Spring 3-25-2010

Microeconomic Analysis of Hours of Informal Care Per Week for Alzheimer's disease patients

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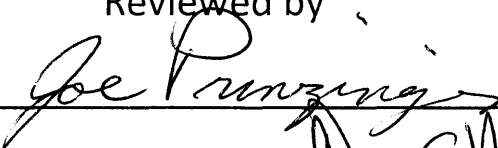March 25, 2010 for Honors in Economics

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Microeconomic Analysis of Hours of Informal Care per Week for
Alzheimer's disease patients

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Senior Research Project

School of Business and Economics

Defense for Honors

March 25, 2010

Abstract

As more Americans are diagnosed with Alzheimer's disease, the demand for treatment and care has been increasing. One of the most critical issues of caring for an Alzheimer's disease patient is the number of unpaid hours that many Americans are contributing to the care for Alzheimer's disease patient. Providing unpaid care can cause issues for the caregivers such as high stress levels, financial problems, and difficulties at work, and thus can result in the patient not receiving the best possible care. Based on previously collected survey data, this econometric study evaluates the determinants of the average number of hours of unpaid care per week provided to an Alzheimer's disease patient. The following variables were found to be significant at the .05 level: number of Activities of Daily Living (ADLS), number of Instrumental Activities of Daily Living (IADLS), whether the Alzheimer's disease patient lived in the home with the caregiver (INHOUSE), whether the caregiver was married (MARRIED), and the age of the caregiver (YEARCARE). The INHOUSE dummy variable had the most significant impact on the dependent variable average hours per week of unpaid care (AVEHRWK). Based these results, a new policy that would reduce tax rates, or provide subsidies to caregivers in certain tax brackets and who have dependents could relieve the stress and additional responsibilities of an unpaid caregiver.

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I. Introduction

Alzheimer's disease is the most common and severe forms of dementia and is a rapidly growing disease with no cure. Alzheimer's disease affects approximately 5.3 million Americans of all ages (Alzheimer's Association, 2009). The Alzheimer's Association (2009) reports that, "every 70 seconds, someone in America develops Alzheimer's disease". The Los Angeles County Department of Public Health (2008) described Alzheimer's disease as "a family disease because the decline in memory and thinking abilities is usually gradual, requiring loved ones to increasingly provide assistance to persons as the condition worsens". Today, approximately 10 million Americans care for a person with Alzheimer's disease or other dementia without pay (Alzheimer's Association, 2009). Individuals providing unpaid care are primarily family members, but are also friends and neighbors of the person with Alzheimer's disease. In 2007, unpaid caregivers provided 8.4 billion hours of care, and in 2008, provided 8.5 billion hours of care (Alzheimer's Association, 2008). The economic value of unpaid caregivers was estimated to be $89 billion in 2007, and $94 billion in 2008 (Alzheimer's Association, p.33). These statistics illustrate a significant rise in the prevalence of Alzheimer's disease and caregiver circumstances. According to the Alzheimer's Association (2009), a caregiver provides an average of 16.6 hours per week of informal or unpaid care for an Alzheimer's disease patient. Alzheimer's disease and caregiving are linked and informal or unpaid care will continue to be a large amount of the care that Alzheimer's disease patients receive (Adess, Schwarte, & Samuels, 2007). As the numbers of those diagnosed with the disease continue to rise, the hours of unpaid care and the economic value of that care will rise. With growing cases of Alzheimer's disease and a subsequent demand for caregivers, it is important to address the care of the Alzheimer's disease patient, and the well-being and the care of the caregiver. Which factors, such as

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caregiver gender, employment status, and number of ADLS and IADLs performed, have the greatest impact on the average number of hours of informal or unpaid care provided per week? How can those factors that are found to have a significant impact on average of hours be addressed? The purpose of this study is to analyze the factors that determine the average number of hours per week of unpaid care provided by a family member, friend, or neighbor for an Alzheimer's disease patient.

II. Literature Review

Informal care has emerged as a rising problem in today's society, especially in coping with Alzheimer's disease patients. In a study of the economic burden of Alzheimer's disease care, Rice et al. (1993) identified four categories of care that an informal caregiver may provide for an Alzheimer's disease patient: Activities of Daily Living (ADLs), Instrumental Activities of Daily Living (IADLs), behavioral management, and social/recreational activities. Key findings of their study also provided evidence that most often caregivers are female, and that males were more likely to take care of the legal and financial responsibilities than the direct care (Rice et al., 1993). Rice et al. (1993) found that caregivers in the community spent an average of 10 hours per day doing several types of caregiving tasks. In addition, they found that a primary caregiver spent an average of 249 hours per month providing unpaid care (Rice et al., 1993). Further evaluating the tasks performed by caregivers, Rice et al. (1993) discovered that more than half of the hours of care provided were dedicated to ADLS and IADLS, such as bathing and administering medications.

Arno, Levine, & Memmott's study in 1999 established a heightened awareness of the informal care issue. Their study escalated the informal or unpaid care issue from a micro level of informal health issue to a macro level of a healthcare policy issue. Arno et al. (1999)

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describe informal caregiving as outside the market economy and "socially and politically invisible". This study reported that the average number of hours per week of care provided to a non-Alzheimer's disease patient in 1996 was 17.6 hours according to the National Family Caregiving Survey (Arno). Narrowing this statistic down specifically to Alzheimer's disease, Arno et al. (1999) reported that an average of 70 hours per week of care was provided to Alzheimer's disease patients.

Contradicting Arno, the Alzheimer's Association & National Alliance for Caregiving (1999) study reported that a caregiver of an Alzheimer's disease patient spent 17.6 hours per week caring for the patient compared to an average of 11.8 hours per week spent caring for a non-Alzheimer's disease patient. Although three years apart, the studies report significantly different numbers for the average hours per week spent caring for an individual with Alzheimer's disease. The Alzheimer's Association & National Alliance for Caregiving (1999) found four key factors that impact the caregiver during duration of care: physical and emotional strain, pressure on other family responsibilities, financial strain, and caregiver employment. Financial strain and caregiver employment can directly impact the hours of care for an Alzheimer's disease patient. Similarly to Rice et al., this report found that ADLs make up a majority of the tasks that Alzheimer's disease caregivers perform (Alzheimer's Association & National Alliance for Caregiving, 1999).

Similarly to Arno et al. (1999), the Alzheimer's Association & National Alliance for Caregiving (2004) study confirms that the impact of caregiving on a caregiver for Alzheimer's disease patients is much greater than those non-Alzheimer's disease patients, especially in hours per week of informal or unpaid care. Although this study does not report an average number of hours per week spent caregiving for an Alzheimer's disease patient, the study does report that 23% of Alzheimer's caregivers reported providing

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constant care of 40 hours per week or more (Alzheimer's Association & National Alliance for Caregiving, 2004). This statistic translates to one in four caregivers providing constant care of 40 hours per week or more. The study also found that more often females are the primary caregivers, the median age for a caregiver is approximately 40 years old, 60% of caregivers are married, and most often caregivers do not have children in the home (Alzheimer's Association & National Alliance for Caregiving, 2004).

Research from the Family Caregiver Alliance (2005) reported that for individuals with severe dementia, the duration of informal care can rise by 46.1 hours per week, which is consistent with the severe form of dementia that is classified as Alzheimer's disease. This report of an average of 46.1 hours per week is consistent with the Alzheimer's Association & National Alliance for Caregiving (2004) that findings that one in four caregivers for Alzheimer's patients provide 40 hours per week or more of unapid care. The Family Caregiver Alliance (2005) reported that 23% of dementia caregivers provide 40 hours per week or more of care compared to 16% of those helping with a non-dementia patient. These findings are consistent with findings from Arno et al. and the Alzheimer's Association & National Alliance for Caregiving (2004) that Alzheimer's disease caregivers bear a great burden in relation to the number of hours spent providing care than non-Alzheimer's or dementia caregivers. Furthermore, the Family Caregiver Alliance (2005) found that about 59% to 75% of caregivers were female and that 59% of caregivers were employed. The Family Caregiver Alliance (2005) also reported that approximately one-fifth (21%) of white and African American populations provide informal care compared to the 18% of Asian and 16% of Hispanic populations that provide informal care for Alzheimer's disease patients.

Zhu and Sano (2006) reported that caregivers provided 70 hours of unpaid or informal care to an Alzheimer's disease patient per week. This number is significantly higher than the 17.6 hours reported by the Alzheimer's Association & National Caregiving Alliance (1999), but is similar to the study by Arno et al. (1999), who reported the same average number of hours per week of informal or unapid care. In addition, Zhu and Sano (2006) confirm that the burden of caring for an Alzheimer's disease patient rises with disease severity, which normally increases with age. Similarly to Arno et al., and the Family Caregiver Alliance report, Zhu and Sano recognize females as the primary caregivers for Alzheimer's patients. Zhu and Sano (2006) also express concern for this aspect of caregiving, because the number of women in the workforce continuing to rise.

The MetLife Mature Market Institute (2006) study of caregivers recognized similar findings to the Alzheimer's Association & National Alliance for Caregiving (1999) report. The MetLife Mature Market Institute study examines the differences between a caregiver caring for a person with Alzheimer's disease and a caregiver caring for a person without Alzheimer's disease. Contrary to the Alzheimer's Association & National Alliance for Caregiving (1999) report and findings by Zhu and Sano (2006), the MetLife Mature Market Institute (2006) reported that caregivers of persons with Alzheimer's disease provide an average of informal or unpaid 47 hours of care per week. As well, the report expands on similar aspects of caregiving such as stress, health, work, and costs (MetLife Mature Market Institute, 2006). The MetLife study provided key findings for factors that had a significant impact on the average number of hours per week of informal or unpaid care provided to an Alzheimer's disease patient. The following three factors impact the number of hours of informal or unpaid care provided to an Alzheimer's disease patient: living arrangement, number of IADL and ADL limitations, and gender of the caregiver (MetLife Mature Market

Institute, 2006). Subsequently, the report also highlights variables that did not impact the hours of informal or unpaid care provided per week, which include the amount of home care benefit, total hours of paid care each week, and advanced age of caregiver. The MetLife study was the only study that directly evaluated the impact of different factors on the average number of hours of informal or unpaid care provided to a person with Alzheimer's disease.

Research from the Los Angeles County Department of Public Health (2008) reported that Alzheimer's disease caregivers provide 22 hours of informal care per week, which is similar to the value reported by Alzheimer's Association & National Alliance for Caregiving (1999) of an average of 17.6 hours per week of informal care provided to an Alzheimer's disease patient. In addition, results from a 2007 demographics analysis of Los Angeles County indicated that 29% of caregivers were Asian/Pacific Islander, which is the second highest falling just under African-Americans at who ranked at 32% (Los Angeles County Department of Public Health, 2008). These percentages most likely represent the key demographics of the L.A. area. This statistic is interesting in comparison to the value reported by the Family Caregiver Alliance (2005) that showed 18% of Asians provided informal care for an Alzheimer's disease patient. Similarly to the Family Caregiver Alliance (2005), the Los Angeles County Department of Health (2008) report found that 48% of individuals who worked 35 hours a week or more reported providing an additional 18 hours per week of informal or unpaid care for someone with Alzheimer's disease.

An AARP Public Policy Institute (2008) study reported that the "typical U.S. caregiver is a 46 year old woman who works outside the home and spends more than 20 hours per week providing unpaid care to her mother". This statement is consistent with the Alzheimer's Association & National Alliance for Caregiving (1999) and the Los Angeles

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County Department of Health (2008) regarding an approximate age, gender, employment status of the caregiver, and the average number of hours spent per week providing informal or unpaid care. Unlike Rice et al. (1993) and the Alzheimer's Association & National Alliance for Caregiving (2004), this study does not explore ADLS or IADLS, which is a major component of Alzheimer's disease care.

In 2008, the Alzheimer's Association reported that 9.8 million family members, friends, and neighbors provided 8.4 billion hours of care in the last year. For the 9.8 million caregivers, the report found that informal caregivers provided an average of 16.6 hours of care per week. This statistics is consistent with the Alzheimer's Association & National Alliance for Caregiving (1999) report of an average of 17.6 hours of informal or unpaid care per week. In addition, the Alzheimer's Association (2008) found that 60% of informal caregivers were female and the average age of a caregiver was 48 years old.

The Alzheimer's Association (2009) released national statistics that show an increase in the number of caregivers providing care, the total hours of care provided, and the quantified economic value of the care. The average number of hours of unpaid care did remain at 16.6 hours per week though throughout the two years (Alzheimer's Association, 2009).The Alzheimer's Association (2009) found that the number informal or unpaid caregivers for an individual with Alzheimer's disease increased to approximately 10 million Americans. The total hours of informal or unpaid care also increased to 8.5 billion hours of care (Alzheimer's Association, 2009). This means that unpaid or informal caregivers provided $94 billion worth of care for persons with Alzheimer's disease or dementia (Alzheimer's Association, 2009). Finally, this report also found that 26% of caregivers were providing care for a person with Alzheimer's disease who resided in their home. These

statistics from 2007 and 2008 confirm the growing need for informal or unpaid caregiver assistance.

Most recently, the Alzheimer's Association (2010) released its annual report, which reflected data from 2009. The 2009 data for family caregiving reports that the number of American's providing unpaid care for an Alzheimer's disease patient has risen to 10.9 million. In addition, 12.5 billion hours of unpaid care were provided in 2009. This 12.5 billion hours of unpaid care translates to an economic value of $144 billion (Alzheimer's Association, 2010). Furthermore, the average hours of unpaid care per week increased to 21.9 hours in the 2009 statistics. New projections have also illustrated that "by mid-century, someone will develop the disease every 33 seconds" (Alzheimer's Association, 2010).

Previous research on informal or unpaid care for an individual with Alzheimer's disease provides analysis of total hours, average hours per week, and the economic value of the informal care provided. The hours of informal or unpaid care for an Alzheimer's disease patient have a significant impact on caregivers and society. Alzheimer's disease care needs will continue to increase. This study will provide an econometric analysis of an extensive number of variables that have been identified as contributing factors to the average number of hours per week of informal or unpaid care provided to an Alzheimer's disease patient. Differing from previous research and studies, this study will examine which variables increase the average number of hours of informal care provided per week to gain a greater understanding of what areas of informal healthcare should be addressed.

III. Theoretical Model

To investigate the average number of hours per week of unpaid care provided by an

Alzheimer's disease caregiver, several variables were identified. The dependent variable is

the average number of hours per week of unpaid care (AVEHRWK) provided to an

Alzheimer's disease patient. Numerous explanatory variables were identified as having a

direct impact on the average number of hours per week of unpaid care provided by an

Alzheimer's disease caregiver. Table 1 on page 12 illustrates all the explanatory variables

used in this study.

Table 1: Independent Variable Abbreviation and Definition

Abbreviation	Definition of Variable
INCOME	Income level (1.00 = < $30K, 2.00 = $30k - $49K, 3.00= $50K - $99K, 4.00 = $100K +)
SEXCARE	Sex of the caregiver (1= male, 0=female)
YEARCARE	Age of caregiver
EMPLOY	Employment status (1 = yes, 0= no)
CHILD	Whether there are children present in the home during care giving (1=yes, 0=no)
PATAGE	Alzheimer's patient age
WHITE	Race (1=white, 0=no)
BLACK	Race (1=black, 0=no)
ASIAN	Race (1= asian, 0=no)
MARRIED	Marital status (1=yes, 0=no)
INHOUSE	Alzheimer's patient lives in the house (1=yes, 0=no)
URBAN	Area caregiver resides (1=urban, 0= no)
RURAL	Area caregiver resides (1=rural, 0=no)
OUTRES	Presence of outside resources for help (1=yes, 0=no)
ADLS	Number of Activities of Daily Living
IADLS	Number of Instrumental Activities of Daily Living

The INCOME variable measures four different levels of income. For this variable, the

expected sign is negative, because healthcare is a normal good and is income inelastic. As a

caregiver's income rises, it would be expected that there is more money to pay for

healthcare assistance such as formal care for an Alzheimer's disease patient. If a caregiver is able to pay for more healthcare assistance for an Alzheimer's disease patient, it would be expected that the average number of hours per week provided of unpaid care would decrease. As income rises, it is expected that the average number of hours per week of unpaid care provided will decrease and vice versus. Thus, the expected relationship is an inverse relationship, and the expected sign for INCOME is negative.

The dummy variable SEXCARE measures whether the caregiver is male or female. A 1 represents that the caregiver is male and a 0 represents that the caregiver is female. Research has shown that females provide more unpaid care for Alzheimer's disease patients than males. Females have different preferences, and maternal instincts for caring for someone than do males. Therefore, the expected sign for SEXCARE is negative. This illustrates that it is expected that if SEXCARE is 1 for male, the average number of hours per week of unpaid care will decrease.

The variable YEARCARE indicates the age of the caregiver. For an individual providing care, it is important to look at their health and capabilities when thinking of caring for an Alzheimer's disease patient. There is an opportunity cost associated with providing unpaid care for an Alzheimer's disease patient. For someone who is older, providing a substantial number of unpaid hours of care could impact their own health as well. Individuals must decide whether it is mutually beneficial to provide unpaid care for themselves and the Alzheimer's disease patient. It is expected that as an individual gets older, their ability to provide Activities of Daily Living (ADLs) are not as great. As a result, the expected sign for YEARCARE is negative, representing an inverse relationship between AVEHRWK and YEARCARE. This indicates that the older the caregiver is, the fewer hours of unpaid care per week he or she will provide.

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Another dummy variable was used to indicate whether a caregiver is employed or not. The variable EMPLOY measures employment and represents employment with a 1 and unemployment with a 0. Caregiving while employed can become very difficult and there has been a great deal of research on how Alzheimer's disease caregiving negatively impacts workplace performance. The caregiver must make decisions based on the opportunity cost of working and caregiving, and whether it is possible to successfully do both. In this case, the choice impacts the Alzheimer's disease patient, the company and the potential caregiver. It would not be mutually beneficial to the caregiver, the company and the patient for a caregiver to work and provide care. In addition, the caregiver must determine the marginal cost versus the marginal benefit of working and most likely paying for care or not working and providing unpaid care. If the caregiver is losing more money while working and paying for care, it would be in the better for the caregiver to be unemployed and providing care. Therefore, the variable EMPLOY is expected to have a negative sign and an inverse relationship with AVEHRWK. It is expected that if a caregiver is employed, he or she will provide fewer number of hours per week of unpaid care.

A dummy variable CHILD measures whether there are children present in the home during caregiving. For this variable, 1 indicates that there are/were children present in the home during the duration of unpaid care provided, and 0 indicates that there were no children present. This variable is impacted by the opportunity cost of caring for an Alzheimer's disease patient while having a child in the home. A caregiver must decide whether it is mutually beneficial to the child or children and the Alzheimer's disease patient to have his or her time split between the two. The expected sign for this variable is negative, because it will most likely not be mutually beneficial to the child or children and the Alzheimer's disease patient to depend on the caregiver for the majority of both of their

care. For CHILD, if there is a child in the home, the average number of hours per week of unpaid care provided is expected to decrease.

The variable PATAGE measures the age of the Alzheimer's disease patient. Research shows that as Alzheimer's disease progresses and the patient gets older, there is an increased demand for care. There are fewer functions that someone with Alzheimer's disease is capable of doing and it becomes necessary to have a greater level of care. PATAGE is expected to have a positive sign, because as the patient gets older, the demand for care increases. In addition, if resources are scarce and paid care is not an option for the total amount of care necessary, the quantity of unpaid care increases, because there becomes no other alternative other than providing unpaid care. As the age of an Alzheimer's disease patient increases, it is expected the average number of hours of unpaid care per week is expected to increase as well.

The following race variables were examined to find whether race is a contributing factor to the average number of hours of unpaid care provided per week: white, black, asian and hispanic. Hispanic is the default variable and, therefore, is not illustrated in the list of variables for this study. The variables WHITE, BLACK, and ASIAN are dummy variables. For each of those variables, 1 indicates that an individual is the respective race or 0 indicates that they are no. These variables were included specifically to determine whether race has an impact on average hours per week of unpaid care provided to an Alzheimer's disease patient. There is no a priori information regarding these variables, and therefore, they have been included to determine whether they have an effect on the average number of hours per week of informal or unpaid care provided to an Alzheimer's disease patient.

The variable MARRIED is a dummy variable that indicates 1 if the caregiver is married and 0 if the caregiver is not married. Whether the caregiver is married or not will impact the average number of hours of unpaid care per week due to the availability of resources. If there are scarce resources, such as income and time, and caregiver is not married and must work, the number of hours of unpaid care will decrease. If the caregiver is married, it is likely that there will be two incomes, and another resource to balance daily necessities and duties while providing unpaid care. The expected sign for MARRIED is positive and is expected to be directly related to AVEHRWK. As a result of the availability of resources in being married rather than not, a caregiver, who is married is expected to provide a greater number of hours of unpaid care per week.

INHOUSE is a dummy variable for whether the Alzheimer's disease patient lives in the house with the caregiver or not. For this variable, if the Alzheimer's disease patient lives in the house with the caregiver, it is expected that the number of hours of care per week will increase. Therefore, the expected sign for INHOUSE is positive. When a caregiver has chosen to have an Alzheimer's disease patient live with them, it is a likely indication that he or she will also provide unpaid care. This could be because of scarce resources similarly to the MARRIED variable. If scarce resources such as income prevent an individual from having an Alzheimer's disease patient live in an assisted living facility, it is likely that he or she will not be able to provide paid care either.

There are two dummy variables that measure whether a caregiver lives in a rural, urban or suburban area. URBAN and RURAL are the variables used and if a caregiver does not indicate either of these, it is classified as a suburban area, which is the default variable. For URBAN, 1 indicates the caregiver lives in an urban area and 0 indicates that the caregiver does not live in an urban area. As well, for RURAL, 1 indicates the caregiver lives

in a rural area and 0 indicates the caregiver does not live in a rural area. The expected sign for URBAN is negative, because when you live in an urban area there is more competition between assisted living communities and homecare. When you live in an urban area, there are more options provided to a caregiver to use at different prices. The expected negative sign of URBAN hypothesizes that the average number of hours of unpaid care provider per week will decrease, because a caregiver is more likely to find some sort of assisted care that he or she could afford. Consequently, the variable expected sign of RURAL will be positive and directly impact the average number of hours per week of unpaid care that is provided to an Alzheimer's disease patient. In a rural area, there may be only one or two assisted living or homecare companies, which does not provide as much competition for a caregiver to find assistance he or she is able to afford. As a result, it is expected that if a caregiver lives in a rural area the number of hours of unpaid care provided will increase.

The variable for OUTRES measures whether the caregiver is provided with any outside resources of help. This could range from the assistance of another individual to a nursing or assisted living facility. OUTRES is a dummy variable, 1 indicates that there are additional outside resources assisting the caregiver and 0 indicates that there are no additional resources assisting the caregiver. The expected sign for OUTRES variable is negative, which illustrates an inverse relationship to the average number of hours per week of unpaid care that is provided. If there is a presence of OUTRES indicated by 1, the number of average hours of unpaid care per week decreases. Demand for a caregiver decreases as more resources for care of an Alzheimer's disease patient became available.

The variable for ADLS measures the number of Activities of Daily Living (ADLs) the caregiver provides. ADLS include bathing and feeding. The expected sign for ADLS is positive. This indicates that as there is a direct relationship between the number of ADLS

and the average number of hours per week of unpaid care provided to an Alzheimer's disease patient. As shown by the theory of demand, as the demand for ADLs increase, the number of hours per week of unpaid care increases as well.

IADLS is a similar variable to ADLS, but IADLS indicate the number of Instrumental Activities of Daily Living (IADLS). These activities include administering medications. The expected sign for the variable IADLS is positive due to the theory of demand as well. The positive sign indicates that there is a direct relationship between IADLS and the average number of hours per week of unpaid care provided to an Alzheimer's disease patient. As the disease worsens, and the demand for IADLs shifts out, the number of hours of unpaid care per week increases.

IV. Presentation and Analysis of Data

For this study, a linear regression was used to identify the determinants of the average number of hours per week spent providing unpaid care for an Alzheimer's disease patient. Belden, Russonello & Stewart provided the data used in this study. The information was originally commissioned for the Alzheimer's Association and National Alliance for its 2004 Caregiving Report. It is cross-sectional survey, which recorded the responses of Alzheimer's disease caregivers and non-Alzheimer's disease caregivers. For this study, the results were narrowed down to just measure the responses of Alzheimer's disease caregivers. Due to the nature of the study, survey data was the only measurement available. Evaluating the data was a critical aspect of this study and the data was examined carefully to account for the types of problems that one can encounter with survey data.

The descriptive statistics (see Appendix Table A.1) for this study provided information about outliers in the NUMCARE variable, which will be discussed later in this section. Furthermore, the mean in the descriptive statistics for AVEHRWK confirmed the

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accuracy of the data, because the mean for AVEHRWK was very similar to other reported average number of hours of unpaid care provided to an Alzheimer's disease patient. The mean for AVEHRWK for this survey data was 14.45 hours, and the Alzheimer's Association (2009) reported that an average of 16.6 hours of unpaid care was provided per week to an Alzheimer's disease patient.

The correlation matrix was examined as well to determine if the variables included in this analysis were highly correlated and to identify if there was multicollinearity. The correlation matrix (See Appendix Table A.3) concluded that none of the variables used in this analysis were highly correlated. As a result, it was not necessary to remove any of the variables due to high correlation.

The estimated equation for this regression based on the hypothesized signs is:

Estimated Equation (1)

$$
\begin{aligned}
&\quad\quad\quad\quad\quad (-)\quad\quad\quad\quad (-)\quad\quad\quad\quad\quad (-)\quad\quad\quad\quad\quad (-) \\
(1)\ &AVEHRWK = \beta_0 + \beta_1\ INCOME + \beta_2 SEXCARE + \beta_3 YEARCARE + \beta_4 EMPLOY \\
&\quad\ (?)\quad\quad\quad\ (?)\quad\quad\quad\ (?)\quad\quad\quad\quad (+)\quad\quad\quad\quad (+)\quad\quad\quad\quad (-) \\
&+ \beta_5 WHITE + \beta_6 BLACK + \beta_7\beta ASIAN + \beta_8 MARRIED + \beta_9 INHOUSE + \beta_{10} URBAN \\
&\quad\ (+)\quad\quad\quad\quad (-)\quad\quad\quad\quad\ (+)\quad\quad\quad\quad (+)\quad\quad\quad\quad\ (+)\quad\quad\quad\quad (-) \\
&+ \beta_{11} RURAL + \beta_{12} OUTRES + \beta_{13} ADLS + \beta_{14} IADLS + \beta_{15} PATAGE + \beta_{16} CHILD \\
&\quad\ (+) \\
&+ \beta_{17} NUMCARE
\end{aligned}
$$

Table 2: Regression Results (1)

Dependent Variable: AVEHRWK
Method: Least Squares
Sample(adjusted): 2 168
Included observations: 101
Excluded observations: 66 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.534358	11.75686	0.470734	0.6391
ADLS	2.014709	0.988920	2.037282	0.0448
ASIAN	20.71638	11.02488	1.879057	0.0637
BLACK	-2.150780	6.987040	-0.307824	0.7590
CHILD	-0.028817	4.011520	-0.007184	0.9943
EMPLOY	-4.214228	3.787184	-1.112760	0.2690
IADLS	1.975087	1.069693	1.846406	0.0684
INCOME	0.851614	1.815190	0.469160	0.6402
INHOUSE	13.46173	4.347566	3.096384	0.0027
MARRIED	-6.021758	3.681887	-1.635508	0.1057
NUMCARE	-0.147284	0.348050	-0.423169	0.6733
OUTRES	-2.369367	3.617156	-0.655036	0.5143
PATAGE	-0.035156	0.088768	-0.396039	0.6931
RURAL	9.623818	4.283237	2.246856	0.0273
SEXCARE	-3.206468	3.645062	-0.879675	0.3816
URBAN	3.058215	3.946971	0.774826	0.4406
WHITE	-0.394476	6.426003	-0.061388	0.9512
YEARCARE	0.030753	0.135299	0.227298	0.8208

R-squared	0.378672	Mean dependent var	16.09901
Adjusted R-squared	0.251412	S.D. dependent var	17.82835
S.E. of regression	15.42526	Akaike info criterion	8.470046
Sum squared resid	19748.91	Schwarz criterion	8.936107
Log likelihood	-409.7373	F-statistic	2.975580
Durbin-Watson stat	2.003458	Prob(F-statistic)	0.000502

The above regression indicates that only ADLS, INHOUSE, and RURAL are significant at the .05 significance level and have the correctly hypothesized signs of a direct relationship with the dependent variable AVEHRWK. It is also relevant to note that the p-values for ASIAN and IADLS are almost significant at the .05 significant level with values of .0637 and .0684 respectively. The R-squared and adjusted R-squared do not represent the best fit for the model. As a result, the data was examined further after this regression. It was found that there were several outliers, which is possible when working with survey

data. The variable NUMCARE was examined against the dependent variable of AVEHRWK.

Table 3 illustrates the outliers in the variable NUMCARE.

Table 3: AVEHRWK and NUMCARE data comparison

AVEHRWK	NUMCARE
1 hour	50 Alzheimer's Disease patients
8 hours	70 Alzheimer's Disease patients
12 hours	16 Alzheimer's Disease patients

The above table reports the number of Alzheimer's disease patients being cared for against the average hours per week of care provided to those patients, and illustrates a disproportional amount of hours against number of patients and thus, represents unlikely circumstances. Results such as these are not uncommon with survey data, and it is important to look closely at the data reported. Consequently, it was determined that those outlying observations should be eliminated and the study should measure the average number of hours per week of unpaid care provided to a single Alzheimer's disease patient in order to focus on the individual at the microeconomic level. It is unclear whether those individuals who reported the results in Table 3 fully understood the question posed during the survey interview.

The data was sorted by the variable NUMCARE and all other observations except those indicating that only one individual with Alzheimer's disease was being cared for were removed. In addition, when examining the data, it became clear that the variable EMPLOY had a total of 76 missing observations. When this variable is included after the NUMCARE variable is eliminated, the sample size is reduced to 66 observations. Therefore, the EMPLOY variable was dropped, because it significantly reduced the sample size and was not significant in Regression 1. In addition, the variables CHILD, PATAGE, WHITE, BLACK,

URBAN, and RURAL were dropped, because they have been found to be irrelevant to this econometric study. They were originally included due to previous research regarding their significance, but appear to be irrelevant in this study when narrowed down to unpaid caregivers of a single Alzheimer's disease patient. The following regression estimates the AVEHRWK of unpaid care when providing for one individual with Alzheimer's disease.

Estimated Equation (2):

$$\overset{(-)}{} \quad \overset{(-)}{} \quad \overset{(-)}{} \quad \overset{(?)}{}$$
$$(2)\ AVEHRWK = \beta_0 + \beta_1\ INCOME + \beta_2 SEXCARE + \beta_3 YEARCARE + \beta_5 \beta ASIAN$$
$$\overset{(+)}{} \quad \overset{(+)}{} \quad \overset{(-)}{} \quad \overset{(+)}{} \quad \overset{(+)}{}$$
$$+ \beta_6 MARRIED + \beta_7 INHOUSE + \beta_8 OUTRES + \beta_9 ADLS + \beta_{10} IADLS$$

Table 4: Regression Results 2

Dependent Variable: AVEHRWK
Method: Least Squares
Sample(adjusted): 1 111
Included observations: 111 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.089943	5.705365	-0.366312	0.7149
ADLS	1.986518	0.692125	2.870170	0.0050
ASIAN	5.575188	8.433711	0.661060	0.5101
IADLS	1.532124	0.747172	2.050563	0.0429
INCOME	-1.019170	1.387983	-0.734281	0.4645
INHOUSE	14.60119	3.724932	3.919853	0.0002
MARRIED	-5.872447	2.902830	-2.023008	0.0457
OUTRES	-1.874229	2.786434	-0.672626	0.5027
SEXCARE	-2.547940	2.714292	-0.938713	0.3501
YEARCARE	0.206440	0.088322	2.337361	0.0214

R-squared	0.364856	Mean dependent var		12.85586
Adjusted R-squared	0.308259	S.D. dependent var		15.83199
S.E. of regression	13.16762	Akaike info criterion		8.079169
Sum squared resid	17512.00	Schwarz criterion		8.323270
Log likelihood	-438.3939	F-statistic		6.446559
Durbin-Watson stat	2.057150	Prob(F-statistic)		0.000000

The second regression yields a higher R-squared and adjusted R-squared. In addition, there are more variables significant at the .05 level. Dropping the EMPLOY variable allowed for a larger sample size without affecting the validity of the model, because the variable EMPLOY was originally insignificant. In comparison to the results in

Table 2, Table 4 illustrates a better model fit. The adjusted R-squared has increased from

.25 to .30, which demonstrates a better fit. The F-statistic has increased from 2.9 to 6.44

and illustrates a better fit than Table 2 as well. Finally, the Akaike info criterion and the

Schwarz criterion have decreased from what was illustrated in Table 2 to Table 4 and a

lower Akaike info criterion and Schwarz criterion shows a better specification.

The variables ADLS, IADLS, INHOUSE, MARRIED, and YEARCARE are all significant

at the .05 level. In addition, the signs for ADLS, IADLS, and INHOUSE were correctly

hypothesized as having positive signs. This indicates that there is a direct relationship

between ADLS, IADLS, and INHOUSE, and the dependent variable. The variables MARRIED

and YEARCARE are significant at the .05 level, but the signs for these variables were not

correct as hypothesized. In the above results, YEARCARE has a direct relationship with

AVEHRWK and MARRIED has an inverse relationship with AVEHRWK. The variables

ASIAN, INCOME, OUTRES, and SEXCARE are not significant in this model, and indicate that

these factors do not impact the average number of hours of unpaid care provided per week

to an Alzheimer's disease patient.

For the variable ADLS, the coefficient is 1.98, indicating that for every one additional

type of Activity of Daily Living that a caregiver performs, 1.98 hours is added to the average

hours per week of unpaid care provided to an Alzheimer's disease patient. IADLS has a

coefficient of 1.53, and this illustrates that for every one additional Instrumental Activity of

Daily Living a caregiver has to perform that the average number of hours of unpaid care

per week will increase by 1.53 hours. The third significant variable, INHOUSE, has a

coefficient of 14.6. For this dummy variable, if an Alzheimer's disease patient lives in the

home with the caregiver, the number of average hours per week will increase by 14.6

hours. MARRIED is the fourth significant variable in this model and has an inverse

relationship with AVEHRWK. Although it was hypothesized that MARRIED would have a positive sign, the average number of hours per week will decrease by 5.87 hours, if the caregiver is married. Finally, YEARCARE is the fifth significant variable. The sign for this variable was hypothesized as negative, because as a caregiver's age increases it can be hypothesized that the opportunity cost of taking care of an Alzheimer's disease patient decreases as the caregivers own health and abilities change. As the regression above indicates, YEARCARE has a positive sign and a coefficient of .20. This value indicates that as the age of the caregiver increases, the average number of hours of unpaid care provided to an Alzheimer's disease patient increases by .20 hours.

The second regression results indicate that there are five significant determinants of the average number of hours per week of unpaid care provided for an Alzheimer's disease patient: ADLS, IADLS, INHOUSE, MARRIED, and YEARCARE. In addition, the coefficients have illustrated to what affect these variables impact the dependent variable AVEHRWK. INHOUSE and MARRIED had the most severe impact on the average number of hours per week of unpaid care, and ADLS, IADLS, and YEARCARE had a less significant impact on AVEHRWK.

V. Conclusion and Policy Implications

This econometric study analyzes the determinants of the average number of hours per week of unpaid or informal care provided to a single Alzheimer's disease patient. Based on previous Alzheimer's disease research, survey data was identified as the best possible source of data to execute this econometric study. There were no other econometric studies evaluating the average number of hours per week of unpaid care provided to a single Alzheimer's disease patient and its determinants. This study identified and analyzed the key explanatory variables that impact the average number of hours per week of unpaid

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care provided to a single Alzheimer's disease patient. This type of analysis has most likely not been widely researched, because of the subjective nature of the topic and the inability to collect authoritative data. The final regression in this study reflected an R-squared of .36. The R-squared measure the overall fit of the model. For this model, the R-squared represents that 36% of the variation in the dependent variable is explained by the independent variables. The R-squared in this model explains why there are not previous studies exploring the determinants of the average number of hours per week of unpaid care provided to an Alzheimer's disease patient. Further research on best practices for collecting and measuring information such as the determinants of the average number of hours per week of unpaid care provided is necessary to obtain a better analysis. This is not present at the current time. Most economic studies regarding Alzheimer's disease care measure cost as the dependent variable.

The following variables were found to be significant at the .05 level: ADLS, IADLS, INHOUSE, MARRIED, and YEARCARE. The variable that had the most significant impact on AVEHRWK was the INHOUSE dummy variable for whether an Alzheimer's disease patient lived in the caregiver's home or not. Based on the results, if an Alzheimer's disease patient resides the caregiver's home, the average number of hours per week of unpaid care provided will increase by 14.6 hours. This is a significant difference in hours of unpaid care provided from caring for someone outside of the home. In addition, the results of this econometric study indicate that race does not have an effect on the average number of hours of informal or unpaid care provided to an Alzheimer's disease patient.

These results indicate that INHOUSE is the number one determinant of the average number of hours per week of unpaid care provided to an Alzheimer's disease patient. This is a crucial finding that should be taken into consideration when seeking to provide aid to

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unpaid Alzheimer's disease caregivers. Providing unpaid care, especially to an Alzheimer's disease patient, has a severe impact on the caregivers family life, finances, and job. In most cases, a caregiver decides to provide in house care for an Alzheimer's disease patient due to financial restrictions. From these results, a policy implication that could is to provide reduced tax rates, or subsidies to caregivers in certain tax brackets and who have dependents. This implication could provide caregivers with the option to provide institutionalized care for an Alzheimer's disease patient and provide relief for them by decreasing the average number of hours per week of unpaid care that is provided.

VI. Opportunities for Further Research

A new caregiving report has been released since the completion of this econometric study. The National Alliance for Caregiving (NAC) and AARP released "Caregiving in the U.S. 2009". This report is the next iteration of the caregiving report used in this study: "Families Care: Alzheimer's Caregiving in the United States 2004". Requesting and analyzing the 2009 study's data is an opportunity for further research in regard to this unpaid caregiving for Alzheimer's disease. A similar study could be performed to compare the results of this study and/or identify new determinants of the average hours of unpaid care provided per week to an Alzheimer's disease patient.

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VIII. Appendix

Table A.1 Descriptive Statistics for Regression 1 for 101 observations

	ADLS	ASIAN	AVEHRWK	BLACK	CHILD	EMPLOY	IADLS	INCOME	INHOUSE
Mean	1.663366	0.029703	16.09901	0.267327	0.326733	0.584158	4.316832	2.237624	0.198020
Median	1.000000	0.000000	10.00000	0.000000	0.000000	1.000000	5.000000	2.000000	0.000000
Maximum	6.000000	1.000000	76.00000	1.000000	1.000000	1.000000	7.000000	4.000000	1.000000
Minimum	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
Std. Dev.	1.996383	0.170613	17.82835	0.444772	0.471358	0.495325	1.810694	1.040659	0.400495
Skewness	0.940174	5.540513	1.583389	1.051478	0.738851	-0.341506	-0.346774	0.316058	1.515557

	MARRIED	NUMCARE	OUTRES	PATAGE	RURAL	SEXCARE	URBAN	WHITE	YEARCARE
Mean	0.504950	1.940594	0.554455	69.46535	0.267327	0.396040	0.366337	0.623762	47.21782
Median	1.000000	1.000000	1.000000	76.00000	0.000000	0.000000	0.000000	1.000000	48.00000
Maximum	1.000000	50.00000	1.000000	98.00000	1.000000	1.000000	1.000000	1.000000	79.00000
Minimum	0.000000	1.000000	0.000000	18.00000	0.000000	0.000000	0.000000	0.000000	18.00000
Std. Dev.	0.502469	4.894531	0.499505	21.10430	0.444772	0.491512	0.484206	0.486857	16.20037
Skewness	-0.019803	9.516374	-0.219125	-0.922816	1.051478	0.425133	0.554847	-0.510949	-0.033851

Table A.2 Descriptive Statistics for Regression 2 for 111 observations

	AVEHRWK	ADLS	ASIAN	BLACK	CHILD	IADLS	INCOME	INHOUSE
Mean	12.85586	1.657658	0.027027	0.225225	0.315315	4.099099	2.369369	0.180180
Median	6.000000	1.000000	0.000000	0.000000	0.000000	4.000000	2.000000	0.000000
Maximum	76.00000	6.000000	1.000000	1.000000	2.000000	7.000000	4.000000	1.000000
Minimum	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
Std. Dev.	15.83199	1.951668	0.162898	0.419625	0.485835	1.887543	0.999345	0.386080
Skewness	1.932723	0.914905	5.833333	1.315560	1.032045	-0.184167	0.143419	1.664266

	MARRIED	OUTRES	PATAGE	RESID	RURAL	SEXCARE	URBAN	WHITE	YEARCARE
Mean	0.432432	0.567568	72.25225	-3.84E-16	0.243243	0.423423	0.351351	0.666667	46.92793
Median	0.000000	1.000000	80.00000	-1.723763	0.000000	0.000000	0.000000	1.000000	49.00000
Maximum	1.000000	1.000000	98.00000	43.38385	1.000000	1.000000	1.000000	1.000000	79.00000
Minimum	0.000000	0.000000	18.00000	-23.71565	0.000000	0.000000	0.000000	0.000000	18.00000
Std. Dev.	0.497660	0.497660	21.00020	12.73431	0.430987	0.496342	0.479558	0.473542	15.41116
Skewness	0.272772	-0.272772	-1.204556	1.266327	1.196887	0.309963	0.622752	-0.707107	-0.074937

Table A.3 Correlation Matrix

	ADLS	ASIAN	AVEHRWK	BLACK
ADLS	1.000000	0.199642	0.462854	-0.091934
ASIAN	0.199642	1.000000	0.319310	-0.075955
AVEHRWK	0.462854	0.319310	1.000000	-0.046500
BLACK	-0.091934	-0.075955	-0.046500	1.000000
CHILD	-0.158247	-0.075955	-0.075345	0.006944
EMPLOY	-0.007243	0.106471	-0.048992	0.181477
IADLS	0.344481	0.193186	0.387292	0.103633
INCOME	0.043000	0.233021	-0.084468	-0.185350
INHOUSE	0.256267	0.228709	0.490833	-0.088561
MARRIED	-0.132105	0.135873	-0.174808	-0.285720
OUTRES	0.315559	0.109810	0.136631	-0.006232
PATAGE	0.198293	0.145492	0.108463	-0.259413
RURAL	-0.008008	-0.067267	0.084159	-0.088561
SEXCARE	0.313178	0.158842	0.034668	-0.127515
URBAN	0.179495	-0.100000	0.063416	0.063296
WHITE	-0.160971	-0.158842	-0.151189	-0.784219
YEARCARE	-0.057121	0.064844	0.134527	-0.156800

	MARRIED	OUTRES	PATAGE	RURAL
ADLS	-0.132105	0.315559	0.198293	-0.008008
ASIAN	0.135873	0.109810	0.145492	-0.067267
AVEHRWK	-0.174808	0.136631	0.108463	0.084159
BLACK	-0.285720	-0.006232	-0.259413	-0.088561
CHILD	0.124226	-0.006232	-0.331070	-0.007380
EMPLOY	-0.139929	-0.080487	-0.270768	-0.046553
IADLS	-0.047132	0.285550	0.057205	0.064401
INCOME	0.457330	-0.054485	0.170538	-0.326033
INHOUSE	0.085813	0.043046	-0.047538	-0.121569
MARRIED	1.000000	0.011147	0.117955	-0.059409
OUTRES	0.011147	1.000000	0.134663	-0.029801
PATAGE	0.117955	0.134663	1.000000	-0.047538
RURAL	-0.059409	-0.029801	-0.047538	1.000000
SEXCARE	0.290836	-0.126821	0.155723	0.023715
URBAN	0.073598	0.213940	0.127107	-0.437237
WHITE	0.336457	-0.124914	0.158603	0.125352
YEARCARE	0.274976	0.149619	0.372162	0.058492

CHILD	EMPLOY	IADLS	INCOME	INHOUSE
-0.158247	-0.007243	0.344481	0.043000	0.256267
-0.075955	0.106471	0.193186	0.233021	0.228709
-0.075345	-0.048992	0.387292	-0.084468	0.490833
0.006944	0.181477	0.103633	-0.185350	-0.088561
1.000000	0.112641	0.122955	0.166176	0.154983
0.112641	1.000000	0.021104	0.066234	0.026602
0.122955	0.021104	1.000000	0.141453	0.392939
0.166176	0.066234	0.141453	1.000000	0.122262
0.154983	0.026602	0.392939	0.122262	1.000000
0.124226	-0.139929	-0.047132	0.457330	0.085813
-0.006232	-0.080487	0.285550	-0.054485	0.043046
-0.331070	-0.270768	0.057205	0.170538	-0.047538
-0.007380	-0.046553	0.064401	-0.326033	-0.121569
-0.127515	0.164701	0.116380	0.240588	0.172782
0.063296	-0.123582	0.022947	0.040779	0.154715
-0.012752	-0.227900	-0.151859	0.178974	-0.023715
-0.339764	-0.558057	-0.006200	0.028209	-0.028898

SEXCARE	URBAN	WHITE	YEARCARE
0.313178	0.179495	-0.160971	-0.057121
0.158842	-0.100000	-0.158842	0.064844
0.034668	0.063416	-0.151189	0.134527
-0.127515	0.063296	-0.784219	-0.156800
-0.127515	0.063296	-0.012752	-0.339764
0.164701	-0.123582	-0.227900	-0.558057
0.116380	0.022947	-0.151859	-0.006200
0.240588	0.040779	0.178974	0.028209
0.172782	0.154715	-0.023715	-0.028898
0.290836	0.073598	0.336457	0.274976
-0.126821	0.213940	-0.124914	0.149619
0.155723	0.127107	0.158603	0.372162
0.023715	-0.437237	0.125352	0.058492
1.000000	-0.182087	0.030244	0.019418
-0.182087	1.000000	-0.137534	0.039236
0.030244	-0.137534	1.000000	0.220286
0.019418	0.039236	0.220286	1.000000

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