The Health of Disability Insurance Enrollees: An International Comparison

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Abstract

Rising costs of disability insurance (DI) programs are putting increased strain on central government budgets across nearly all developed economies. Yet little is known about how well countries target those in the poorest health across countries, or within a country over time. In this paper, we use the Survey of Health, Ageing, and Retirement in Europe (SHARE) and the Health and Retirement Study (HRS) in the United States during 2004-14 to measure (a) the average health of people aged 50-64 receiving DI, and (b) the effectiveness of the DI safety net in covering those in poor health. Using these two measures, we find that U.S. and Danish DI programs appear successful at targeting benefits to those in the worst health, with France and Belgium less so. We also demonstrate how these measures can be used to evaluate changes over time in DI policies, for example by measuring secular changes in targeting effectiveness following large reductions in DI enrollment (as in the Netherlands and Denmark) or expansions (as in the U.S.).

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1. Introduction

There are large variations across countries in the fraction of the population age 50-64 receiving disability insurance (DI) payments, ranging from 3.2 percent in France and 4.4 percent in Italy to 12.7 percent in Denmark and 15 percent in Sweden.[1] Most countries are concerned about disability insurance enrollment, and the resulting pressure on public sector budgets in Europe and the United States (European Commission, 2006; OECD, 2003, 2010; McVicar, 2008; Leibman, 2015).

Previous literature suggests that institutional features of disability programs reflecting ease of being accepted and generosity of benefits are important determinants of the overall size of a country's DI program (Börsch-Supan, 2006, 2010, 2011; Milligan and Wise, 2012). Yet there is little or no information about the characteristics of disability insurance enrollees across countries. Do programs with high enrollment rates accept more "gray-area" applicants who are in better health or who have better job opportunities than average? Or do smaller-than-average disability insurance programs fail to cover those who are truly ill? When countries scale back on disability programs, do the declines in enrollment occur among healthier or less healthy individuals?

One approach to characterizing the health of DI enrollees is to estimate the labor supply effects of those rejected from DI (e.g., Bound, 1984; Maestes et al., 2013), but these estimates reflect the labor market opportunities of the incremental DI enrollee, and are difficult to compare across countries with different labor markets. Milligan and Wise (2012) found little association across countries between mortality rates and self-reported health of DI enrollees across countries,

[1] These estimates are from SHARE and HRS data for 2012, described below, in Table A.2.

but mortality captures only the sickest among the disabled, and does not capture broader measures of disability among those who survive. A third approach, pioneered by the OECD (2003, 2010), characterizes DI programs across countries along a range of dimensions such as the severity of disability needed to qualify, the duration and size of the compensation, and types of vocational and employment support, summarized by numerical scores giving equal weight to each dimension. Yet it is difficult to know how well official government regulations translate into actual practice in the DI programs on a day-to-day basis, nor what is the optimal weighting scheme of these disparate measures.

In this paper, we introduce a new approach to quantitatively assess the ability of country-level disability insurance programs to target those in poor health. We base estimates on micro-level data from the Health and Retirement Study (HRS) and the Survey of Health, Ageing, and Retirement in Europe (SHARE) for a set of 10 European countries and the United States for respondents between ages 50-64 from 2004-12. Our approach is based on an earlier literature on the *targeting* of income assistance programs to those most in need (e.g., Besley and Kanbur, 1993; Brady and Burrowa, 2012; Finkelstein and Notowidigdo, 2018). In a similar way, we seek to measure how well disability programs target those in the poorest health, both across countries and over time.

There are a number of ways to characterize disability (Mitra, 2005). We exploit the richness of health-related information available in both SHARE and HRS to construct three different health indices following the principal components methodology used by Poterba, Venti and Wise (2010, 2011, 2013). Our first index is based on the variant of Poterba, Venti and Wise (2013), (PVW) expanded to include the SHARE data and designed to capture an overall measure of health and capacity for work. The second index of health uses the same principal component

methodological approach of PVW, but is based on capturing functional ability, as in Mont and Loeb (2010); we refer to this as ML. Third, we use a similar principal component approach to create a mental health index/depression (MHD) index, to capture the severe impact of depression on employment even when the individual is healthy along other dimensions (OECD, 2012). Finally, we also consider a fourth hybrid summary measure that is the *minimum* of these three indices, suitably rescaled in percentile terms.

Our primary focus is therefore on health percentile measures *within* countries. This latter approach avoids biases that arise because of country-specific differences in how individuals respond to survey questions about health (e.g., Kapteyn, Smith and van Soest, 2009, van Soest et al., 2011). That said, as sensitivity analysis we also consider differences in (measured) absolute health across countries.

We first create semi-parametric representations of how country-specific DI recipiency varies across the entire distribution of health, and in addition consider several summary statistics. The first is the average (percentile) health status among those receiving disability insurance. Average health percentiles will tend (almost mechanically) to be higher in countries with larger DI programs, but conditional on the size of the program, countries more effective in targeting will experience lower average percentile health measures for those on disability insurance. The second summary statistic captures the ability of the DI program to cover people in the bottom decile of the health distribution.

The third measure captures the possibility that countries use their disability programs to insure against poor labor market outcomes or jobs involving manual labor prior to retirement. That is, if countries use their DI programs in part to cover not just those who are disabled, but those who are less severely disabled but with low educational levels (as a proxy for market

skills), then we would want to capture those objectives in our models. We therefore consider a model that captures the extent to which country-specific disability programs "sort" on the basis of a combined index that captures both health and market skills (as measured by educational attainment).

Using pooled survey data from the 2004/5-2014/15 SHARE and corresponding HRS waves, we find large differences across countries in the health status of people receiving DI benefits.[2] Consider for example two countries with roughly sized DI programs, the U.S. (10 percent of the 50-64 population during 2004-14) and Belgium (8.4 percent in same period). Using the PVW index, we find that the average percentile of health for DI enrollees in the US is 15.1; for Belgium 25.4 percent, suggesting that the US DI system is more effective in targeting those who are in poor health.[3] The ML index, based on Mont and Loeb (2010), yields similar results, and if anything indicates a slightly better "fit" in the sense that the average percentile health measure is often lower than the PVW index across countries.[4]

The fraction of people in the bottom decile of the health distribution who are covered by DI also differs across countries, ranging from France (just 12.4 percent), to the U.S. (51.9 percent), Denmark (51.7 percent), and Sweden (60 percent). These differences are attenuated but persist when we include the receipt of early retirement programs that could substitute for DI insurance (e.g., Borghans et al., 2014). Furthermore, it does not appear that low educational attainment (relative to tertiary education) has any significant impact on the likelihood of DI

[2] Note that the SHARE data is not perfectly matched temporally to the HRS data; for example Wave 6 of Share (2015) is matched to Wave 12 of the HRS (2014).

[3] We also consider an alternative interpretation below – that the lengthy process of application and appeal in the U.S. may adversely affect health.

[4] In other words, the ML index appears to do a slightly better job of predicting who is on disability, at least according to this metric.

enrollment, conditional on health – except in Denmark. This result is consistent with Denmark's recognition as a country with "best practice" DI programs (according to OECD, 2009) that help to keep disabled people with better employment opportunities in the labor force.

Finally, we can track how well these micro-based measures capture the impact of DI reforms reducing DI enrollment, such as the Netherlands and Denmark, or the impact of growth, such as the US and Belgium. For example, de Jong et al. (2013) and Koning and Lindeboom (2015) have shown that more intensive screening of disability applicants in the Netherlands led to improved targeting of recipients. We also find a decline in enrollment rates, a modest improvement in targeting, but with the DI coverage of those in the poorest health slipping from 52.4 percent in 2004 to 42.3 percent in 2012.[5] The reverse pattern is found in the U.S., where disability rates have increased from 8.3 percent to 11.7 percent during this period, and the safety net has improved, increasing coverage of the bottom decile from 44 percent in 2004 to 57 percent in 2014 . As more countries embark on DI reforms, these quantitative measures can be used to monitor country-level success or failure in targeting those in poor health.

2. Model and Estimation

The general theory of targeting is straightforward; A given level of social spending should be targeted to those in greatest need. For example, in the case of poverty alleviation, targeting is diluted when higher-income households receive financial transfers, or when truly poor households fail to receive these transfers (Brown et al., 2016). The problems arise when the objective of the transfer program, to alleviate poverty, leads to adverse incentives that lead to greater revenue costs and inadequate provision of benefits, for example when recipients change

[5] The corresponding decline for any pension was from 65.4 percent in 2004 to 57.7 percent in 2012.

their behavior in order to qualify for the transfer or a larger cash payment from the program (Besley and Kanbur, 1993). These issues of incentive compatibility arise as well in disability insurance programs, which are further complicated by the inability to even measure health, or functional capabilities in the sense of Amartya Sen (Sen, 1995; Mitra, 2005; Mont, 2007). Thus countries may optimally (or sub-optimally) adopt a variety of different approaches for transferring resources to the disabled. Aside from qualitative information on government policies (OECD, 2003, 2010), there is little quantitative evidence across countries on characteristics of individuals who qualify (or who do not qualify) for disability insurance.

To fill this gap, we consider a general model of disability application (and acceptance), and its empirical implementation. The objective of disability insurance is to provide financial support for those with mental or physical disabilities leading to poor market opportunities and the need for financial assistance. We consider two versions of the model. In the simplest version, we assume that the primary determinant of whether the individual receives disability insurance is health status. Of course, health status is a complex multi-factorial concept, and we consider several approaches to measuring it below.

DI receipt occurs through a two-step process. First, the individual chooses to apply for DI insurance, and then the application is reviewed (and perhaps initially rejected) by the DI agency. Thus receipt of benefits is the product of the binary variable of whether one applies, and whether the application is approved. Our reduced form model of this two-step process is:[6]

[6] In the logistics model, it can be shown that the reduced form coefficients reflected weighted averages of the parameters related to application, and the parameters that determine the likelihood of acceptance given the application takes place.

$$
\begin{aligned}
& Y_{ij}^{*} = \beta_j X_{ij} + \alpha_j (h_{ij} - H_j) + u_{ij} \\
(1) \qquad & Y_{ij} = 1 \quad if \quad Y_{ij}^{*} > 0 \\
& Y_{ij} = 0 \quad otherwise
\end{aligned}
$$

where Y_{ij}^{*} is a linear index for individual i and country j which, if positive, implies that the application (or receipt) $Y_{ij} = 1$ occurs, and where Y_{ij} is zero otherwise, and $\sigma_j^2 = Var(u_{ij})$. The (joint) decision of whether to apply, and whether the applicant is accepted, is also dependent on factors such as age, sex, and marital status; these are measured by the vector X_{ij}. While we use these variables in the regression analysis, our primary focus is on national rates of disability or functionality within our age group of 50-64.[7]

The likelihood that Y_{ij}^{*} is positive in turn depends on the health h_{ij} of the individual, and whether it exceeds the country-specific benchmark H_j. (Note that better health corresponds to a higher h, which means that $\alpha_j < 0$.) There are 3 key factors that determine the country level rate of people receiving DI. The first is the distribution of health status h_{ij}. Because of concerns about differences across countries in how disability is perceived and reported (e.g., Kaptyen, Smith, and van Soest, 2009), the primary focus is on the relative distribution of health within a country; thus h_{ij} will in practice be considered in country-specific percentile terms (as in Poterba, Venti, and Wise, 2013, and Meijer, Kapteyn, and Andreyeva, 2011 for a related approach; Chetty et al. (2014) also focuses on percentile rankings for income); we also consider absolute measures in sensitivity analysis. Because the uniform distribution of h_{ij} is identical across countries, this

[7] It is not entirely clear how to interpret β; it may reflect preferences of individuals, or discrimination on the part of disability boards. In our analysis below, we assume that our primary interest is in comparing disability based on health and functionality, and not with regard to age or sex. Furthermore, as we show below, the age and sex composition of our countries are very similar.

also means that the estimated coefficient α_j can be compared meaningfully across countries as well.

Second, countries may differ with regard to the benchmark rate of health H_j, setting higher or lower standards for whether the individual's disability qualifies as sufficiently serious to warrant financial assistance. Clearly, a higher H_j will lead to a larger population receiving disability. The third factor is the ratio α_j/σ_j which captures the ability of the disability program to target those with poor health. Since σ_j, or the standard deviation of u_j, is normalized to one in our Probit regressions, we interpret the estimated α as the combined effect of both. If the application process is a pure lottery, the estimate of α will be zero, while if the selection process is nearly deterministic and targeted to those in poor health, the ratio will be large in magnitude. In practice, we allow for the magnitude of α to vary across the distribution of health.

In the results below, we show the entire distribution of DI recipiency by country across all health percentiles, but also calculate several summary statistics that capture the degree to which the DI programs target those in worse health. One approach is to consider average health conditional on enrollment in a DI program:

$$\mu_{DI} = E(h_{ij}) \mid \beta_j X_{ij} + \alpha(h_{ij} - H_j) > u_{ij} \tag{2}$$

Rearranging, and summing over each of the N_j individuals in the sample for country j

$$\mu_{DI_j} = \sum_{i=1}^{N_j} P(i) F\left[\frac{\beta_j X_{ij} + \alpha(P(i)_j - H_j)}{\sigma_j}\right] \tag{3}$$

where P(i) is the cumulative percentile measure of individual i's health status and F the normal cumulative distribution. Ignoring X for the moment, and noting that the weighting function P(i) is similar across countries, in general the average percentile health of those on DI will be higher in country j the smaller in magnitude is α_j/σ_j, and the smaller is H_j, or the cutoff point for

eligibility. In other words, countries where it is easier to gain DI coverage, and where targeting is less focused, will tend to exhibit higher measures of average health conditional on DI receipt.[8]

A measure that captures a different aspect of targeting is the fraction of those in some percentile P of the health distribution covered by DI. That is,

$$\lambda_{DI_j} = E(\beta_j X_{ij} + \alpha(h_{ij} - H_j) > u_{ij}) \mid h_{ij} < P^* \tag{4}$$

That is, when P* = 0.10, for example, or the bottom decile of the health distribution, then λ_{DI_j} captures the fraction of people in that bottom decile enrolled in DI, and thus captures the porousness of the safety net. There is no theoretical basis for choosing a P*, and so we choose somewhat arbitrarily the bottom decile of the health distribution for people aged 50-64 as those potentially appropriate for a safety-net.

Our final and third approach is to estimate α_j/σ_j directly using Probit estimation methods that adjust for characteristics of individuals, X_{ij}, that may differ between DI enrollees and non-enrollees. More realistically, disability insurance applications and approvals could also be affected by job market opportunities; a college graduate with muscle weakness may be less likely to qualify for disability insurance compared to a manual laborer who didn't finish high school. In this case, the estimating reduced form equation can be written

$$\begin{aligned} Y_{ij}^* &= \beta_j X_{ij} + \alpha_j (h_{ij} - H_j) + \gamma_j (w_{ij} - W_j) + u_{ij} \\ Y_{ij} &= 1 \quad if \quad Y_{ij}^* > 0 \\ Y_{ij} &= 0 \quad otherwise \end{aligned} \tag{5}$$

where labor market opportunities are reflected in the potential market wage w_{ij} relative to the country-specific wage deemed relevant for disability insurance, W_j. Given the difficulty in

[8] We acknowledge that comparing means of percentiles across countries may lead to biases if for example the variance of true "health" differs across countries.

measuring wages for people not in the labor force, in the empirical analysis we proxy w_{ij} using education. Since higher wages make DI insurance applications less likely to qualify, we hypothesize that $\gamma < 0$.

3. Data

We use data from the Survey of Health, Ageing and Retirement in Europe (SHARE) and the US Health and Retirement Study (HRS) for the years 2004, 2006, 2010, and 2012 (waves 1, 2, 4, and 5 for SHARE and waves 7, 8, 10, and 11 for HRS).[9] [10] For Europe, we focus on the ten European countries that participated in every wave of SHARE. They are a balanced representation of the various regions in Europe, ranging from Scandinavia (Sweden and Denmark) through Western and Central Europe (the Netherlands, Belgium, France, Germany, Switzerland and Austria) to the Mediterranean (Spain and Italy). Properties of the SHARE data, such as response rates and sample sizes, have been reported elsewhere (e.g., Börsch-Supan,

[9] This paper uses data from SHARE wave 4 release 1.1.1 (March 2013), SHARE wave 1 and 2 release 2.5.0 (May 2011) and SHARELIFE release 1 (November 2010). The SHARE data collection has been primarily funded by the European Commission through the 5th Framework Programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life), through the 6th Framework Programme (projects SHARE-I3, RII-CT-2006-062193, COMPARE, CIT5- CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the 7th Framework Programme (SHARE-PREP, N° 211909, SHARE-LEAP, N° 227822 and SHARE M4, N° 261982). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, R21 AG025169, Y1-AG-4553-01, IAG BSR06-11 and OGHA 04-064) and the German Ministry of Education and Research as well as from various national sources is gratefully acknowledged (see www.share-project.org for a full list of funding institutions).

[10] Most SHARE countries were on a harmonized bi-annual schedule. However, the schedule of fieldwork in the different countries depended on the timing of partially de-centralized funding. SHARE wave 1 was fielded mostly in 2004, with some interviews taking place in 2005. SHARE wave 2 was fielded in 2006 and 2007. SHARE wave 4 was fielded mostly in 2011 with some interviews taking place in 2010 and in 2012. In this paper we associate SHARE wave 1 with 2004, SHARE wave 2 with 2006, and SHARE wave 4 with 2010. The 2008 wave of SHARE (Wave 3- SHARELIFE), was designed to capture information about respondents' life histories, and contained very different questions from the other waves. We therefore excluded this year from both data sources.

2007). About two-thirds of the variables in SHARE are identical to variables in HRS, and most of the remainder is fairly comparable (Börsch-Supan, 2007).

Disability insurance is defined as all branches of publicly financed insurances against the loss of the ability to perform gainful employment. Receipt of disability benefits is determined by responses to questions specific to each survey.[11] For HRS respondents, we use a derived variable provided by RAND that describes the respondent's disability status in each wave. Respondents are considered to be receiving disability benefits if this variable indicates that they were currently receiving benefits from SSI, SSDI, or both. For SHARE respondents, we determine disability benefit receipt by recoding answers to country-specific questions about receipt of public disability benefits.[12]

[11] In SHARE's first wave, several countries asked DI and accidents/sickness benefits separately, but from Wave 2 onward, DI and accidents/sickness benefits are asked in the same question. Sickness benefits are typically made when an individual employee is unable to work as a result of a medical condition and the resulting reduction in earnings is compensated (in full, or in part). Eligibility is generally established based on an insurance record. It is assumed that the inability to work as a result of the medical condition will be temporary and that a return to work can be expected. If the medical condition turns out to be long-standing, and a return to work is therefore unlikely, the claimant will typically be transferred to a disability insurance payment (e.g. invalidity or incapacity benefit). The amount might be flat or earnings-related.

[12] Following Borsch-Supan et al. (2016), the DI institutions considered in each country are the following: Staatliche Invaliditäts- bzw. Berufsunfähigkeitspension, Versehrtenrente oder Krankengeld (aus der Haupt- und Nebenbeschäftigung) in Austria, Wettelijke/ Aanvullende uitkering bij ziekte of invaliditeit of wettelijke uitkering bij beroepsziekte of arbeidsongeval, Allocation/pension maladie/invalidité/incapacité légale, Deuxième assurance maladie/invalidité/incapacité légale in Belgium, Rente de l'assurance invalidité (AI), Rente der Invalidenversicherung (IV), and Rendita invalidità (AI) in Switzerland, Erwerbsminderungsrente bzw. Beamtenpension wegen Dienstunfähigkeit, oder Krankengeld in Germany**,** Førtidspension, including sygedagpenge in Denmark, Pensión pública de invalidez/incapacidad or prestación pública por enfermedad, Segunda pensión pública de invalidez/incapacidad or segunda prestación pública por enfermedad; Pensió pública d''invalidesa / incapacitat or prestació pública per malaltia, Segona pensió pública d'invalidesa / incapacitat o segona prestació pública per malaltia in Spain, Pension d'invalidité publique (including rente d'accident du travail and allocation supplémentaire d'invalidité) in France, Συνταξη αναπηρ ΄ ΄ιας in Greece, Indennità pubblica di disabilità; and pensione pubblica di invalidità or di inabilità (including assegno di accompagnamento) in Italy, WAO, Waz, WIA, and other invaliditeitspensioen in the Netherlands, Sjukersättning (förtidspension) and sjukbidrag in Sweden, SSDI and SSI disability pension in the United States (US).

Our analysis depends critically on measuring health status. Perhaps the most commonly used measure of health status is self-reported health. This indicator, however, has potential shortcomings, such as a lack of reliability (Crossley and Kennedy, 2002), potential self-reporting biases (although see Benitez et al., 2004), difficulty in comparing across countries (Banks et al., 2004; Kapteyn, Smith and van Soest, 2009), and limited granularity because everyone is sorted into just 4 or 5 categories. Instead, we exploit the richness of health-related information available in both SHARE and HRS to create several health indices based on the methodology introduced by Poterba, Venti and Wise (2010, 2011, 2013).[13] Their approach views "true" health as a latent construct for which several noisy measures are available. They begin with a large number of variables that are assumed to be related to the underlying health status, perform a principal component analysis on them and obtain the first principal component of these indicators. They use this first principal component as a health index measure.

We expand on this approach to allow for cross country comparisons. We pool data across years and perform separate principle components analyses for each country. We retain the first principal component and use this to create country- and year-specific percentile scores for each respondent.[14]

Our main index, denoted PVW, follows closely the construction of the variant of their index proposed in Poterba, Venti and Wise (2013). We use 23 different items which provide a large amount of health-related information, including body mass index (BMI), nine indicators for functional health limitations (difficulties in walking 1 block in HRS or 100 meters in SHARE, sitting, getting up from a chair, climbing stairs, lifting heavy objects, picking a coin from a table,

[13] See Kapteyn and Meijer (2014) for an insightful review of alternative approaches.
[14] We do not adjust for age (aside from considering just ages 50-64 across countries) to capture true health (rather than health conditional on age); in practice the distribution of ages across countries is very similar (see Table 1).

raising arms over head, pushing/pulling large objects), one indicator for having problems with at least one activity of daily living (ADL), indicators for having experienced chronic diseases or conditions (high blood pressure, diabetes, cancer, lung diseases, heart problems, stroke, arthritis, psychological problems), indicators for the use of health care services in the past year or two (having visited a doctor, an hospital or a nursing home), and having had back pain (Appendix Table A.1).

To capture the complex relationship between disability and health, we construct additional indices of health status. Our second approach, which we call the "ML" index, addresses the issue that disability arises from the interaction of an individual's functional status and the environment, focusing on a set of indicators that emphasizes functional ability, as in Mont and Leob (2010). This is based on 22 items, including the same nine indicators for functional health limitations used in PVW, but more detailed information on limitations with ADL (separate indicators for difficulties with dressing, bathing, walking across a room, eating, getting out of bed ad using the toilet), as well as indicators for difficulties with instrumental activities of daily living (IADLs), such as the ability to use a map, use a phone, manage money, manage medications, shopping, or prepare one's own meals, and the presence of health problems limiting work or the usual activities, and excluding diagnosed diseases, which conversely are included in the PVW index (Appendix Table A.1).

Mental disorders are among the most common causes of disability (OECD, 2012), and someone with a severe mental illness may be unable to work, despite being in otherwise robust health. We construct a third index, meant to capture mental health with a strong focus on mental health and depression (MHD hereafter) which relies on the set of questions used to construct the

CES-D depression score in HRS and the Euro-D depression score in SHARE (Appendix Table A.1).[15]

Finally, we also consider a fourth hybrid summary index that is the *minimum* of these three indices, suitably rescaled in percentile terms, reflecting the idea that a bad score along just one of these dimensions will qualify the individual for disability insurance as well as making it very difficult for them to work.

In the empirical analysis, we focus on individuals aged between 50 and 64 in each wave. We consider individuals until age 65 because in all the countries of our sample, disability insurance benefits are automatically converted to old age pension benefits at age 65. We drop all respondents with missing values for our dependent variable (whether receiving disability payments) or at least one of the variables used in the health indices. Thus, the final sample consists of an unbalanced sample of 63,929 person-waves from SHARE and 32,555 person-waves from the HRS. Actual regression samples may be smaller due to individuals with key X_{ij} variables that are missing.

Table 1 presents descriptive statistics for the main variables used in the analysis, by country. The gender composition of our sample is fairly balanced across countries. Respondents on average are 57 years old in every country. Between 71 (Austria) and 80 (Italy) percent of them are married. One variable that shows a remarkable degree of heterogeneity across countries is the proportion of individuals self-reporting being retired: one out of 10 Swiss and Dutch, compared to about one out of five in the US and Belgium, and 41.5 percent in Austria (Gruber and Wise, 1998).

[15] Recall that while the questions asked in the U.S. and in SHARE countries are not identical, we only need to assume that the battery of questions rank individuals similarly within the country.

Educational attainments for these cohorts of individuals are also fairly different across countries. Education for the SHARE cohorts was split into primary, secondary, and tertiary relying on the ISCED-97 coding provided.[16] For the HRS, primary corresponds to 11 years of education or less, secondary to 12 years, and tertiary to more than 12 years of education. The U.S. has the largest share of individuals having attained a tertiary level of education (58.5%). At the other extreme, the Mediterranean countries in our sample, Spain and Italy, have the largest share of individuals with a primary level of education (69.6% and 61.2%, respectively).

4. Results

4.1 Cross sectional analysis

Table 2 shows summary statistics for individuals aged 50-64 receiving Disability Insurance by country. Disability Insurance enrollment rates vary widely across countries, with the 2004-12 average percentage of those receiving DI benefits ranging from less than 3 percent in France to more than 16 percent in Sweden. The US enrollment rate (9.7 percent) is only slightly higher than the European SHARE average of 8.5 percent.

Figure 1a provides a comparison of the distribution of DI enrollees by PVW health status index decile, for the entire 2004-12 data, for two countries with similar fractions of people age 50-64 with disability benefits, the U.S. (9.7%), and Belgium (9.2%). The distribution of benefits in the U.S. is skewed more to the left, meaning that a larger fraction of DI benefits accrue to people who report worse health. Note the relatively high fraction of Belgium enrollees who

[16] The SHARE generated variables files provide the 1997 International Standard Classification of Education (ISCED-97) coding. We combined the ISCED-97 codes 0 (none), 1 (primary education), 2 (lower secondary education), into one category ("primary"), the codes 3 (upper secondary education) and 4 (post-secondary, non-tertiary education) into another category ("secondary"), and categories 5 (first stage of tertiary education) and 6 (second stage of tertiary education) into yet another category ("tertiary"). See separate Data Appendix for further details (not yet completed).

report health status *above* the median decile. Similarly, Figure 1b compares Austria and Switzerland, again two countries with similar sized DI programs; Switzerland exhibits better (more targeted) coverage of those in the bottom health deciles and lower (more targeted) coverage of those in the highest health deciles.

The fraction of individuals in the bottom decile of the health distribution covered by DI is shown in Table 2 by country. (The same information can be found in Figures 1a and 1b for the four selected countries.) Sweden (0.63) and Denmark (0.52) do the best with regard to covering this group, but the U.S. (0.51) is not far behind; France (0.12) is the least successful in covering those in the bottom decile.

Successful targeting of those in the poorest health implies a high fraction in the lowest decile covered by DI (λ_{DI}), and (condition on λ_{DI}) a low average percentile health level (μ_{DI}). Figure 2 shows the 11 countries in our sample arrayed by their value for λ_{DI} and μ_{DI}; the horizontal axis is in reverse so that the right side is lower and hence more desirable; the ideal would be in the Northeast corner of the graph. Rather than attempt to develop societal tradeoffs between λ_{DI} and μ_{DI} (which may differ across countries, and would likely depend on the marginal social costs of raising taxes to fund such programs), we instead seek to characterize DI systems that are more or less efficient in targeting; a DI program to the Southwest of another would be considered less efficient under any weighting of λ_{DI} and μ_{DI}. For example, according to Figure 2, Denmark would be ranked better in targeting than Spain, and Spain in turn better than France. Comparing DI systems with higher and lower overall coverage rates (e.g., Sweden versus Italy) would be more problematic, since DI system with a higher enrollment rate will tend to experience a higher average percentile health (μ_{DI}) and a higher fraction in poor health covered (λ_{DI}), thus drifting towards the Northwest.

Table 2 also includes the OECD (2003, 2010) indicators, with the first capturing the generosity/compensation of the program (OECDg), and the second on employment or integration (OECDe).[17] The generosity/compensation indicator focuses on dimensions such as the coverage of the program, the extent of disability needed to qualify for benefit entitlement, the duration and size of compensation, the type of medical assessment (if any) required to certify disability, and the extent of vocational assessment. The employment/integration indicator focuses on the whole range of employment and rehabilitation measures, such as the type and extent of employment support, the timing and comprehensiveness of vocational rehabilitation programs, and the work incentives provided for beneficiaries. Table 2 shows that for generosity, Sweden leads the list (with a score of 37 out of 50), followed by the Netherlands (32) and Switzerland (32), and with the U.S. the least generous (17). The employment/integration indicator (OECDe) is highest in Denmark (37) and lowest in Italy (18). The correlation coefficients between the OECDg and OECDe composite measures, and our primary measure of DI disability, is modest; between 0.34 and 0.45 (and none significant), so while we appear to be capturing a common element across countries, the correlation among the measures is not large.[18]

4.2 Alternative measures of insurance coverage

Many countries rely more on other pension programs beside just their DI program, and so it is useful to consider also broader classifications of pension support beyond DI. Borghans, Gielen, and Luttmer (2014), for example, demonstrate considerable substitution between DI

[17] Each of the two policy dimensions is divided into ten sub-dimensions. The sub-dimensions are all given equal weight and the same score range, from 0 to 5 points. The points for each sub-dimension are then added to obtain the overall score, with 50 being the possible maximum score for each indicator.
[18] The lack of strong correlation might appear to be the consequence of different "snapshots" of generosity or employment programs in the 2000s, rather than our data which covers 2004-2012. However, even when we limit our data to earlier years, the correlation is relatively weak.

benefits and other forms of social insurance. Figure 2a shows the distribution of pension, unemployment insurance, DI, and other support in France and Denmark by health status decile (using the PVW index). The red area shows the additional coverage by non-DI public pensions, the green next area reflecting private pensions, and the remaining top segment the share of the decile not receiving any pension.

It is clear that the low reliance on DI programs in France is offset by the use of other social welfare programs such as unemployment insurance, particularly in comparison to Denmark. However, the non-DI support does not strongly target those in the worst health, so that in France, half of those in the bottom health decile receive no support from the government. These results are consistent with Arrighi et al. (2015) who find evidence that applicants can be discouraged by local semi-autonomous County Councils policies that include setting low benefits. By contrast, in Denmark nearly 80 percent of the bottom health decile are receiving some kind of support. That rates of DI and pension/UI support among the healthiest decile are 20% in both Denmark and France suggests more effective targeting of resources to the disabled in Denmark.

We return to the comparison between Belgium and the U.S., two countries with similar sized DI programs, in Figure 3b. A pattern similar to the earlier comparison in Figure 1a is apparent; three-quarters of those in the bottom health decile receive some kind of support in the U.S. compared to 67 percent in Belgium, while support in the (e.g.) 7^{th} health decile in Belgium, 39 percent, is substantially above the corresponding support in the U.S., 23 percent. The higher overall support across health deciles in Belgium cannot be entirely attributed to early retirement, as the U.S. retirement rate in our sample, 20 percent, is only slightly below that in Belgium, 23 percent (Table 1).

Retirement rates are quite different in Switzerland (10 percent) and Austria (40 percent). Figure 3c shows how the distribution of non-DI pensions and other government support is fairly consistent across health deciles in Austria, leading to higher rates of support in the bottom health decile (69 percent compared to 51 percent). That said, in Switzerland only 13 percent receive some benefit among the healthiest decile, compared to 26 percent in Austria. The distribution of benefits across deciles of health status in additional countries are provided in Figure 3d.

4.3. Alternative measures of health status

Table 3 provides measures of the average percentile of those on DI for the PVW measure (Column 1), the Mont-Loeb (ML) index of functionality (Column 2), the mental health/depression index (Column 3), and the minimum score, suitably renormalized (Column 4). One issue with these alternative measures is that many more individuals are likely to bunch up in the healthiest group, since (for example) a large fraction of the population do not report any symptoms of depression. To ensure that the percentiles can be compared across these four categories, we renormalize so that the mean percentile of the sample is still equal to 50.5.[19]

The PVW and ML indices tend to rank individuals quite similarly ($r>0.8$), and each is also positively correlated, but less strongly, with the MHD index. For most countries, the average percentile for the ML measure was comparable to, or even slightly less than, the PVW average percentile, providing support for the Mont and Loeb (2011) view that functionality is a good predictor of DI enrollment. We provide additional sensitivity analysis in Appendix Tables A.2 and A.3 by health definition and year.

4.4 Regression Analysis

[19] For example, if there were 42 percent of the healthiest people in country j reporting no depression symptoms, then each of them would be assigned a percentile value of 79 rather than 58.

We next estimate α_j/σ_j in a Probit model, separately for each country and for the entire SHARE sample. We control for characteristics of the respondents (X_{ij}) such as age, gender, marital status, self-reported retirement status, and report results in Table 4 as marginal effects using the PVW index as the measure of health h_{ij} (there was little appreciable difference when we used the ML index). Because the distribution of the health percentiles are similar across countries, we can compare the magnitude of the α_j coefficients estimates across countries.[20] We allow for nonlinearity in α by using dummy variables for the bottom three deciles of health status (the excluded reference group are individuals whose health status are above that 30th percent group).[21] Focusing on the coefficients for Decile 1 of health, the largest magnitude coefficients are in Denmark (0.481), Sweden (0.478), the Netherlands (0.441) and the U.S. (0.426). Even at Decile 3 of health, there is a considerably higher probability of DI receipt in Denmark (0.144), Sweden (0.128) and the Netherlands (0.132), with the marginal effects for this decile considerably smaller in other countries. Across countries, the Spearman rank-order correlation statistic is highly significant between λ_{DI} and the α coefficient for Decile 1 (0.94, $p < .001$).

Table 5 reports Probit estimates for the models in (2), expanding the specifications in table 4 to include education as a measure of labor market opportunities. In most countries, the weight placed on education is modest, suggesting that conditional on health, a tertiary education reduces the chance of DI receipt by 3 percentage points or less. The exception is Denmark, where the coefficient for tertiary education is highly significant and predicts a reduced likelihood of receiving DI benefits by 11 percentage points. This likely reflects differences in policies

[20] Of course, differences across countries in the level of DI enrollment will mean that two countries with similar estimates of α (in probabilities) will differ with regard to relative risk or odds ratios.

[21] Additional decile measures were not generally significant and did not affect education coefficients.

towards encouraging people who are not in perfect health to continue working in Denmark. As an OECD (2009) study found,

> The disability scheme in *Denmark* which was reformed in 2003 incorporates a most fundamental conceptual shift. Disability assessment is now focused on what a person can do rather than their loss of capacity; more precisely, the extent to which a person is able to carry out a subsidised job (a so-called "flex-job"). A disability benefit is only granted where capacity is held to be permanently reduced to the extent that a flex-job cannot be performed, and participation in rehabilitation would not help to restore this capacity. In determining capacity, a comprehensive individual resource profile is being put together which includes measures of health, social and labour market proximity criteria. In this respect, Denmark is a best-practice example within the OECD (p. 19).

In other words, Denmark is the only country in our sample that has successfully targeted DI benefits to older people with weak work skills as well as to those in poor health.

4.5 Secular changes in DI enrollment and targeting

We also consider changes over time in DI enrollment, λ_{DI}, and μ_{DI} across countries. Figure 4a exhibits DI enrollment rates in 5 countries; two with remarkably similar patterns of decline -- Denmark and the Netherlands, two with similar patterns of increase – Belgium and the U.S., and the fifth, Sweden, which by 2012 had the largest share (18 percent) of this age group covered by disability insurance. While Denmark and the Netherlands each began in 2004 with roughly double the DI rates of Belgium and the U.S., by 2012 their DI rates were nearly identical. In Denmark, the decline reflected longer-term trends in employment and other factors (Bingley et al., 2014), but in the Netherlands, this decline in enrollment rates was the consequence of a fundamental reform in their DI program; Koning and Lindebloom (2015) find, like we do, that the success of the Netherlands reforms were associated with both a sharp decline in the number of people on disability, as well as a drop in the percentage of those in the bottom

decile of health status that were covered through the DI program, shown in Figure 4b.[22] While the time-series data is less precisely measured than the aggregated cross-section data, the fraction covered by DI in the lowest health decile declined between 2004-12 substantially in the Netherlands (from 52 to 42 percent) and even more in Denmark (from 62 to 45 percent). These secular declines are attenuated when considering any support; see Appendix Table A.3.

Conversely, there was a rise in coverage for lowest health decile associated with expanding U.S. coverage (e.g., Autor and Duggan, 2006), and Belgium coverage, and especially in Sweden, which by 2012 covered the highest fraction of people (71.5 percent) in the bottom decile of health (Figure 4b). Finally, Figure 4c shows little change in the average health of those on disability, except for the Netherlands which shows a substantial decline from 27 to 23 percent (Appendix Table A.2), suggesting a reduction in eligibility among more healthy recipients.

5. Discussion and Conclusion

There are few objective approaches to monitoring the characteristics of public disability insurance programs across countries and over time. In this paper, we study the reported health and work opportunities of the population age 50-64 enrolled in a disability insurance (DI) program across a sample of 10 European countries and the United States. We observed considerable differences across countries with regard to the composition of people eligible for DI benefits relative to those without DI benefits. While previous work has sought to describe the institutional features of individual country-level programs, as in OECD (2003, 2010), this paper uses a flexible semi-parametric approach to quantify characteristics of DI programs based on micro-level data from SHARE and the HRS for DI enrollees and non-enrollees.

[22] Garcia Mandico et. al (2016) show that, following the disability insurance reform, those with musculoskeletal diseases had more success in going back to work than those with mental illness.

The variations across countries do not appear to be explained either by labor market considerations – that is, that some countries are more likely to insure against poor labor market opportunities than others – or by alternative social insurance programs that supplement disability programs. Whether these differences reflect societal preferences for other goals effected through the use of disability insurance, imperfect screening (e.g., Mitra, 2005), or more general random variability in the disability application and appeal process (as in Maestas, Mullen and Strand, 2013, and French and Song, 2014), is not clear. Nonetheless, we believe that these objective measures of disability insurance targeting are useful metrics that can be used to assess the performance of country-level disability programs at a point in time, and over time.

To our knowledge, we are the first to quantify targeting efficiency of DI programs across a range of developed countries. Denmark and the U.S. appeared to be quite effective in targeting DI benefits to those in the poorest health, while France and Belgium appear to be less effective in targeting DI benefits. It may appear surprising that the U.S. DI program appeared to be so successful in targeting, given the very long waiting period and extensive appeals for people with what appear to be serious disabilities (Eckholm, 2007). In one view, the difficult process of applications in the U.S. could be a successful screen to prevent healthy individuals from applying. A more worrisome interpretation of the U.S. data is that the long periods of time not working during applications and appeals have an adverse impact on work capacity (as shown by Maestas, Mullen and Strand, 2013), which in turn would be plausibly associated with adverse effects on measured health status. In this hypothetical case, the restrictive DI enrollment process *causes* poor health among enrollees.

We also developed a regression model that captures differences across countries in the degree to which they weight health status versus market opportunities. For example, even

holding health status constant, Denmark shows a much stronger gradient of DI eligibility by education, suggesting that even disabled college graduates are encouraged to find work. Most countries, however, showed only modest differences (or none at all) in DI eligibility across education groups, and the U.S. system in particular appears to discourage work effort (Burkhauser and Daly, 2011). The recent successes of supported employment in the U.S. and Europe, by which mentally disabled people are encouraged to return to appropriate work, shows considerable promise (Burns et al, 2007), and there is at least suggestive evidence that at least in the U.S., such programs can pay for themselves by reducing disability and medical costs (Drake, et al., 2009).

There are several limitations to this study. The first is that our information is limited to enrollment, and not the level of benefits. Partial disability payments among those in better health may be consistent with government objectives, and thus explain why some countries appear to have enrolled so many who report themselves to be in relatively good health. Yet these countries do not appear to be much better at covering less healthy people, who would likely benefit substantially from even modest DI payments. As well, low disability rates could have a secondary impact on the demand for applying for benefits, as in Arrighi et al. (2015).

Second, the health status indices may not fully reflect the ability to work, particularly when interacted with the type of industry. A broken leg will be more of a problem for construction workers than for computer programmers. This is not a problem if the degree of bias is similar across countries, but we do not know the magnitude of such bias.

A third concern would be if measures of health care are intrinsically ordinal, so that using percentiles abstracts from real differences in health across countries. For example, someone in the 15th percentile in the U.S. may be in much poorer health than someone in the 15th percentile

in England (e.g., Banks et al., 2006), complicating comparisons across countries. To minimize such biases, we focus on relative measures of support (that is, comparing DI support for the 1st decile with the 10th decile) and on temporal changes in the same country.

The primary concern of many policy makers has been with the rapid and unsustainable growth in DI programs worldwide that do not appear to be associated with worsening health (Milligan and Wise, 2012; Borsch-Supan, 2007, 2011; Börsch-Supan and Roth, 2011). Our new measures of disability insurance efficiency cannot answer the question of what is the appropriate size of DI programs in a particular country, which is fundamentally a political issue. But our new measures can at a minimum provide an objective approach to measuring the extent to which DI programs target those in the poorest health and least able to work.

More importantly, the longitudinal nature of the SHARE and HRS data allow policy makers to monitor the consequences of disability insurance reform to better understand the consequences of reducing DI enrollment in response to budgetary pressures, especially as new waves become available. Amartya Sen (1995), writing about the targeting of income transfers to the poor, identified a key tradeoff between the "type II error of including the nonpoor among the poor" and the "type I errors of not including some real poor among the listed poor." In the context of disability policy, it is impossible to judge the success of a given policy reform, and the ability to avoid what Sen terms Type I and Type II errors, without objective longer-term monitoring of the health of DI recipients and non-recipients. This paper provides a new framework for providing systematic measures of program targeting that allows for comparing DI programs both across countries and over time.

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Table 1: Descriptive Statistics, 2004-14

Country	N	Male	Age	Fraction Married	Fraction Retired	Primary Education	Tertiary Education
Sweden	6,824	0.504	57.4	0.676	0.122	0.283	0.333
		(0.006)	(0.049)	(0.006)	(0.004)	(0.006)	(0.006)
Denmark	7,494	0.496	57.0	0.686	0.151	0.140	0.454
		0.006	0.048	0.005	0.004	0.004	0.006
Germany	8,663	0.492	57.2	0.697	0.162	0.097	0.316
		0.005	0.043	0.005	0.004	0.003	0.005
Belgium	12,064	0.498	56.7	0.713	0.217	0.353	0.338
		0.005	0.038	0.004	0.004	0.004	0.004
France	9,744	0.489	56.6	0.700	0.263	0.310	0.263
		0.005	0.043	0.005	0.004	0.005	0.005
Switzerland	5,676	0.496	57.0	0.678	0.092	0.217	0.166
		0.007	0.053	0.006	0.004	0.006	0.005
Austria	6,824	0.490	57.2	0.661	0.396	0.195	0.256
		0.006	0.047	0.006	0.006	0.005	0.005
Spain	8,420	0.494	56.7	0.760	0.134	0.678	0.149
		0.005	0.045	0.005	0.004	0.005	0.004
Italy	8,614	0.485	56.8	0.780	0.251	0.599	0.094
		0.005	0.045	0.004	0.005	0.005	0.003
US	41,812	0.479	57.6	0.710	0.212	0.127	0.593
		0.003	0.019	0.002	0.002	0.002	0.002

Source: Authors' calculations using SHARE wave 1, 2, 4, 5, and 6; and HRS waves 7, 8, 10, 11, and 12. Based on pooled sample of respondents age 50 through 64 in each wave. Percentage values, except for Age (average age). Retired based on self-reported labor market activity. Standard errors reported in parentheses.

Table 2: Variables included in the indices

	PVW	ML	MHD HRS	MHD SHARE
Health care utilization				
# hospital visits in past year (SHARE)/2 years (HRS)	X			
# days in nursing home in past year (SHARE)/2 years(HRS)	X			
# MD visits in past year (SHARE)/2 years (HRS)	X			
Difficulties with activities of daily living (ADL)				
Dressing, including shoes and socks		X		
Bathing or showering		X		
Walking across a room		X		
Eating, cutting up food		X		
Getting in or out of bed		X		
Using the toilet, including getting up or down		X		
At least one ADL	X			
Mobility, fine motor, and functional limitations				
Walking 1 block (HRS) or 100 meters (SHARE)	X	X		
Difficulty sitting for 2 hours	X	X		
Difficulty getting up from chair	X	X		
Difficulty climbing a flight of stairs	X	X		
Difficulty stooping	X	X		
Difficulty lifting 10 lbs	X	X		
Difficulty picking up a dime	X	X		
Difficulty raising arms over head	X	X		
Difficulty pushing/pulling large object	X	X		
Medical history				
Ever had high blood pressure	X			
Ever had diabetes	X			
Ever had cancer	X			
Ever had lung disease	X			
Ever had heart problems	X			
Ever had stroke	X			
Ever had psych problems (SHARE- depression only)	X			
Ever had arthritis	X			
Back pain	X			
Difficulties with instrumental activities of daily living (IADL)				
using a map in a strange place		X		
telephone calls		X		
managing money		X		
taking medications		X		
Shopping for groceries		X		
preparing a hot meal		X		

Table 2: Variables included in the indices (continued)

	PVW	ML	MHD HRS	MHD SHARE
CESD depression questions				
Felt depressed last week			X	
Everything was an effort last week			X	
Sleep was restless last week			X	
Was happy last week			X	
Felt lonely last week			X	
Enjoyed life last week			X	
Felt sad last week			X	
Could not get going last week			X	
EURODEP depression questions				
Sad or depressed last month				X
Any hopes for the future				X
Felt would rather be dead in last month				X
Tend to blame self/feel guilty				X
Trouble sleeping recently				X
Loss of interest in last month				X
Irritable recently				X
Loss of appetite				X
Fatigue in last month				X
Difficulty concentrating on entertainment				X
Difficulty concentrating on reading				X
Enjoyed any activities recently				X
Cried in last month				X
Ever had depression symptoms greater than 2 weeks				X

.

Table 3: Percentage of Population Receiving Disability and Pension Benefits, Fraction of DI Recipients in Bottom 10% of PVW Health Status, and OECD Disability Scores: 2004-14

Country	Fraction on DI	Any DI, UI, or Pension	Mean Percentile of those receiving DI	Fraction receiving DI in bottom decile	OECDg	OECDe
Sweden	0.150	0.329	22.8	0.600	37	32
	0.004	0.006	0.709	0.019		
Denmark	0.127	0.314	21.6	0.514	28	37
	0.004	0.005	0.771	0.019		
Germany	0.072	0.310	21.5	0.247	24	35
	0.003	0.005	0.941	0.015		
Belgium	0.084	0.420	23.3	0.331	25	24
	0.003	0.004	0.781	0.013		
France	0.032	0.358	26.5	0.124	25	26
	0.002	0.005	1.513	0.011		
Switzerland	0.061	0.175	18.0	0.313	32	27
	0.003	0.006	1.195	0.019		
Austria	0.072	0.466	26.2	0.239	24	30
	0.003	0.006	1.095	0.017		
Spain	0.072	0.295	22.6	0.273	27	22
	0.003	0.005	1.005	0.015		
Italy	0.044	0.310	20.4	0.193	26	18
	0.002	0.005	1.161	0.013		
US	0.100	0.356	14.7	0.519	17	21
	0.002	0.002	0.238	0.007		

Percentage of individuals receiving disability insurance (column 1), receiving any public pension (column 2), receiving any pension (column 3), average PVW health index of individuals receiving DI (column 4), percentage of individuals receiving DI who are in the bottom 10% of PVW health index (column 5), OECD generosity (compensation) score (column 6) and employment (integration) score (column 7). Standard errors in parentheses. Source: OECD (2010) and authors' calculations using SHARE Waves 1,2,4,5,6, and HRS Waves 7 through 12. All estimates, except for OECD scores, are population-weighted.

Table 4: Average Health Percentile for Those on DI Using Alternative Measures of Health Status, by Country: 2004-14

Country	PVW Index	ML Functional Status	Depression Score	Minimum of Three Indices (Rescaled)
Sweden	22.3	21.3	32.5	21.4
	(0.71)	(0.63)	(0.85)	(0.63)
Denmark	21.7	20.5	31.9	20.8
	(0.77)	(0.69)	(0.90)	(0.66)
Germany	24.1	24.0	34.6	23.5
	0.94	0.94	1.22	0.94
Belgium	25.4	25.1	34.8	25.1
	0.78	0.75	0.85	0.75
France	26.2	23.3	36.8	24.5
	1.51	1.30	1.58	1.33
Switzerland	18.0	17.9	30.9	18.0
	1.19	1.13	1.54	1.16
Austria	26.4	26.2	35.3	25.9
	1.10	1.07	1.29	1.05
Spain	24.7	23.9	32.7	21.7
	1.00	0.94	1.18	0.85
Italy	20.3	18.9	33.0	19.8
	1.16	1.07	1.54	1.12
US	15.1	13.6	28.4	16.1
	0.24	0.18	0.36	0.23

Source: Authors' calculations using SHARE Waves 1,2,4,5,6, and HRS Waves 7 through 12.

Table 4: Ratio of proportion receiving DI in top median to the proportion receiving DI in bottom decile, for each health index:

Country	PVW Index	ML Functional Status	Depression Score	Minimum of Three Indices (Rescaled)
Sweden	0.083	0.038	0.203	0.075
Denmark	0.079	0.039	0.198	0.056
Germany	0.097	0.061	0.230	0.089
Belgium	0.099	0.079	0.231	0.104
France	0.098	0.057	0.298	0.106
Switzerland	0.040	0.032	0.159	0.034
Austria	0.102	0.072	0.254	0.103
Spain	0.090	0.067	0.202	0.063
Italy	0.073	0.029	0.192	0.055
US	0.033	0.013	0.141	0.020

Source: Authors' calculations using SHARE Waves 1,2,4,5,6, and HRS Waves 7 through 12. Standard errors in parentheses.

Table 5: Probit Marginal Effects – Model 1 – PVW Health Index

	SHARE	SE	DK	DE	BE	FR	CH	AT	ES	IT	US
Health index											
Decile 1	0.301	0.482	0.477	0.278	0.325	0.125	0.318	0.148	0.268	0.205	0.422
	(0.006)	(0.022)	(0.020)	(0.018)	(0.015)	(0.012)	(0.022)	(0.017)	(0.018)	(0.016)	(0.009)
Decile 2	0.146	0.259	0.250	0.167	0.147	0.052	0.117	0.076	0.140	0.084	0.231
	(0.005)	(0.021)	(0.019)	(0.016)	(0.013)	(0.009)	(0.017)	(0.013)	(0.015)	(0.012)	(0.008)
Decile 3	0.069	0.125	0.123	0.088	0.067	0.015	0.039	0.053	0.057	0.054	0.104
	(0.004)	(0.020)	(0.017)	(0.013)	(0.011)	(0.007)	(0.012)	(0.012)	(0.012)	(0.011)	(0.007)
Mean dep var	0.081	0.150	.127	.072	0.084	0.032	.061	.072	.072	.044	.100
N obs	71,455	6,123	7,306	8,440	11,728	9,377	5,555	6,574	7,936	8,406	37,736

Dependent variable: 1 if receives DI benefits, 0 otherwise. PVW Health index. All specifications include the following additional covariates: dummy variables for male, age groups 55-59 and 60-64, marital status, retired, interview year. Regressions on the whole SHARE sample include also country dummies. Robust standard errors in parentheses.

Source: Authors' calculations using SHARE Waves 1,2,4,5,6, and HRS Waves 7 through 12. Based on pooled sample of respondents aged 50 through 64 in each wave.

Table 6: Probit Marginal Effects – Model 2 – PVW Health Index

	SHARE	SE	DK	DE	BE	FR	CH	AT	ES	IT	US
Health index											
Decile 1	0.282	0.471	0.431	0.269	0.306	0.118	0.295	0.141	0.252	0.183	0.400
	(0.006)	(0.023)	(0.021)	(0.018)	(0.015)	(0.012)	(0.022)	(0.016)	(0.018)	(0.015)	(0.010)
Decile 2	0.137	0.253	0.217	0.161	0.138	0.050	0.112	0.073	0.131	0.074	0.219
	(0.005)	(0.021)	(0.018)	(0.016)	(0.013)	(0.009)	(0.017)	(0.013)	(0.015)	(0.011)	(0.008)
Decile 3	0.0639	0.121	0.106	0.085	0.062	0.014	0.0362	0.052	0.052	0.048	0.099
	(0.004)	(0.019)	(0.016)	(0.013)	(0.011)	(0.007)	(0.012)	(0.012)	(0.012)	(0.010)	(0.007)
Education											
Secondary	-0.0172	-0.021	-0.049	-0.009	-0.020	-0.003	-0.0160	-0.011	-0.016	-0.011	-0.017
	(0.002)	(0.009)	(0.007)	(0.007)	(0.004)	(0.003)	(0.005)	(0.006)	(0.005)	(0.003)	(0.002)
Tertiary+	-0.0305	-0.036	-0.102	-0.018	-0.030	-0.008	-0.0242	-0.014	-0.031	-0.022	-0.028
	(0.002)	(0.010)	(0.008)	(0.006)	(0.004)	(0.003)	(0.004)	(0.006)	(0.004)	(0.003)	(0.003)
Mean dep var	0.081	0.150	.127	.072	0.084	0.032	.061	.072	.072	.044	.100
N obs	71,303	6,121	7,298	8,435	11,726	9,347	5,547	6,571	7,854	8,404	37,736

Dependent variable: 1 if receives DI benefits, 0 otherwise. PVW Health index. All specifications include the following additional covariates: dummy variables for male, age groups 55-59 and 60-64, marital status, retired, interview year. Regressions on the whole SHARE sample include also country dummies. Robust standard errors in parentheses.
Source: Authors' calculations using SHARE Waves 1,2,4,5,6, and HRS Waves 7 through 12. Based on pooled sample of respondents aged 50 through 64 in each wave.

Figure 1a: Percent of Population on Disability Insurance, by Health Status, United States and Belgium: 2004-14

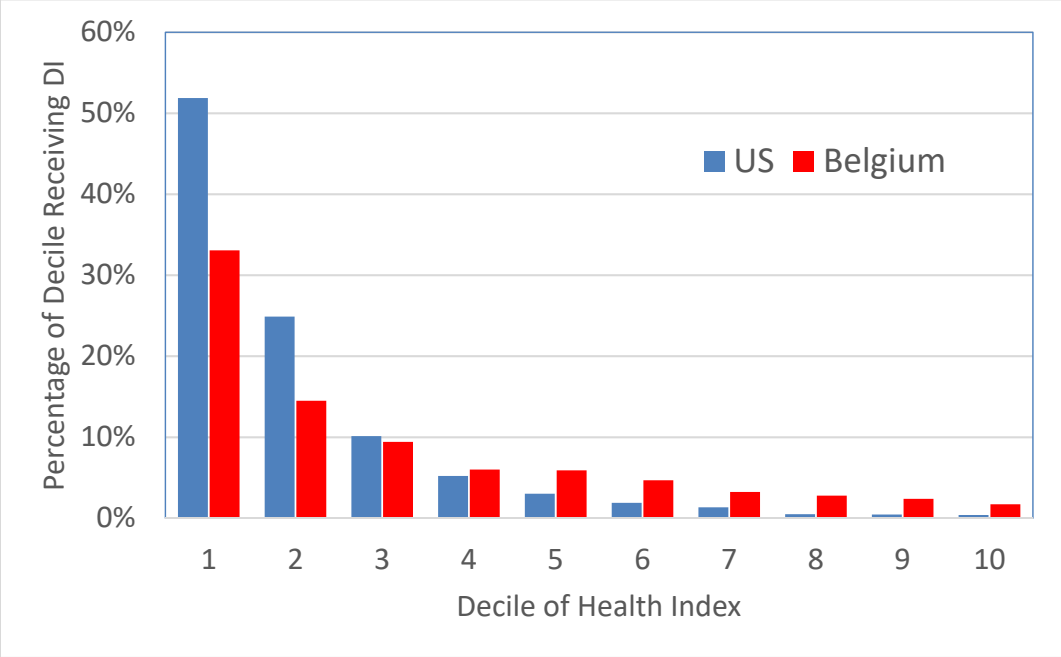
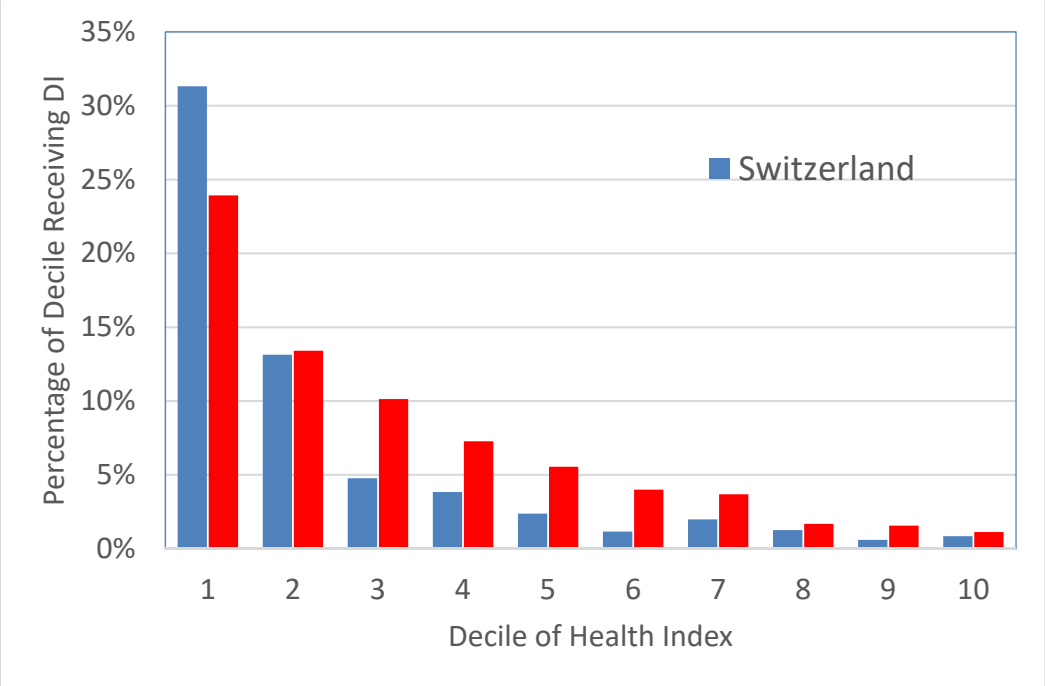
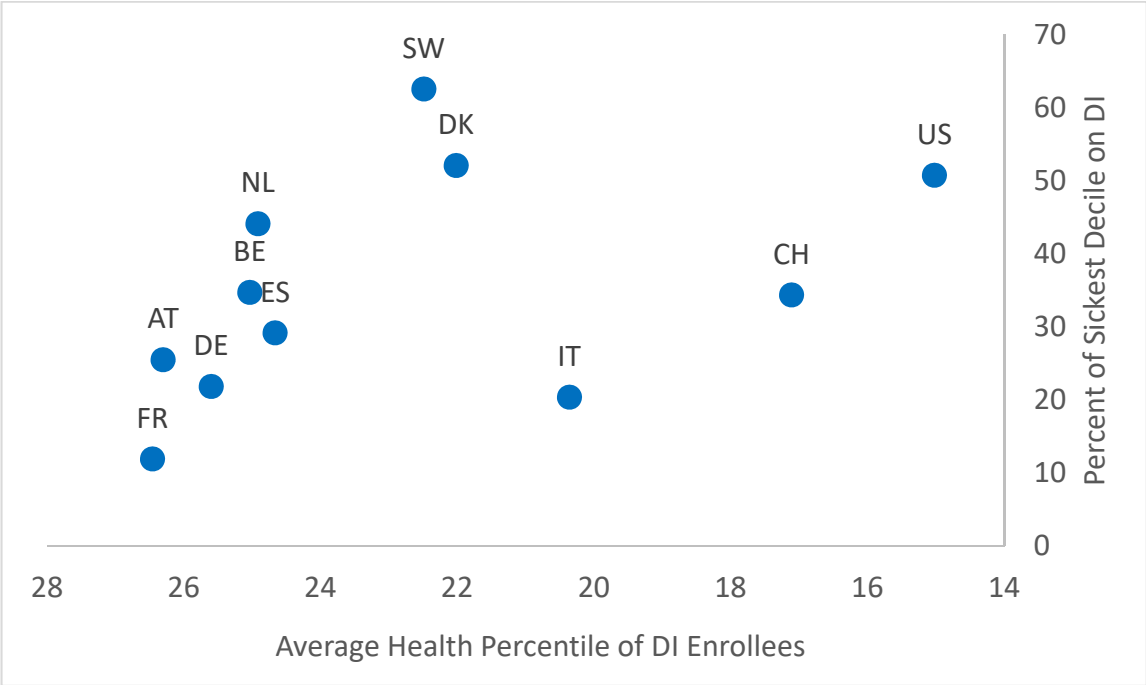


Figure 1b: Percent of Population on Disability Insurance, by Health Status, Switzerland and Austria: 2004-14



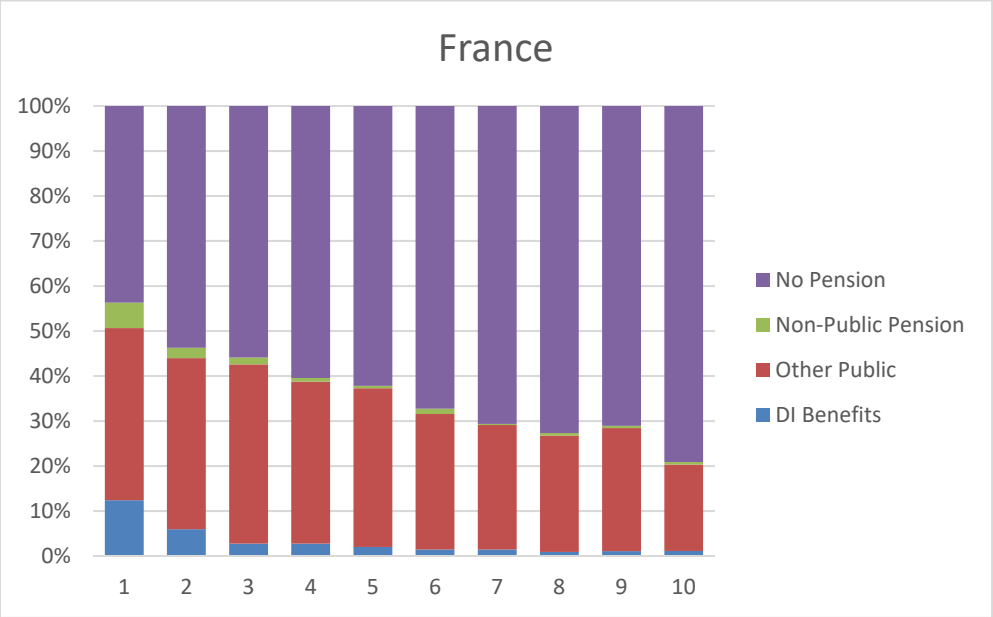
Source: Authors' calculations using SHARE wave 1 (2004/2005), wave 2 (2006/2007) and wave 4 (2011/2012) and HRS wave 7, wave 8 and wave 10. Based on a sample of individual 50-64 respondents. PVW health index. Population-weighted data.

Figure 3: Average Health Percentile of DI Enrollee, and Percentage of Sickest Decile on DI, by Country: 2004-2012



Notes: The horizontal axis is the average percentile health of those enrolled in disability insurance (DI) (reverse order), the vertical axis is the percentage of those in the bottom health decile enrolled in DI. DE denotes Germany, CH Switzerland, ES Spain, AT Austria, DK Denmark, IT Italy, FR France, NL Netherland, BE Belgium.

Figure 3a: Disability Insurance Receipt, and Any Pension Receipt, by Health Decile: France and Denmark, 2004-14



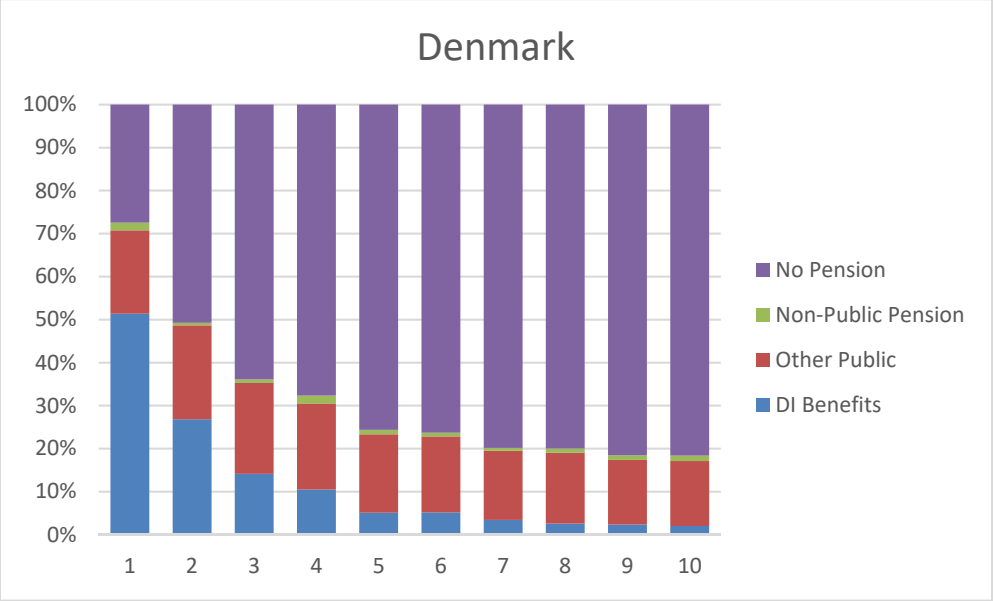
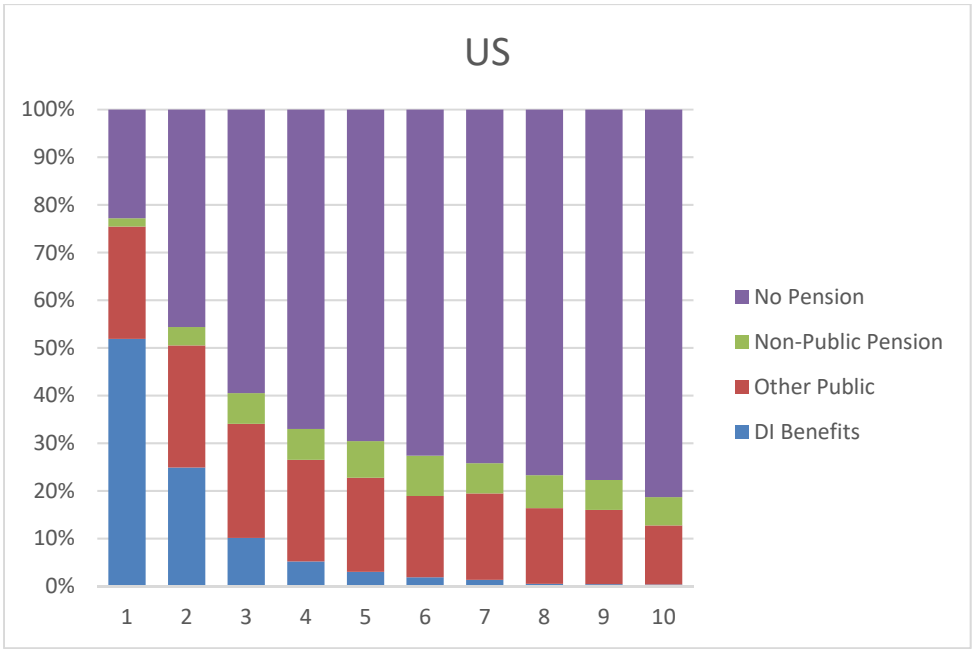


Figure 3b: Disability Insurance Receipt, and Any Pension Receipt, by Health Decile: U.S. and Belgium, 2004-14



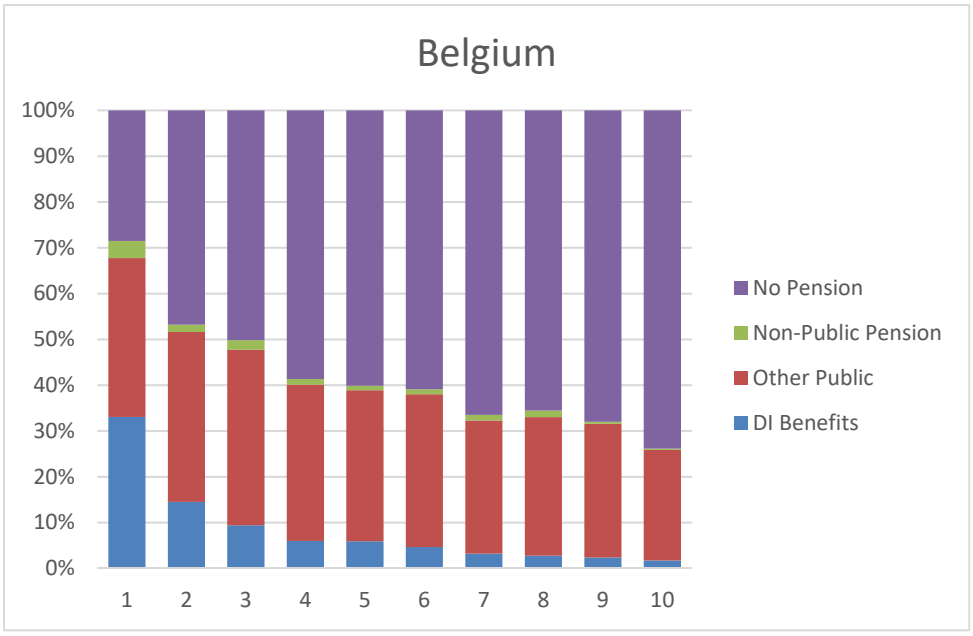
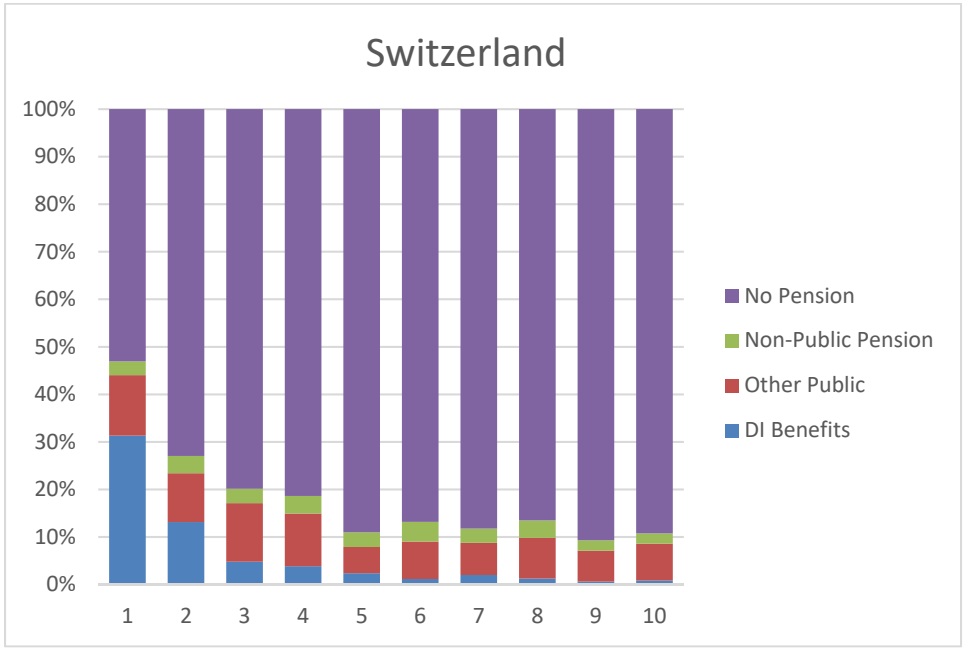


Figure 3c: Disability Insurance Receipt, and Any Pension Receipt, by Health Decile: Switzerland and Austria, 2004-14



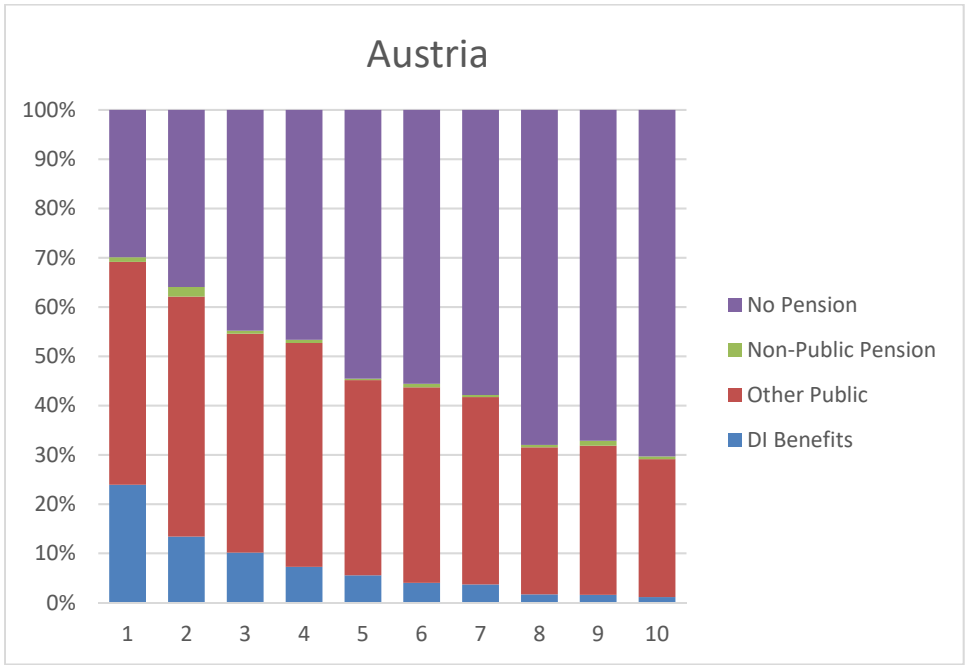
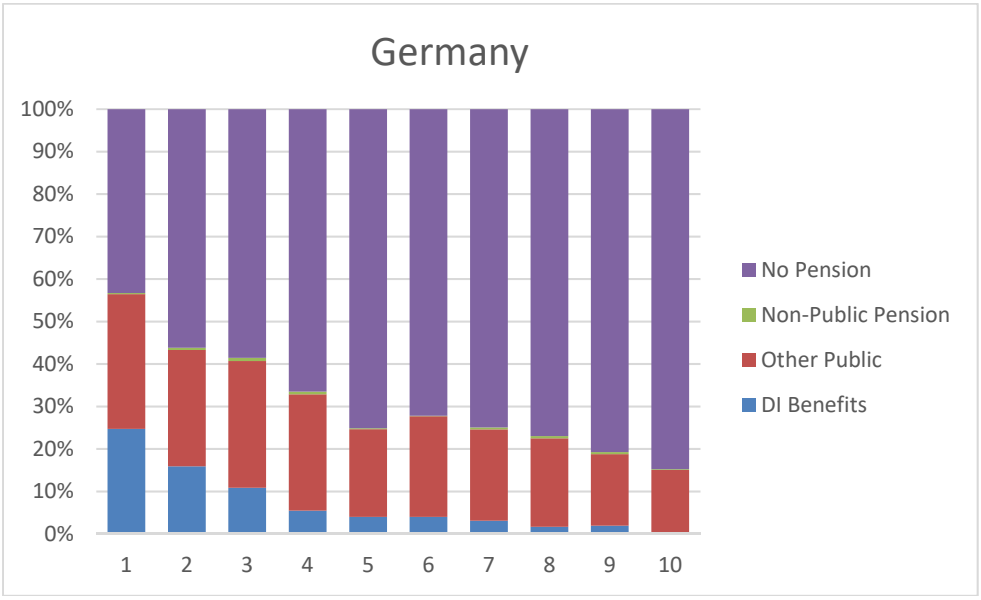
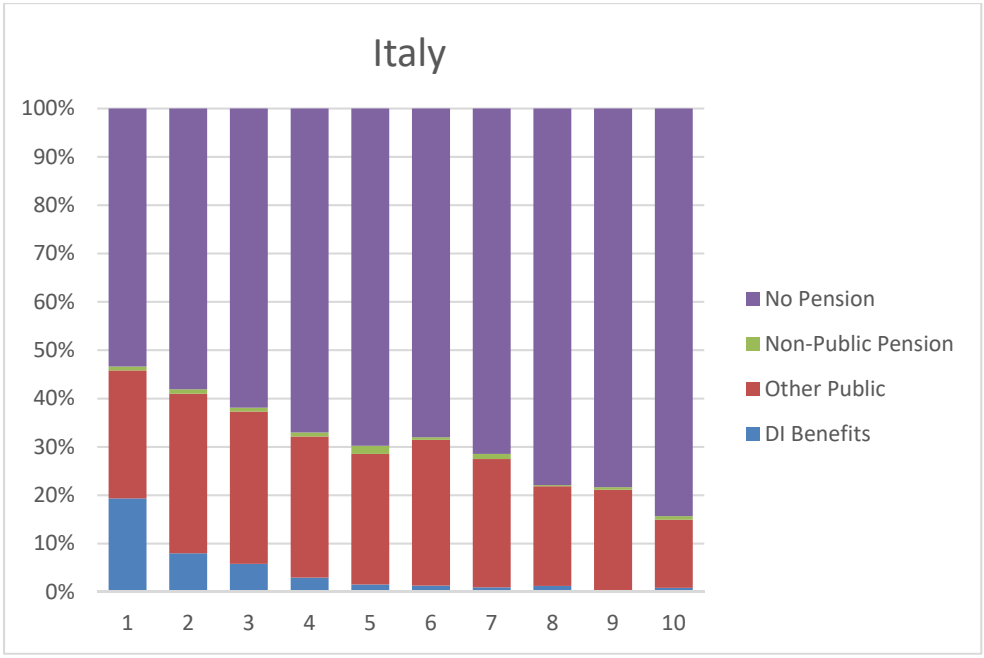
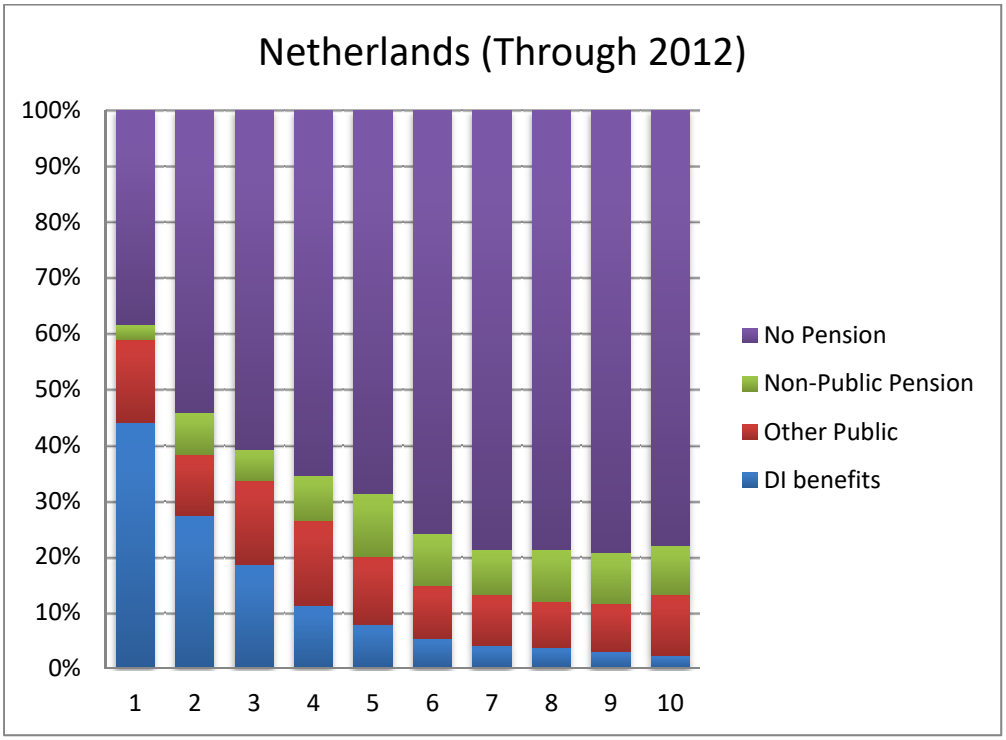
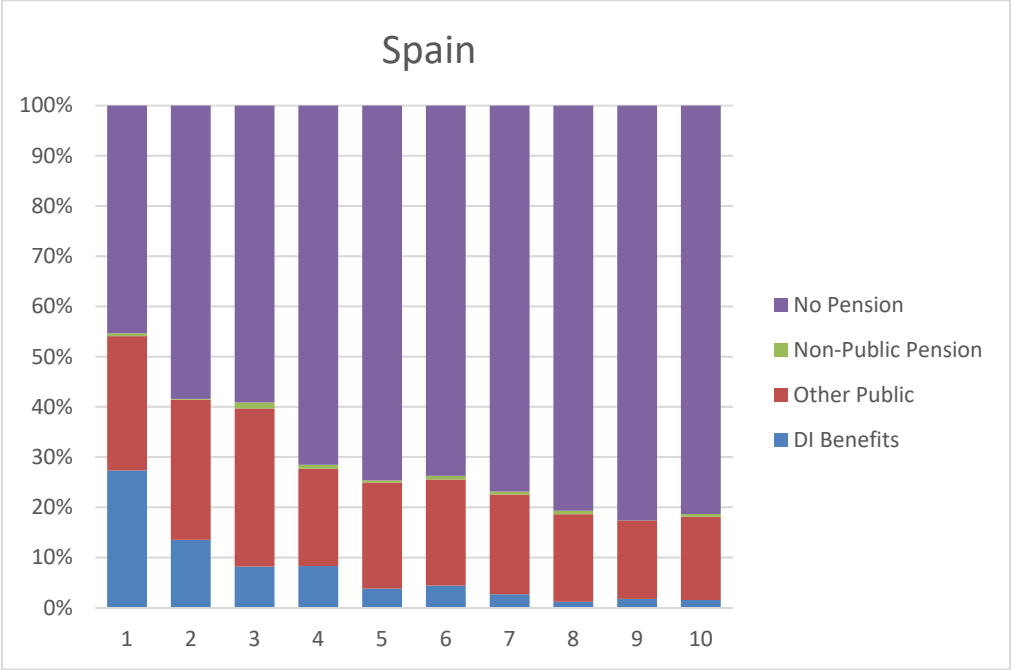


Figure 3d: Disability Insurance Receipt, and Any Pension Receipt, by Health Decile: Additional Countries in Sample, 2004-12






Netherlands (Through 2012)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
2
3
4
5
6
7
8
9
10
No Pension
Non-Public Pension
Other Public
DI benefits


Spain
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
2
3
4
5
6
7
8
9
10
No Pension
Non-Public Pension
Other Public
DI Benefits

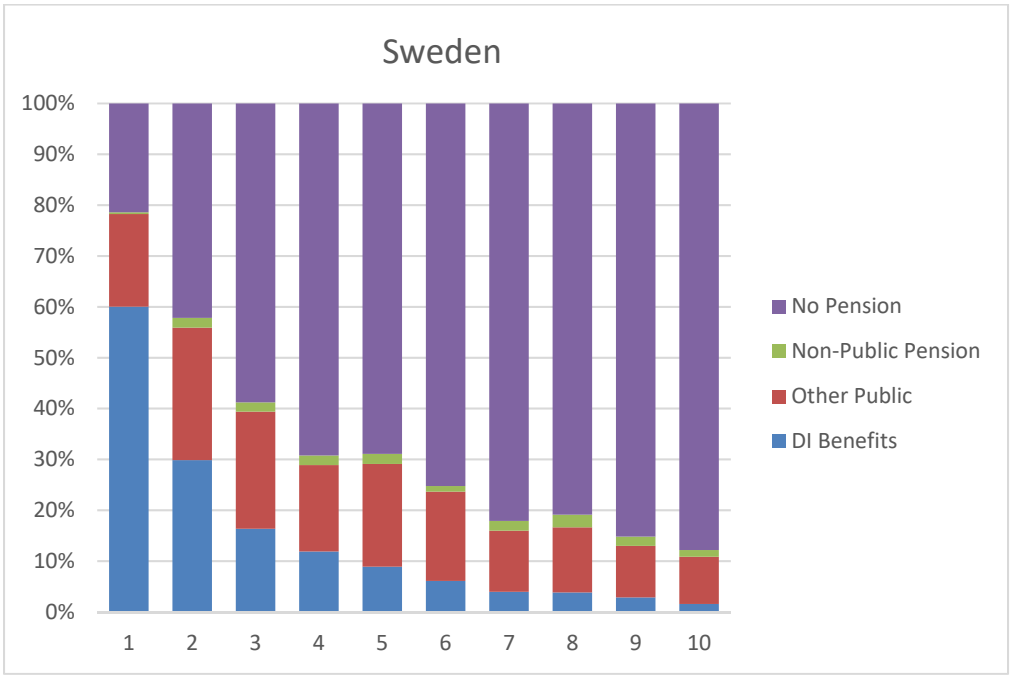


Figure 4a: Trends in Disability Insurance Enrollment as a Percentage of the Overall Population Aged 50-64 in 5 Selected Countries: 2004-12

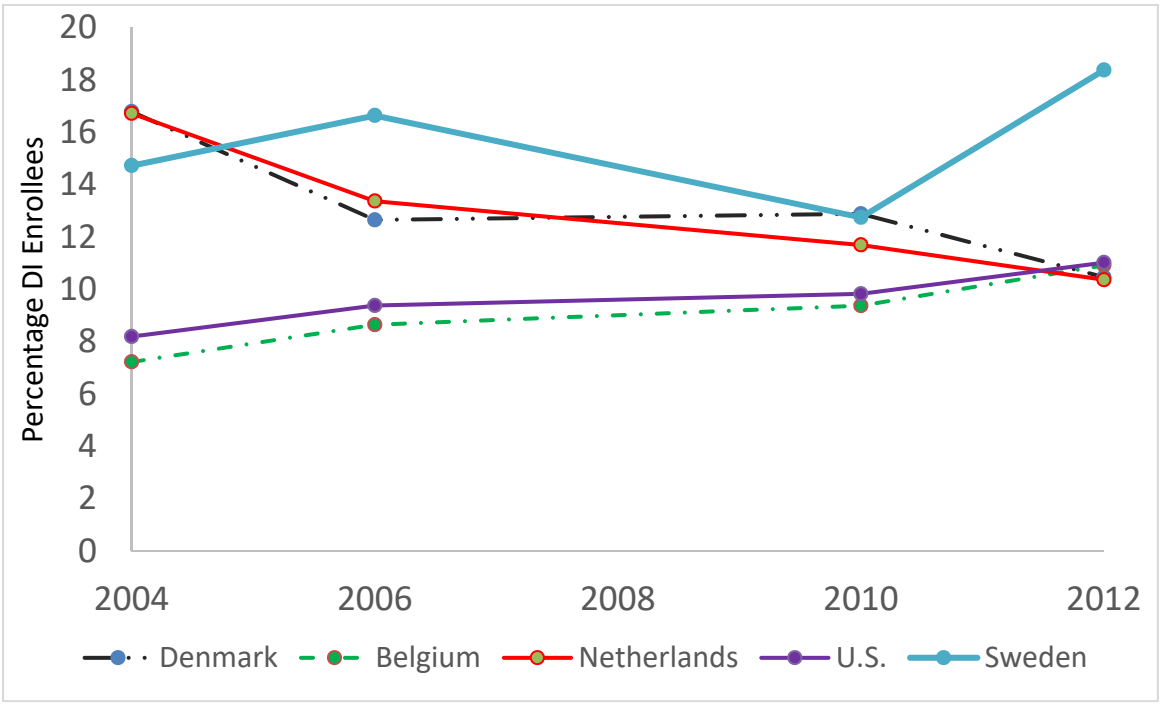


Figure 4b: Trends in the Percentage of the Sickest Decile Covered by Disability Insurance, Aged 50-64 in 5 Selected Countries, 2004-2012

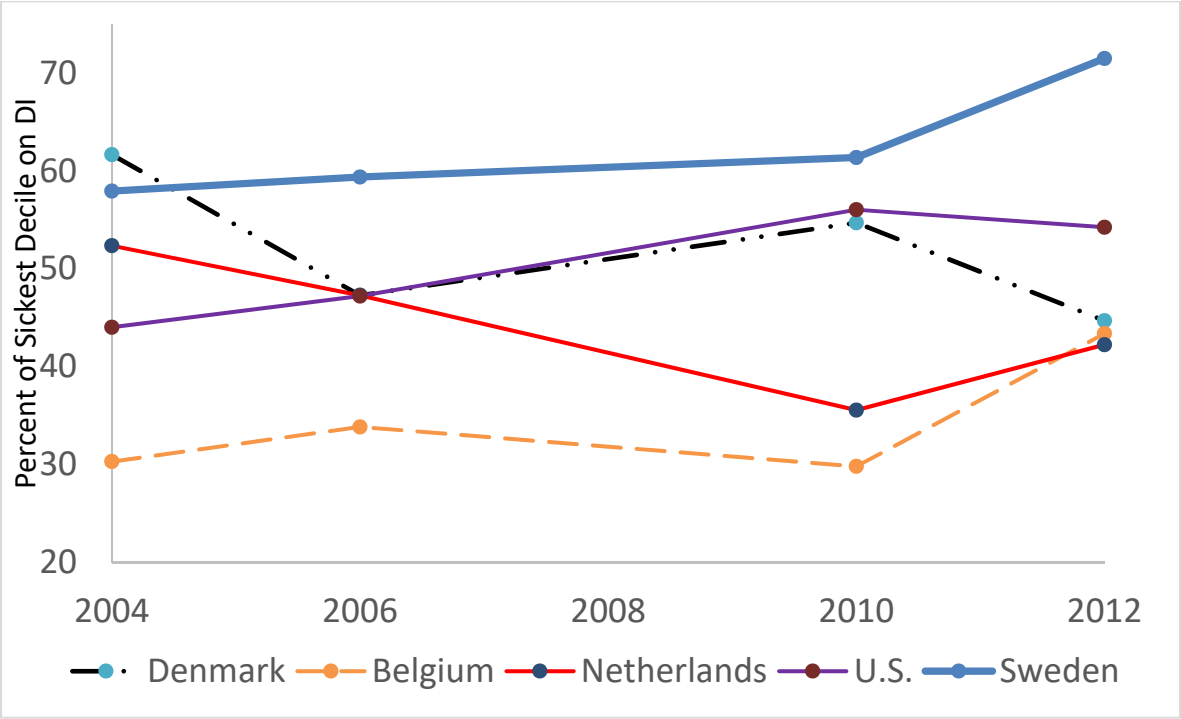
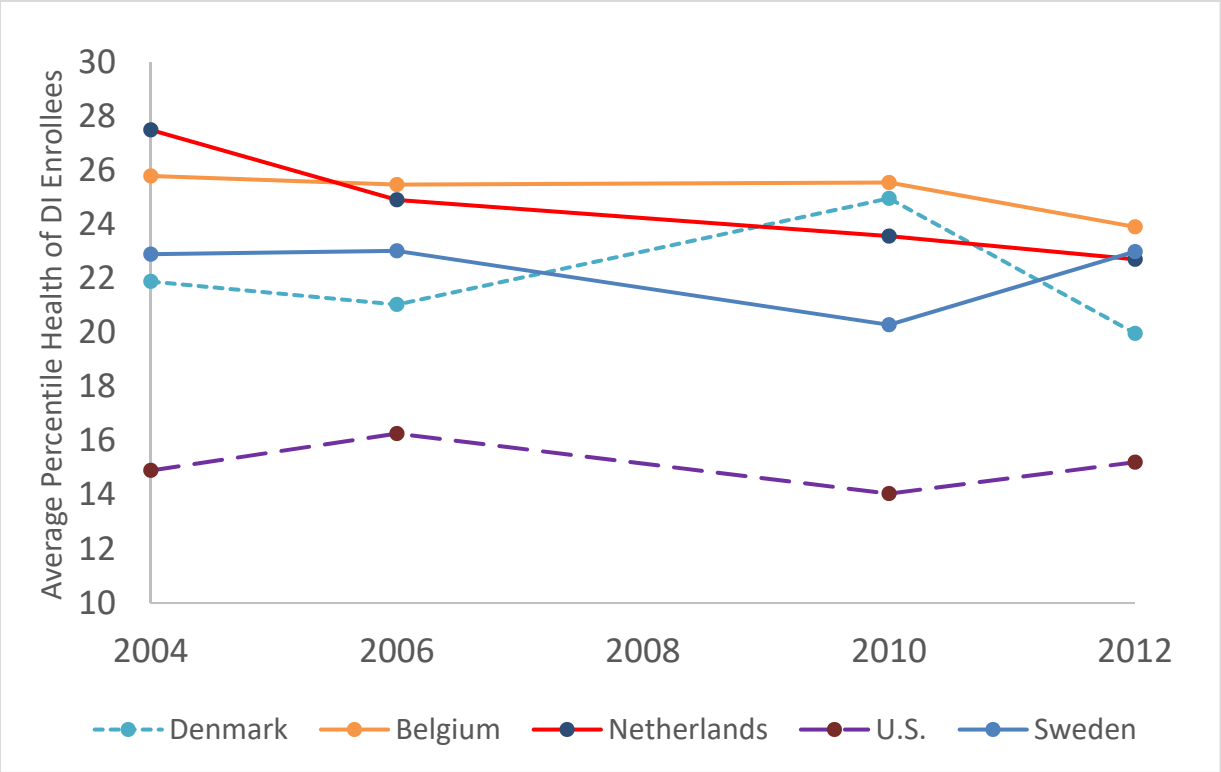

Percent of Sickest Decile on DI
70
60
50
40
30
20
2004
2006
2008
2010
2012
Denmark
Belgium
Netherlands
U.S.
Sweden

Figure 4c: Trends in Average Percentile Health of Disability Insurance Enrollees Aged 50-64 in 4 Selected Countries, 2004-2012



Appendix

Table A.2: Average Percentile Health of People on Disability Insurance

				Of those receiving DI benefits, mean percentile:			
Sweden		Fraction DI	N	PVW	ML	MHD	Minimum
	2004	0.148	242	22.9	21.6	33.3	14.5
	2006	0.167	226	23.0	22.9	35.8	15.4
	2010	0.128	93	20.3	18.4	29.3	12.9
	2012	0.184	331	23.0	22.3	32.6	14.0
Denmark							
	2004	0.169	153	21.9	21.4	33.5	14.5
	2006	0.127	180	21.0	20.7	32.4	13.3
	2010	0.129	148	25.0	21.8	32.4	14.8
	2012	0.105	238	20.0	19.4	28.4	12.5
Germany							
	2004	0.053	80	21.1	19.6	34.8	12.7
	2006	0.061	75	28.8	29.3	35.2	17.4
	2010	0.087	42	30.3	30.8	37.5	19.7
	2012	0.075	215	21.4	19.9	31.3	13.4
Netherlands							
	2004	0.168	262	27.5	26.9	34.4	17.0
	2006	0.134	185	24.9	27.5	34.6	17.8
	2010	0.118	149	23.6	24.2	40.6	17.7
	2012	0.104	213	22.7	24.2	35.4	14.6
Belgium							
	2004	0.073	130	25.8	22.9	36.0	15.5
	2006	0.087	137	25.5	27.5	34.0	17.9
	2010	0.094	275	25.5	25.6	35.3	16.5
	2012	0.110	313	23.9	22.3	29.8	13.5
France							
	2004	0.038	62	21.5	18.0	32.4	12.9
	2006	0.016	18	31.5	37.5	40.5	16.5
	2010	0.029	95	24.9	22.9	36.9	14.4
	2012	0.030	61	30.6	25.6	35.7	18.4
Switzerland							
	2004	0.081	41	19.1	18.3	29.7	13.5
	2006	0.067	52	17.3	19.4	29.1	12.0
	2010	0.059	102	17.9	17.9	32.7	11.9
	2012	0.050	67	13.4	12.9	29.7	9.3
Austria							
	2004	0.048	36	22.2	22.4	37.8	14.8
	2006	0.078	37	25.9	28.9	37.1	18.2
	2010	0.090	207	26.0	24.3	34.2	16.1
	2012	0.071	115	28.9	26.4	32.7	18.5
Spain							
	2004	0.078	88	25.5	25.2	32.9	14.5
	2006	0.086	74	26.5	24.9	35.8	18.4
	2010	0.081	116	24.4	26.7	28.5	14.7
	2012	0.067	178	22.3	21.2	39.8	13.4
Italy							
	2004	0.057	78	24.4	21.3	34.1	16.2
	2006	0.057	69	18.1	20.9	38.5	13.3
	2010	0.042	70	20.6	15.1	31.2	12.3
	2012	0.030	73	16.6	14.2	28.7	10.1
US							
	2004	0.083	727	14.9	13.0	27.3	10.0

2006	0.094	628	16.3	14.3	29.3	10.8
2010	0.099	1176	14.0	12.7	27.6	9.4
2012	0.111	1154	15.2	14.2	29.2	10.6

Table A.3: Percentage of Those in the Bottom Decile of Each Health Index Receiving Disability or Any Pension

	PVW		ML		MHD	
	DI	*Any Pension*	*DI*	*Any Pension*	*DI*	*Any Pension*
Sweden						
2004	0.579	0.843	0.595	0.856	0.323	0.577
2006	0.594	0.773	0.623	0.813	0.422	0.742
2010	0.614	0.852	0.669	0.877	0.386	0.590
2012	0.715	0.774	0.698	0.737	0.518	0.557
Denmark						
2004	0.617	0.792	0.660	0.814	0.407	0.538
2006	0.473	0.752	0.513	0.759	0.347	0.553
2010	0.547	0.749	0.567	0.746	0.338	0.471
2012	0.447	0.702	0.469	0.687	0.278	0.478
Germany						
2004	0.219	0.522	0.231	0.540	0.139	0.431
2006	0.167	0.628	0.182	0.589	0.150	0.459
2010	0.168	0.310	0.194	0.311	0.137	0.259
2012	0.303	0.582	0.338	0.602	0.245	0.469
Netherlands						
2004	0.524	0.654	0.566	0.665	0.428	0.520
2006	0.473	0.680	0.426	0.665	0.286	0.479
2010	0.356	0.561	0.372	0.580	0.214	0.435
2012	0.423	0.577	0.456	0.595	0.217	0.443
Belgium						
2004	0.303	0.668	0.294	0.638	0.148	0.506
2006	0.339	0.671	0.316	0.702	0.218	0.612
2010	0.298	0.627	0.335	0.666	0.228	0.529
2012	0.434	0.693	0.489	0.730	0.337	0.609
France						
2004	0.189	0.533	0.209	0.516	0.094	0.361
2006	0.052	0.377	0.056	0.406	0.020	0.249
2010	0.127	0.542	0.137	0.541	0.048	0.426
2012	0.114	0.550	0.116	0.555	0.068	0.498
Switzerland						
2004	0.400	0.606	0.407	0.619	0.217	0.428
2006	0.357	0.507	0.368	0.481	0.274	0.416
2010	0.334	0.484	0.322	0.474	0.176	0.348
2012	0.291	0.439	0.322	0.474	0.136	0.261
Austria						
2004	0.178	0.714	0.162	0.662	0.079	0.546
2006	0.265	0.743	0.259	0.664	0.243	0.732
2010	0.301	0.700	0.315	0.740	0.219	0.575
2012	0.261	0.615	0.274	0.630	0.135	0.514
Spain						
2004	0.273	0.513	0.236	0.535	0.214	0.440
2006	0.360	0.491	0.329	0.530	0.224	0.452
2010	0.256	0.473	0.272	0.497	0.289	0.519
2012	0.284	0.475	0.270	0.506	0.140	0.437
Italy						

	2004	0.195	0.490	0.254	0.564	0.181	0.407
	2006	0.260	0.590	0.298	0.616	0.129	0.424
	2010	0.197	0.463	0.235	0.448	0.136	0.415
	2012	0.167	0.366	0.182	0.406	0.119	0.270
US							
	2004	0.440	0.680	0.452	0.683	0.257	0.499
	2006	0.472	0.737	0.490	0.742	0.258	0.544
	2010	0.560	0.763	0.555	0.781	0.281	0.558
	2012	0.542	0.697	0.543	0.716	0.305	0.535

Sources for Tables A.2 and A.3: Authors' calculations using SHARE wave 1, 2, 4, and 5; and HRS waves 7, 8, 10, and 11.
) Based on sample of respondents aged 50 through 64 in each wave.