible estimates of the effects of treatment if the desired balancing of observable covariates is achieved, standard t-tests for equality of means in the treatment and comparison groups, after matching on the scores, were performed for every specification. Table 2 demonstrates that this approach is very successful in this regard, leading to a complete covariate balance.[6]

Table 2 about here.

A final check of the quality of the matching procedure comes from a comparison of the distribution of the propensity scores of the carers and non-carers. As Figures 1 and 2 show, there are no common support problems. There are many controls for each carer within small intervals of the estimated propensity scores. Overall, the distribution of the matched non-carers resembles the distribution of carers, and there is thus an overlap in the estimated propensity scores. Hence, it can be concluded that the propensity score approach works very well.

Figures 1 and 2 about here.

[6] The results from the t-tests for equality of means in the treatment and comparison groups after matching for certain care levels or after the difference-in-differences propensity score matching are not presented in the interest of brevity. However, in these subsamples complete covariate balances were achieved as well.

Matching Results

The estimate of the effect of care provision on mental and physical health is based on a comparison of the drug intake of carers and non-carers. Table 3 provides evidence from all four variations of the propensity score matching on the differences in drug intake between these two groups. While the first four columns of Table 3 report the estimates for males, the last four columns report the results for females. Overall, the matched comparisons tend to confirm the unmatched comparisons quite closely. The intakes of antidepressants, tranquilizers, analgesics and gastrointestinal agents are higher for carers than for non-carers. The differences are substantial and amount, in the case of antidepressants, up to 7 DDDs per year for women. Hence, care provision goes along with an antidepressant intake increase by almost 80% (see Table 1), such that the economic significance of the results is high. While the point estimates of the effect of caregiving on antidepressants intake by females tend to be slightly smaller in absolute values when employing other matching techniques than the nearest-neighbor with replacement, overall the results are robust, both quantitatively and qualitatively.

Table 3 about here.

In the next step, the effects of caring for dependent persons in certain care levels compared to non-carers are considered. The results reported in Table 4 are limited to antidepressants and tranquilizers. The other specifications mostly did not reveal significant differences across care intensities. The effects for antidepressants and tranquilizers increase and gain significance the higher the care level is. Considering antidepressants, in the most severe care level, the effect is twice as high compared to the lowest level. Accordingly, carers of impaired persons in care level 3 consume on average about 8-10 DDDs more of antidepressants per year than non-carers.

Table 4 about here.

The difference-in-differences propensity score approach confirms the positive effects regarding antidepressants and tranquilizers for both sexes. As documented in Table 5, the results for all other drugs are insignificant when using this approach. Moreover, the point estimates for the psychoactive drugs are overall higher in the difference-in-differences propensity score approach. As this approach concentrates on the health effects at the beginning of the caregiving episodes which usually extend over some years, this result shows that informal caregiving goes along with mental strain from the

start of the episode. In contrast, physical health appears not to be affected at the beginning of the caring episode.

Table 5 about here.

In order to get an idea of the results in terms of costs from the payer's perspective (the insurance companies), a back-on-the-envelope calculation is performed focusing on antidepressants and extrapolating the results to the entire German population. In a subsample of TK insured in 2009, the average price for one DDD of antidepressants amounts to € 0.81 (the standard deviation is 0.77 and the price range goes from € 0.17 to € 6.35). As it is well documented in the literature that most caregivers are female (see e.g. Miller and Cafasso, 1992), I concentrate on the results for females and consider the results from the propensity score matching without the differentiation of the care levels. Taking the lowest obtained result for women (3.73 DDDs) and multiplying it by all informal caregivers in Germany in 2009 (1,620,762), the costs resulting from the higher antidepressant intake are almost € 5 million.[7] Note that only the number of dependent persons who are solely cared by their family and friends is considered in this calculation. However, another 555,198 dependent person received out-patient care by their family and friends and/or formal care services.

Although the administrative data set has many advantages, it did not allow to address some problems. One problematic issue in the analysis is that the caregiver's health may be affected by both the provision of care and the fact that a loved person is impaired. In the latter case, health outcomes could be affected by the mental strain even if no care service is provided by oneself to the impaired person. This would lead to an overestimation of the effect (Schmitz and Stroka, 2013).

5 Sensitivity Analysis

As mentioned above, the estimation of treatment effects with matching estimators is based on the CIA. Thus, if the treated and non-treated differ in unobserved characteristics, the results reported above may be biased. This potential problem is addressed with the bounding approach proposed by Rosenbaum (2002). This approach

[7] Calculation: 3.73 DDD* € 0.81 per DDD*1,620,762 informal carers = € 4,896,808. As the estimated effects for men are only slightly lower, the calculated amount of costs should not change significantly when taking male carers into account.

calculates upper and lower bounds on the test statistics used to test the hypothesis of no care effect for different values of hidden bias, i.e. it determines how strongly an unobserved variable must influence the selection process in order to undermine the implications of the matching analysis. Table 6 presents the bounding results for the propensity score giving the outcome of the p-values from the Wilcoxon sign-rank test for the ATT, while setting the level of hidden bias to a certain value Γ.[8] The parameter Γ reflects the assumption about hidden bias in treatment assignment. At each Γ, a hypothetical significance level is calculated, which represents the bound on the significance level of the treatment effect in case of hidden bias. By comparing the Rosenbaum bounds on treatment effects at certain levels of Γ it is possible to assess the strength that the unmeasured heterogeneity or endogeneity would require so that the obtained effects from the matching analysis would have arisen solely through selection effects.

Table 6 shows that the robustness to hidden bias varies considerably across the outcome variables. While the results regarding antidepressants and tranquilizers are very robust to hidden bias, this is not the case considering analgesics and gastrointestinal agents. In the case of antidepressants, the statistics imply that at Γ=1.40 in case of males and Γ=1.35 in case of females, the treatment effect is no longer statistically significant at p=0.05. For tranquilizers, this is the case at an even higher Γ. The value is not even shown in the table as it lies at Γ=1.70 in case of males and at Γ=1.55 in case of females. The large values of Γ in case of antidepressants and tranquilizers suggests that, having matched on observed covariates, the unobserved confounding variable would have to increase the likelihood of treatment by around 40% or 35% depending on the sex in the case of antidepressants and by around 70% or 55% depending on the sex in the case of analgesics. Regarding analgesics and gastrointestinal agents, the statistics imply for both males and females that at Γ=1.10 the treatment effects are no longer statistically significant at p=0.05.

Table 6 about here.

[8] Due to reasons of brevity no bounds are calculated for the additional models regarding certain care levels or the difference-in-differences propensity score matching.

6 Discussion

This paper uses the propensity score matching approach to empirically compare the drug intake of carers and non-carers, taking observable covariate differences into account. The relationship between health and care provision is assessed by exploiting a rich data set with comprehensive information on various health outcomes. The empirical analysis for Germany, a country that is the largest in Europe with a pronounced social security system, and subject to a strong demographic change, reveals that both female and male carers seem to have a higher drug intake of antidepressants, tranquilizers, analgesics and gastrointestinal agents. The effects on the mental health even increases with the care severity of the dependent individuals. However, this is not the case regarding physical health.

Additional analyses for the short-run effect after take up of informal care responsibilities show negative effects regarding antidepressants and tranquilizers. Thus, it appears that informal caregiving is mentally burdensome from the beginning whereas the physical burden seems to occur in case of longer caring-episodes. However, in the case of cardiac agents, no significant results could be found at all, showing clearly that care provision does not affect the heart condition. These results are in line with Coe and Van Houtven (2009), who find evidence for immediate negative effects on carers' mental health and negative effects regarding physical health only in the long run. As shown by Schmitz and Stroka (2013), the mental health effect is boosted if individuals work full-time in the labor market.

The German government recently acknowledged that a realignment of the care system is necessary. This analysis contributes to the current debate on how to realign the care system in Germany and countries with similar demographic developments. Certainly, this paper does not postulate that informal home care should be fully replaced by professional care due to increased drug intake of caregivers. This paper does not provide a full cost-benefit analysis of different types of care to decide which one is the best from an economic perspective. However, one should note that the results suggest that the costs for informal family care are higher than usually assumed.

Figures

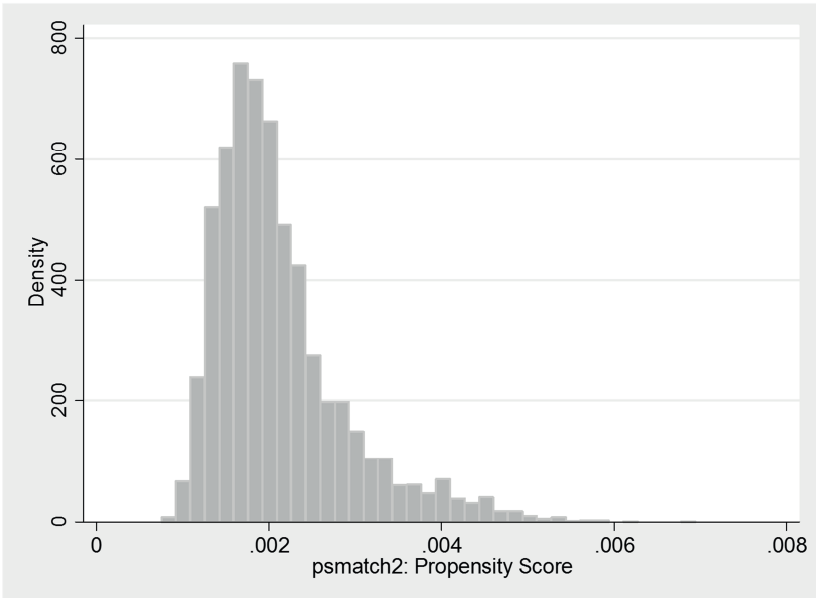

Figure1: Density Distribution of the Propensity Score: Treated Males (Kernel)

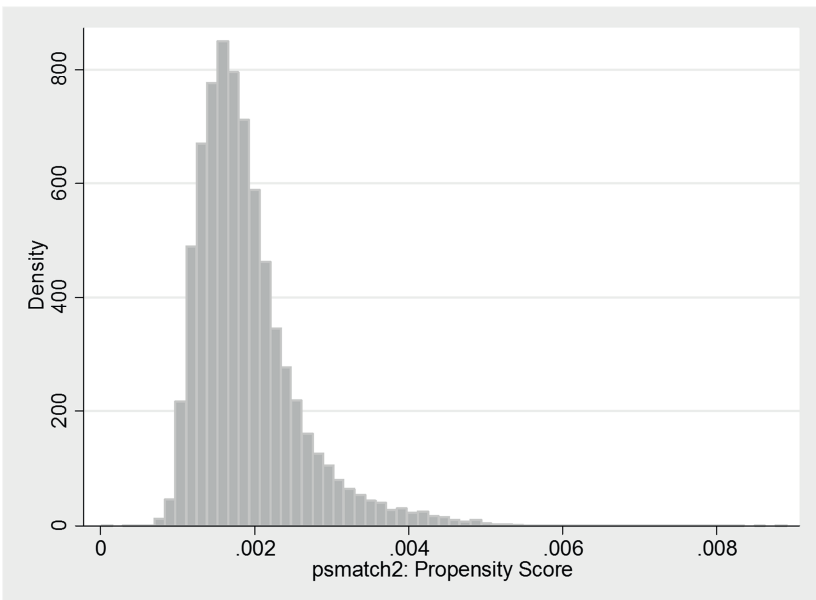

Figure2: Density Distribution of the Propensity Score: Untreated Males (Kernel)

Tables

Table 1: Descriptive Statistics

	Carer		Non-Carer	
Variable	Mean	Std.Dev.	Mean	Std.Dev.
Dependent variables:				
Antidepressants	14.926	(73.768)	9.243	(58.959)
Tranquilizers	1.823	(16.437)	0.909	(11.768)
Analgesics	3.363	(23.516)	2.054	(16.747)
Antihypertensives	96.894	(274.968)	91.598	(276.570)
Cardiac agents	15.989	(78.390)	15.506	(80.644)
Gastrointestinal agents	17.789	(78.390)	14.413	(68.906)
Independent variables:				
Information on care provision				
Care provision (all care levels)	1.000	(0.000)		
Care provision to person in care level 1	0.240	(0.427)		
Care provision to person in care level 2	0.209	(0.407)		
Care provision to person in care level 3	0.096	(0.295)		
Care provision to person in unknown level	0.454	(0.498)		
Socio-economic characteristics				
Female	0.557	(0.497)	0.400	(0.490)
Age	48.944	(7.858)	47.650	(7.672)
Foreign nationality	0.022	(0.146)	0.027	(0.161)
Employment				
Part-time employed	0.370	(0.483)	0.220	(0.414)
Self-employed	0.002	(0.046)	0.003	(0.059)
Unemployed	0.030	(0.170)	0.022	(0.146)
Temporaray unemployed	0.025	(0.155)	0.030	(0.171)
Pensioner	0.032	(0.175)	0.020	(0.142)
Education				
No educational achievemen	0.063	(0.242)	0.050	(0.217)
University degree	0.292	(0.455)	0.313	(0.464)
Work position				
Apprentice				
Blue-collar worker	0.036	(0.187)	0.047	(0.212)
Craftsman	0.053	(0.224)	0.077	(0.266)
Master craftsman	0.017	(0.129)	0.027	(0.161)
White-collar employee	0.522	(0.500)	0.629	(0.483)
Health status				
Number of hospitalizations	0.127	(0.596)	0.117	(0.476)
Diseases of the liver	0.073	(0.260)	0.065	(0.247)
Disorders of the thyroid gland	0.199	(0.399)	0.156	(0.363)
Stroke	0.006	(0.081)	0.006	(0.075)
Invasive neoplasms	0.057	(0.232)	0.051	(0.220)
Diseases of the digestive system	0.075	(0.263)	0.066	(0.248)
Parkinson's disease	0.001	(0.034)	0.001	(0.003)
Observations	13,466		5,211,086	

Table 2: Covariate Balance – Individual t-Test

			Males					Females		
Variable	Unmatched	Kernel	Radius	NN with Repl.	NN without Repl.	Unmatched	Kernel	Radius	NN with Repl..	NN without Repl.
Socio-economic characteristics										
Age	17,71***	1,58	-0,11	0,07	0,05	16.28***	0.46	-0.26	0.28	0.29
Foreign nationality	-1,39	0,91	0,18	0,36	0,36	-3.55***	1.02	0.18	-0.12	-0.06
Employment										
Part-time employed	15,70***	1,33	1,14	-0,25	-0,22	21.78***	-0.93	0.08	-0.28	-0.28
Self-employed	-1,33	0,14	0,22	-0,33	-0,33	-1.88*	0.32	0.25	0.21	0.21
Unemployed	3,03***	-0,16	-0,17	-0,23	-0,23	4.71***	1.26	0.53	-0.5	-0.5
Temporaray unemployed	1,42	0,24	-0,05	0,35	0,35	3.41***	1.03	-0.24	-0.23	-0.23
Pensioner	10,51***	-0,54	1,29	0,09	0,09	4.83***	0.20	0.86	0.12	0.06
Education										
No educational achievemen	2,71***	1,87	0,05	0,42	0,42	4.49***	0.50	0.13	0.16	0.16
University degree	3,51***	-1,13	-0,38	-0,07	-0,09	-3.46***	-0.66	-0.59	-0.08	-0.06
Work position										
Learner	1,48	-0,13	0,14	-0,26	-0,26	0.02	0.6	0.06	0.00	0.00
Blue-collar worker	-2,45***	0,77	-0,37	0,59	0,59	-2.55***	0.93	-0.22	0.16	0.16
Craftsman	-4,06***	0,62	0,47	0,19	0,19	-2.54***	0.2	0.76	0.31	0.31
Master craftsman	-3,07***	0,42	-0,44	-0,2	-0,2	0.24	0.12	-0.14	0.87	0.87
White-collar employee	-3,55***	-0,14	-0,76	-0,12	-0,14	-20.00***	0.54	-0.21	0.07	0.07
Health status										
Number of hospitalizations	0,32	1,13	0,05	0,62	0,62	2.42***	1.13	0.38	2.01	1.98
Diseases of the liver	3,57***	0,65	0,17	-0,03	-0,06	5.60***	0.27	0.44	0.35	0.39
Disorders of the thyroid gland	3,94***	0,56	-0,09	-0,45	-0,48	3.09***	-0.34	1.59	-0.24	-0.26
Stroke	2,65***	0,90	0,18	0,67	0,77	0.17	0.83	0.01	1.26	1.26
Invasive neoplasms	0,86	1,64	0,04	-0,04	-0,04	1.79*	0.45	0.3	0.37	0.34
Diseases of the digestive system	3,97***	0,67	0,16	0,22	0,19	5.57***	0.17	0.6	0.55	0.55
Parkinson's disease	1,20	0,50	0,05	1,39	1,39	1.63	0.87	0.15	0.28	0.28
Year	-11,42***	0,75	1,09	-0,10	-0,10	-13.49***	0.16	0.28	0.02	0.02

Notes: Significant at ***: 1% level; **: 5% level; *: 10% level.

Table 3: Treatment Effect of Care Provision

	Effects for Males				Effects for Females			
	Kernel	Radius	NN with Repl.	NN without Repl..	Kernel	Radius	NN with Repl.	NN without Repl.
Antidepressants	5.05***	4.87***	1.02	5.52***	3.93***	3.73***	7.14**	4.11***
	(5.52)	(5.33)	(0.37)	(4.94)	(4.46)	(4.23)	(2.37)	(3.50)
Tranquilizers	0.66***	0.65***	0.73	0.47*	0.82***	0.79***	0.96	0.86***
	(3.47)	(3.38)	(1.00)	(1.69)	(3.99)	(3.87)	(1.54)	(3.43)
Analgesics	1.26***	1.21***	1.71**	1.41***	0.87***	0.83***	0.30	0.67*
	(4.39)	(4.18)	(2.26)	(4.24)	(3.06)	(2.94)	(0.29)	(1.81)
Cardiac agents	-0.68	-1.07	-0.27	-1.66	0.64	0.48	-1.50	-0.62
	(-0.53)	(-0.84)	(-0.05)	(-0.88)	(0.99)	(0.75)	(-0.56)	(-0.66)
Gastrointestinal agents	3.43***	3.02***	3.32	4.53***	2.10**	2.03**	-1.45	2.93***
	(3.04)	(2.68)	(0.86)	(3.09)	(2.52)	(2.43)	(-0.48)	(2.65)
Untreated on support	3,125,140	3,125,140	3,125,140	3,125,140	2,085,946	2,085,946	2,085,946	2,085,946
Treated on support	5,696	5,696	5,696	5,696	7,492	7,495	7,495	7,495

Notes: Significant at ***: 1% level; **: 5% level; *: 10% level; t-values in parentheses.

Table 4: Treatment Effect of Care Provision by Care Level

	Effects for Males				Effects for Females			
	Kernel	Radius	NN with Repl.	NN without Repl..	Kernel	Radius	NN with Repl.	NN without Repl..
Antidepressants								
Care level I	4.54**	4.38**	2.31	3.58	5.02***	4.45***	8.27**	5.36**
	(2.27)	(2.20)	(0.63)	1.40	(2.69)	(2.40)	(2.34)	(2.13)
Care level II	7.75***	7.53***	4.04	6.44**	6.25***	5.90***	7.40**	6.64**
	(3.50)	(3.40)	(1.08)	(2.33)	(2.91)	(2.75)	(1.97)	(2.46)
Care level III	10.46***	10.35***	7.26	8.54*	8.60***	8.33***	10.88**	10.76***
	(2.84)	(2.81)	(1.44)	(1.90)	(2.88)	(2.80)	(2.27)	(2.79)
Unknown care level	3.32***	3.16***	-2.33	3.05**	1.39	1.13	5.33*	3.03*
	(2.78)	(2.65)	(-0.68)	(2.00)	(1.23)	(1.00)	(1.64)	(1.95)
Tranquilizers								
Care level I	0.15	0.12	-0.12	-0.25	1.08**	1.00**	0.75	0.75
	(0.56)	(0.45)	(-0.10)	(-0.41)	(2.28)	(2.11)	(0.77)	(1.21)
Care level II	0.51	0.63	0.78	0.84	0.58	0.64	0.94	0.89*
	(0.91)	(1.09)	(0.96)	(1.29)	(1.33)	(1.42)	(1.24)	(1.65)
Care level III	1.20*	1.17	1.80**	1.53**	2.74***	2.71***	2.80**	2.95***
	(1.65)	(1.61)	(2.31)	(2.00)	(3.01)	(2.99)	(2.19)	(2.76)
Unknown care level	0.81***	0.78***	0.91**	0.89***	0.29	0.26	0.77**	0.59**
	(3.14)	(3.02)	(2.22)	(3.04)	(1.35)	(1.19)	(2.20)	(2.36)

Notes: Significant at ***: 1% level; **: 5% level; *: 10% level; t-values in parentheses. Treated males in care level 1: 145, untreated: 984,439, treated males in care level 2: 69, untreated: 955,328; treated males in care level 3: 110, untreated: 958,760; treated males in unknown care level: 180, untreated: 984,762; treated females in care level 1: 204, untreated: 641,477; treated females in care level 2: 163, untreated: 652,989; treated males in care level 3: 92, untreated: 657,368; treated females in unknown care level: 57, untreated 644,936. All treated and untreated on support.

Table 5: Treatment Effect of Care Provision from Difference-in-Differences Propensity Score Matching

	Effects for Males				Effects for Females			
	Kernel	Radius	NN with Repl.	NN without Repl.	Kernel	Radius	NN with Repl.	NN without Repl.
Antidepressants	6.51***	6.44***	5.97	6.11**	7.79***	7.56***	6.06	7.64**
	(3.06)	(3.03)	(1.42)	(2.14)	(2.71)	(2.63)	(1.18)	(2.17)
Tranquilizers	1.83**	1.76**	2.19**	2.24***	1.98**	1.94*	2.47**	2.47**
	(2.37)	(2.29)	(2.11)	(2.73)	(1.97)	(1.93)	(2.17)	(2.37)
Analgesics	0.02	0.06	-0.17	-0.10	0.69	0.59	-1.08	-0.04
	(0.04)	(0.14)	(-0.14)	(-0.16)	(1.05)	(0.90)	(-0.69)	(-0.04)
Cardiac agents	-0.09	0.03	-1.56	0.63	-0.82	-1.12	-3.04	-2.34
	(-0.04)	(0.01)	(-0.27)	(0.18)	(-0.56)	(-0.77)	(-0.99)	(-1.13)
Gastrointestinal agents	2.31	2.47	1.76	1.98	-4.22	-4.05	-1.47	-3.96
	(0.95)	(1.02)	(0.32)	(0.61)	(-1.66)	(-1.60)	(-0.29)	(-1.17)
Untreated on support	985,448	985,448	985,448	985,448	657,989	657,989	657,989	657,989
Treated on support	502	503	503	503	516	516	515	515

Notes: Significant at ***: 1% level; **: 5% level; *: 10% level; t-values in parentheses.

Table 6: Rosenbaum Bounds

Variable	P-Critical at Γ:														
	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70
Males															
Antidepressan	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.009	0.056	0.203	0.459	0.726	0.900	0.974	0.995
Tranquilizers	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.008	0.028	0.072
Analgesics	<0.001	0.002	0.052	0.315	0.731	0.952	0.996	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000
Gastrointest. agents	<0.001	0.021	0.249	0.734	0.969	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Females															
Antidepressan	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.023	0.094	0.254	0.487	0.718	0.878	0.959	0.989	0.998
Tranquilizers	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.003	0.011	0.031	0.072	0.143	0.247	0.377
Analgesics	0.016	0.126	0.419	0.757	0.940	0.991	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Gastrointes. agents	0.025	0.197	0.578	0.885	0.985	0.999	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Notes: Results for NN with Repl. p-critical is p+

Appendix

Table A1: Definition of variables

Variable	Description
Dependent variables:	
Antidepressants	sum of prescribed DDDs of antidepressants in the considered year
Tranquilizers	sum of prescribed DDDs of tranquilizers. sedatives and hypnotics in the
Analgesics	sum of prescribed DDDs of analgesics in the considered year
Antihypertensive agents	sum of prescribed DDDs of antihypertensive agents in the considered year
Cardiac agents	sum of prescribed DDDs of cardiac agents s in the considered year
Gastrointestinal agents	sum of prescribed DDDs of gastrointestinal agents in the considered year
Independent variables:	
Information on care provision	
Care provision (all care levels)	=1 if care provision to impaired person in any care level. 0 otherwise
Care provision to person in care level 1	=1 if care provision to impaired person in care level 1. 0 otherwise
Care provision to person in care level 2	=1 if care provision to impaired person in care level 2. 0 otherwise
Care provision to person in care level 3	=1 if care provision to impaired person in care level 3. 0 otherwise
Care provision to person in unknown level	=1 if care provision to impaired person in unknown care level. 0 otherwise
Socio-economic characteristics	
Female	=1 if female. 0 otherwise
Age	age of individual
Foreign Nationality	=1 if not German. 0 otherwise
Self-employed	=1 if self-employed. 0 otherwise (reference group: employed)
Part-time worker	=1 if part-time worker or home worker. 0 otherwise
Unemployed	=1 if unemployed. 0 otherwise (reference group: employed)
Temporary unemployed	=1 if unemployed up to 150 days in a year. 0 otherwise
Pensioner	=1 if pensioner. 0 otherwise (reference group: employed)
Education	
No educational achievemen	=1 if no educational achievement. 0 otherwise (reference group: professional education)
University degree	=1 if university degree. 0 otherwise (reference group: professional education)
Work position	
Apprentice	=1 if learner. 0 otherwise
Blue-collar worker	=1 if blue-collar worker. 0 otherwise
Craftsman	=1 if craftsman. 0 otherwise
Master craftsman	=1 if master craftsman. 0 otherwise
White-collar employee	=1 if white-collar employee. 0 otherwise
Health status	
Number of hospitalizations	number of hospitalizations in the considered year
Diseases of the liver	=1 if diseases of the liver were diagnosed in the considered year. 0 otherwise
Disorders of the thyroid gland	=1 if disorders of the thyroid gland were diagnosed in the considered year. 0 otherwise
Stroke	=1 if stroke was diagnosed in the considered year. 0 otherwise
Invasive neoplasms	=1 if invasive neoplasms were diagnosed in the considered year. 0 otherwise
Diseases of the digestive system	=1 if diseases of the digestive system were diagnosed in the considered year. 0 otherwise
Parkinson's disease	=1 if stroke was diagnosed in the considered year. 0 otherwise

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