The Macroeconomics of Alzheimer: A Few Scenarios

Christian Zimmermann*
Federal Reserve Bank of St. Louis, IZA, CESifo and RCEF

February 15, 2014
Very incomplete text so far

Abstract

Dementia-like deseases like Alzheimer are forecasted to affect a growing proportion of the population within decades. These deseases cannot be treated but their likelihood can be forecasted with genetic analysis and through memory tests, which has implications for foreward looking behavior. The applied microeconomic literature has reasonably well documented the costs to the affected person and family. There is, however, no attempt to understand the macroeconomic implications of such deseases affecting a significant share of the population. This paper offers a first reflection in this regard, building a life-cycle model with overlping generations. I study several scenarios where individuals respond in various ways to the likelihood of being affected by the desease in the future or to be unexpectedly hit by hit. I find that there can be very diverse and divergent outcomes whose selection can be influenced by policy.

*zimmermann@stlouisfed.org. The views expressed are those of individual authors and do not necessarily reflect official positions of the Federal Reserve Bank of St. Louis, the Federal Reserve System, or the Board of Governors.

1 Introduction

Alzheimer's is a disease on the rise. For reasons that are not well established, the proportion of Alzheimer's sufferers ahs increased from XXX% to XXX% at age XXX in XXX decades. XXX forecasts that this proportion will reach XXX in XXX. While this disease is usually not deadly, it leads to dramatic losses in quality of life for those affected and their family. The reason is that patients suffer from major losses in memory and are not able to carry out basic activities of daily life.

While there have been some studies in the economic and health literature that try to understand the costs of Alzheimer's and some other dementia-like diseases, the aggregate consequences have not been explored. This paper offers a first shot at this question. One is to expect that as the disease becomes more prevalent, people will be more aware of it and prepare for it, for example by increasing savings towards the costs of treating it. If these effects are large enough, they could also have an impact on people that are not yet affected, through general equilibrium effetcs such as changes in interest rates.

To this end, this paper explores several scenarios that could also help us understand some of the policy tools that could be available to counter some of the ill effects of the rise of Alzheimer's disease. First, I study the impact of the expected increase in the proportion of people affected by dementia diseases like Alzheimer's. Then I look how an increase in the cost of treating the disease, which is so far incurable, changes results. Where there is currently medical progress is in the predicatibility of the disease, through cognitive tests on older patients and through genetic analysis for younger ones. One scenario is to look how the behavioral changes conditional on people's knowledge about their suceptibility to the disease can change aggregate outcomes. Finally, I address the controversial issue of assisted suicide, which is currently allowed in some countries and US states, and how it could affect savings decisions and utlimately aggregate variables.

These results are established by using a simple Aiyagari-style economy, comparing steady-states across scenarios. The economy is parametrized using the medical literature and well as some results from health economics.

2 A primer on dementia

Dementia is a loss of cognitive abilities to a person that was previously largely unaffected. This loss must be serious enough to impair activities beyond what would be expected from the normal aging process. Most people that are affected are beyond retirement age, and dementia can come in many forms. It can affect memory, problem solving, attention, and expression. Its most common form is Alzheimer's disease, which most often gets press because its patients cannot recognized familiar places or people and get disoriented performing previously routine tasks.

3 A minimalist model

What is the simplest possible model that can help us understand the macroeconomic consequence of Alzheimer's disease? The essential ingredients are: some demographics, some motivations for savings, some heterogeneity in disease probabilities to build the scenarios, and the potential for disease related changes in time preference as well as costs to self and family. As this is a disease that arises in retirement, I do not think it is essential to think about labor supply, unless we want to think how active relatives may have to care for a disease sufferer. We are for the moment leaving this out and assume an exogenous labor supply.

Thus, an overlapping generations model with an exogenous income process within an Aiyagari (1994) framework is indicated, with each agent carrying genetic predisposition to Alzheiner's disease that can be uncovered at some cost. Once affected, time-preference changes. Life time is fixed except in the scenario that would allow for assisted suicide. Let us go through the details.

An individual lives for 13 periods of 5 years, starting at age 20 and is characterized in each period by assets s, health h and partner health h^p. The individual is born with genes g and partner genes g^p. A value of 1 for the last four variables implies a healthy outlook. As in standard macro models, preferences are defined over streams of expected discount future utilities from consumption:

$$\max E \sum_{i=0}^{13} \beta(h)^i U(c_i). \tag{1}$$

Note that we allow for the discount rate to change with the health status, as suggested by the medical literature: $\beta(0) > \beta(1)$. The budget contraint covers income from labor (w) and asset return (r) and expenses for consumption (c) and health related expenses for oneself (d) or the partner (d^p). Note that for the partner, we put the cost only in monetary terms, which are easier to quantify than a utility cost of caring for an Alzheimer's patient. Note that an individual retires at age 65, or at $i = 10$ with no pension:

$$1_{i<10} w + (1+r) a_i = a_{i+1} + c_i + 1_{h=0} d + 1_{h^p=0} d^p. \tag{2}$$

Health pertains only to Alzheimer's disease, which is irreversible once it is activated. Its activation follows a stochastic process that depend on age and genes with probabiblity $p^h(i, g)$. The distribution of genes is exogenous.

Factor prices are marginal factor products, where factors are aggregated into a production function:

$$L = \frac{9}{13}, \tag{3}$$

$$K = \sum_{i=1}^{13} a_i, \tag{4}$$

$$r = \frac{\partial F(K, L)}{\partial K}, \tag{5}$$

$$w = \frac{\partial F(K,L)}{\partial L}. \tag{6}$$

Finally, we need to ensure that assets and consumption stay non-negative.

4 Some numbers

While we can easily obtain some qualitative results from this model, the interesting part is to get an idea of the magnitude of the effects. Given the simplicity of the model, we should not expect this to be precise, but rather a motivation for further research. For a quantitative analysis, we take a stance about functional forms and parameter values. For the production function, we take a standard Cobb-Douglas function with a labor-income share of 64%. Despite the fact that the utility function has only one argument, its determination is more complex than usual because we want to run a scenario where assisted suicide is allowed. Thus, being alive needs to have some value and death is normalized to zero.[1] γ captures this value:

$$u\left(c_{it}\right) = \frac{\left(\gamma c_{it}\right)^{1-\rho}}{1-\rho}, \tag{7}$$

where we set $\gamma = 11.3$ following Viscusi and Aldy (2003) which estimates that the the value of life in the US is about \$7 million, or 11.3 times lifetime consumption. ρ is set to 1, that is, logarithmic utility, and we will play around with it to check for the robustness of the results.

Next, we need to establish values for some disease-related variables. First, we discuss the distribution of genes that predispose to suffering from Alzheimer's disease. From XXX, about XXX% of the population is thought to carry gene XXX. We assume that the distribution of this gene is independently distributed across partners. From XXX, we also learn that a person carrying such a gene has a XXX% probability of eventually suffering from the disease, while it is XXX% for those not carrying the gene. And from XXX, we learn that the onset of Alzheimer's is for XXX% of all patients at age XXX. From this we establish the following unconditional (for scenarios where people do not know their genotype) and continal probabilities of starting with Alzheimer's:

Age	$g =?$	$g = 1$	$g = 0$
65–69			
70–74			
75–79			
80–84			

For the cost of suffering from the disease, I use XXX to set $g = XXX$. For the cost to the partner, I use XXX to set $g^p = XXX$. Finally, $\beta_1 = 0.95^5$ for healthy individuals and $\beta_0 = XXX$ as recommended by XXX.

[1] Given that Alzheimer's patients do not feel the impact their disease has on other and themeselves, there is no disutility from being sick. The assisted suicide decision would thus be purely economic, and expectedly controversial.

5 Running through some scenarios

5.1 The banchmark

5.2 Increase in proportion of Alzheimer sufferers

5.3 Increase in cost of treatment

5.4 Earlier detection of Alzheimer

5.5 Genetic testing

Use of it with imperfect results, perfect results.

5.6 Allowing for assisted suicide

6 Conclusions

7 References

Viscusi, K., and Aldy, J. (2003). The value of a statistical life: a critical review of market estimates throughout the world. *Journal of Risk and Uncertainty, 27*(1): 5–76.

8 Tables