The Relationship between Cognitive Decline and Early Retirement:
A New Approach Using Genetic Material

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Background

Bad health is often cited as a reason for early retirement. Understanding the role of bad health on retirement decisions presents serious challenges to empirical researchers due to the inherent endogeneity between health and labor market participation. Estimated effects of health may be mis-estimated if individuals use health as a justification for leaving the labor force early, often referred to as the "justification hypothesis."

There has been extensive work exploring the role of various physical impediments on retirement decisions; there is much less attention paid to the effects of cognitive capacities on labor market participation. Still, what little work has been done has shown that cognitive skill plays a large role in both labor market participation and wages (Heckman et al., 2006; McArdle et al., 2009, Willis and Smith, 2001). In fact, a recent paper (McArdle et al., 2009) states that "dimensions of cognitive skills are potentially important but often neglected determinants of the central economic outcomes that shape overall well-being over the life course." Estimates of cognitive decline in middle age vary because of differences in definitions but range between 1%-25% (Bischkopf J, Busse A, and Angermeyer MC, 2002). A recent paper by Rohwedder and Willis (2010) used an instrumental variable approach to show that there is exists a causal relationship between early retirement and subsequent cognitive decline; whether there exists a causal relationship in the other direction remains an open question. This study will examine the role that cognitive decline in middle age plays on the decision to withdraw early from the labor force.

There are many reasons to believe that cognitive decline is a driver of retirement decisions. For one, the nature of the workforce depends increasingly on intellectually-demanding jobs. As the number of 'white collar' jobs grows in comparison to manual labor, intellectual capacity and cerebral strength may become more important determinants of job productivity and job satisfaction. As such, the decline in cognitive ability has growing importance in retirement decisions. There is already an extensive literature of the effect that this change in occupational structure has on the perceived and real productivity of older workers (see Borsch-Supan, 2008 for a review of this literature) but little work exploring subsequent retirement decisions. Finally, changes in cognition can impact preferences by changing the relative utility of work and leisure.

Empirical Strategy

Incorporating health problems into a standard retirement model is complex, due to endogeneity concerns. Cognitive state is an input into both work and non-market activities, and both leisure and work are inputs into both the current cognitive state and the pace of decline. Moreover, both health and labor market decisions are likely to be correlated with additional confounding variables, some of

which may be unobserved. Therefore, the predicted effects of cognitive impairment on retirement age are theoretically ambiguous. An instrumental variable approach can be used to estimate the causal impact of cognitive decline on early retirement. The empirical strategy of this paper is to use the genetic variation across individuals as instruments to serve as a source of identification. I will exploit the facts from Mendelian randomization that any given gene is both randomly assigned from one parent to offspring, as well being independent of the assignment of any other gene (known as Mendel's Second Law). While this random allocation is at a the family level (from parent to child), at a population level it has been demonstrated that genetic variants are largely unrelated to the many socioeconomic and behavioral characteristics that are closely linked with each other and that confound conventional observational studies (von Hink Kessler Sholder et al., 2010; see Bhatti et al., 2005; Davey Smith et al.,2008; Kivimäki et al., 2008; Lawlor et al., 2008).

While use of genetic markers as instrumental variables is receiving increasing attention from demographers, to date only a handful of studies have used genes as instruments, and none have explored economic outcomes of the middle aged or elderly. A series of papers have used genetic markers to identify the causal impact of poor health on academic performance in adolescents (Ding et al., 2007; Norton and Han, 2008; Fletcher and Lehrer, 2009; von Hink Kessler Scholder et al., 2010). However, given the complexity of genes and their interactions both with each other and environmental factors, there are very specific conditions that need to be met for genetic variants to be used as instruments. While genetic epidemiology studies have emphasized the importance of carefully examining these conditions, with a few exceptions (see von Hink Kessler Scholder et al., 2010), these have not been well defined in the current demographic literature. I will therefore discuss the conditions as defined in the epidemiology literature and relate them to the IV assumptions used in the statistics literature. This paper will also be the first to use this empirical technique to explore labor market outcomes for adults.

Data

This project will use phenotypic, genotypic and life-course information for a sample of approximately 12,000 respondents through the 2010 The Health and Retirement Study (HRS) Respondent Survey and Genetic-Wide Association Study (GWAS). The Genetic-Wide Association Study (GWAS) is a newly released database from the HRS that includes close to 2.5 million data points (referred to as Single-Nucleotide Polymorphisms, or SNPs) of genetic material.

The HRS is well-known for its high quality measurement of many key SES and labor market outcomes including wealth, income, and retirement decisions. In addition, HRS includes in some waves several salient dimensions of cognitive skills. These cognition constructs include immediate and delayed memory recall, numeracy and questions about difficulties operating familiar or old machines, handling finances, and doing arithmetic problems. Importantly, the longitudinal nature of the survey will allow me to track cognitive changes over time, rather than a static measure of cognitive endowment. This paper will utilize the richness of this data to explore both various individual measures and composite measures of cognition and cognitive decline as they relate to retirement decisions.

Given the confidential nature of genetic data, the approval process to gain access to these recently available data is long and complex; I have recently gained access to some of the data and am awaiting approval for other components of the database necessary for analysis. As such, I am not able to provide any descriptive tables or figures for the purpose of this submission. However, the remaining pieces should become available to me in the coming weeks, and I am well-prepared[1] to begin analysis immediately. There are currently less than twenty researchers who have gained access to this data and I believe my contribution to the field using this novel database will be important.

Choice of Instrument

Like cognitive function at any static point, cognitive decline with age shows individual differences: some people show marked cognitive declines that begin around ages 50, while others retain very good cognitive function well into old age (Birren and Schaie, 2005; Schaie, 2008). Apolipoprotein E (APOE) is a gene that has been associated with variations in cognitive change started at mid-age. For a variety of reasons, APOE is a very good candidate to use as an instrument for this study. The gene is inherited in a variety of forms in which the risks to cognitive declines vary systematically by allelic make-up. The genetics literature has shown that variations in volumes of $\varepsilon 4$ homozygotes (possessing two $\varepsilon 4$ alleles) are associated with declines in memory performance, nonverbal reasoning (Deary et al., 2007), information processing speed (Luciano et al., 2009), and deficits in visual attention (Johnson et al., 2007).

Importantly, the cognitive decline that occurs with APOE gene begins only in adulthood; there have been no studies linking individuals with the ε 4 allele to any cognitive disadvantage in childhood or through ages 30 (Anstey and Christensen, 2000), eliminating the possibility that it is a life-long cognitive disadvantage that leads to different retirement decisions for these individuals. Likewise, since individuals are not aware of their allelic makeup until cognitive decline may already begun, there is little likelihood that other behaviors related to APOE are mediating this relationship. All of these and other assumptions will be tested as part of the study.

While APOE provides an excellent candidate for an instrument, the paper will also utilize the richness of the genetic-wide association study and it's nearly 2.5 million snps to explore other potential genetic instruments. Specifically, in following in the literature of behavioral genetics, I will also explore the possibility of creating a composite index based on a combination of snps with positive associations to cognitive decline.

Expected Contributions

This study seeks to explain the causal role of cognitive decline in older-aged American on retirement decisions. It will provide several new contributions. First, it will provide much-needed information on the role of cognitive decline on labor market decisions. Secondly, it will add to the small but promising literature using genetic materials as instruments by addressing new questions, as well as by drawing

[1] In preparation of the impending GWAS data release, I have also been working with simulated data in order to create the necessary programs for my analysis and test null findings.

more heavily from the epidemiological literature that has previously been missing in previous works. Finally, it will be the first of its kind to use the Health and Retirement Survey's new GWAS data for this type of study.

The full paper will provide a careful analysis of cognitive decline in the sample of respondents and its relationship and implications on retirement decisions. There will also be details on the genetics instruments and its relationship to cognition with relation to the biological literature. Finally, the model will be specified and tested, with a thorough discussion of results and robustness checks. The paper will conclude with a general discussion of the role of cognition on labor market outcomes for middle-aged and elderly Americans, as well as thoughts on the validity and promise of using genetic material in social science research.

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