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Master Thesis [Economics of Sustainability]

Assessing the wage penalty and heterogeneity in the wage penalty experienced by informal caregivers in the Netherlands over time.

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Abstract

Informal caregivers often experience conflicts between their caregiving duties and employment. Therefore, consequences of informal caregiving can be reduced working hours or withdrawal from employment entirely (Raiber et al., 2024). This may result in reduced earning when starting to provide informal care. How much income on average is lost when starting to provide care, is defined as wage penalties. This study focusses on these wage penalties experienced by caregivers in the Netherlands in the period 2012 to 2023 using LISS panel data. Uniquely, this paper uses an Event Study to investigate the topic. The main findings show a statistically significant wage penalty of 1.45 percent when providing informal care. This wage penalty seems to increase over time and is especially present for male caregivers and caregivers having finished mbo, wo, or hbo as the highest educational level. The results give the impression that employment may indeed be a mechanism of this relation.

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1. Introduction

In 2019, already 5 million individuals in the Netherlands provided informal care. This corresponds to 35 percent of the Dutch population at that time (de Boer et al., 2020). In the next decades, this number is expected to increase as the demand for informal care increases due to ageing of the society (Bolin et al., 2008; Borg & Hallberg, 2006; de Boer et al., 2020; Zigante, 2018; Hoefman et al., 2019; Kolodziej et al., 2018; Koopman et al., 2020; McKenzie et al., 2010; Michaud et al., 2010; Schmitz & Westphal, 2015; Schofield et al., 2019; van Houtven et al., 2010), increasing share of people with a chronic disease (Hoefman et al., 2019; Koopman et al., 2020; Schofield et al., 2019), and altering health policies towards more informal care (Borg & Hallberg, 2006; Elayan et al., 2024; Zigante, 2018; Hoefman et al., 2019; Koopman et al., 2020; McKenzie et al., 2010). Moreover, shortages in the formal care sector feeds the expected shift to informal care (Actiz, 2023; Elayan et al., 2024).

This is a serious problem as providing informal care does not come without consequences. Previous research highlights that informal caregivers have a higher risk of developing a depression or a burnout (Bom et al., 2019; Borg & Hallberg, 2006; Do et al., 2014; Ervin et al., 2022; Hoefman et al., 2019). Also, their overall life satisfaction and quality of life is lower on average compared to non-caregivers (Borg & Hallberg, 2006; Le & Ibuka, 2023; Goodrich et al., 2012; Verbakel, 2014; Wang et al., 2021). Next to these health effects, there are also economic consequences. The main economic consequences of providing informal care are a loss of productivity, forgone labour hours, and withdrawal from the workforce (Bolin et al., 2008; Elayan et al., 2024). These consequences often result in substantial wage losses for employees combining employment and informal care (Raiber et al., 2022; Heitmueller & Inglis, 2004; van Houtven et al., 2010; 2013; Schmitz and Westphal, 2017). In 2020, 1.8 million employees needed to combine both activities. This represents one out of four employees. It is predicted to increase to 2.1 million in 2040 (TNO, 2023). Caregivers thus may have systematic disadvantages and lower wages compared to non-caregivers due to the caregiving duties. This is known as the wage penalty of informal caregiving (Raiber et al., 2022; Heitmueller & Inglis, 2004; van Houtven et al., 2010; 2013; Schmitz and Westphal, 2017).

It is of societal relevance to get a better understanding of process in society, such as the developments of informal care and associated costs like forgone earnings. The substantial

number of caregivers and magnitude of current costs emphasize the necessity of research into these developments. In 2019 the annual costs of caregiving were estimated to range between 17.5 billion and 30.1 billion euros which corresponds to €1,230 to €2,119 per inhabitant. When these costs would have been paid by the government, taxes should have been risen by five to eight percent (Elayan et al., 2024). In these calculations, wage losses are considered based on international literature, though the wage penalty in the Netherlands can differ significantly from other countries and periods. Therefore, it is essential to investigate how the relationship between informal care and income and different aspects of the relationship behave in the Netherlands.

Monitoring the cost and negative externalities of informal caregiving is also essential when evaluating health policies regarding informal care and the sustainability of these policies in the long run. Policy makers often overlook the cost associated with informal care (Elayan et al., 2024; van Houtven et al., 2013). However, a policy shift to more informal care is only sustainable if informal caregivers and society in total can bear the financial burden, also in the future.

Wakabayashi & Donato (2006) show that there is a risk of poverty as the wage penalty has led to poverty for certain women in the USA. Detecting the different subgroups facing higher wage penalties and therefore facing higher risk of poverty is of importance for an equal society, therefore also being of political and societal relevance.

As previous information highlights the expectancy of wage penalties in the Netherlands and the importance of identifying this, I will study this topic in this paper. Specifically, I will study the following research question:

“What is the impact of providing informal care on earnings over time in the Netherlands, and how does this relation differ for heterogeneous age, gender, and ethnical, urban and educational backgrounds?”

I will use LISS panel data from the years 2012 to 2023 to study this research question. This high-quality data is obtained from CenterData and it surveys diverse topics under a representative and large sample of Dutch individuals. The main independent variable is whether someone provides informal care. The two main dependent variables are an individual's

employment status and their net income per month. In total, the sample used consists out of 57,955 observations from 11,016 individuals.

Raiber et al. (2022) already highlight the existence of wage penalties for caregivers in the Netherlands. In the literature, employment adjustments due to work-care conflicts, is the main mechanism appointed for this relationship. Therefore, in the base regressions applied, I will mostly try to replicate the findings on income and employment using Pooled OLS methodology. I hypothesize that there will be a statistical significant wage penalty and a lower probability of being employed when providing informal care, *ceteris paribus*.

The most innovative part of my research will be the dynamic aspect of the relationship between informal caregiving and income over time using an Event Study. Event Studies are mostly known for their application in research about parental wage penalties. Applying this methodology on informal caregiving is of added value because of two main reasons. The first reason is that it studies the effect up to six years after starting the provision informal care. Most studies focus on the short-term (Bom et al., 2019), while wage penalties may be persistent due to forgone promotions (Kolodziej et al., 2018) and deteriorated labour market prospects (Mozhaeva, 2021; Raiber at al., 2024; Xue et al., 2023). Secondly, I compare caregivers with future caregivers who do not provide care yet within this method. Most studies compare caregivers with non-caregivers. Though, there may be self-selection into caregiving in which certain groups of people, such as females, are more likely to be caregivers (Carmichael et al., 2010; Ervin et al., 2022; Michaud et al., 2010; van Houtven et al., 2010; Schulz and Monin, 2011; Nizalova, 2012). Therefore, caregivers and non-caregivers may not be perfectly comparable and thus no valid counterfactuals. Caregivers compared to future caregivers may be better counterfactuals resulting in more valid results, despite the smaller sample used.

Another contribution to the literature is the inclusion of interaction effects to allow for heterogeneity in the wage penalty experienced. When focussing on ethnical minorities, they often experience obstacles such as financial and language barriers, which may result in a higher incidence and intensity of informal care and therefore higher wage penalties (Rote & Moon, 2018; Cohen et al., 2019). This heterogeneity is mostly studied in the USA, but it is questionable if these effects are also found in the Netherlands. For gender heterogeneity, previous literature finds ambiguous results. Women generally provide more care and experience a higher pressure due to the caregiving (Wakabayashi & Donato, 2005), though especially men gain skills through

the caregiving or face bigger opportunity costs (Raiber et al., 2022; Kolodziej et al., 2018; van Houtven et al., 2010;2013). Also, for urban and socio-economic background and age of caregivers, ambiguity about the heterogeneity exist. Differential labour market factors, availability of formal care and demographics, influence the wage penalty experienced by rural and urban individuals (Casado-Marin et al., 2011; Cohen et al., 2022). These factors make that higher wage penalties for rural areas are found in the USA (Cohen et al., 2022), while the wage penalty in urban areas is larger in China (Wang et al., 2021). Opportunity costs and financial factors influence the differential association for different socio-economic groups (Bauer & Sousa-Poza, 2015; Carmichael et al., 2010; Henz, 2006; Tokunaga & Hashimoto, 2017; Casado-Marin et al., 2011), while retirement and labour market opportunities influence the heterogeneity by age (Raiber et al., 2024). To conclude, it is uncertain how the relationship between informal care and wages behaves for these different subgroups in the Netherlands. Therefore, it is of added value to investigate this. I hypothesize that there will be some heterogeneity, though which direction is difficult to predict.

In the following, I will first present the previous research on this topic more elaborate in section 2. In section 3, I will emphasize the data and methodology used. After this, the results will be presented in section 4. Overall, my results highlight the existence of wage penalties in the Netherlands for informal caregivers. Especially male caregivers and caregivers who finished hbo, wo, or mbo as highest educational level are associated with the largest wage losses when starting to provide informal care. The wage penalties found seem to increase over time. The wage penalties may be driven by employment adjustments as providing care is indeed correlated with a lower probability of being employed. Finally, these results will be concluded and discussed in section 5.

2. Literature

2.1 Background information

When looking at wage penalties experienced by informal caregivers, it is important to consider the existing literature on informal care. Informal care is defined by the Organisation for Economic Co-operation and Development (OECD) as providing any help to older family members, friends and people in the social network of the informal caregiver, living inside or outside their household, who require help with everyday tasks (OECD, 2023). These tasks can be various things, such as keeping an eye on the care recipient, emotional support, household support, or nursing tasks (de Boer et al., 2020). However, this definition of informal care can differ substantially per institution or author in the literature.

Informal care is an important source of long-term care as worldwide 60 percent of elderly in need receive solely informal care (OECD, 2023). In Europe, 72 billion hours of informal care is done annually (Elayan et al., 2024). In Western countries, on average 30 percent of people provide informal care (Hoefman, van Exel, & Brouwer, 2019). In 2019, approximately 5 million people in the Netherlands provided informal care, which corresponds to about 35 percent of the Dutch population at that time (de Boer et al., 2020). On average 7 hours of care was provided per week (de Boer et al., 2020). Although figures can differ substantially between countries (OECD, 2023), it is shown that informal care is mostly given by women (Zigante, 2018; Johnson & Lo Sasso, 2006; Schofield et al., 2019) and by people aged 50 up to retirement age (OECD, 2023; Schofield et al., 2019; Kolodziej, Reichert, & Schmitz, 2018).

Current literature highlights different demand and supply factors which may in all likelihood result in an increased number of informal caregivers and the pressure experienced by them in the near future. The first demand factor is that there is a demographic change in which the share of elderly in need of care is increasing (Bolin et al., 2008; Borg & Hallberg, 2006; de Boer et al., 2020; Zigante, 2018; Hoefman et al., 2019; Kolodziej et al., 2018; Koopman et al., 2020; McKenzie et al., 2010; Michaud et al., 2010; Schmitz & Westphal, 2015; Schofield et al., 2019; van Houtven et al., 2010). The ageing is mainly due to decreasing birth rates and increasing life expectancy because of health care advances such as developments in medicine (Elayan et al., 2024; Zigante, 2018; Johnson & Lo Sasso, 2006; Kolodziej et al., 2018; Schmitz & Westphal,

2015; Verbakel, 2014). Due to the increase in the share of people with a chronic disease, more elderly need care (Hoefman et al., 2019; Koopman et al., 2020; Schofield et al., 2019). Another trend on the demand side are cutbacks in public health expenditures and shifts to informal care in the long-term care policies. Likely, this will result in more demand for informal care (Borg & Hallberg, 2006; Elayan et al., 2024; Zigante, 2018; Hoefman et al., 2019; Koopman et al., 2020; McKenzie et al., 2010).

On the supply side, the ageing of societies and lower birth rates results in relatively less people available in the workforce for formal and informal care (de Boer et al., 2020; Elayan et al., 2024; Kolodziej et al., 2018; Verbakel, 2014). Furthermore, women emancipation results in more working hours and less available hours for informal care provision for females, while most of the informal care is given by women (Zigante, 2018; Johnson & Lo Sasso, 2006; Verbakel, 2014). Lastly, due to the increasing number of single and divorced individuals, people need to work to meet personal needs, leaving less time for informal caregiving (van Houtven et al., 2010; Verbakel, 2014).

Considering these developments, it seems surprising to see a decline in the percentage of informal caregivers who give intensive care in the Netherlands. In 2022, 13 percent of caregivers provided care for a minimal period of three months and more than eight hours per week. This percentage was 14 to 15 percent in the period 2015-2019. Though, the average hours of care provided increased from 10 to 11 hours a week in the period 2015-2019 to 13 hours a week in 2022 (CBS, 2023). These trends may be granted to the Dutch policy direction of more hours of care divided over more caregivers. This policy direction aims at less burden on the caregivers as in 2019 already more than 9 percent of caregiver felt overburdened (de Boer et al., 2012; Koopman et al., 2020).

The policy shift towards more informal care is partially driven by the perception among policy makers that these policies are cost-effective (Schmitz & Westphal, 2015; Zigante, 2018). Though, policy evaluations often do not consider the cost of informal care (Krol et al., 2015). These costs include the externalities of informal care such as on employment, wages, and mental and physical health such as further described in section 2.2. As the costs of informal care can be substantial, omitting them could influence the decision-making process and the cost-effectiveness of policies significantly (Elayan et al., 2024; Goodrich et al., 2012; Krol et al., 2015).

Literature tries to estimate an hourly unit cost of informal care, mostly based on opportunity costs, proxies of formal caregiving, or willingness to pay (Hoefman et al., 2019; Oliva-Moreno et al., 2017). Oliva-Moreno et al. (2017) apply a literature review and find an average hourly value of €11.43 based on 91 previous cost-of-illness analyses. Van den Berg et al. (2008) find a lower-bound mean value of €12.36 per hour in the Netherlands with data from 2001 and 2002. This hourly value is found when doing conjoint analysis in which several scenarios are rated by caregivers. The ratings represent utilities and disutilities of the participants which are translated into a hourly opportunity costs value. Hoefman et al. (2012) calculate the willingness to accept value using a discrete choice experiment in which respondents must choose between two scenarios with nine characteristics. Some characteristics differed between the scenarios, such as the caregiving hours and monetary compensation for the caregiving. These two characteristics were used to calculate the willingness to accept value. They find an average value of €14.57 per hour in the Netherlands in 2011.

Altogether, the total estimated annual cost of informal care in the Netherlands was between €17.5 billion and €30.1 billion in 2019. These costs were based on unit costs identified in literature and the Dutch Manual for Costing Studies in Health Care, and corresponds to 2.15 percent and 3.71 percent of the GDP in that same year. Therefore, they are comparable with the public expenditures on long-term formal care (Elayan et al., 2024). These numbers are yet again expected to increase due to the different factors mentioned above.

In all European countries increased attention goes to informal care policies due to the informal care shortages expected. There is an expected shortage of 20,000 informal caregivers for 2060 in the Netherlands, which is a relatively small shortage compared to other European countries (Zigante, 2018). The relatively small shortage may be attributed to the high prevalence of part-time working among women in the Netherlands, which allows a relatively high share of women to provide informal care next to employment (Elayan et al., 2024; Raiber et al., 2024). The country also stands out by its superior employment protection and conditions which allows for temporary leaves and reduced employment hours (Raiber et al., 2024). This is strengthened by the country being a frontrunner in introducing policies such as social security, respite care, training and legislation to support informal caregivers (Zigante, 2018). This political attention could have significant impact on decisions concerning employment made by informal caregivers and their experienced wage penalty.

2.2 The consequences of informal care

There is a wide literature about the consequences of informal care. Informal care may have direct economic impact on the time spent on employment and on out-of-pocket expenses, and indirect economic impact on the productivity of caregivers (Bolin et al., 2008; Elayan et al., 2024). When focussing on employment, almost all studies show that caregiving is negatively associated with employment, more specifically with hours worked at the intensive margin and employment status at the extensive margin (Arber & Ginn, 1995; Bauer & Sousa-Poza, 2015; Bolin et al., 2008; Casado-Marin et al., 2011; Ciani, 2012; Heitmueller & Inglis, 2004; Henz, 2006; Johnson & Lo Sasso, 2006; Kolodziej et al., 2018; Krol et al., 2015; Michaud et al., 2010; Mozhaeva, 2021; van Houtven, 2010, 2013; Wakabayashi & Donato, 2005; Raiber et al., 2024). Johnson and Lo Sasso (2006) find an average reduction of 367 working hours per year between 1994 and 1998 in the USA, which corresponds to a decrease of 41 percent. Van Houtven (2010, 2013) find also for the USA between 1992 and 2008 a decrease of around two percentage point in the probability of being employed when giving informal care. They also find that women who keep being employed, reduce their hours worked with three to ten hours per week on average. Kolodziej et al. (2018) find with European data from 2004 to 2013 that caregivers are 14 percentage points less likely to work compared to non-caregivers. Whether the effect on hours worked or the employment status is larger, depends on the study and characteristics of the country of study. Influential factors could be the generosity of labour market protection systems and part-time working possibilities (Arber & Ginn, 1995; Heitmueller & Inglis, 2004; Mozhaeva, 2021).

As informal caregivers thus often experience conflicts with employment (Schulz & Monin, 2011; Raiber et al., 2022), a common response is to stop working, reduce working hours, or change to lower paying jobs when starting to give informal care (Raiber et al., 2024). This can have consequences on wages. Most studies show a negative association. A positive effect can be found when skills are developed throughout the caregiving which are of added value in the labour market (Raiber et al., 2022). Bolin et al. (2008) find no association between hourly wages and informal caregiving when studying European data originating from 2004. At the same time, Heitmueller and Inglis (2004; 2007) find significant wage gaps based on hourly wage rates when comparing non-caregivers and caregivers in the UK between 1991 and 2002. The average wage gap is estimated to be around six percent and almost twice as large for people caring more

than 20 hours a week. Schulz and Monin (2011) indicate in their literature overview that becoming a caregiver is often associated with a higher risk of living in poverty and having financial stressful times. Wakabayashi and Donato (2005) show lower annual earnings of on average 750 US dollars per year when starting with giving informal care in the USA between 1987 and 1992.

Several studies find a wage penalty when comparing caregivers to non-caregivers and assessing how much caregivers on average earn less. Van Houtven et al. (2010; 2013) find such a wage penalty in the USA with data from 1992 to 2008. Caregivers on average face an 0.66 US dollar lower hourly wage. This is mainly driven by female caregivers as there is a wage penalty of 0.40 US dollar per hour found for women and there is a wage premium of 2.20 US dollar per hour found for men. The effects in Europe are expected to be larger as the social safety net is known to be better in Europe and people can afford to take temporary leaves, reduce working hours, or stop working (van Houtven et al., 2010; Heitmueller & Inglis, 2004). Indeed, Raiber et al. (2022) study wage penalties in the Netherlands in 2020 and find that there is a substantial wage penalty, especially for men. Caregiving was associated with earning 11 euros less per hour for men and 2 euros less per hour for women. Schmitz and Westphal (2017) show a slightly smaller wage penalty of 1 to 1.50 euro per hour in Germany with data from 2001 to 2013.

This wage penalty is found when comparing caregivers with non-caregivers. Though, these two groups may not be comparable due to self-selection into informal caregiving. For instance, women are initially more likely to be caregivers (Arber & Ginn, 1995; Xue et al., 2023), which is enhanced by the part-time working culture under women (Arber & Ginn, 1995). Family factors such as the number of spouses, singleness, number of children (Henz, 2006; Tokunaga & Hashimoto, 2017), and social class (Henze, 20006; Quashie et al., 2022; Tokunaga & Hashimoto, 2017; Wang et al., 2021) can be determining in becoming a caregiver or not. Also, people who have a worsen health (Johnson & Lo Sasso, 2006) or less attachment to the labour market (Henz, 2006) are more likely to become an informal caregiver. When people with less attachment or females are indeed more likely to become an informal caregiver, this is of major concern for estimating the effects of caregiving as these groups may have lower wages initially and therefore cause reverse causality. In the current literature, Carmichael et al. (2010), Ervin et al. (2022), Michaud et al. (2010), van Houtven et al. (2010), Schulz and Monin (2011), and Nizalova (2012) find such reverse causality in which lower wages are associated with higher

likelihood of being an informal caregiver in different settings. The previous results on income and employment found may therefore be biased.

Next to economic consequences, informal care may impact the mental and physical health of the caregivers. Literature shows an ambiguous effect on both types of health. Informal caregiving is mostly associated with worse mental health (Bauer & Sousa-Poza, 2015; Bom et al., 2019; Borg & Hallberg, 2006; Do et al., 2014; Le & Ibuka, 2023; Ervin et al., 2022; Hoefman et al., 2019; Krol et al., 2015; Verbakel, 2014; Wang et al., 2021). For instance, it can result in higher risk of developing a depression (Bom et al., 2019; Do et al., 2014; Ervin et al., 2022; Hoefman et al., 2019), worse mental health scores (Bom et al., 2019), stress (Borg & Hallberg, 2006; Do et al., 2014; Hoefman et al., 2019; Wang et al., 2021), higher risk of a burnout (Borg & Hallberg, 2006), and increased anxiety (Borg & Hallberg, 2006; Ervin et al., 2022). Overall, the life satisfaction and quality of life of informal caregiver is on average lower compared to non-caregivers (Borg & Hallberg, 2006; Le & Ibuka, 2023; Goodrich et al., 2012; Verbakel, 2014; Wang et al., 2021). The mechanisms through which these effects show up may be less social interactions (Borg & Hallberg, 2006; Le & Ibuka, 2023), the loss of leisure (Le & Ibuka, 2023), time scarcity due to multiple roles (Ervin et al., 2022), chronic stress (Ervin et al., 2022; Schulz & Monin, 2011), and the unpredictable and uncontrollable nature of informal caregiving (Schulz & Monin, 2011).

There are also some papers who highlight the positive impact of informal caregiving on the health of the caregivers (Michaud et al., 2010; Schulz & Monin, 2011; Verbakel, 2014). Schulz and Monin (2011) report that caregiving can also result in increased sense of self-worth, identity and a goal in life, learning new skills, and strengthened relations with loved ones. As a consequence, this may result in decreased risk of mortality, positive emotions and better mental and physical health which is the opposite of the findings above. Verbakel (2014) acknowledges that informal care can indeed result in positive experiences and consequences, such as better ability to deal with stress, intrinsic fulfillment, increased skills, companionship and a rewarding feeling.

Informal care can have detrimental consequences on the physical health (Bauer & Sousa-Poza, 2015; Bom et al., 2019; Goodrich et al., 2012; Hoefman et al., 2019; Schulz & Monin, 2011), such as increased pain in daily activities (Bom et al., 2019), drug intake (Bom et al., 2019; Hoefman et al., 2019), risk of mortality (Goodrich et al., 2012; Hoefman et al., 2019), and

morbidity (Goodrich et al., 2012). Though, most studies that investigate both mental and physical health effects highlight that the effects on mental health are larger (Bauer & Sousa-Poza, 2015; Le & Ibuka, 2023; Schulz & Monin, 2011).

Most studies investigate the short-term effects of informal care as identified by Bom et al. (2019) in their literature review. Raiber et al. (2022) and Schmitz and Westphal (2017) investigate the long-term consequences of caregiving on employment and wages in the Netherlands and Germany, respectively. Both studies find a consistent wage penalty over time. Schmitz and Westphal (2015) even find no statistically significant effect in the short-term but do find it in the long-term. A medium- or long-term view is important to consider as informal care and possible associated wage losses may accumulate over time and have lifelong consequences, such as on retirement savings (Johnson & Lo Sasso, 2006; Kolodziej et al., 2018; Mozhaeva, 2021, Raiber et al., 2024; van Houtven et al., 2010, 2013), forgone promotions (Kolodziej et al., 2018) and overall labour market prospects (Mozhaeva, 2021; Raiber et al., 2024; Xue et al., 2023). Therefore, I will take a medium-term view up to six years after starting to provide care.

2.3 Heterogeneity in the effects of informal caregiving

After examining the consequences of informal caregiving on employment, wages, and physical and mental health, one might ask oneself whether there is heterogeneity in these observed effects.

First, gender differences should be emphasized as women perform relatively more informal care and therefore may bear the biggest burden of informal care (Wakabayashi & Donato, 2005). Also in the Netherlands, relatively more women provide care compared to men (de Boer et al., 2020). In 2022, 15 percent of all Dutch women aged above 16 gave informal care while this was 10.9 percent for Dutch men aged above 16 (VZinfo, 2023). Also, women provide higher intensity care and experience greater social pressure in general (Le & Ibuka, 2023). This all may result in larger effects for this group. Indeed, Arber and Ginn (1995), Bauer and Sousa-Poza (2015), Covinsky et al. (2001), Henz (2006), and Xue et al. (2023) observe greater effects of giving informal care on hours worked and/or employment status for women. Bom et al. (2019) and Le and Ibuka (2023) also find stronger mental health effect for females. There are a few opposing results, such as Kolodziej et al. (2018) who find a stronger negative effect for men on

labour market participation, which they attribute to greater opportunity costs such as forgone wages for male caregivers. Furthermore, van Houtven et al. (2010) find no statistically significant heterogeneous effects for men and women on employment.

When examining how the intensity of caregiving influences the relation between caregiving and employment or health, the existing literature illustrates clearly that when the intensity increases, the effects found are stronger. This is due to increased burden experienced, time devoted to the caregiving and conflict of the different duties and roles in the caregiver's life (Arber & Ginn, 1995; Bauer & Sousa-Poza, 2015; Bom et al., 2019; Le & Ibuka, 2023; Koopman et al., 2020; Mozhaeva, 2021; Raiber et al., 2022, 2024). Intensity is shown to be stronger when recipient and caregiver are co-residing (Arber & Ginn, 1995; Bauer & Sousa-Poza, 2015; Casado-Marin et al., 2011; Covinsky et al., 2001; Le & Ibuka, 2023; Michaud et al., 2010; Carmichael et al., 2010), when recipient and caregiver are family such as in a child-parent relationship (Borg & Hallberg, 2006; Le & Ibuka, 2023; Covinsky et al., 2001; Ervin et al., 2022; Koopman et al., 2020), when the caregiving takes a longer period (Casado-Marin et al., 2011), when the caregiver is a woman (Simard-Duplain, 2022), and when the caregiver is employed (Wang et al., 2021).

Literature shows ambiguous heterogeneity in economic effects of caregiving for different ethnic groups. Mozhaeva (2021) studies wage penalties in the Baltic states and finds that wage penalties are stronger in Estonia and Latvia, which are countries with stronger family cultures. They acknowledge the cultural element could be a crucial factor in the differential findings for the three countries. Bolin et al. (2008) investigate Europe on cultural heterogeneity as Southern European countries are known for stronger family ties. Conversely, they find that effects on employment status and hours worked are less strong in Southern Europe, which may be explained by the prevailing norm of providing assistance to family. This norm is enhanced by the lower level of public spending in the formal care sector in Southern and Eastern Europe as this may result in a higher probability of providing informal care due to necessity of providing care for someone's own family (Kolodziej et al., 2018; Quashie et al., 2022).

When looking within countries, in the USA the prevalence of informal care is higher under racial and ethnic minorities as they experience language barriers, discrimination and monetary barriers to the formal health care system (Rote & Moon, 2018; Cohen et al., 2019). Therefore, African American and Hispanic Americans are more likely to reduce working hours to provide

care to parents compared to White Americans (Covinsky et al., 2001; Cohen et al., 2019). In the Netherlands, a larger proportion of native Dutch provide informal care compared to non-Western Dutch individuals. This is surprising as native Dutch people state more often that providing care is a duty of the government compared to people with a non-Western migration background. People with a non-Western background tend to state that it is a duty of acquaintances. This unexpected finding could be due to people with a non-Western background regarding the care as a normal occurrence, therefore not reporting it. When giving care, people with a non-Western background do provide care at a higher intensity which result in higher levels of burden experienced (de Boer et al., 2020). This is the opposite of the findings of Do et al. (2014) who report higher depression and stress rates for White Americans. This highlights the need for studying the situation specifically for the Netherlands as ethnicity seem to influence the relation between employment or wages and informal caregiving though heterogeneously for different countries.

Family cultures could influence heterogeneity between ethnical groups, but also heterogeneity between urban and rural areas. Other differences between urban and rural areas that could influence these effects, are labour market differentials (Casado-Marin et al., 2011), formal care availability (Casado-Marin et al., 2011) and demographic composition (Cohen et al., 2022). Cohen et al. (2022) show caregiving intensity is substantially higher in rural areas in the USA due to distance to formal care facilities. This results in worsser wellbeing and economic status for those caregivers. McKenzie et al. (2010) study the same topic and country as Cohen et al. (2022) and find no clear rural-urban heterogeneity. Wang et al. (2021) show in China higher intensity caregiving in urban areas. Which mechanisms are in play in the Netherlands is debatable. Shortages in the formal health care system and demographics may behave different in urban and rural areas in the Netherland, which may influence wage penalties of informal caregiving in the different areas. Hence, it is important to study this possible heterogeneity.

Different socio-economic groups also may experience heterogeneous effects as they might face diverging costs when considering providing informal care. Existing literature fails to identify clear heterogeneous effects. Low-income caregivers may face financially no choice and must combine work and caregiving, therefore experiencing stronger effects on health and no effects on employment (Bauer & Sousa-Poza, 2015). This while richer and higher educated people may be able to afford more formal care (Carmichael et al., 2010; Henz, 2006; Tokunaga &

Hashimoto, 2017), have higher opportunity costs due to forgone opportunities and higher wages in the labour market (Carmichael et al., 2010; Casado-Marin et al., 2011; Tokunaga & Hashimoto, 2017), or can afford to take more time out of employment (Carmichael et al., 2010; Henz, 2006). These considerations can result in ambiguous effects. This may explain why Carmichael et al. (2010), Henz (2006), Quashie et al. (2022), Wakabayashi & Donato (2005) and Tokunaga & Hashimoto (2017) find greater effects for low-income caregivers on employment, Do et al. (2014) and Arber and Ginn (1995) find the greatest effect for the middle-class on health and employment respectively, and Wang et al. (2021) find the greatest effect for high socio-economic groups. As clear effects are thus lacking and different mechanisms may be involved, I will study the heterogeneous effects of socio-economic status by including the proxy education as an interaction term.

When analyzing heterogeneous age effects, it is notable that there are relatively many caregivers aged 45 to 65 in the Netherlands. They are characterized by giving high intensity, long-term and high burdened informal care (de Boer et al., 2014). The caregivers close to the retirement age may sooner decide to stop working due to early retirement options. Though, young caregivers may experience a stronger work-care conflict (Raiber et al., 2024). These statistics raise the question whether the association between caregiving and wages or employment differs for various age groups. Borg and Hallberg (2006) and Le and Ibuka (2023) indeed find stronger mental health effects for younger caregivers in Sweden and Japan, respectively. When looking at wages, Wakabayashi and Donato (2005) find no significant effect for younger caregivers, solely for caregivers aged 46 or above. Raiber et al. (2024) investigates the Netherlands and find greater effects on working hours for young caregivers, while the effects on stop working were the greatest for the age group 45 to 54 years old. As the findings of Raiber et al. (2024) in the Netherlands would result in differential wage penalties, it is interesting to study age heterogeneity as part of this study.

Finally, some papers highlight additional characteristics of caregivers which may result in heterogeneous effects. For instance, marriage can provide companionship which results in better coping with the mental burden of caregiving (Bauer & Sousa-Poza, 2015), or it can create a traditional gender division and additional conflict between duties resulting in stronger negative effects (Arber & Ginn, 1995; Bom et al., 2019; Wakabayashi & Donato, 2005). Having children also results in additional conflicting duties. Therefore, caregivers with children may experience

greater consequences of caregiving (Do et al., 2014; Henz, 2006). Lastly, certain diseases such as dementia and recovery from strokes may result for high-intensity informal care which can result in greater consequences on employment, wages, and health (Covinsky et al., 2001; Ervin et al., 2022).

2.4 Conclusion

Informal care is an increasingly important fundament in the long-term care systems of western countries (Elayan et al., 2024; Zigante, 2018; Koopman et al., 2020; Mozhaeva, 2021; Schulz & Monin, 2011; Verbakel, 2014). In 2019, the estimated costs of informal care were already as great as the costs of long-term formal care (Elayan et al., 2024). There are numerous studies that show that informal caregiving can be associated with decreased hours worked, a lower probability of being in the labour market, a wage penalty, and worsen mental health. Next to the intensity of the care, the gender, ethnicity, socio-economic status, the urbanization rate of the place of residence and age of the caregiver can cause heterogeneity within these associations. Though, as many papers in the literature conclude, the influence of individual caregivers' characteristics on the relation between informal caregiving and wages, employment and health are difficult due to the interdependence of many characteristics (Do et al., 2014; Le & Ibuka, 2023; Cohen et al., 2019; Bauer & Sousa-Poza, 2015).

3. Data & Methods

3.1 Data

To research the wage penalty of informal caregivers in the Netherlands, I will use the Longitudinal Internet studies for the Social Sciences (LISS) dataset of CenterData by Tilburg University. This dataset is compiled out of monthly internet surveys. It is a panel dataset from 2007 onwards about diverse topics, such as health, religion, education, employment, family, norms and values and economic situation (Mulder & Das, 2023). LISS exists out of a Core Study and numerous additional temporary studies. The LISS Core Study exist of different thematic studies, including the Work and Schooling Study which touch upon topic such as labour market participation, job characteristics, pensions, and schooling. The Work and Schooling Study is available between 2008 and 2023 and it consists of sixteen waves. Each year in April and May the survey is distributed to the participants (Streefkerk, 2024).

The LISS surveys are sent to the LISS panel, which is a group of individuals who are followed over time. This panel is a representative sample based on the population register by Statistics Netherlands (Mulder & Das, 2023). The Work and Schooling Study is applied on a selection of this panel. On average, each year 5,850 people participate in the Work and Schooling Study. Though the sample varies from year to year with a total of 16,882 individuals participating over the years I use. The data is therefore an unbalanced dataset. If the missing years for individuals are non-random, there is a risk of bias as some observations may be present for more years therefore skewing the results. As shown in Figure A.1 in Appendix A, respondents mostly participate for only a few waves, reducing the risk of skewed result due to a few individuals who participate in many waves. Though, this risk is not totally excludable.

The main independent variable in this study is *Informal Care*, which is a dummy variable containing whether someone provides informal care or not. I will use the variable *Informal Care* from the Work and Schooling Study. The other variables are added from general background variables provided by LISS. The exact questions, definitions and changes of the variables I used can be found in Appendix B. *Income* is the main dependent variable used in all regressions. It is a continuous variable containing the self-reported net income per month. In the main regression, *Income* is included as logarithm. If it is missing, it is estimated based on the gross

income as explained by de Vos (2008, 2011). Additionally, I use *Employment* as dependent variable. This dummy variable contains whether the individual is employed or unemployed.

Other important independent variables are *Age*, *Urban*, *Education*, *Ethnicity* and *Gender*. *Age* is included as a categorical variable with the groups 15-24 years, 24-34 years, 35-44 years, 45-54 years, 55-64 years, and 65 years or older. *Urban* is a categorical variable containing the urbanity of the place of residence of the participant. It can take the values very strongly urban (2,500 or more people per km²), strongly urban (1,500 to 2,500 people per km²), moderately urban (1,000 to 1,500 people per km²), little urban (500 to 1,000 people per km²), and non-urban (less than 500 people per km²). *Education* contains the highest level of completed education and it is also included as a categorical variable. The categories present are primary school, vmbo, havo/vwo, mbo, hbo, wo and other. Other can be either other kind of education, not finished education yet or is still following education. *Ethnicity* shows the origin of the participant. It is included as a categorical variable taking the values Dutch, Western, or non-Western background. Lastly, *Gender* is included as a dummy variable with the values male and female.

Family is a control variable I use. It is a categorical variable containing the number of household members. The categories are one person, two persons, three persons, four persons, five persons, and six persons or more. *Marital Status* is a categorical control variable which describes the civil status of the participant. The categories are married, separated, divorced, widow/widower, and never been married.

In total, the panel dataset contains 93,589 observations. Observations are dropped if the gender is neither female or male (9 observations), urbanisation rate is invalid (1 observation), or income was not known, not shared or zero (14,677 observations). The variable containing the ethnical background of individuals is present in the dataset only after 2011. Therefore, only wave five until sixteen from the years 2012 to 2023 will be used. After considering this and dropping the missing values for *Income*, *Informal Care*, *Urban*, and *Ethnicity*, 57,955 observations over 11,016 individuals remain in the analysis.

3.2 Methodology

To assess whether informal caregiving is associated with wage losses, I will use two methods. First, I will exploit a Pooled OLS method to obtain average treatment effect. The main regression used for this method is shown in equation one.

$$\begin{aligned} \text{Log}(\text{Income})_{it} = & \beta_0 + \beta_1 * \text{Informal Care}_{it} + \beta_2 * \text{Age}_{it} + \beta_3 * \text{Urban}_{it} + \beta_4 * \text{Education}_{it} \\ & + \beta_5 * \text{Ethnicity}_i + \beta_6 * \text{Gender}_i + \beta_7 * \text{Family Size}_{it} + \beta_8 * \text{Marital Status}_{it} + \gamma_t + \varepsilon_{it} \quad (1) \end{aligned}$$

In this equation, the logarithm of the net income per month is the dependent variable. It is tested whether the income is significantly different when someone indicated to provide informal care compared to someone who did indicate to provide no informal care. β_1 is the main coefficient of interest.

Age, Urban, Education, Ethnicity, Gender, Family Size, and Marital Status are added as control variables. Control variables should control for factors that determine wages and also the decision to provide care partially. The age of the individual could be an example of such a factor. Older individuals may initially have higher earnings and show a higher likelihood in providing care due to parents in need of care. If Dutch cities and smaller villages differ significantly in family and care culture and labour market outcomes, the place of residence could also be a biasing factor. I control for educational background as higher educated individuals on average earn more and they may be less likely to provide informal care due to high opportunity costs and ability to buy private formal care (Carmichael et al., 2010; Henz, 2006; Tokunaga & Hashimoto, 2017; Casado-Marin et al., 2011). The family and care culture of different ethnic groups may result in heterogeneity in the probability to provide informal care. This while minorities also earn less, on average (Jongen et al., 2019). Therefore, it is needed to control for ethnicity. Females often provide more informal care and earn less (van Houtven et al., 2013; OECD, 2023; Wakabayashi & Donato, 2005), which may bias the results found. Single people may have more time to provide informal care, though they also might have higher earnings due to this. The opposite may be true for big families and families with children. Therefore, these factors also should be included. Finally, year fixed effects, γ_t , are included to control for wage and care trends over time. I control for heteroskedasticity by including robust standard errors in the error term, ε_{it} .

As outlined in section 2.3, there may be heterogeneous effects for different age groups, urban backgrounds, genders, ethnical groups and educational levels. Therefore, I include in equation two interaction terms between the variables *Age*, *Urban*, *Education*, *Ethnicity* and *Gender*, and *Informal Care*. In this regression β_1 gives the average treatment effect of providing informal care on wage losses for the reference individuals who are 65 years of age or older, live in extremely urban places, have completed vmbo as the highest educational level, have a Dutch origin, and are men. $\beta_3, \beta_5, \beta_7$, and β_9 shows whether the average treatment effect found is heterogeneous for various age groups, urban backgrounds, educational levels, ethnical backgrounds, and genders, respectively.

$$\begin{aligned} \text{Log}(\text{Income})_{it} = & \beta_0 + \beta_1 * \text{Informal Care}_{it} + \beta_2 * \text{Age}_{it} + \beta_3 * \text{Informal Care}_{it} * \text{Age}_{it} + \\ & \beta_4 * \text{Urban}_{it} + \beta_5 * \text{Informal Care}_{it} * \text{Urban}_{it} + \beta_6 * \text{Education}_{it} + \beta_7 * \text{Informal Care}_{it} \\ & * \text{Education}_{it} + \beta_8 * \text{Ethnicity}_{it} + \beta_9 * \text{Informal Care}_{it} * \text{Ethnicity}_{it} + \beta_{10} * \text{Gender}_i + \beta_{11} \\ & * \text{Informal Care}_{it} * \text{Gender}_{it} + \beta_{12} * \text{Family Size}_{it} + \beta_{13} * \text{Marital Status}_{it} + \gamma_t + \varepsilon_{it} \quad (2) \end{aligned}$$

Literature identifies the negative association between informal caregiving and employment as a mechanism through which wages are impacted. Due to the work-care conflicts, individuals with care duties often choose to stop working or reduce working hours (Raiber et al., 2024). This may drive the wage effects of caregiving. To get an indication whether this may be the case in this study, I apply regression one and two on the employment status of individuals. This is shown in regressions three and four, in which *Employment* is taken as dependent variable. Notably, these regressions are applied only for individuals aged 24 to 64 years, i.e. working ages, as employment status is not relevant for other ages. Therefore, the number of observations in these regressions are reduced to 34,207 observations from 7,554 individuals. The employment status tests for employment adjustments at the extensive margin. Though, there could also be an effect on the intensive margin, i.e. the hours worked. Despitefully, there are no variables to test for this mechanism.

$$\begin{aligned} \text{Employment}_{it} = & \beta_0 + \beta_1 * \text{Informal Care}_{it} + \beta_2 * \text{Age}_{it} + \beta_3 * \text{Urban}_{it} + \beta_4 * \text{Education}_{it} \quad (3) \\ & + \beta_5 * \text{Ethnicity}_i + \beta_6 * \text{Gender}_i + \beta_7 * \text{Family Size}_{it} + \beta_8 * \text{Marital Status}_{it} + \gamma_t + \varepsilon_{it} \end{aligned}$$

$$\begin{aligned} \text{Employment}_{it} = & \beta_0 + \beta_1 * \text{Informal Care}_{it} + \beta_2 * \text{Age}_{it} + \beta_3 * \text{Informal Care}_{it} * \text{Age}_{it} + \\ & \beta_4 * \text{Urban}_{it} + \beta_5 * \text{Informal Care}_{it} * \text{Urban}_{it} + \beta_6 * \text{Education}_{it} + \beta_7 * \text{Informal Care}_{it} \\ & * \text{Education}_{it} + \beta_8 * \text{Ethnicity}_{it} + \beta_9 * \text{Informal Care}_{it} * \text{Ethnicity}_{it} + \beta_{10} * \text{Gender}_i + \beta_{11} \\ & * \text{Informal Care}_{it} * \text{Gender}_{it} + \beta_{12} * \text{Family Size}_{it} + \beta_{13} * \text{Marital Status}_{it} + \gamma_t + \varepsilon_{it} \quad (4) \end{aligned}$$

Secondly, I will apply an Event Study as explained by Clarke and Tapia-Schyte (2021) to assess dynamic effects of informal care on wage losses over time. The results show the effects per period before or after the event of providing care for the first time. This event can take place at different point of time for each individual in the sample, which is known as staggered treatment. As care recipients need care at different points in time, this is an important property of the method.

It is important to note that only individuals who change from not giving care to giving care at some time over the period of study are considered with this method. In the literature, the wage penalty is often found when comparing caregivers with non-caregivers. Though, it is questionable if these two groups are comparable. There may be people with certain characteristics that are more likely to be caregivers due to self-selection, as explained in section 2.2. Therefore, non-caregivers and caregivers may not be good counterfactuals. To overcome this methodological issue, I will compare solely individuals who will provide care at some point during the period of study and for minimal three years when applying the Event Study. Therefore, the sample is restricted to 3,261 observations of 381 individuals.

The main output of interest generated with this method will be graphical evidence. This evidence is based on equation five.

$$\begin{aligned}
 Income_{it} = & \beta_0 + \sum_{j=2}^J \beta_j (Lead\ j)_{it} + \sum_{k=1}^K \lambda_k (Lag\ k)_{it} + \beta_{10} * Age_{it} + \beta_{11} * Urban_{it} + \\
 & \beta_{12} * Education_{it} + \beta_{13} * Ethnicity_i + \beta_{14} * Gender_i + \beta_{15} * Family\ Size_{it} + \\
 & \beta_{16} * Marital\ Status_{it} + \gamma_t + \varepsilon_{it}
 \end{aligned} \tag{5}$$

Equation five tests for the statistical significance of the association between informal caregiving and wages for each year before or after starting informal care for the first time separately. Three leads and six lags and are included, i.e. J=3 and K=6. *Age*, *Urban*, *Education*, *Ethnicity*, *Gender*, *Family Size*, and *Marital Status* are included as control variables with the same reasoning as before. Year fixed effects, γ_t , are included and the standard errors are clustered at the individual level.

As section 2.3 describes that the association between informal caregiving and wages may show heterogeneity especially for gender, I also will analyse regression five separately for men and women.

3.3 Internal validity

It is important to note that all variables are self-reported as they are based on surveys. This introduces the risk of self-report bias. It can be that participants are dissatisfied with their income, for instance, and therefore report it differently. Or participants think it is impolite to ask directly about someone's income, therefore reporting something else as act of privacy or protest. This results in noisy data. This may be a valid concern, especially as there are surprisingly many people with zero income (Elshout, 2022). Despite removing people with zero income, self-report bias is still of concern for the validity of the results.

A major limitation of the data is that there seem to be a substantial number of individuals that change from giving care to not giving care anymore. Additionally, there appears to be individuals that experience different caregiving episodes for different care recipients with a gap in between the years. Also, some individuals show gaps in years of completion of the survey. It is obscure whether they provided care in between the years of completion or not. These data limitations may introduce a spurious relation as the years in which the caregivers do not give care can be used to work and supplement savings. Therefore, there is no income effect measured which may be there. As the Event Study methodology is not able to cope with this issue, I will have to restrict the data to people that provide informal care minimal three years. I assume caregiving has substantial influence on choices such as employment and wages when caregivers provide care for three years or more.

Another concern for the internal validity of the results is the possibility of omitted variable bias. This occurs when there are factors that partially explain the earnings of an individual, but also influences the probability that someone provides informal care. For instance, gender could be such a factor as females do have lower wages on average (van Houtven et al., 2013), though they are also more likely to provide informal care (de Boer & Keuzenkamp, 2009). For this reason, I control for gender, age, urban background, ethnicity, education, family size, and marital status of individuals. Nevertheless, there may be other factors such as the health of the caregiver that can cause bias. When the caregiver has a poor health, this may result in less hours worked or being unemployed which has the consequence of a lower income. Though, having a poor health oneself may also be associated with a lower probability of taking care of someone else through informal care. When not controlling for the health, the effect of informal care on income is not truly the effect of informal caregiving. Though it is a combined effect of having

a poor health and therefore having a lower wage and the wage penalty of informal caregiving. As I am unable to control for all the factors possibly causing omitted variable bias, this remains a valid concern for the validity of my results.

Reverse causality may also be a relevant concern for the validity. In section 2.2, I describe that caregivers with certain characteristics are more likely to be caregivers. This can be women or people with less attachment to the labour market, for instance (Henz, 2006). These people may have lower wages initially, therefore causing reverse causality. In contrast, it seems likely that rich people can afford more formal care and the opportunity costs of forgone wages is higher for people with higher wages as more income must be given up when working less due to informal care duties. This decreases the likelihood of providing informal care for richer individuals. In the literature, Carmichael et al. (2010), Ervin et al. (2022), Michaud et al. (2010), van Houtven et al. (2010), Schulz and Monin (2011), and Nizalova (2012) find such reverse causality in which lower wages are associated with higher likelihood of being an informal caregiver in different setting.

When applying the Event Study, the parallel trend assumption is an additional assumption. It entails that before providing care the different subgroups must have had the same trend in income. When this is not true, the effects found can also be due to trends that were happening before. Therefore, the results are a combination of the effect of informal caregiving and this other trend. It must be that the differences in income losses for different subgroups must be due to the heterogeneous reactions to informal caregiving and would not have happened if the informal caregiving was not provided.

3.4 Descriptive statistics

Table 1 shows the descriptive statistics of the variables used. The mean and standard deviation of the continuous variables *Income* and *Age* and percentages of the categorical variables are shown. Columns 1, 2 and 3 contain the descriptive statistics for the entire sample used in the Pooled OLS regressions, while Columns 4, 5 and 6 show it for the sample used in the Event Study.

Table 1. Descriptive Statistics

	Full Sample			Event Study Sample		
	Percentage (1)	Mean (2)	Std. Dev. (3)	Percentage (4)	Mean (5)	Std. Dev. (6)
Net Monthly Income		1876.96	3569.10		1693.14	940.64
Informal Care						
No	85.43			35.42		
Yes	14.57			64.58		
Age		54.09	16.99		58.08	12.18
15-24 years	4.68			0.92		
25-34 years	11.52			2.42		
35-44 years	14.10			8.10		
45-54 years	17.11			27.35		
55-64 years	19.70			29.68		
65 years and older	32.89			31.52		
Urban						
Extremely urban	15.82			12.11		
Very urban	25.38			24.20		
Moderately urban	21.32			22.29		
Slightly urban	20.59			22.39		
Not urban	16.89			19.01		
Education						
Primary school	3.55			3.50		
Vmbo	21.31			19.53		
Havo/Vwo	9.48			11.35		
Mbo	24.62			27.87		
Hbo	26.28			26.37		
Wo	11.76			9.35		
Other	3.00			2.02		
Ethnicity						
Dutch	85.17			90.52		
Western	8.66			6.13		
Non-western	6.17			3.34		
Gender						
Male	48.91			43.88		
Female	51.09			56.12		
Family Size						
One person	24.11			18.09		
Two persons	43.94			46.92		
Three persons	10.75			13.68		
Four persons	14.31			15.15		
Five persons	5.50			5.34		
Six persons or more	1.40			0.83		
Marital Status						
Married	55.30			69.27		
Separated or Divorced	11.65			13.46		
Widow or widower	6.89			3.16		
Never been married	26.17			14.11		
Employment						
Unemployed	18.92			24.23		
Employed	81.08			75.77		

(continued)

Table 1 (*continued*)

Observations	57,955	3,261
Individuals	11,016	381

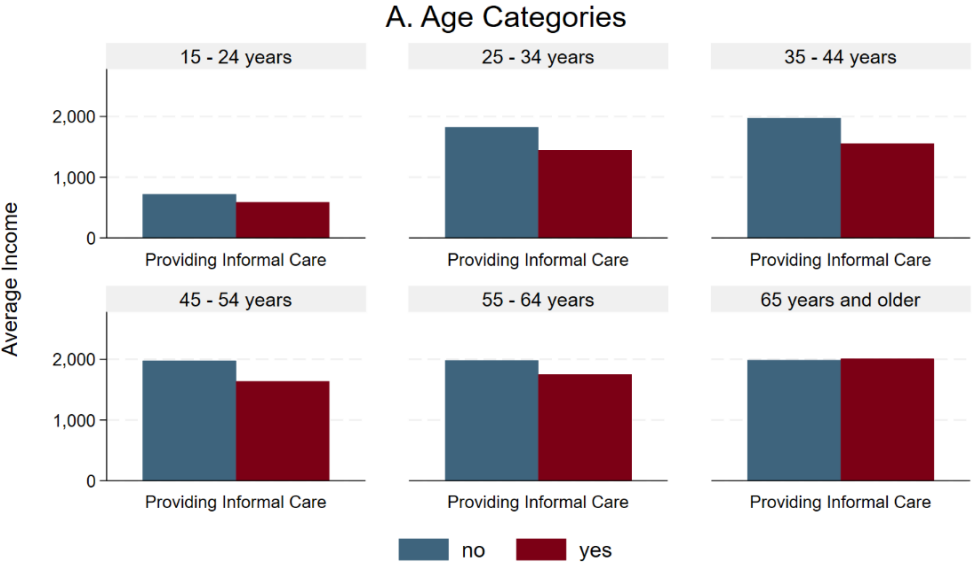
Notes: This table shows the mean and standard deviation of the continuous variable *Income* and *Age* (Column 2, 3, 5 and 6) and the percentage of each category of the categorical variables (Column 1 and 4). Columns 1, 2, and 3 display the descriptive statistics of the whole sample and columns 4, 5 and 6 display it for sample used in the Event Study. The mean of income is given in Euro's and Age in years. Numbers are rounded to two decimals.

The average net monthly income in the total sample is 1877 euros. When restricting the sample to people that perform informal care for at least three years at some point in the period of study, the average net monthly income declines to 1693 euros. Notably, the standard deviation of the full sample is large. The large standard errors of the average income highlights that the distribution of income is right-skewed, as shown in Figure C.1 in Appendix C. There are a few individuals with substantially larger monthly earnings. The median income of 1726 euros of per month, is therefore also slightly lower compared to the mean income. To limit the impact of the large standard deviation in the full sample, I will use the logarithm of *Income* in the Pooled OLS regressions.

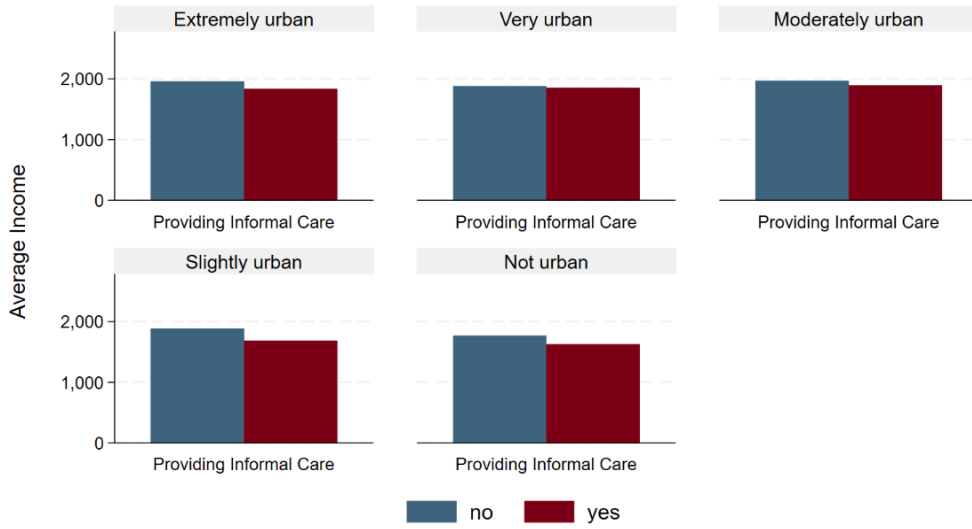
The percentage of people performing informal care is about 15 percent in the main study, while this percentage is 65 percent in the Event Study sample. This is a substantially higher percentage, mainly due to the selection of the sample as observations that never perform informal care are dropped. The average ages in the samples are 54 and 58, highlighting that the Event Study sample contains slightly older people, specifically relatively more individuals aged 45 to 64 years. When looking at the urban and educational background, the two samples show similar figures. Most people live in very, moderately, or slightly urban places and obtained a vmbo, mbo or hbo degree. About 85 percent of observations has a Dutch background in the total sample, which is moderately higher in the restricted sample. In both samples the proportion of women is relatively higher compared to men. For family size the samples are comparable, as about 45 percent of the observations is in a two-person household, 20 to 25 percent is in a one-person household, and 15 percent is a four-person household. In the total sample most people are either married or never married, while in the restricted sample 70 percent of the observations is married. Finally, in 75 to 80 percent of observations are employed.

Figure 1 shows the average income per gender, age, urban, education and ethnicity category, for giving and not giving informal care separately. In most cases, the average income when providing care is lower compared to when not giving informal care. In Panel A, the subgroup

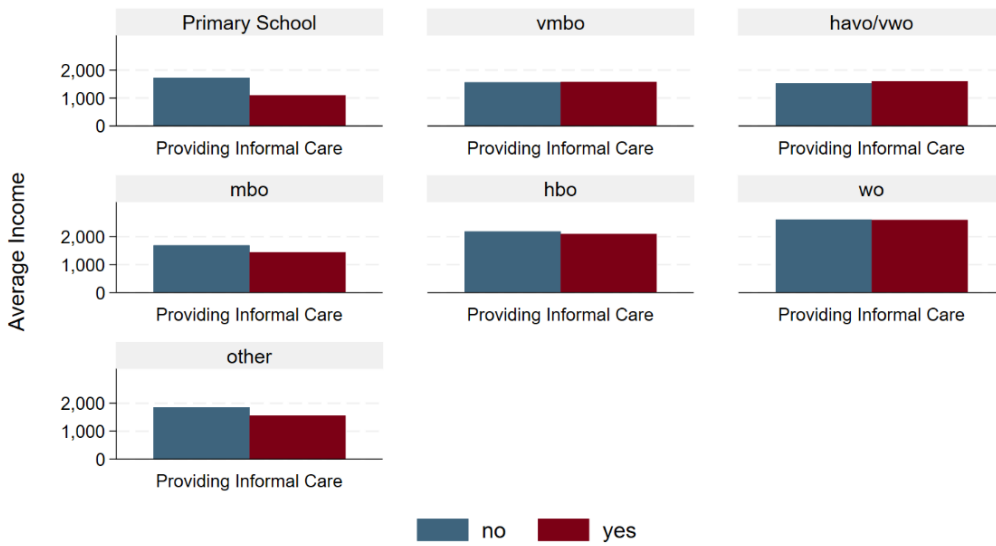
15-24 years always has lower average incomes. This may be explained by educational duties. For the age group 65 and older, the average income moves upwards when starting to provide informal care. The different magnitudes of the observed decrease may entail heterogeneous effects for the different age groups. When looking at the different urban backgrounds in Panel B, there are only minimal decreases shown. This may lead to insignificant effects of providing care on income. In Panel C, the average incomes for different educational groups are shown. When comparing the different educational levels, there seems to be ambiguous associations. For people with the highest finished education being primary school, mbo, hbo and other, there seems to be a decrease in average income when providing care. Though, for those with the highest level of completed education being vmbo, havo/vwo and wo, there seems to be no change or a marginally increase in incomes. In Panel D, people with a Non-western, Dutch and Western origin all seem to have a decrease in average incomes when comparing caregivers and non-caregivers. Though, the size of the decreases seems to differ per group, with Non-western background showing the most substantial decrease. Lastly, males and females seem to respond differently to providing care. Males show a moderate increase in average income, while females show a decrease in average income when starting to provide informal care.



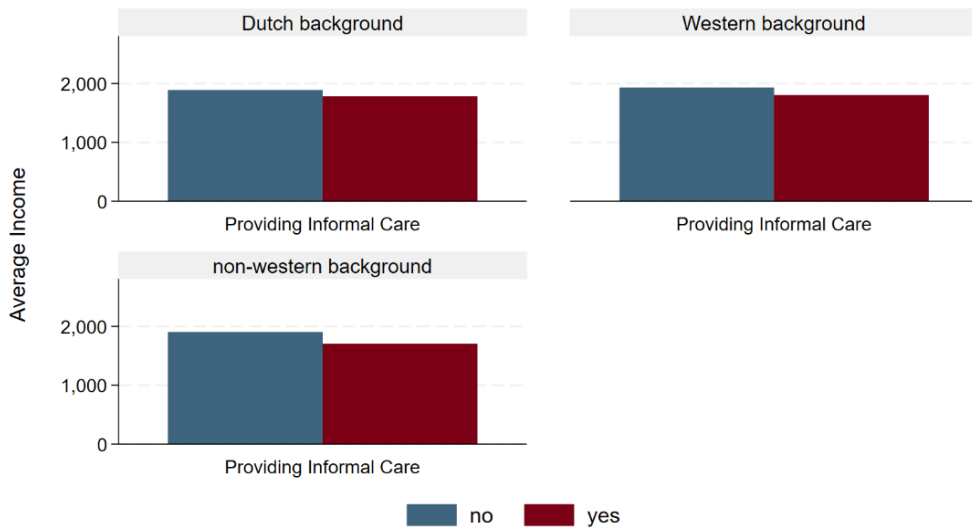
B. Urbanisation level



C. Educational level



D. Ethnical background



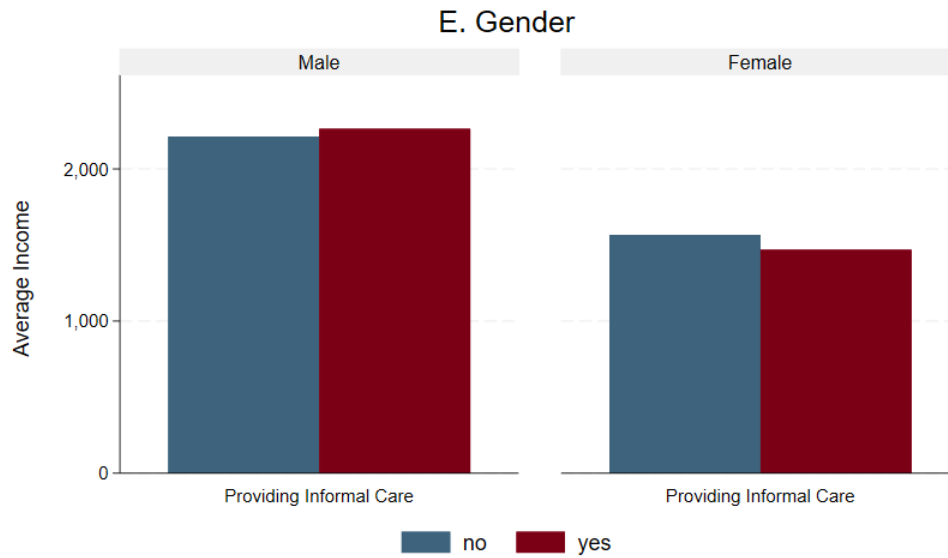


Figure 1. Average income levels per subgroup

Notes: This figure shows the average income per subgroup. Averages are shown for observations not giving and giving informal care separately. Panel A, B, C, D and E shows the Age, Urban, Education, Ethnicity, and Gender categories, respectively.

4. Results

4.1 Main results

This section presents the main results needed to answer the research question whether providing informal care is associated with a wage penalty in the Netherlands. First, the results of the Pooled OLS method are presented in Table 2. Column 1 of Table 2 displays the findings when including *Age*, *Education*, *Urban*, *Ethnicity*, and *Gender* as control variables. It shows that providing informal care is associated with a statistically significant decrease of 1.45 percent income per month compared to not providing informal care at the 5 percent significance level, *ceteris paribus*. As shown in Table 1, the average net income per month in the sample is 1,877 euros. A decrease of 1.45 percent would therefore correspond to a decrease of about 27 euros per month and 327 euros per year. This highlights the economic significance of these findings, especially as the right-skewed distribution of income indicates that majority of people in the sample have lower wages at which 1.45 percentage of wage loss could result in an increased financial burden.

These main results found confirm previous studies. As described in section 2.2 informal caregivers often experience conflict between employment and their caregiving duties. This explains why in many previous studies, such as studies from Heitmueller and Inglis (2004; 2007), Schulz and Monin (2011), Wakabayashi and Donato(2005), van Houtven et al. (2010; 2013), Raiber et al. (2022), and Schmitz and Westphal (2017), they find a negative association between providing informal care and wages. This is in line with my findings as the main association between providing informal care and earnings in Column 1 of Table 2 is negative.

When looking at the magnitude of the association, the 1.45 percent found is relatively small compared to previous studies. Van Houtven et al. (2013) find a wage loss of 3.1 percent for women providing care. Heitmueller and Inglis (2004, 2007) find overall wage losses of 2 to 10 percent. The wage loss of 750 US Dollars found by Wakabayashi and Donato (2005) in their study corresponds to approximately 6 percent. Comparing these results, let me conclude the size of the coefficient found is relatively small.

Table 2. Regression Results Pooled OLS

	(1)	(2)	(3)	(4)
	Log(Income)	Log(Income)	Employment	Employment
Informal Care	-0.0148** (0.0058)	0.0231 (0.0202)	-0.0254*** (0.0064)	-0.0409 (0.0287)
Age				
15-24 years	-0.771*** (0.0275)	-0.770*** (0.0278)		
25-34 years	-0.109*** (0.0157)	-0.107*** (0.0158)		
35-44 years	0.0035 (0.0142)	0.0034 (0.0142)	-0.0150** (0.00609)	-0.0154** (0.00616)
45-54 years	0.0423*** (0.0124)	0.0447*** (0.0126)	-0.0334*** (0.0079)	-0.0323*** (0.0079)
55-64 years	0.0073 (0.0105)	0.0095 (0.0109)	-0.0671*** (0.0092)	-0.0663*** (0.0093)
Informal Care * Age				
15-24 years		0.0063 (0.0883)		
25-34 years		-0.0369 (0.0293)		
35-44 years		0.0046 (0.0182)		0.0013 (0.0190)
45-54 years		-0.0129 (0.0135)		-0.0132 (0.0177)
55-64 years		-0.0099 (0.0142)		-0.0125 (0.0176)
Education				
Primary school	-0.254*** (0.0412)	-0.250*** (0.0412)	-0.0143 (0.0509)	-0.0138 (0.0454)
Havo/Vwo	0.0503 (0.0320)	0.0553* (0.0326)	0.0687*** (0.0215)	0.0648*** (0.0212)
Mbo	0.269*** (0.0234)	0.276*** (0.0237)	0.0874*** (0.0189)	0.0869*** (0.0188)
Hbo	0.521*** (0.0219)	0.528*** (0.0221)	0.135*** (0.0160)	0.129*** (0.0160)
Wo	0.686*** (0.0278)	0.691*** (0.0280)	0.161*** (0.0162)	0.157*** (0.0162)
Other	0.0812** (0.0403)	0.0769* (0.0415)	0.0696*** (0.0258)	0.0722*** (0.0270)
Informal Care * Education				
Primary school		-0.0320 (0.0320)		0.0020 (0.105)
Havo/Vwo		-0.0285 (0.0255)		0.0272 (0.0243)
Mbo		-0.0416** (0.0187)		0.0056 (0.0220)
Hbo		-0.0403** (0.0167)		0.0392* (0.0211)
Wo		-0.0387* (0.0223)		0.0336 (0.0250)
Other		0.0367 (0.0306)		-0.0176 (0.0483)

(continued)

Table 2. (continued)

Urban				
Very urban	-0.0189** (0.0093)	-0.0210** (0.0096)	-0.0123 (0.0081)	-0.0117 (0.0084)
Moderately urban	-0.0127 (0.0121)	-0.0158 (0.0123)	-0.0055 (0.0088)	-0.0068 (0.0091)
Slightly urban	-0.0242** (0.0119)	-0.0240** (0.0122)	-0.0146 (0.0092)	-0.0168* (0.0096)
Not urban	-0.0419*** (0.0133)	-0.0416*** (0.0137)	-0.0165 (0.0104)	-0.0161 (0.0106)
Informal Care * Urban				
Very urban		0.0143 (0.0154)		-0.0044 (0.0171)
Moderately urban		0.0221 (0.0170)		0.0075 (0.0189)
Slightly urban		-0.0019 (0.0168)		0.0158 (0.0193)
Not urban		-0.0021 (0.0192)		0.0001 (0.0199)
Ethnicity				
Western	-0.0328* (0.0183)	-0.0337* (0.0184)	-0.0368*** (0.0141)	-0.0380*** (0.0143)
Non-western	-0.106*** (0.0214)	-0.105*** (0.0215)	-0.0823*** (0.0159)	-0.0867*** (0.0161)
Informal Care * Ethnicity				
Western		0.0066 (0.0175)		0.0091 (0.0220)
Non-western		-0.0054 (0.0261)		0.0339 (0.0298)
Gender				
Female	-0.383*** (0.0103)	-0.380*** (0.0104)	-0.0709*** (0.0073)	-0.0704*** (0.0074)
Informal Care * Gender				
Female		-0.0180 (0.0113)		-0.0008 (0.0136)
Constant	7.303*** (0.0228)	7.297*** (0.0229)	1.826*** (0.0192)	1.829*** (0.0193)
Family Size included	Yes	Yes	Yes	Yes
Marital Status included	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
R-Squared	0.3871	0.3875	0.0804	0.0808
Observations	57,955	57,955	34,207	34,207
Individuals	11,016	11,016	7,554	7,554

Notes: This table shows the regression results using Pooled OLS. In column one and two, informal care is regressed on the logarithm of net monthly income. Informal care is a dummy variable containing whether someone provides informal care or not. Column three and four uses employment as main dependent variable. It is tested whether providing informal care changes the probability of being in paid employment or self-employed compared to being unemployed. This is tested for people of working-age, 24 to 64 years. The reference age group is the group 24 to 35 years in these two columns. In column one and three, Age, Urban, Education, Ethnicity, and Gender are added as control variables. In column two and three, these variables are additionally added as interaction terms. In all columns, the variables Family Size and Marital Status and year fixed effects are included. Robust standard errors are in parentheses and rounded to four decimals. *** p<0.01, ** p<0.05, * p<0.1

To assess the potential of a dynamic association over time, I apply an Event Study. Figure 2 shows the main result of the Event Study. The accompanied regression results can be found in Appendix D. When inspecting Figure 2, the parallel trend assumption seems to hold as the confidence intervals of the periods before starting to provide care do cross with zero indicating no significant association before starting to provide care. This is confirmed by testing for the joint significance of these two periods. This results in a p-value of 0.221. Therefore, there seems to be no parallel trends in the periods before the event.

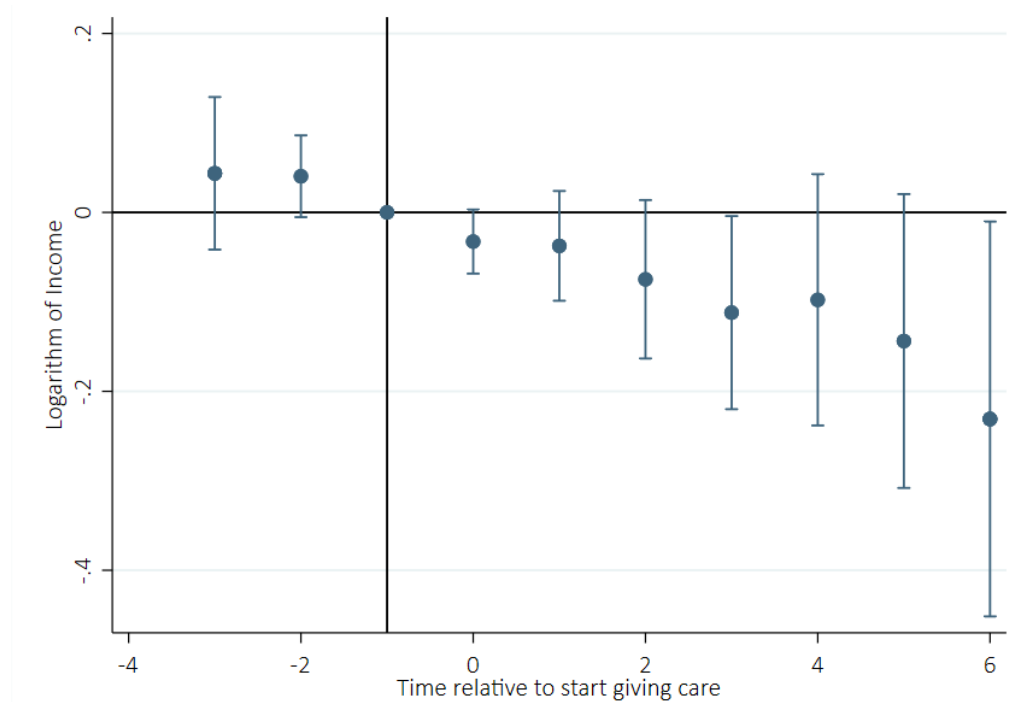


Figure 2. Wage penalty experienced by informal caregivers over time

Notes: This figure shows the wage penalty experienced by informal caregivers in the Netherlands obtained by applying an Event Study and regressing the time relative to performing informal care for the first year on the logarithm of the net monthly income. It shows the dynamic aspect of the association over time. The year before starting informal care is taken as reference point. Accompanying coefficients can be found in Appendix D.

When examining the periods after the event, there seems to be a wage penalty which increases over time. The size of association decreases from about minus 4.4 percent lost earnings per month in the period that the caregivers start to provide care to about minus 23.1 percent forgone income per month in year six after starting to provide informal care. As shown in Appendix D, when applying the Event Study on income directly, this results in magnitudes of lost earnings between 46 euros and 367 euros per month. In all cases, these magnitudes are massive. The increase of the association over time may be due to increased intensity experienced as longer period of caregiving is associated with higher intensity of care (Casado-Marin et al., 2011).

Higher intensity care has the consequence of increased effects on employment and health, as described in section 2.3.

Though, only when providing 3 or 6 years of care, these associations are statistically significant at the 5 percent significance level. When applying an F-test for joint significance of the periods after starting to provide care, a p-value of 0.164 is found. Therefore, I do not reject the null hypothesis of similar wages before and after starting to provide informal care. There is not enough statistical evidence to state that informal caregiving has influence on wages in all periods.

These Event Study results are more ambiguous compared to my previous results and results of previous studies in which clear wage penalties are found. It is in line with Schmitz and Westphal (2015) who find solely long-term effects and no short-term effects.

4.2 Heterogeneity in the wage penalty

In Column 2 of Table 2, I test for heterogeneity in the association between informal caregiving and income by adding interaction terms between *Informal Care* and *Age*, *Gender*, *Education*, *Urban* and *Ethnicity*. The main association between informal care and income increases to 2.3 percent gained earnings per month when providing care in this column. It is statistically insignificant at the 10 percent significance level and it is specifically for reference individuals who are male, aged 65 years or older, have the highest completed education vmbo, live in an extremely urban area and have a Dutch ethnicity.

When inspecting whether this association is different for various age groups, the statistically insignificant results highlight the lack of heterogeneity based on age. This is surprising as literature raises the expectation that there may be a stronger association for the younger age groups due to larger work-care conflicts and for older age groups that are closer to retirement as they tend to take early retirement and stop working (Raiber et al., 2024). I do not find such heterogeneity. Compared to individuals 65 years or older, individuals aged 15 to 35 years do show lower wages at the 1 percent significance level, while individuals aged 45 to 54 years are associated with higher wages compared to people 65 years or older. In Column 4, I also add the interaction terms in the regression of informal care on employment to test whether the mechanism employment status shows the same pattern for different subgroups as the main

association between caregiving and income does. It seems that there is neither a significant heterogeneity for different age groups in the association with employment.

When looking at the different educational group, some heterogeneous associations can be found. People that have completed mbo, hbo and wo are associated with higher income losses when providing care compared to individuals having completed vmbo as highest educational level, at the 10 percent statistical significance level, *ceteris paribus*. These increases in wage penalties range from 3.9 to 4.2 percent, which is quite large in absolute numbers. Current literature fails to identify heterogeneous effects of different socio-economic groups as identified in section 2.3. Low socio-economic people may find themselves in a position of no option to quit working due to financial constraints (Bauer & Sousa-Poza, 2015). Higher socio-economic groups may have a choice between providing care themselves or outsourcing it but do face substantial higher opportunity costs (Carmichael et al., 2010; Tokunaga & Hashimoto, 2017). I find that continuing education after secondary school does enlarges the wage penalty experienced by caregivers. It is difficult to identify what drives this association as opportunity costs may explain why people completing mbo, hbo or wo compared to vmbo may experience higher wage penalties. Though if this is true, I would expect that the wo group with the highest levels of income would show the biggest losses, which is not true in Table 2. Also, the mechanism of employment status may solely be present for the hbo group.

The association between informal care and earnings or employment does not seem to differ for individuals with different urban backgrounds. Previous studies by Casado-Marin et al. (2011), Cohen et al. (2022), McKenzie et al. (2010) and Wang et al. (2021) highlight that factors such as labour market opportunities, formal care availability, and demographic composition may cause heterogeneous effects. It may be that these factors are not relevant in the Netherlands due to density of the country. Even though, individuals in very urban, slightly urban and not urban areas are associated with lower earnings compared to individuals living in extreme urban areas, *ceteris paribus*.

The ethnical background of individuals does neither show any heterogeneity, both for income and employment. This is opposing current literature as it shows that language barriers, discrimination, monetary barriers and family culture may result in higher informal care frequencies and wage consequences for minorities (Rote & Moon, 2018; Cohen et al., 2019; Covinsky et al., 2001). Monetary barriers may be present as people with a Western or Non-

Western background are associated with statistically significant lower net monthly income compared to individuals with a Dutch background, *ceteris paribus*. The other mechanisms mentioned in previous literature, seem to be missing as there is no statistically significant heterogeneity found.

Lastly, the gender of the caregiver seems to have no influence on the wage penalty experienced as the coefficient of the interaction term with gender is statistically insignificant at the 10 percent significance level, both for income and employment in Table 2. This while females are associated with lower earnings and a lower share of employed individuals compared to males, with percentages around 38 percent and 7 percent respectively. Also, literature highlights that women provide on average more informal care and experience larger pressure and intensity (Wakabayashi & Donato, 2005; Le & Ibuka, 2023), which results in larger employment, wage and mental health consequences (Arber & Ginn, 1995; Bauer & Sousa-Poza, 2015; Bom et al., 2019; Covinsky et al., 2001; Henz, 2006; Le & Ibuka, 2023; Xue et al., 2023). It might be that men experience higher opportunity costs which results in larger associations for this group (Kolodziej et al., 2018; Raiber et al., 2022), though literature finds less evidence for this argument.

To get a better understanding of the impact of gender in wage penalties, I also applied the Event Study for females and males separately. Results are shown in Figure 3 and Appendix D. In figure 3 the evidence for a heterogeneous association between informal care and income over time for the two genders is limited of scope. For both groups, the periods before starting to provide care are jointly insignificant, indicating that pre-trends are unlikely. After starting to provide care, especially male caregivers do show substantial wage losses over time. This is confirmed when applying an Event Study on income directly as done in Figure D.2 in Appendix D. Especially after five and six years after starting to provide care, the wage penalty reach up to 24.7 percent per month which is statistically significant at the 5 percent significance level. This corresponds to a value of more than 500 euros per month. For females there also seem to be a wage penalty which is smaller compared to males, but still of considerable magnitude.

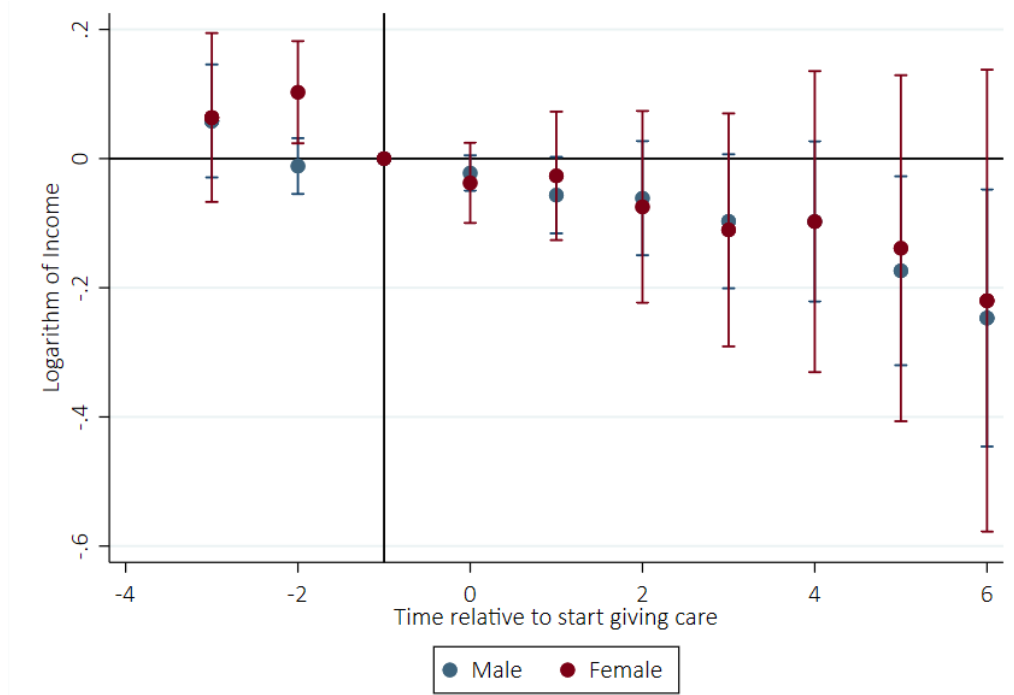


Figure 3. Wage penalty experienced by informal caregivers over time by gender

Notes: This figure shows the wage penalty experienced by informal caregivers in the Netherlands obtained by applying an Event Study and regressing the time relative to performing informal care for the first year on the logarithm of the net monthly income. It shows the dynamic aspect of the associations over time for males and females separately. The year before starting to provide informal care is taken as reference point. Accompanying coefficients can be found in Appendix D.

The association for females is not statistically significant. When looking at the joint significance of all periods after the event for the two genders separately, the coefficients for male caregivers result in a p-value of 0.049 and the coefficients for female caregivers result in a p-value of 0.735. For male caregivers, I do reject the null hypothesis of similar wages before and after starting to provide care at the 5 percent significance level. Though, for female caregivers, I do not reject this null hypothesis. Therefore, I conclude that there appears to be a wage penalty especially for male caregivers after a few years of providing care. This result is consistent with Raiber et al. (2022) who also find in the Netherlands substantial wage penalties for specifically men.

4.3 Employment as possible mechanism

Providing informal care often result in reduced employment, either at the intensive or extensive margin (Raiber et al., 2024; Mozhaeva, 2021). This can be a mechanism for wage penalties. To

examine whether the extensive margin operates as a mechanism, I regress informal care on the employment status for people in the working ages using Pooled OLS. The results can be found in Table 2 Column 3 and 4. In Column 3 *Age, Education, Urban, Ethnicity* and *Gender* are added as control variables. In Column 4 they are added as interaction terms.

The result indicates that when people provide informal care, they are indeed associated with a lower likelihood to be employed, *ceteris paribus*. The size of this association is 2.54 percent. As shown in Column 4, this association is slightly higher, i.e. 4.09 percent, for reference individuals who are men, are 25 to 34 years of age, have completed vmbo as the highest education, live in an extremely urban area and have a Dutch ethnicity. As 81 percent of the sample is employed, a reduction of 2.54 percent corresponds to a substantial absolute number of people. In line with Bauer and Sousa-Poza (2015), Bolin et al. (2008), Casado-Marin et al. (2011), Ciani (2012), Heitmueller and Inglis (2004), Henz (2006), Kolodziej et al. (2018), Michaud et al. (2010), Mozhaeva (2021), van Houtven et al. (2010; 2013) and Raiber et al. (2024), the extensive margin of employment is reduced when comparing caregivers to non-caregivers. The employment status can therefore be a possible mechanism of the wage penalty found before.

Preferably, informal care would also be regressed on the hours worked to test whether the intensive margin of employment possibly functions as mechanism too. Though, due to data availability this is not possible. However, there is a variable present for caregivers that indicated to work less due to caregiving duties which shows how many hours those people started to work less. This variable may give some indication on the association between informal care and hours worked per week. More information about the variable can be found in Appendix B. The frequencies of the different answers given are shown in Figure 4. It is shown that most individuals who answered this question reduced their hours with less than 20 hours a week with a peak at a reduction of 8 hours per week. This figure, therefore, gives the indication that reducing employment at the intensive margin may be a mechanism through which the wage penalty can be found.

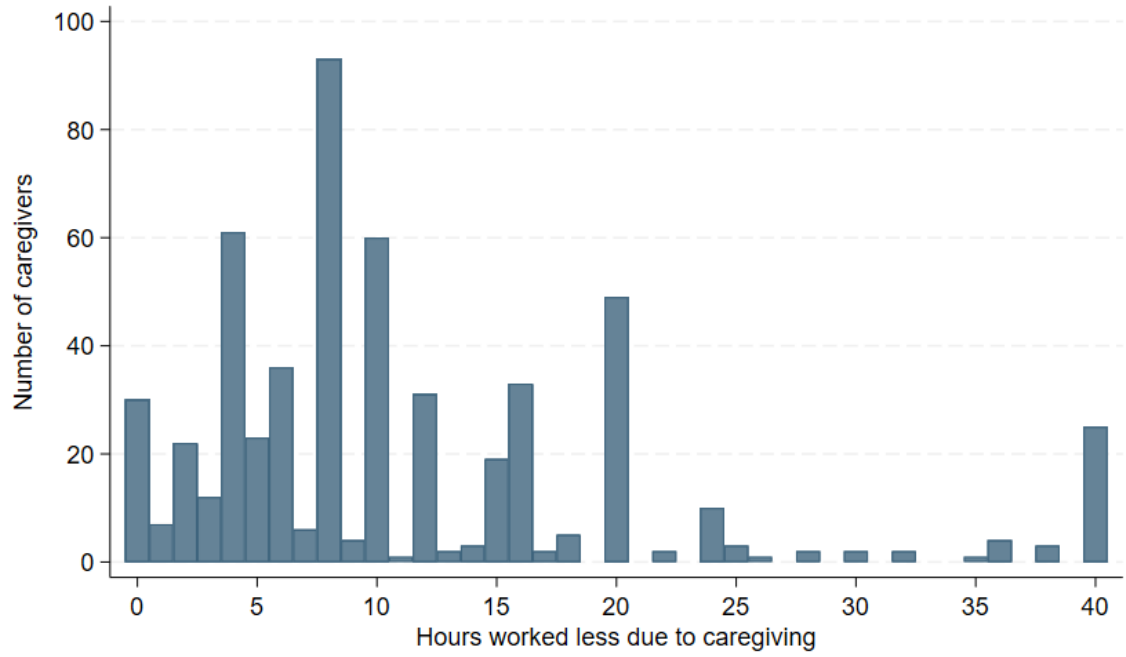


Figure 4. Distribution of hours worked less due to caregiving

Notes: This figure gives an indication of how many hours people report to work less due to their caregiving duties. In total, 554 observations were present for this variable.

5. Discussion and Conclusion

In this paper, I study whether providing informal care is associated with wage losses for caregivers in the Netherlands. Specifically, I research losses in net monthly income due to informal caregiving between 2012 and 2023 using the LISS panel dataset. In 2019 approximately 5 million Dutch people provided informal care which corresponds to 35 percent of the population (de Boer et al., 2020). Demographic and health changes of the Dutch population and a policy shift towards less formal care, constitute the expectation that this number increases in the near future (Bolin et al., 2008; Borg & Hallberg, 2006; de Boer et al., 2020; Elayan et al., 2024; Zigante, 2018; Johnson & Lo Sasso, 2006; Hoefman et al., 2019; Kolodziej et al., 2018; Koopman et al., 2020; McKenzie et al., 2010; Michaud et al., 2010; Schmitz & Westphal, 2015; Schofield et al., 2019; van Houtven et al., 2010; Verbakel, 2014). Previous literature highlights that providing informal care may have a direct effect of a work-care conflict which can lead to working less hours or quitting employment entirely (Arber & Ginn, 1995; Bauer & Sousa-Poza, 2015; Bolin et al., 2008; Casado-Marin et al., 2011; Ciani, 2012; Heitmueller & Inglis, 2004; Henz, 2006; Johnson & Lo Sasso, 2006; Kolodziej et al., 2018; Krol et al., 2015; Michaud et al., 2010; Mozhaeva, 2021; van Houtven, 2010, 2013; Wakabayashi & Donato, 2005; Raiber et al., 2024). Consequently, wage losses can be expected when starting to provide care. Several studies indeed find such a wage penalty when comparing caregivers to non-caregivers. The wage penalties found range from 0.40 US dollar loss per hour (van Houtven et al., 2010; 2013) to 11 euros per hour (Raiber et al., 2022).

When inspecting the general association between income and providing informal care by applying a Pooled OLS, my results show that providing informal care is associated with a statically significant decrease of 1.45 percent monthly income compared to not providing informal care, *ceteris paribus*. This association found may be due to consequences of providing care on employment as informal caregiving is associated with a higher probability of being unemployed. Also, there is some evidence that informal caregiving is associated with working less hours. However, this evidence is limited of scope.

An innovative aspect within my study is that I investigates the dynamics of the association between informal caregiving and wages over time when applying an Event Study. I emphasize the correlation for each year after starting the provision of informal care up to six years after

this event. This is important as wage consequences can accumulate over time and can have lifelong consequences (Johnson & Lo Sasso, 2006; Kolodziej et al., 2018; Mozhaeva, 2021, Raiber et al., 2024; van Houtven et al., 2010, 2013). The other major advantage of applying an Event Study is the comparison of individuals that provide informal care to individuals that will provide informal care in the future, but do not do this yet. As certain groups of people tend to self-select into caregiving (Carmichael et al., 2010; Ervin et al., 2022; Michaud et al., 2010; van Houtven et al., 2010; Schulz and Monin, 2011; Nizalova, 2012), comparing caregivers to future caregivers may give more accurate results as these two groups may be more valid counterfactuals compared to caregivers and non-caregivers. The disadvantage of this method is that the number of observations drops massively when applying the restriction of having to provide at least three years at some point of time in the period of study. This reduces the statistical power of the analysis. Fortunately, the overall quality of the data used in my study is of a particularly high standard and contains a high number of observations over time.

The results of the Event Study led me reach the conclusion that there is suggestive evidence of a wage penalty for informal caregivers in the Netherlands which grows over time and can reach considerable levels, despite the joint insignificance of the coefficients.

The relationship between informal care and income does not vary significantly between different age groups, ethnical backgrounds, and urban backgrounds. The relationship seems to show heterogeneity for different educational levels. Individuals who have completed mbo, hbo and wo are associated with higher income losses when providing care compared to individuals who have completed vmbo as the highest educational level. Underlying causes of these results remain unclear. Further study is necessary to reveal this.

Previous literature highlight that especially for gender there may be heterogeneity, due to consistent gender roles in society (Johnson & Lo Sasso, 2006; Xue et al., 2023). At first sight, I do not find statistically significant heterogeneity between men and women. Though, when inspecting the dynamic aspect of this relationship for the different genders, there seems to be substantial wage losses especially for men. Over time, informal care is association up to about 24.7 percent or 500 euros loss in monthly earnings for males. Therefore, I conclude that even though the weak statistical power, there seems to be wage losses for particularly male caregivers.

Overall, there seems to be a significant wage penalty for informal caregivers in the Netherlands which may be driven by employment adaptation. This relationship seems to grow over time and may especially present for male caregivers and caregivers having obtained hbo, wo, or mbo as the highest educational level.

These findings are not surprising and mostly confirm the hypotheses. As described in section 2.2, most previous studies do find a negative association between informal care and income. Raiber et al. (2022) also investigate wage penalties in the Netherlands in about the same time period but with a different method and a different dataset. They find wage penalties of 2 euros for women and of 11 euros for men in the Netherlands. My results of a statistically significant wage penalty and particularly for male caregivers align almost perfectly with these previous findings.

As mentioned in the result section, the magnitudes found in the Pooled OLS regressions are relatively small compared to other studies. There may be several factors contributing to this observation. One explanation may be found in the inclusion of retired individuals and young individuals still attending education in the dataset. For these individuals, employment is not relevant. Therefore, they may experience no work-care conflict which results in no wage penalty for these groups. As shown in Table 1, almost 30 percent of the observations are retired. Thus, this may have major influence. Another factor may be that most informal caregivers already experience a high burden of caregiving (de Boer et al., 2020). Therefore, they may not participate in the LISS surveys as this requires additional time from the caregivers. Though, these individuals who decide to not participate may experience the biggest wage losses. Lastly, when comparing the magnitude of the results to other countries, it is important to note the social security system and the part-time work culture in the Netherlands. As Elayan et al. (2024) and Raiber et al. (2024) emphasize, a relatively high share of Dutch women works part-time. When working part-time, there is more time left for caregiving without having to make sacrifices such as quitting employment or having an unpaid leave. This may result in a smaller wage loss. Additionally, the Netherlands is internationally known for its high level of employment security (Raiber et al., 2024). Also, it is a frontrunner in supportive policies for informal caregivers (Zigante, 2018). These generous compensations may result in less work-care conflict, which may lead to not modifying employment and therefore no consequences for wages. The results

found may therefore being relatively small and arguably guide as a lower bound in the international context.

When examining the heterogeneity in the association between informal caregiving and wages, the findings highlight that heterogeneity for various age, urban, and ethnical groups is lacking. Literature highlights various mechanisms why heterogeneity is found in other settings. Examples are the possibility of early retirement for individuals of older ages (Raiber et al., 2024), the availability of formal care in rural areas (Casado-Marin et al., 2011), and discrimination and barriers for minorities (Rote & Moon, 2018; Cohen et al., 2019). Finding no significant heterogeneity may also entail that these different mechanisms counteract and interact with each other, making heterogeneity more complex than thought. Due to a lack of variables on this topic, I ignore the mechanisms, though, they should be investigated in further studies.

As described in section 3.3, a major limitation of the data is that there is a substantial number of individuals who withdraw from caring, who pause caregiving for some years in between, or who drop out of the data for a few time periods. The current methods used are not able to address this issue. Therefore, I restricted the data to individuals who perform care at least three periods in the period of study. It is important to note that the threshold of three years is arbitrarily chosen. I assume that three years of caregiving has substantial influence on other choices made in life. In further studies, other thresholds and econometric methods which can address this data issue should be considered. In other disciplines, methods are developed who can tackle this data issue. When utilizing multiple imputation methodology, missing values are replaced by estimated values (Oostenbrink, Maiwenn, & Rutten-van Molken, 2003). Other examples of such methods are as-treated and intention-to-treat analyses which look at people who actually do the treatment the total period of study or people's initial treatment, respectively (Felker & Teerlink, 2010).

Additionally, in further studies it would be beneficial to investigate other methodologies to cope with issues due to self-selection into caregiving, omitted variable bias, and reverse causality. For instance, with the Instrumental Variable (IV) method the independent variable is estimated with an explanatory variable and this explanatory variable is regressed on the outcome variable. When this variable and the outcome variable do not correlate, this method gives causal effects. Ciani (2012) used the presence of a disabled individual or an individual with a poor health in the household as an IV for informal caregiving.

In summary, this study confirms that there may be wage penalties for informal caregivers in the Netherlands. Policy makers should pay attention to this as it concerns a substantial number of people in the country. Even though the Netherlands already develops policies aiming at reducing the financial burden of caregiving (Zigante, 2018), more should be done. Especially as the number of caregivers and therefore number of people experiencing a wage loss is expected to increase, partially due to policy directions chosen by them. Also, attention should be paid to whether caregivers know and are able to apply for support schemes. The findings concerning the lack of heterogeneity in the association entail that there are no additional support programs, trainings or cash benefits targeted at specific age, urban, and ethnical subgroup needed. Specifically attention should be paid to male caregivers and caregivers who provide care for a longer period within specific informal care policies.

6. Appendix

6.1 Appendix A

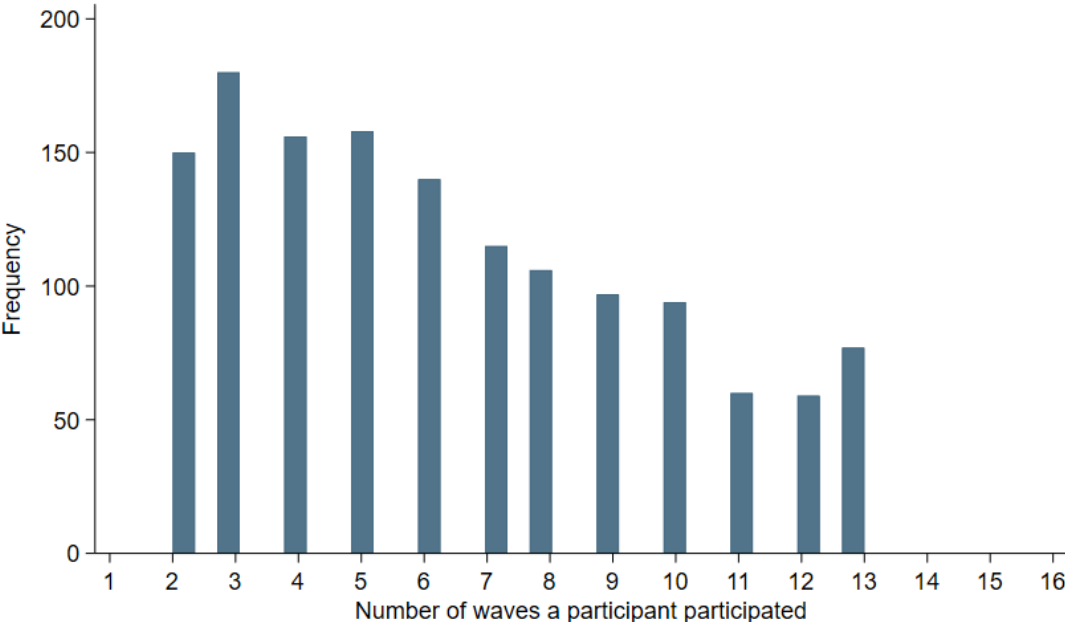


Figure A.1. Distribution of the number of waves individuals participate in the Work and Schooling Study

Note: This figure shows how many waves the individuals in the sample participate in the Work and Study survey. There are 11,016 individuals and individuals do participate on average five waves.

6.2 Appendix B

This Appendix shows the questions asked in the surveys which are the base for the variables used. These questions are cited from the codebook and online questionnaire. For simplicity some answers are aggregated into one category. If this is the case, this will be indicated in italics under the variable explanation.

Income

Background Variables - (Elshout, 2022) (Data Archive LISS Data, sd)

For research such as this, it is important that we can roughly classify households in income groups.

Using the list below, please enter the requested information about the monthly income of the member of your household.

Yourself

[Person 2]

[Etc.]

Please enter the amount only, so without euro currency sign, decimal points or commas, or any letters.

If a member of your household does not have any income, enter a 0 (zero) for the gross and net monthly income.

Estimate based on bruttoink if net income not entered. For more information see on our website: 'Imputation income LISS until sept 2011.pdf', Klaas de Vos, 2008. From September 2011 see file: 'imputation income LISS from sept 2011.pdf', Klaas de Vos, 2011

Employment

Background Variables - (Elshout, 2022) (Data Archive LISS Data, sd)

Please indicate in the list below what best describes the members of your household. Principal occupation

Yourself

[Person 2]

[Etc.]

1 Paid employment

2 Works or assists in family business

3 Autonomous professional, freelancer, or self-employed

4 Job seeker following job loss

5 First-time job seeker

6 Exempted from job seeking following job loss

- 7 Attends school or is studying
- 8 Takes care of the housekeeping
- 9 Is pensioner ([voluntary] early retirement, old age pension scheme)
- 10 Has (partial) work disability
- 11 Performs unpaid work while retaining unemployment benefit
- 12 Performs voluntary work
- 13 Does something else
- 14 Is too young to have an occupation

Individuals in group 1, 2, and 3 are assembled in the category employed. Individuals in group 4, 5, 6, 8, 10 and 11 are merged in the category unemployed. Other categories are not taken into consideration.

Informal Care

Q450 Work and Schooling Study - (Streefkerk, 2023)

Do you provide informal care?

Informal care is care provided to chronically ill, handicapped or needy persons by close relations such as: family members, friends, acquaintances, and neighbours. Informal care is typified by the previously existing personal tie between the care giver and receiver. The care provided can be household care, personal care, or administrative help. Informal care is typically also long-lasting care without payment.

1 yes

2 no

Gender

Background Variables - (Elshout, 2022) (Data Archive LISS Data, sd)

Please enter the name, gender, and birth date of every member of your household, including yourself. Also enter this information for members not participating in the panel. Further on in this questionnaire you can indicate which of these persons are participating and which are not.

1 Male

48

2 Female

3 Other

The option other is dropped as it is only present since 2022 and 9 observations had this answer. This is too small for valid results.

Age

Background Variables - (Elshout, 2022) (Data Archive LISS Data, sd)

Calculated based on: Please enter the name, gender and birth date of every member of your household, including yourself. Also enter this information for members not participating in the panel. Further on in this questionnaire you can indicate which of these persons are participating and which are not.

1 14 years or younger

2 15 - 24 years old

3 25 - 34 years old

4 35 - 44 years old

5 45 - 54 years old

6 55 - 64 years old

7 65 years or older

The category younger than 14 years is not present as the Work and Schooling Survey is done with people above 16 years of age.

Family

Background Variables - (Elshout, 2022) (Data Archive LISS Data, sd)

This questionnaire contains questions about the composition of your household.

It is important that you consider ALL members of your household. That is, including children AND people that are not participating in the panel. Further on in this questionnaire you can indicate which of these persons are participating and which are not.

The following persons are considered to be members of a household:

- The head of the family.
- The partner of the head of the family, married or unmarried.
- All children living at home. Children not or no longer living at home do not count as household members.
- All other persons ‘boarding’ with you, meaning that they share meals with you and stay the night in your house, and so on. These could include, for example, parents or parents-in-law that live with you.
- These persons are considered part of the household if they normally spend at least four days a week in your home, sharing meals and staying the night, and so on.

How many members does your household consist of, including yourself? (also count persons not participating in the panel)

1 one person

2 two persons

3 three persons

4 four persons

5 five persons

6 six persons

7 seven persons

8 eight persons

9 nine persons or more

The groups 7, 8, and 9 are added to the group six persons. This due to the small number of observations in the groups 6, 7, 8, and 9.

Marital Status

Background Variables - (Elshout, 2022) (Data Archive LISS Data, sd)

Using the list below, can you please indicate the civil status of each member of your household?
What best describes their situation?

Yourself

[Person 2]

[etc.]

A person is separated if he/she is still married by law, but no longer lives together with his/her spouse.

- 1 Married
- 2 Separated
- 3 Divorced
- 4 Widow or widower
- 5 Never been married

Group 2 and 3 are merged into the group Separated or Divorced.

Urban

Background Variables - (Elshout, 2022) (Data Archive LISS Data, sd)

Urbanity of residence

- 1 Very strongly urban
- 2 Strongly urban
- 3 Moderately urban
- 4 Little urban
- 5 Non-urban

Urbanity: area density per km²

- very strong 2,500 or more
- very strong 1,500 to 2,500
- moderate 1,000 to 1,500
- little 500 to 1,000
- not less than 500

Education

Background Variables - (Elshout, 2022) (Data Archive LISS Data, sd)

In the table below, please indicate the educational level of the members of your household. Select the highest level that a person ever attended or is attending now. After that, select the highest level that this person has already completed (with a diploma or certificate).

- 1 primary school
- 2 vmbo
- 3 havo/vwo
- 4 mbo
- 5 hbo
- 6 wo
- 7 others
- 8 Not finished any education (yet)
- 9 Is still following education

The groups 7, 8 and 9 are merged into one group: others.

Ethnicity

Background Variables - (Elshout, 2022)

Origin

- 0 Dutch background
- 101 First generation foreign, Western background
- 102 First generation foreign, non-western background
- 201 Second generation foreign, Western background
- 202 Second generation foreign, non-western background
- 999 Origin unknown or part of the information unknown (missing values)

The groups are added to three groups: 0 Dutch background, 1 Western background (101 and 201), and 2 non-western background (102 and 202).

Hours Worked Less

Q450 Work and Schooling Study - (Streefkerk, 2023)

How many hours per week have you started working less because of this informal care, and since when?

Open Question

6.3 Appendix C

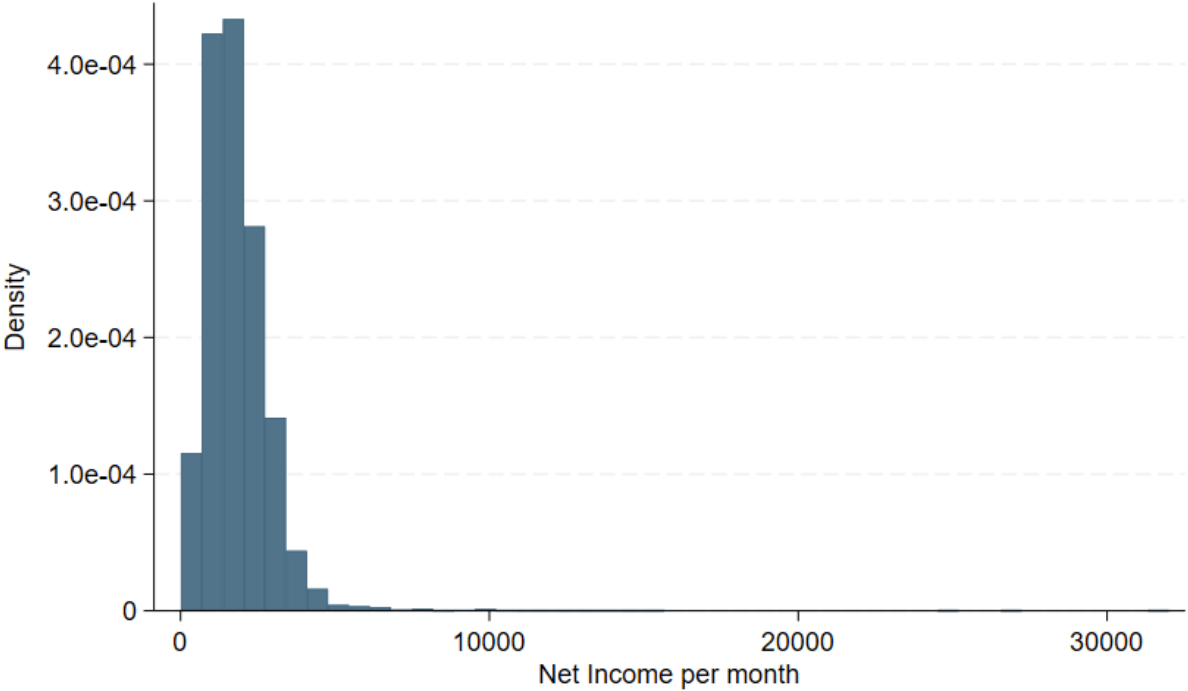


Figure C.1. Distribution of Income for observations below 40.000

Notes: This figure shows the distribution of net monthly earnings in euros. It looks at observations earning less than 40,000 euros per month. 33 observations had a higher income level and were not taken into consideration in this figure.

6.4 Appendix D

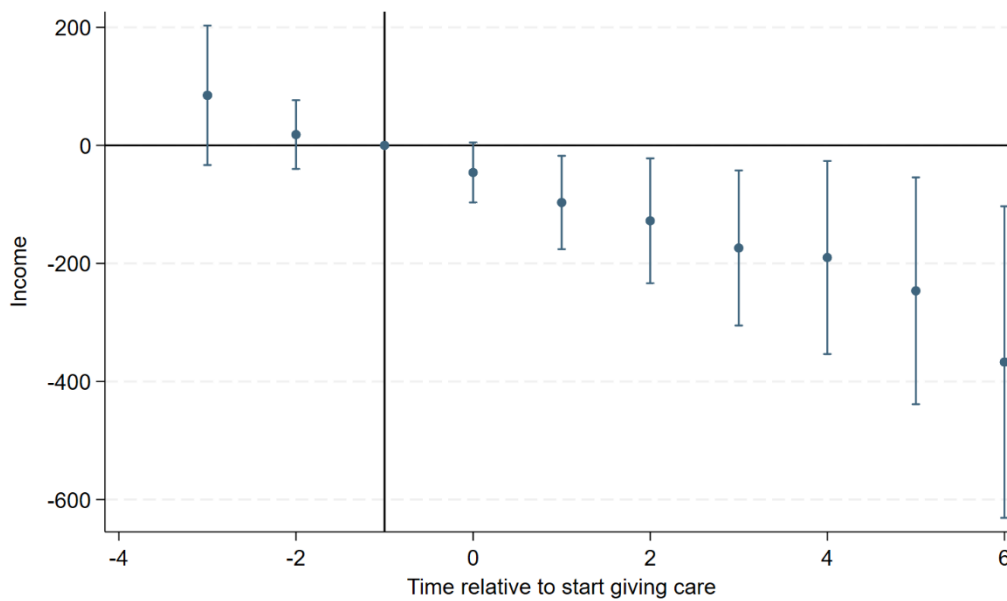


Figure D.1. Wage penalty experienced by informal caregivers over time

Notes: This figure shows the wage penalty experienced by informal caregivers in the Netherlands obtained by applying an Event Study and regressing the time relative to performing informal care for the first year on net monthly income. It shows the dynamic aspect of the association over time. The year before starting informal care is taken as reference point. Accompanying coefficients can be found in Table C.1.

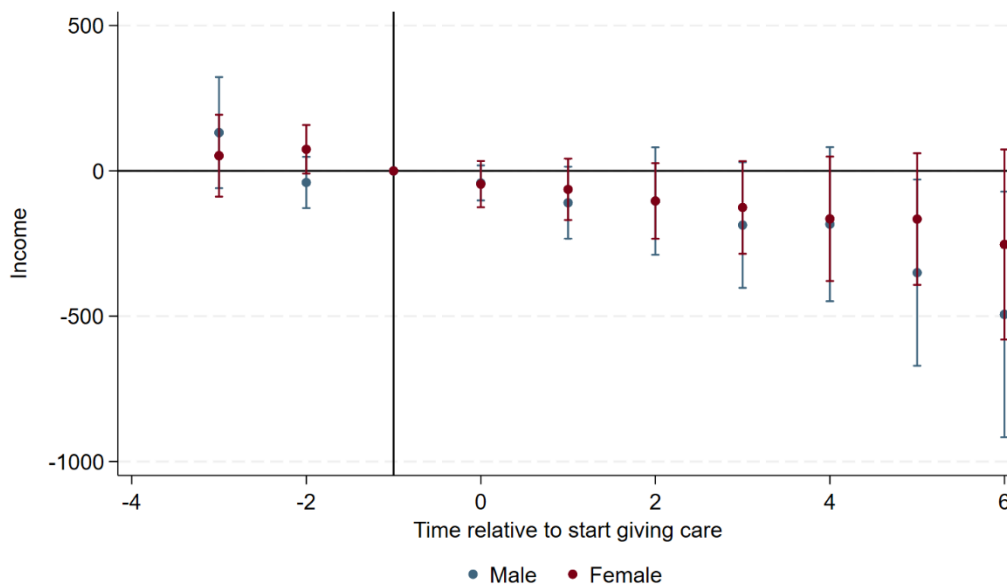


Figure D.2. Wage penalty experienced by informal caregivers over time by gender

Notes: This figure shows the wage penalty experienced by informal caregivers in the Netherlands obtained by applying an Event Study and regressing time relative to performing informal care for the first year on net monthly income. It shows the dynamic aspect of the association over time for females and males separately. The year before starting informal care is taken as reference point. Accompanying coefficients can be found in Table C.1.

Table D.1. Regression Results Event Studies

	(1) Log (Income)	(2) Log (Income)	(3) Log (Income)	(4) Income	(5) Income	(6) Income
Age						
25-34 years	0.625** (0.306)	1.202* (0.660)	0.351* (0.194)	143.0 (242.2)	407.7 (277.3)	-0.8 (202.8)
35-44 years	0.683** (0.323)	1.404** (0.701)	0.400* (0.224)	334.9 (264.5)	1,096*** (350.5)	134.3 (225.1)
45-54 years	0.714** (0.316)	1.430** (0.693)	0.435** (0.217)	396.5 (259.4)	1,159*** (317.7)	205.5 (219.3)
55-64 years	0.705** (0.317)	1.331* (0.691)	0.471** (0.224)	369.0 (267.3)	927.5*** (308.4)	281.2 (224.5)
65+ years	0.705** (0.320)	1.223* (0.687)	0.571** (0.237)	251.0 (286.0)	633.2** (316.7)	310.6 (239.1)
Urban						
Very urban	-0.132** (0.066)	-0.078 (0.091)	-0.087 (0.082)	-224.5* (128.7)	-230.5 (230.3)	-112.0 (121.4)
Moderately urban	-0.123* (0.068)	-0.088 (0.095)	-0.077 (0.090)	-186.3 (132.0)	-185.6 (237.8)	-127.9 (128.2)
Slightly urban	-0.115 (0.076)	-0.031 (0.092)	-0.135 (0.108)	-110.5 (130.6)	-80.8 (225.9)	-74.9 (126.4)
Not urban	-0.157** (0.079)	-0.040 (0.104)	-0.194* (0.114)	-210.2 (142.2)	-140.4 (265.5)	-218.4 (136.6)
Education						
Vmbo	0.010 (0.170)	0.004 (0.160)	0.235 (0.329)	3.9 (203.1)	-76.7 (336.2)	144.7 (175.0)
Havo/Vwo	0.347** (0.166)	0.285 (0.178)	0.623* (0.322)	465.5** (224.3)	554.1 (386.7)	516.5*** (181.0)
Mbo	0.273* (0.159)	0.205 (0.150)	0.578* (0.322)	272.8 (197.5)	241.1 (317.3)	442.6** (177.5)
Hbo	0.604*** (0.160)	0.542*** (0.156)	0.875*** (0.324)	934.6*** (218.5)	1,052*** (347.8)	909.3*** (207.1)
Wo	0.672*** (0.167)	0.555*** (0.159)	1.183*** (0.343)	1,123*** (234.4)	1,098*** (340.3)	1,520*** (288.1)
Other	0.160 (0.187)	-0.059 (0.185)	0.611* (0.342)	57.79 (242.7)	-135.3 (361.2)	420.3** (211.4)
Ethnicity						
Western	0.150* (0.085)	0.230 (0.158)	-0.005 (0.094)	278.7 (188.8)	546.6 (431.5)	9.1 (136.7)
Non-western	0.000 (0.107)	-0.122 (0.100)	0.114 (0.155)	-54.0 (156.8)	-218.2 (231.2)	96.1 (206.1)
Gender						
Females	-0.515*** (0.051)			-748.6*** (81.7)		
Leads						
Lead 3	0.0437 (0.0434)	0.0583 (0.0443)	0.0636 (0.0663)	84.9 (60.1)	131.6 (96.8)	52.2 (71.5)
Lead 2	0.0404* (0.0232)	-0.0116 (0.0219)	0.103** (0.0401)	18.3 (29.6)	-39.9 (44.7)	74.2* (42.4)

(continued)

Table D.1 (continued)

Lags						
Lag 0	-0.0326*	-0.0225	-0.0377	-45.9*	-41.5	-45.6
	(0.0182)	(0.0139)	(0.0315)	(25.9)	(30.5)	(40.3)
Lag 1	-0.0374	-0.0566*	-0.0268	-96.8**	-109.7*	-63.8
	(0.0312)	(0.0300)	(0.0505)	(40.2)	(62.7)	(53.5)
Lag 2	-0.0748*	-0.0613	-0.0748	-127.8**	-103.8	-103.6
	(0.0450)	(0.0447)	(0.0753)	(53.8)	(93.6)	(66.0)
Lag 3	-0.112**	-0.0971*	-0.110	-173.8***	-186.4*	-125.9
	(0.0549)	(0.0525)	(0.0915)	(66.8)	(109.5)	(80.9)
Lag 4	-0.0978	-0.0975	-0.0976	-190.0**	-183.5	-164.9
	(0.0714)	(0.0628)	(0.118)	(83.2)	(134.3)	(108.6)
Lag 5	-0.144*	-0.174**	-0.139	-246.4**	-350.3**	-165.9
	(0.0835)	(0.0741)	(0.136)	(97.7)	(162.3)	(114.9)
Lag 6	-0.231**	-0.247**	-0.220	-367.1***	-494.0**	-253.4
	(0.112)	(0.101)	(0.181)	(134.2)	(214.0)	(165.9)
Constant	6.590***	6.011***	5.972***	1,360***	858.7	529.5*
	(0.331)	(0.714)	(0.344)	(350.6)	(549.2)	(301.1)
Family Size included	Yes	Yes	Yes	Yes	Yes	Yes
Marital Status included	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,261	1,431	1,830	3,261	1,431	1,830
R-squared	0.401	0.384	0.264	0.427	0.328	0.332

Notes: This table shows the results regressing informal care on the logarithm of income in Column 1, 2, and 3 and on income in Column 4, 5, and 6, using the Event Study method. The net monthly income is the main dependent variable and whether someone provides informal care is the main independent variable. Column 1 and 4 uses the total sample, while Column 2 and 5 use males and Column 3 and 6 females separately. Age, Urban, Education, Ethnicity, Gender, Family Size, and Marital Status are included as control variables. Year fixed effects are included and there is clustered at individual level. Lead 1 is used as reference point. Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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