Social Science & Medicine 136-137 (2015) 44–51

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

The effect of a severe health shock on work behavior: Evidence from different health care regimes

Nabanita Datta Gupta [a], Kristin J. Kleinjans [b, *], Mona Larsen [c]

[a] Aarhus University, Denmark
[b] California State University, Fullerton, USA
[c] SFI – The Danish National Center for Social Research, Denmark

ARTICLE INFO

Article history:
Available online 7 May 2015

Keywords:
Health shock
Health insurance
Health care systems
Work
United States
Denmark

ABSTRACT

In this paper, we use the policy variation of two different types of health insurance in the US and in Denmark – employer-provided and universal insurance combined with substantial differences in expected and actual medical out-of-pocket expenditures – to explore the effect of new severe health shocks on the labor force participation of older workers. Our results not only provide insight into how relative disease risk affects labor force participation at older ages, but also into how different types of health care and health insurance systems affect individual decisions of labor force participation. Although employer-tied health insurance and greater out-of-pocket medical expenditures give US Americans greater incentives to continue to work, we find only small differences in the work response between the two countries. We provide compelling evidence that our somewhat counterintuitive finding is the result of differential mortality and baseline health differences coupled with distinct treatment regimes under the respective health care systems.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

Cross country comparisons of health care systems give important insights into determinants of health and mortality. For example, recent studies provide evidence that despite higher cumulative disease risk of US Americans, their age-specific mortality rates are similar to those of the British (Banks et al., 2006). In this paper, we advance the literature on how disease and disease risk differ between countries to address the question of how these country differences affect labor force participation at older ages. More specifically, we are interested in how severe health shocks (defined as newly diagnosed cancer, heart attack, or stroke) affect the probability of not working in the United States versus in Denmark. The two countries enjoy nearly the same level of prosperity and growth, and similar levels and trends in population aging and life expectancy. Yet, health care systems contrast sharply with income tax-financed universal insurance and nationalized health care in Denmark compared to the 'multi-payer' US health care system dominated by private insurance and characterized by high health care costs. The answers to this question not only provide insight into how relative disease risk affects labor force participation at older ages, but also how different types of health insurance systems result in different choices of health care delivery that affect individual labor force participation decisions.

In the paper, we explore the effect of severe health shocks of older workers on their probability of not working. We use the policy variation of two different types of health insurance – universal and employer-provided combined with substantial differences in expected and actual medical out-of-pocket expenditures – to investigate whether health shocks have different effects on work behavior. This circumvents the problem of self-selection into employment with different types of health insurance since the way health care is financed affects the cost, quality and mode of delivery of health care. To our knowledge, no studies have examined this interaction between health shocks and health care systems and its implications for labor force participation.

2. Health shocks and labor supply

Severe health shocks may reduce desired labor supply by increasing the disutility of work and reducing the ability to work. At the same time, health shocks increase financial needs – for instance, through increased medical cost – and thus may increase desired labor supply. The evidence on the net effect of health

* Corresponding author. Department of Economics, Mihaylo College of Business and Economics, California State University, Fullerton, Fullerton CA 92834-6848, USA.
E-mail address: kkleinjans@fullerton.edu (K.J. Kleinjans).

http://dx.doi.org/10.1016/j.socscimed.2015.05.008
0277-9536/© 2015 Elsevier Ltd. All rights reserved.

shocks on labor supply is mixed. For example, McClellan (1998) finds that individuals experiencing health shocks are twice as likely to exit the labor force as those who do not. Controlling for unobserved heterogeneity, however, reduces the magnitude of the dynamic relationship between poor health in the previous period and current non-employment (Haan and Myck, 2009). Furthermore, the sample used and the type of health shock considered matter. Bradley et al. (2005) find that married women who were diagnosed with breast cancer are more likely to continue working and even to increase work hours than those who were not.

Workers who have health insurance through their employment have a greater incentive to continue working in order to keep their health insurance, especially after suffering from a health shock that results in higher medical expenditures. Empirical evidence in the US for this job-lock effect (Madrian, 1994) in the absence of a health shock, however, is mixed. Identifying and quantifying the effect is difficult because of potential self-selection into employment with different types of health insurance coverage and the correlation of health insurance and pension-related incentives with work behavior (Madrian, 2006). Sidestepping these issues by exploiting exogenous variation in US 'continuation of coverage' COBRA mandates (laws allowing workers to purchase temporary continuing health insurance coverage after leaving a firm), Gruber and Madrian (1995) find that access to one year of continuation benefits raises the retirement hazard by 30 per cent for men aged 55 to 64. Boyle and Lahey (2010) exploit the expansion of health care for veterans in the mid-1990s and find that older veterans – compared to non-veterans and veterans without access to health care – are more likely to stop working and to work fewer hours. Bradley et al. (2012) study the response of married, healthy men to a health shock, and find that those with employer-tied health insurance (compared to those insured through their spouses) are more likely to remain employed after suffering from a health shock that is associated with higher future health care costs but not with immediate increases in morbidity.

Other authors have dealt with these identification issues by estimating structural dynamic programming models of retirement decisions, modeling Social Security benefit rules and health insurance. These models generally find small effects of job lock (French and Jones, 2011). Although structural models are able to evaluate policy reforms, because of state space considerations they typically are restricted to using crude health controls rather than detailed medical conditions. Cross-country comparisons improve our understanding of how differences in institutions affect individual behavior, and more specifically in our context, how health and mortality affect labor force participation. The difficulty, which cannot be entirely overcome, lies in identifying the mechanisms involved. Causality is hard to establish since countries differ in many ways but evidence can be used to provide a compelling story. In this study, we find that the effect of a severe health shock on discontinuing to work is similar in the US and Denmark. We provide evidence that differential mortality from cancer and differences in baseline health in the two countries coupled with distinct treatment regimes adopted in the respective health care financing systems can explain the lack of differences in labor supply response to a health shock in the two countries.

3. Theoretical mechanisms

In this section we examine the broad theoretical mechanisms through which health shocks influence the decision to stop working. In a simple framework, an individual approaching retirement decides in each period whether to continue to work or to retire. The individual chooses the retirement age that maximizes the sum of the (discounted) per-period utilities over the remaining lifetime. Workers derive disutility from hours of work and utility from consumption. The budget constraint is dictated by wages and asset income while working, and by pensions and social security benefits when retired, which depend on the age at retirement.

Retiring today implies moving to a lower consumption level and potentially forgoing benefit accrual which are weighed against the current disutility of working. Most benefit systems, however, are not actuarially fair. Benefit accrual – the increase in present discounted value of future retirement benefits if retirement is deferred by a year – is typically negative at older ages (Gruber and Wise, 2004), implying that the benefit accrual effect is likely to be small.

A health shock could enter in this model by way of both substitution and income effects. First, a health shock will affect the disutility of work, e.g. by making work more onerous, although this may be mitigated to some extent by employer accommodation and by recovery of functioning. This substitution effect tends to accelerate retirement. Second, a serious health event may reduce life expectancy, thus lowering the importance of benefit accrual, further accelerating retirement. Third, assuming hours of work do not adjust upwards following the health shock, a negative income effect due to increased medical expenses may result in delayed retirement. Hence, it is likely that a health shock defers retirement when workers must pay out-of-pocket costs for their medical treatment. The marginal benefit of continuing to work is higher if workers have health insurance they lose when retiring. This effect should be stronger for workers who suffered from a health shock since their medical expenditures are higher.

There are significant differences in how health care is provided in the US and Denmark. While the US system is a mixed public-private system with non-hospital care provided by mainly private facilities, health care in Denmark is publicly financed and provided, with free and universal access to primary and secondary health care. Thus, in the Danish case of universal health insurance the income effect is small since medical expenses are minor. This is different in the United States, where out-of-pocket medical expenditure can be sizeable and include prescription and medical services co-pays and fees even for those with health insurance. In our US sample, mean out-of-pocket medical expenditures (in 2000-$) are $1479 (this is similar to other reports, e. g., Duetsch, 2008). Out-of-pocket medical expenditures are much higher for individuals with new cancer or new CVD. Compared to the previous wave, mean differences in expenditures for those who did not suffer from either are $5, but expenditures for those with new cancer increased by $3487 and for those with new CVD by $2107. Information on medical expenses is not available in the Danish sample. Information about costs excluding subsidies from the Prescription Database, which despite its name includes information on all out-of-pocket medical expenditures, show that average out-of-pocket medical expenditures are less than a quarter of the US level (Simonsen et al., 2010). Hence, in Denmark the income effect is lower (although not gone, since Danes still pay some out of pocket costs), making retirement more likely following a health shock than in the US, assuming equal preferences for leisure in both countries and a similar-sized substitution effect. This country difference increases for those individuals in the US who lose their health insurance when they stop working, increasing medical expenses after retirement. This additional income effect ("job-lock") makes continued work more valuable and thus these individuals even more likely to keep working (Madrian, 1994; Gruber and Madrian, 2002).

Based on the above, one would expect a health shock to induce US Americans more than Danes to continue to work. This assumes, however, that there are no context or selection into work differences between the US and Denmark. Since we will be exploring these differences in the empirical part of the paper, it is useful to

mention at this point some of the competing forces that could differentially affect the substitution effect of US Americans and Danes. In particular, there might be differences between responses to a health shock because of differences in its severity (including related mortality) and the types of treatments used and, therefore, in the disutility from working. Institutional differences across the two settings could also play a role. We discuss this in Section 6.

4. Data

4.1. Sample selection

Our samples are selected to make the US and the Danish samples as similar as possible. Note that all data was provided to us in anonymized form, thus ethical approval was not necessary. We estimate the effect of a health shock occurring between time t − 2 and time t on the probability of not working for pay at time t + 2, that is, between two and four years later. We use time t + 2 to measure the labor outcome rather than time t because we cannot distinguish Danes who are on sick leave from those who are working for pay at time t since sickness benefits can be granted for up to one year. Using time t + 2 is also useful because in the US quite a few individuals initially stop working but return to work, mostly within a short period of time (Maestas, 2010), and those individuals should be classified as working in our analysis.

For the US, we use data from five waves (1994–2002) of the HRS, a national biennial panel survey of individuals born between 1931 and 1941 and their spouses. This survey is sponsored by the National Institute of Aging and conducted by the University of Michigan. We use the public use files produced by the RAND Center for the Study of Aging, RAND HRS data version J and fat files, and the HRS exit files. We restrict the sample to HRS age-eligible individuals between ages 56 and 64 at time t + 2 in order to eliminate those eligible for Medicare and circumvent the problem of small sample sizes due to low labor force participation at older ages. Thus, the sample consists of three three-wave periods based on 5 waves of data (1994–1996–1998, 1996–1998–2000, and 1998–2000–2002). After list-wise deletion of person-year observations with missing information, of those who are on or have applied for disability or are receiving Medicare or Medicaid at time t − 2, and of those who were not working at any time before time t during our sample period (including in 1992), the final sample includes 7869 person-wave observations from 3799 individuals, including those who passed away during the four year-span between time t − 2 and time t + 2.

The Danish data consists of a 20% random sample of individuals from the population registers from the years 1993–2001. We selected, in correspondence to the HRS sample, individuals aged 56–64 years at time t + 2. Information on objective health measures are merged from the National Patient Registry and consist of new diagnoses made at hospital admissions in any given year. As in the US sample, we select individuals who are working in all waves prior to time t during our sample period. To match the sampling framework of the HRS, three three-time periods are constructed (1993–1995–1997, 1995–1997–1999, 1997–1999–2001). The final sample includes 138,284 person-wave observations and 63,271 individuals.

4.2. Variable definitions

We define individuals as working if they receive pay from work. Instead of focusing narrowly on labor market exit through retirement, we use the widest definition of non-work as possible, including retirement, unemployment, disability, other types of benefit receipt (such as welfare benefits) or being outside the labor market. Such a definition is not affected by the institutional differences between Denmark and the US that might result in different types of transition pathways from work to retirement, such as the use of disability as bridge between work and retirement. Thus, the outcome measure is a dichotomous variable defined as working for pay or not.

Following McClellan (1998), we define an individual as having had a health shock between times t − 2 and t if the individual suffered from new cardiovascular disease (CVD − defined as heart attack or stroke) or a new cancer, excluding skin cancers, and was hospitalized. The Danish measures use medical diagnoses made at the time of hospital discharge and, therefore, the hospitalization is related to the health shock. In the HRS, we are not able to relate the hospitalization to the health shock.

In the US HRS, the health shock measures are self-reported doctor-diagnosed conditions. Subjective reports of health are prone to justification bias (Anderson and Burkhauser, 1985), but individuals are less likely to misreport the presence or new diagnosis of a specific and severe condition. We report a robustness check on differences in self-reported health and hospital-based medical diagnoses in Denmark in Section 6.4. Even though health measures need not be correlated with work incapacity (Bound, 1991), we only consider serious conditions (CVD, new cancer), which can be expected to impose work limitations.

The estimations include controls for couple status, age and education dummies, race dummies (for the US only), a dummy variable for self-employment, and logs of income and wealth. All of these are measured at time t − 2, except for the age dummies which are measured at time t + 2 to facilitate the discussion of the effects of a health shock on labor force participation at early and normal retirement ages. We refrain from adding replacement rates or potential retirement benefit streams as explanatory variables because of endogeneity concerns (Bound, 1989).

4.3. Descriptive statistics

Table 1 shows some of the summary statistics for each country (more are available online at Supplementary File) for the samples split in three groups, defined at time t + 2: those working, not working, and who have passed away. In the estimations, we will mostly use the first two groups, but also report results from estimations using the entire sample.

Labor force participation is lower in Denmark than in the US with 35.5% compared to 24.1% of individuals not working two periods after the health shock. Although the samples are comparable with 2.5% and 2.6% deceased, 4.1% of the HRS sample experiences a health shock over this period while the corresponding figure in the Danish case is much lower with 2.0%. When disaggregating by type of shock - cancer or CVD - we see that both the incidence of CVD and its burden among the deceased are higher in the US, while more Danes who die during the sample period were diagnosed with new cancer.

5. Empirical model

To estimate the effect of a health shock between time t − 2 and t on the probability of not working for pay at time t + 2 we estimate a probit model of not working, where the latent variable $NW^*_{i,\,t+2}$, is the unobserved propensity to not work at time t + 2 given that the individual was working at time t − 2. It is given by:

$$NW^*_{i,t+2} = \beta_0 + \beta_{HS} HS_{i,[t-2,\,t]} + \beta'_X X_{i,t-2} + \beta'_{AGE} AGE_{t+2} + \varepsilon_{i,t+2} \quad (1)$$

for i = 1, … N, with

Table 1
Summary statistics, Denmark and US, means by work status at t + 2.

	Denmark			US		
	Working	Not working	Deceased	Working	Not working	Deceased
New cancer	0.006	0.011	0.278	0.012	0.023	0.218
New CVD	0.004	0.006	0.026	0.014	0.036	0.139
Age at time t + 2	59.735 (2.228)	61.458 (1.973)	60.917 (2.274)	60.443 (2.253)	61.487 (2.106)	60.921 (2.175)
Woman	0.389	0.512	0.185	0.452	0.480	0.351
# of observations	85,704	49,086	3494	5774	1893	202
Row%						
Men	0.661	0.303	0.036	0.740	0.230	0.031
Women	0.564	0.425	0.011	0.727	0.253	0.020

Working sample. Means are taken over all persons-year observations. Standard deviations are shown in parentheses, except for dummy variables.

$$NW_{i,t+2} = \begin{cases} 1 & if\ NW^{*}_{i,t+2} > 0 \\ 0 & else \end{cases}, \quad (2)$$

where $NW_{i,t+2}$ is the observed indicator for not working at time t + 2; $HS_{i[t-2,t]}$ measures the occurrence of a health shock between t − 2 and t with β_{HS} being the key parameter of interest, the effect of an acute new health shock on the propensity of not working; *X* is a vector of controls measured at time t − 2; and *AGE* is a vector of age dummies measured at time t + 2. $\varepsilon_{i,t+2}$ is standard normally distributed. Standard errors are adjusted for multiple observations of individuals. Because of differences in labor force participation and susceptibility to different types of severe health shocks, we estimate all models separately by gender. Throughout the paper, we report the average of the partial effects (APEs) for a discrete change from zero to one for dummy variables. This regression is estimated separately for each country, and for each type of health shock we compare β^{US}_{HS} to β^{DK}_{HS}.

A parsimonious specification is chosen to avoid any endogeneity via the regressors. Specifically, we do not control for health insurance status in the US sample. Individuals who are insured may have different unobserved characteristics than those uninsured with respect to tastes for work, risk-taking, discounting behavior etc., so that the inclusion of health insurance status in the estimation may bias the effect of a health shock on labor supply. For example, French and Jones (2011) find that those with employer-provided retiree health insurance have stronger preferences for leisure than those without. Instead, the identification strategy used in this paper consists of comparing similar individuals in a setting where insurance is universal and out-of-pocket medical expenditures are low to a setting in which some individuals may select themselves into jobs providing insurance while for others this option does not exist. Furthermore, by conditioning on a wide and relevant set of observables, we reduce other sources of potential heterogeneity. As a robustness check we included the (likely endogenous) insurance status dummies and interactions, and found no statistically significant differences.

Health shocks are treated as occurring exogenously following, e.g., McClellan (1998). Certain risk factors (such as high blood pressure) are strong predictors of heart attack or stroke. Negative health events have also been linked to unemployment or a poor working environment. However, we argue here that the timing of such negative health effects is largely unanticipated as our focus is only on *new* health shocks. In addition, by narrowing the sample to individuals who were working for pay before suffering from a health shock we ensure that our samples consist of relatively healthy older individuals.

6. The effect of new health shocks on the probability of not working

We first present the results from our baseline estimations, followed by our investigation of the effects of differences in mortality, the severity of health shocks, and treatment, and potentially differential attrition. We end with a brief summary of further robustness checks conducted to ensure that the results are not dependent on small changes in the definitions of the variables included or on country differences in the measurement of the health shocks.

6.1. The effect of cancer and CVD on the probability of not working

We begin by comparing the results from the baseline specification of the effects of health shocks on not working, shown in Table 2. The average partial effects (APEs) show that US men may respond more strongly to CVD than Danish men (with APEs of 0.180 and 0.079, respectively, different at a statistical significance level of 15%). US and Danish women, on the other hand, react similarly to health shocks. Women seem to respond less to new onset of cancer than men and more strongly to CVD, especially in the Danish sample.

Since labor force participation in Denmark is lower than in the United States for the age groups considered in our analysis, it is

Table 2
Probit: average partial effects for not working at t + 2 by gender.

		Denmark		US	
		(1)	(2)	(3)	(4)
		Women	Men	Women	Men
New cancer		0.071***	0.098***	0.048	0.139**
		(0.019)	(0.022)	(0.059)	(0.065)
New CVD		0.214***	0.079***	0.205***	0.180***
		(0.049)	(0.020)	(0.073)	(0.047)
Log Pseudo-Likelihood		−34,295.62	−40,023.09	−1912.45	−2081.90
# of Individuals		27,260	34,129	1737	1965
# of Observations		58,421	76,369	3518	4149
Predicted Probabilities					
New cancer	No	**42.92%**	**31.37%**	**25.76%**	**23.52%**
	Yes	**50.03%**	41.13%	**30.58%**	37.47%
New CVD	No	**42.97%**	**31.37%**	**25.56%**	**23.26%**
	Yes	64.40%	39.27%	46.07%	41.24%

Clustered standard errors are shown in parentheses. Stars denote statistical significance at the *** 1%, ** 5%, and * 10% level. Additional controls include: age dummies, educational categories, couple status at t − 2, self-employment status at t − 2, log of wealth at t − 2, log of income at t − 2, and race (US only). The only statistically significantly different APEs for not working across countries by gender are for new CVD for men (at the 15% level). Bold predicted probabilities are statistically significantly different across countries by gender at the 5%-level or lower.

illuminative to compare the predicted probabilities (shown at the bottom of Table 2). This comparison shows that US men who have not suffered from a health shock have lower predicted probabilities of not working than Danish men but that predicted probabilities for men who suffered from a health shock are not statistically significantly different. This is different for women – not surprisingly given the APEs. Danish women have statistically significantly lower predicted labor force participation rates whether they suffered from a health shock or not. The exception is new CVD, where predicted probabilities are not statistically significant even though they are much higher for Danish women, which is the result of small cell sizes.

The APEs increase with age and rise sharply at the early retirement ages in both countries (age 60 in Denmark and age 62 in the US; results not shown). We discuss this in more detail in Section 6.3.

We also investigated whether new cancer and new CVD increase the probability of part-time work for those who are still working at time $t + 2$, and found this to be the case for Danish women who suffered from new cancer and US men who suffered from new CVD, further increasing the differences in effects we find in our baseline analysis (results available upon request). As a specification check, we also estimated the effects of weeks worked for the US sample (this information is not available for the Danish sample), and found qualitatively similar effects.

In summary, our baseline estimations of the APEs of a health shock on the probability of not working show almost no difference between the countries, with a (weakly) greater response of US men to CVD and no statistically significantly differences in women's response. In what follows, we present evidence that in light of the different health care and health insurance regimes, differences in health and mortality are likely to explain our lack of finding differences between the two countries.

6.2. The role of health and health care differences

The US and Denmark do not only differ in their health insurance types, but also in the underlying health of their populations and types of health care provided. In what follows we argue that higher screening rates and more aggressive treatment as well as greater co-morbidities in the US significantly contribute to the explanation of our findings. Since new cancer and CVD are very different diseases, we will discuss these separately, starting with new cancer.

Cancer diagnosis, treatment, and outcomes differ greatly in the US and Denmark. Cancer incidence and screening rates are much higher in the US than in Europe (Crimmins et al., 2011; Howard et al., 2009). Thus, cancer is detected at earlier, more curable stages in the US (American Cancer Society, 2011). Even though the US might be over-screening, it is likely that the higher screening rates reduce mortality (Cutler, 2008; Preston and Ho, 2009). For example, for the age group 50–64, US women are almost four times more likely to have had a mammography in the past 2 years than Danish women and US women have higher breast cancer incidence rates and higher 5-year survival rates (Howard et al., 2009). Rates for colon cancer screening tests and PSA tests are likewise much higher in the US (Garcia and Crimmins, 2013; Howard et al., 2009), and lung cancer is much more likely to be detected at early stages (Bjerager, 2006). At the same time, less severe cases cancer are more likely to be treated in the US than in Europe and treatment is more aggressive (Quinn, 2003). Lower screening rates and less aggressive treatment in Denmark may result in higher mortality rates as undetected cancers often reach a more advanced stage. Age-standardized cancer mortality rates are higher in Denmark than in the US (Crimmins et al., 2011). Most strikingly, 5-year age-standardized survival rates for prostate cancer in Denmark are less than half of those for the US (Garcia and Crimmins, 2013). Not only are more men being tested and prostate cancer thus discovered at earlier stages in the US, but treatment is also more aggressive (prostatectomy is the first treatment adopted for about one third of all new diagnoses in the US, see Harris and Lohr, 2002). In contrast, in Scandinavia watchful waiting and hormone therapy are typically the first line of treatment and prostatectomy is used in only 3% of diagnosed cases (Kvåle et al., 2007).

To assess the effect of mortality and the resulting sample selection on our results about the effects of a new health shock on the probability of not working, we conducted a probit analysis of the probability of death between time $t - 2$ and time $t + 2$ (shown in Table 3). The difference is striking – Danish men are much more likely to die after being diagnosed with new cancer than US men (63.5% versus 27.4%). Note that since in this comparison the difference between the two samples is likely to be more pronounced, and this does not take into account health-related attrition in the HRS as well as missing information on prior diseases for some deceased individuals in the HRS, the results should only be taken as suggestive. However, the probability of dying in our samples is the same (see Table 1) and overall mortality rates in the two countries are similar according to the Mortality Database of the World Health Organization.

Our results show that Danish men were substantially more likely to die from cancer but that those who survived were just as likely to be working as US men following a diagnosis of new cancer. This may arise because men who survive cancer in Denmark are more positively selected than their US counterparts in terms of their health (i.e. cancer stage). This should make them less likely to stop working. Even though our results (as shown in Table 2) are not statistically different between Danish and US men, they also do not contradict that this might be the case.

When considering the effect of new CVD, we find no statistically significant differences in mortality. This may at first seems surprising since, as in the case of cancer, there are significant differences in health and health care in the two countries. In our sample, the share of individuals experiencing a new CVD is much higher in the US with 2.3% than in Denmark, where it is only 0.5%. This is in line with national data, which show that US Americans are more likely to suffer from heart disease than Europeans (Preston and Ho, 2009). US Americans also have a higher incidence of cardiovascular risk factors than Danes with much higher rates of hypertension, obesity, high cholesterol, and diabetes. For example, 50% of US Americans aged 50 and above have high blood pressure, 33.1% are obese, 21.7% have high cholesterol, and 16.4% have been diagnosed with diabetes (Thorpe et al., 2007). The corresponding percentages for Danish men (women) are much lower: 30.7% (28.4%) have hypertension, 14% (13.3%) are obese, 17.4% (6.7%) have high cholesterol, and 8.1% (6.7%) have diabetes (Andreyeva et al., 2007). Even though it is possible that these differences result from underdiagnosis in Denmark, it is likely that this is less important for these risk factors than for cancer (Howard et al., 2009; Michaud et al., 2011). Comparing self-reports and biomarkers of diabetes and hypertension, Banks et al. (2006) found these to be very similar and much higher in the US than in the UK.

Risk factors do not only predict the onset of CVD but also increase its severity (Fallow and Singh, 2004). Poor underlying health and poorer physical functioning also make it more difficult to recover and return to work after such a severe health shock. This can explain our earlier finding that US men are more likely than Danish men to stop working as a result of new CVD. On the other hand, there is evidence that the US health care system is better equipped to treat patients with CVD, which could explain why there is no difference in mortality from new CVD between Denmark and US. Compared to other high income countries, more affected

Table 3
Probit: average partial effects for deceased by t + 2 by gender.

		Denmark		US	
		(1)	(2)	(3)	(4)
		Women	Men	Women	Men
New cancer		0.222***	0.608***	0.190***	0.249***
		(0.014)	(0.015)	(0.045)	(0.052)
New CVD		0.022	0.111***	0.079***	0.088***
		(0.018)	(0.014)	(0.035)	(0.029)
Log Pseudo-Likelihood		3074.36	−10,060.53	−297.59	−506.71
# of Individuals		27,544	35,727	1767	2032
# of Observations		59,067	79,217	3589	4280
Predicted Probabilities					
New cancer	No	**0.78%**	2.65%	**1.54%**	2.48%
	Yes	23.01%	**63.50%**	20.57%	**27.42%**
New CVD	No	**1.09%**	**3.51%**	**1.81%**	**2.72%**
	Yes	3.27%	14.60%	9.71%	11.48%

Please see Table 2 for notes. The only statistically significantly different APEs for deceased across countries by gender are for new cancer for men (at the 1% level). Bold predicted probabilities are statistically significantly different across countries by gender at the 5%-level or lower.

individuals are taking medications for their conditions, treatment regimes are more aggressive, and survival rates higher in the US (Preston and Ho, 2009). One might expect that the outcome depends on having health insurance. Unfortunately, the sample size does not allow to test whether individuals without insurance who are less likely to get screened for diseases (Preston and Ho, 2009) have higher mortality. In contrast, countries with stronger supply-side restrictions on the adoption of intensive treatments due to global budgeting and centralized health care planning, such as the Scandinavian countries and Canada, have been slower to adopt costly medical technologies for heart attack care such as cardiac catheterization, bypass surgery and angioplasty (TECH Network, 2001).

All in all, two differential forces seem to be at play: First, US Americans are more likely to suffer from CVD and, when diagnosed, suffer from more severe CVD. Thus, they might be more likely to stop working even if this implies the loss of health insurance. Second, however, because of more aggressive and timely treatment, survival rates of CVD might be improved. Indeed, our findings support this reasoning – US men are more likely to stop working (and women about the same), while there are no statistically significant differences in mortality following new CVD in our sample.

Following a suggestion by one of the referees, we pooled the US and Danish samples, adjusting for the much larger Danish register sample. Income and wealth were measured as Z scores based on each country's distribution, and health shocks were interacted with the country. The results were the same as before – the effect of a health shock only differs across country in two cases: US men with new CVD are slightly more likely to be not working at t + 2 compared to Danish men, while US men with new cancer are substantially less likely to die at t + 2 compared to Danish men. Results are available online at Supplementary File.

6.3. Differential attrition and unobserved heterogeneity

One potential factor that could affect our results is differential attrition, since labor force participation rates of older individuals are higher in the US than in Denmark. The cumulative hazard is about the same for individuals under age 60 and much higher for Danes at older ages. From the age of 60, many Danish blue-collar workers take advantage of an early retirement program (VERP), which explains the sharp rise in the hazard rates, particularly for women.

In the US, individuals with high discount rates, low assets and poor health are more likely to stop working (Gustman and Steinmeier, 2005). It is possible that this selection is even stronger in Denmark than in the US. There exist a multitude of early exit options, and a generous and somewhat more easily accessible disability pension in Denmark tends to siphon out low wage workers from the labor market early, a group for whom the replacement rate from early retirement pensions is high (Bingley et al., 2004). Thus, individuals in Denmark who continue to work at older ages are probably predominantly high SES, white-collar workers with stronger tastes for work and in relatively better health and, therefore, more prone to return to work following a health shock. Pre-existing co-morbidities (such as cardiac disease) are more prevalent among low SES groups (Marmot, 2001) and reduce the number of work hours and increase labor market exit (Saeki et al., 1995). If the Danish sample were more selected due to these reasons than comparable US Americans, the effect of a health shock would be weaker.

To test the importance of differential selection, we repeated the analysis for individuals below age 60 at time t + 2 only, since until age 59 - as mentioned above - the retirement hazard is similar in the two countries. The results (not shown) are qualitatively similar to the previous results, although estimated less precisely because of the smaller sample sizes. We conclude that we do not find evidence that differential sample selection can explain our results.

6.4. Robustness checks

6.4.1. Differences in the measurement of health shocks

As mentioned earlier, the prevalence of health shocks is lower in the Danish sample with 2.0% compared to 4.1% in the US sample. This is similar to the finding by Banks et al. (2009) that rates of heart attacks, strokes, and cancer were much higher in the US than in England. This provides support that differences in the severity of health shocks are real. Nevertheless, it is possible that some of the difference is the result of the differences in measurement of health shocks. In the Danish data, health shocks are doctor-diagnosed and contingent on a related hospital stay. In the US data, the health shock is self-reported (as diagnosed by a physician) and contingent on a hospital stay, which may or may not be related. One would expect health shocks that are not necessarily related to a hospital stay to be less severe, biasing the estimate of the average partial effect in the case of the US downward. This could explain some of the country differences we find, especially with respect to cancer, which might be less likely to result in a hospital stay than CVD. On the other hand, it is also possible that self-reported hospital stays are underreported in the HRS. To investigate this, we re-estimated the baseline model with health shocks defined without conditioning on a hospital stay (results not shown). This effectively broadens the range of health shocks compared to those used in the Danish sample. We find smaller APEs, in line with the likelihood that health shocks that do not lead to hospitalization are less severe and have, therefore, less impact on labor market participation. Despite this, we find patterns similar to the baseline results.

The second difference in the measurement of health shocks is the use of medical diagnoses in the Danish sample and of self-reports in the US sample. A large literature has considered the inherent biases in self-reported measures of health, in particular with respect to labor supply (Bound, 1991). We are constrained to making a register-survey comparison because no panel survey of the elderly exists in Denmark that is comparable to the HRS in terms of size and richness. One way of addressing this issue is to test for survey-register differences in the Danish case. To investigate this, we use the Danish cross-sectional National Health Interview Survey from 2000, conducted by the National Institute of

Public Health, which has been merged to register data. Limiting the sample to 56–64-year-olds in 2000 who were working in 1998, we estimated probit regressions of not working in the year 2000 on the same controls as before (measured in 1998). Because of the survey-register link-up, two measures of health shocks are available: the previously defined register-based measure of diagnoses of CVD or cancer made at hospitalization, and a survey measure of individual self-reports (either the presence of the disease or whether told by a doctor) on the existence of CVD or cancer. Health shocks are measured as occurring in 1999–2000. The results (not shown) show that the APEs for men for CVD and cancer are slightly higher when using the register-based measure but not statistically different. Larger effects from the register-based measure imply that there should be less responsiveness in the US sample. (The cell sizes for women are too small to draw meaningful inferences.)

6.4.2. Work accommodations

Finally, a health shock may raise the disutility of work and thereby accelerate retirement. This effect may be weaker in Denmark since municipalities pay for necessary workplace adaptations, provide employers with wage subsidies and give sick-listed workers a form of social support that facilitates continued work without risk of benefit loss. Most of these schemes came into being in the mid to late 1990's during the latter part of the sample period. Still, if US workplaces are considerably less accommodating of workers with health problems this may explain some of the difference in the findings. While no direct information on workplace accommodation is available in the data, workers in the HRS are asked whether their job is stressful and whether or not the job is physically demanding. Plausibly, workers with health conditions who are not accommodated find working more stressful and demanding. Including these indicators, however, barely changes the coefficients of the health shocks (results not shown).

7. Conclusions

This paper compares the effect of severe health shocks on the probability of not working among a sample of elderly workers from the Danish Longitudinal Registers and a comparison sample from the US HRS. We find few country differences, even though the job lock effect of employer-based health insurance and the stronger income effect of higher medical expenditures in the US should induce US Americans more than Danes to continue to work. We provide what we believe is compelling evidence that health differences coupled with distinct treatment regimes under the respective health care systems can explain this somewhat counterintuitive finding.

Our results contribute to the discussion of how disease and disease risk cause different selectivity in the labor market across countries, and thereby shed light on how different health insurance choices and their implied differences for the type of health care system affect individual response to severe health events. An important difference between the United States and Denmark seems to be a focus in the former health care system on radical treatment in complex cases requiring technology-intensive specialized treatment and prolonging longevity, especially in the case of cancer. On the other hand, a nationalized health care system, such as the Danish one, offers lower screening rates and less aggressive treatment in return for universal life-long primary care that may reduce risk factors and overall disease burden. These tradeoffs can imply differences in surviving workers' health across settings. Thus, our findings can explain why Danes' labor force participation – despite having universal health insurance with low out-of-pocket medical expenses – does not lead to substantially greater withdrawal from the work force following a health shock, and underscore the importance of taking into account differences in disease risk as well as different health care regimes across countries.

Acknowledgments

We thank two anonymous referees for helpful suggestions, Malene Kallestrup-Lamb and Karl Fritjof Rasmussen for research assistance, and Kristina Bacher Svendsen for advice on the aggregation of the diagnostic codes. We also thank Jacob Nielsen Arendt, Paul Bingley, Thomas Crossley, Ronald Ehrenberg, Andrew Gill, Hendrik Jürges, Arie Kapteyn, Dean Lillard, Nicole Maestas, Pierre-Carl Michaud, Gwenaël Piaser, John Romley, Niels Skipper, Arthur van Soest, and participants at the IZA workshop on "The Well-Being of the Elderly", the Netspar Workshop in Utrecht, the 12th SOLE meetings, iHEA Sixth World Congress, the European Congress of Epidemiology 2013 (invited lecture), and seminars at Cornell ILR, ROA Maastricht, and California State University, Fullerton, for helpful comments.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2015.05.008.

References

American Cancer Society, 2011. Cancer Facts & Figures 2011. Atlanta.
Anderson, K.H., Burkhauser, R.V., 1985. The retirement-health nexus: a new measure of an old puzzle. J. Hum. Resour. 20 (3), 315–330.
Andreyeva, T., Michaud, P.-C., van Soest, A., 2007. Obesity and health in Europeans aged 50 years and older. Public Health 121 (7), 497–509.
Banks, J., Marmot, M., Oldfield, Z., Smith, J.P., 2006. Disease and disadvantage in the United States and in England. JAMA 295 (17), 2037–2045.
Banks, J., Marmot, M., Oldfield, Z., Smith, J.P., 2009. The SES health gradient on both sides of the Atlantic. In: Wise, D.A. (Ed.), Developments in the Economics of Aging. University of Chicago Press/NBER, pp. 359–406.
Bingley, P., Datta Gupta, N., Pedersen, P.J., 2004. The impact of incentives on retirement in Denmark. In: Gruber, J., Wise, D. (Eds.), Social Security Programs and Retirement Around the World: Micro-Estimation. University of Chicago Press, Chicago, IL, pp. 153–234.
Bjerager, M., 2006. Delay in Diagnosis and Treatment of Lung Cancer. PhD thesis. Research Unit and Department of General Practice, University of Aarhus, Aarhus.
Bound, J., 1989. The health and earnings of rejected disability insurance applicants. Am. Econ. Rev. 79 (3), 482–503.
Bound, J., 1991. Self-reported versus objective measures of health in retirement models. J. Hum. Resour. 26 (1), 106–138.
Boyle, M.A., Lahey, J.N., 2010. Health insurance and the labor supply decisions of older workers: evidence from a US department of veterans affairs expansion. J. Public Econ. 94 (7–8), 467–478.
Bradley, C.J., Neumark, D., Motika, M.I., 2012. The effects of health shocks on employment and health insurance: the role of employer-provided health insurance. Int. J. Health Care Finance Econ. 12, 253–267.
Bradley, C.J., Neumark, D., Bednarek, H.L., Schenk, M., 2005. Short-term effects of breast Cancer on labor market attachment: results from a longitudinal study. J. Health Econ. 24 (1), 137–160.
Crimmins, E.M., Garcia, K., Kim, J.K., 2011. Are international differences in health similar to international differences in life expectancy? In: Crimmins, E.M., Preston, S.H., Cohen, B. (Eds.), International Differences in Mortality at Older Ages: Dimensions and Sources. The National Academies Press, Washington DC, pp. 68–102.
Cutler, D.M., 2008. Are we finally winning the war on cancer? J. Econ. Perspect. 22 (4), 3–26.
Duetsch, M., 2008. Out-of-pocket health care spending patterns of older Americans, as measured by the consumer expenditure survey. Consum. Expend. Surv. Anthol. 46–51.
Fallow, G.D., Singh, J., 2004. The Prevalence, type and severity of cardiovascular disease in diabetic and non-diabetic patients: a matched-paired retrospective analysis using coronary angiography as the diagnostic tool. Mol. Cell. Biochem. 261 (1), 263–269.
French, E., Jones, J.B., 2011. The effects of health insurance and self-insurance on retirement behavior. Econometrica 79 (3), 693–732.
Garcia, K., Crimmins, E.M., 2013. Cancer screening in the U.S. and Europe: policies, practices, and trends in cancer incidence and mortality. In: Hoque, N., McGehee, M.A., Brashaw, B.S. (Eds.), Applied Demography and Public Health. Springer, New York, NY (Chapter 9).
Gruber, J., Madrian, B.C., 2002. Health Insurance, Labor Supply, and Job Mobility: A

Critical Review of the Literature. NBER WP 8817.
Gruber, J., Madrian, B.C., 1995. Health-insurance availability and the retirement decision. Am. Econ. Rev. 85 (4), 938–948.
Gruber, J., Wise, D.A., 2004. Social Security Programs and Retirement Around the World – Micro-Estimation. University of Chicago Press, Chicago, IL.
Gustman, A.L., Steinmeier, T., 2005. The social security early entitlement age in a structural model of retirement and wealth. J. Public Econ. 89 (2–3), 441–463.
Haan, P., Myck, M., 2009. Dynamics of health and labour market risks. J. Health Econ. 28 (6), 1116–1125.
Harris, R., Lohr, K.N., 2002. Screening for prostate cancer: an update of the evidence for the US preventive services task force. Ann. Intern. Med. 137 (11), 917–929.
Howard, D.H., Richardson, L.C., Thorpe, K.E., 2009. Cancer screening and age in the Unites States and Europe. Health Aff. 28 (6), 1838–1847.
Kvåle, R., Auvinen, A., Adami, H.-O., Klint, A., Hernes, E., Møller, B., Pukkala, E., Storm, H.H., Tryggvadottir, L., Tretli, S., Wahlqvist, R., Weiderpass, E., Bray, F., 2007. Interpreting trends in prostate cancer incidence and mortality in the five Nordic countries. J. Natl. Cancer Inst. 99 (24), 1881–1887.
Madrian, B.C., 1994. Employment-based health insurance and job mobility: is there evidence of job-lock? Q. J. Econ. 109 (1), 27–54.
Madrian, B.C., 2006. The US Health Care System and Labor Market. NBER WP 11980.
Maestas, N., 2010. Back to work. Expectations and realizations of work after retirement. J. Hum. Resour. 45 (3), 718–748.
Marmot, M., 2001. Economic and social determinants of disease. Bull. World Health Organ. 79, 906–1004.
McClellan, M., 1998. Health events, health insurance and labor supply: evidence from the health and retirement survey. In: Wise, D.A. (Ed.), Frontiers in the Economics of Aging. University of Chicago Press, Chicago, IL, pp. 301–350.
Michaud, P.-C., Goldman, D., Lakdawalla, D., Gailey, A., Zheng, Y., 2011. Differences in health between Americans and Western Europeans: effects on longevity and public finance. Soc. Sci. & Med. 73 (2), 254–263.
Preston, S.H., Ho, J., 2009. Low Life Expectancy in the United States: Is the Health Care System at Fault?. NBER WP 15213.
Quinn, M.J., 2003. Cancer trends in the United States – a view from Europe. J. Natl. Cancer Inst. 95 (17), 1258–1261.
Saeki, S., Ogata, H., Okubo, T., Takahashiand, K., Hoshuvama, T., 1995. Return to work after stroke: a follow-up study. Stroke 26 (3), 399–401.
Simonsen, S., Skipper, L., Skipper, N., 2010. Price sensitivity of demand for prescription drugs: exploiting a regression kink design. In: Working Paper 10–1. University of Aarhus, Department of Economics.
TECH Network, 2001. Technological change around the world: evidence from heart attack care. Health Aff. 20 (3), 25–42.
Thorpe, K.E., Howard, D.H., Galactionova, K., 2007. Differences in disease prevalence as a source of the U.S.-European health care spending gap. Health Aff. 26 (6), w678–w686.