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Pathways to Retirement, Income, and Cause-Specific Mortality Risks in the Netherlands

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Pathways to Retirement, Income, and Cause-Specific Mortality Risks in the Netherlands

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Abstract

We examine to what extent pathways to statutory retirement other than employment are associated with adverse health conditions as measured by increased cause-specific mortality risk during retirement. To do so, we estimate a dependent competing risks model using Dutch administrative data. We find that income is not associated with cancer mortality risk but that the mortality risks for cardiovascular disease and other diseases are about twice as high among low-income as among high-income individuals. Additionally, younger birth cohorts have a lower overall mortality risk because of their lower mortality risk for cardiovascular disease (CVD). Finally, compared to individuals who remain employed during the three years preceding statutory retirement, among those who are early retired, unemployed, self-employed, or nonparticipating we find no significantly different mortality risks for cancer, CVD, or other diseases. Such risks, however, are about twice as high among individuals on disability during the three years preceding statutory retirement. These findings suggest that the effectiveness of policies aimed at increasing employment among individuals aged 55–64 may, on average, not be adversely affected by the health conditions of nonemployed individuals other than those on disability.

JEL codes: C41, I10, J00

Keywords: Duration analysis, cause-specific mortality risk, labor market status

1. Introduction

The aging of the Dutch population has raised concerns about the sustainability of the welfare state as it increases public expenditures on, for instance, long-term care and retirement pensions (Van Ewijk *et al*., 2006). Because one means of alleviating the burden of an aging population on public finances is to increase labor force participation and so raise social security contributions and tax revenues, social security programs and pension schemes are, since the 1990s, being redesigned to create stronger incentives for continued work at older ages. These reforms, together with the increased labor force participation of women, have probably contributed to the rising participation in the workplace of the 55–64 population from under 30% in the mid-1990s to 45% in 2007 (Euwals *et al*., 2009; van Oorschot, 2007). Recent reforms like the abolishment of the favorable fiscal treatment of early retirement contributions (CPB, 2005) and a tax exemption for individuals who continue working after age 62 (Stimulansz, 2009), as well as the proposed rise in the statutory retirement age from 65 to 67 (CPB, 2009, 2010), are expected to further increase employment among the 55+ population.

Nevertheless, the success of, and the political support for, policies aimed at increasing employment among individuals aged 55–64 depends, among other things, on the health conditions of the nonemployed in this age group. One particular concern is that nonemployed individuals may have health limitations that prevent them from remaining employed until the statutory retirement age. An obvious group of such individuals is those drawing disability insurance benefits, but the concern also extends to other groups like early retirees who for health reasons may have chosen to leave the labor force before the statutory retirement age. Although several empirical studies have addressed this issue, the findings are contradictory. For instance, Tsai *et al*. (2005) and Bamia *et al*. (2007) find an increased mortality risk for early retirees in the U.S. and Greece, respectively, whereas Coe and Lindeboom (2008), Brockman *et al*. (2009), and Litwin (2007) find no such increased risk for early retirees in the U.S., Germany, or Israel, respectively.[1] One reason to expect *a priori* that early retirement does not affect mortality risk in countries like the Netherlands is the presence of a disability insurance scheme that selects individuals with health-related reduced employability out of the labor force. This selection implies an increased mortality risk among individuals drawing disability insurance benefits. Empirical support for this implication is available for Germany (Brockman *et al*., 2009), Norway (Gjesdal *et al*., 2007), and Sweden (Karlsson *et al*., 2007).

This paper aims to contribute to the economics literature on the health-related employability of the unused labor capacity among the 55–64 population in the Netherlands and to the epidemiological literature on socioeconomic differences in cause-specific mortality risk. Accordingly, we examine to what extent pathways to retirement other than employment are associated with adverse health conditions among this population as measured by increased cause-specific mortality risk after the statutory retirement age of 65.[2] If, for instance, we find an increased postretirement mortality risk among the nonemployed, then the effectiveness of policies aimed at increasing employment among the 55–64 population may, on average, be adversely

[1] Related issues are the adverse health effects from dismissals (Sullivan and von Wachter, 2009, and Eliason and Storrie, 2007, for the U.S.; Iversen *et al*., 1987, for Denmark) and employees on temporary contracts (Kivmäki *et al*., 2003, for Norway).

[2] One advantage of using mortality risk is that, in contrast to self-reported health limitations in household surveys, which may yield a justification bias (Kalwij and Vermeulen, 2008), it is an objective measure of health.

affected by health limitations. The pathways to statutory retirement at age 65 delineated here are the years of being employed, self-employed, unemployed, nonparticipating, early retired, or on disability insurance benefits between the ages of 58 and 64. We relate these pathways to three competing causes of death—cancer, cardiovascular disease (CVD), and other diseases. Differentiating these causes of death allows us to assess whether socioeconomic differences in mortality risk in the Netherlands are much greater for CVD than for cancer as reported, for instance, in Marmot *et al*.'s (1991) influential Whitehall study for Great Britain. We also control for household income and examine which causes of death are linked to the frequently observed negative association between income and mortality risk (see, e.g., Kalwij *et al*., 2009, for the Netherlands).[3]

Our methodological framework for analyzing socioeconomic differences in cause-specific mortality risk is a competing risks model. Our model conditions not only on observed characteristics but also on an unobserved individual specific effect (see, e.g., Katsahian *et al*., 2006) which allows for a dependency between the different competing risks. The model therefore also takes into account that with age the sample becomes more selective in terms of both the observed and unobserved characteristics (e.g., Van den Berg, 2001).

The paper is organized as follows. Section 2 describes the data. Section 3 outlines the statistical model, and section 4 reports the empirical results. Section 5 summarizes the main findings and concludes the paper.

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[3] We refer, for instance, to Duleep (1986), Huisman *et al*. (2004, 2005), van Kippersluis *et al*. (2010), Marmot *et al*. (1991), Menchik (1993), and Smith (1999) for further empirical evidence and discussions on the socioeconomic variation in health- (and cause-) specific mortality risk(s).

2. Data

The data are taken from the 1989–2007 Income Panel Study of the Netherlands (IPO, Inkomens Panel Onderzoek, CBS 2009a) and the 1997–2008 Causes of Death registry (DO, Doodsoorzaken, CBS 2009b), both gathered by Statistics Netherlands. The IPO, a representative sample of the Dutch population, consists of an administrative panel dataset of, on average, about 95,000 selected individuals per year who are followed longitudinally. Sampling is based on individuals' national security number, and the selected individuals are followed for as long as they are residing in the Netherlands on December 31 of the sample year. The dataset includes individuals living in institutions for the elderly, such as nursing homes. Individuals born in the Netherlands enter the panel for the first time in the year of their birth, and immigrants to the Netherlands in the year of their arrival. An individual only exits the panel on death or emigration from the Netherlands.

The IPO contains data on gender, age, marital status, income, homeownership, and labor market status. These data are obtained from official institutions, most particularly, the population registry and tax office. The DO, on the other hand, provides information on the date of death and at most four causes of death for all residents deceased during the 1997–2008 period. Multiple causes of death include a primary cause and up to three secondary causes. These data, all registered using version 10 of the International Coding of Diseases (ICD10),[4] are provided by medical examiners who are legally obliged to submit them to Statistics Netherlands. The DO

[4] http://www.who.int/classifications/apps/icd/icd10online/

dataset also assigns a personal identifier that allows determination of whether an individual in the IPO has died by the next calendar year and, if so, the causes of death.

We select individuals who turned 65 during the 1996–2007 period, meaning that individuals from the oldest cohort (born in 1931) are included in the data for at most 12 years and individuals from the youngest cohort (born in 1942) are included for only 1 year. This selected sample consists of 57,757 observations for 10,013 individuals. We remove 3.8% of the observations because of negative or zero income or missing values on the variables to be analyzed. The hypothesis of the same mortality rate among the individuals excluded and those included is not rejected,[5] which implies no endogenous sample selection. Panel attrition for reasons other than mortality (mainly emigration) is about 0.12% per year. The resulting sample consists of 55,553 observations for 9,618 individuals, 1,147 of whom died during the sample period.

2.1 Variable Definitions, Descriptive Statistics, and Differential Mortality

We define age as the individual's age on January 1 of each year because in the Netherlands, the calendar year is also the fiscal year for income measurement, meaning that this choice ensures that income at age 65 is measured over the first entire calendar year of retirement. The dependent variable in our analysis is cause-specific mortality after the statutory retirement age of 65. For this variable, we distinguish between the two major causes of death, cancer (ICD10 code C00-D48) and CVD (ICD10 code I00-I99), and refer to all other causes of death as "other diseases." These latter, which include infectious diseases, diabetes, pneumonia, diseases of the digestive system, and fatal injuries, cannot be further disaggregated

[5] The corresponding *p*-value is 0.214.

because of data limitations. The explanatory variables are gender, marital status at age 65, homeownership at age 65, standardized household income at age 65, and labor market status from age 58 onward. Table 1 describes how these variables, defined below, relate to cause-specific mortality rates.

Table 1 confirms the accepted pattern that men have a higher mortality rate than women: the three rightmost columns show that differential mortality with respect to gender appears to be equally strong for the different causes of death. The marital status variable distinguishes between a single adult household that includes divorcees (hereafter, single), a married or cohabiting couple (married), and a widowed individual. As table 1 shows, individuals married at age 65 have relatively lower mortality rates for CVD and other diseases but about the same cancer mortality rate as individuals who are single or widowed at age 65. Homeowners at age 65 have a lower mortality rate than renters, an observation apparently related mainly to the mortality risks for CVD and other diseases.

The IPO income data, which are based primarily on records from the tax office and institutions that pay out (insurance) benefits, contain detailed and accurate information on all income components on an individual level. Based on the largest income component, Statistics Netherlands assigns one of the following labor market statuses to each individual: employed, self-employed, unemployed (receiving unemployment insurance or assistance benefits), on disability (receiving disability or [long-term] sickness insurance benefits),[6] early retired (receiving pension income), or

[6] The disability insurance scheme is referred to as the WAO or WIA and the (long-term) sickness insurance scheme as the ZW (see www.uwv.nl). Because data limitations prevent a more refined classification, if, for example, an individual is partially disabled but the main source of income is employment, we classify this person as employed.

nonparticipating (receiving no labor income, pension, or benefits). Eligibility for disability insurance benefits is assessed by a medical doctor based on health conditions that adversely affect individual employability.[7]

Although our selected sample starts in 1996, the IPO dataset also contains information on the labor market status for all individuals in our sample from 1989 onward, meaning that we observe labor market status for all these individuals from age 58 onward. As shown in column 1, table 1, the 36.9% employment rate for 58-year-old individuals drops to 16.4% by age 62, while the proportion of those on disability increases slightly from 13.1% at age 58 to 14.3% at age 62. Between ages 58 and 62, the percentage of early retirees increases from 14.4% to 36.6%. We also observe a higher mortality rate related primarily to CVD and other diseases among individuals on disability but a higher mortality rate from cancer among the self-employed. Apart from these observations, no clear pattern emerges on cause-specific mortality rates by labor market status at ages 58 and 62.

For both the individual and the spouse (when present), we use income at the age of 65 as a proxy for lifetime income, which the health-economic theory suggests is associated with mortality risk (see, e.g., Grossman, 2000). Standardized household income is defined as an individual's lifetime income together with that of the spouse when present, gross of taxes and social insurance contributions, measured in 2005

[7] Since the early 1990s, the disability insurance system has been reformed toward stricter eligibility conditions (see, e.g., de Vos *et al*., 2010), which may have caused individuals who begin claiming disability insurance benefits to become, on average, less healthy over time. However, in our empirical analysis we found no evidence for this assumption when testing if the impact of the pathway "years on disability" on mortality during retirement varies with the year when the claim started.

euros using the consumer price index and, for married individuals, divided by the equivalence scale provided by Statistics Netherlands (Siermann *et al*., 2004).[8]

As Table 1 shows, in line with the findings of other European studies (see, e.g., Kalwij *et al*., 2009, for a summary), the mortality rate is about twice as high among individuals in the lowest quartile of the income distribution than among individuals in the highest quartile (3.0% versus 1.6%). Income also appears most strongly associated with CVD mortality and most weakly linked to cancer mortality. These findings conform, to those of, for instance, Huisman *et al*. (2005) who, using data from eight European countries, report higher mortality risk among low- than among highly educated groups for all causes of death other than prostate cancer for men and lung cancer for women.

Although the cause-specific mortality rates given in table 1 refer to the so-called primary cause of death, medical examiners also report up to three contributing causes often termed secondary causes of death (see table 2). For example, if an individual with a fatal form of cancer dies from CVD, the medical examiner reports CVD as the primary cause of death and cancer as the secondary cause (as in 11 cases listed in table 2). Nevertheless, given the level of aggregation, the secondary cause of death may be the same as the primary one; for instance, an individual may suffer from two different cancers, making cancer both the primary and secondary cause of death (as in 22 cases given in table 2). About one-third of the recorded deaths in our sample have a secondary cause of death that is different from the primary cause. The next

[8] We exclude income from other household members, present in about 12% of the households but mostly children. This exclusion does not affect our results. Although income includes pension, labor, transfer, and capital income for individuals 65 and older, over 90% of income consists of public retirement pension benefits and occupational pension income (see Knoef *et al*., 2009, for further details on the income measures in the IPO).

section discusses how we use this additional information to allow for dependency between the cause specific mortality risks. For a detailed discussion of the multiple causes of death and Statistics Netherlands' method for recording them we refer to Mackenbach *et al*. (1995, 1997).

3. Cause-Specific Mortality Model

Our empirical model for analyzing cause-specific mortality risk is a discrete-time competing risks model that allows for dependency across these risks through time-invariant observed and unobserved heterogeneity. The dependent variable is whether an individual is deceased by the next calendar year and if so, whether the cause of death is cancer, CVD, or other diseases.

The cause-specific mortality risk conditional on age and individual characteristics is formalized as follows:

$$\Pr\left(M_{j,a+1}(i)=1 \mid M_{j,a}(i)=0, X_a(i), \eta(i); \beta_j, \alpha_j\right) = F_j\left(X_a(i)\beta_j + \alpha_j \eta(i)\right), \quad (1)$$

where $F_j(.)$ is the logistic cumulative distribution function that corresponds to mortality cause j ($j \in \{1,2,3\}$). $M_{j,a+1}(i)$ is equal to 1 if individual i became a years old and died at age (a+1) from cause j, and 0 otherwise. $X_a(i)$ is a (1xk) vector of an individual's observed characteristics at age a with a corresponding (kx1) parameter vector β_j. $\eta(i)$ is a time-invariant unobserved individual characteristic (a random effect) that is assumed to be independent of individual's observed characteristics. The parameter α_j allows the unobserved characteristic to have a different impact on each of the three specified causes of death.

The age dependency of cause-specific mortality risk is modeled using a linear age function (in the index).[9] The model includes the following covariates: gender, birth cohort, marital status at age 65, homeownership at age 65,[10] and the logarithm of standardized household income at age 65. The inclusion of these covariates, all shown to be associated with mortality risk (e.g., Kalwij *et al*., 2009, and Van den Berg *et al*., 2006, for the Netherlands), provides insights into the socioeconomic variation in cause-specific mortality risk. To measure the extent to which pathways other than employment are associated with cause-specific mortality risk during retirement once socioeconomic variables like income are controlled for, we include labor market status at age 58 and years in each labor market status from age 59 until age 64. It should be noted, however, that although we take the position that there is, or might be, an association between covariates like pathways to retirement and cause-specific mortality risk, we do not claim any causal relation.

3.1 Model Estimation

We observe an individual from age 65 until death or until the last sample year. With $A(i)$ denoting the age of the individual when last observed in the sample, the variable $m_j(i)$ is equal to 1 if j is the cause of death at age $A(i)+1$ ($j \in \{1,2,3\}$), and 0 otherwise. We summarize all information observed for individual i in the vector $Z(i) = \left(\left\{ X_a(i) \right\}_{a=65}^{A(i)}, \eta(i), A(i), m_1(i), m_2(i), m_3(i) \right)$. The probability of individual i surviving from age 65 to age $A(i)$ and either surviving to or being deceased at age $A(i)+1$ from mortality cause j is given by

[9] Kalwij *et al*. (2009) present empirical evidence in favor of using a linear age function.

[10] Grundy and Holt (2001) argue that homeownership is a good proxy for older people's socioeconomic status.

$$P_i\left(Z(i),\eta(i);\beta,\alpha\right)=\prod_{j=1}^{3}\left[\left(\prod_{a=65}^{A(i)-1}\left(1-F_j\left(X_a(i)\beta_j+\alpha_j\eta(i)\right)\right)\right)^{I(A(i)>65)}\right.$$

$$\times\left(1-F_j\left(X_{A(i)}(i)\beta_j+\alpha_j\eta(i)\right)\right)^{(1-m_j(i))}$$

$$\left.\times\left(F_j\left(X_{A(i)}(i)\beta_j+\alpha_j\eta(i)\right)\right)^{m_j(i)}\right], \qquad (2)$$

where $\beta=(\beta_1,\beta_2,\beta_3)$ and $\alpha=(\alpha_1,\alpha_2,\alpha_3)$. The first term in the right-hand side of equation (2), in between the square brackets, is the survival probability up to $A(i)$, the second term is the probability of surviving one more year, and the third term is the probability of being deceased from cause j at age $A(i)+1$.

As previously explained, $\eta(i)$'s are unobserved random effects, meaning there is no empirical counterpart to equation (2). We therefore assume that the random effects are normally distributed with a zero mean and a variance of σ^2 and take the conditional expectation of equation (2) with respect to η:

$$E_\eta\left(P_i\left(Z(i),\eta(i);\beta,\alpha\right)\right)=\int_{-\infty}^{+\infty}P_i\left(Z(i),\eta(i);\beta,\alpha,\sigma\right)d\Phi\left(\frac{\eta(i)}{\sigma}\right), \qquad (3)$$

where $\Phi(.)$ is the cumulative normal distribution function. The maximum likelihood estimates of the model parameters are given by

$$\left(\hat{\alpha},\hat{\beta},\hat{\sigma}\right)=\underset{\alpha,\beta,\gamma,\sigma}{\operatorname{argmax}}\sum_{i=1}^{n}\log\left(\int_{-\infty}^{+\infty}P_i\left(Z(i),\eta(i);\beta,\alpha,\sigma\right)d\Phi\left(\frac{\eta(i)}{\sigma}\right)\right), \qquad (4)$$

where n is the number of individuals. We evaluate the integral of equation (4) using a Gaussian quadrature (see, e.g., Cameron and Trivedi, 2005).[11]

3.2 Model Identification

[11] For estimation, we use the MATA module of the STATA software (www.stata.com).

One well-known feature of a competing risks model is that one has to make an assumption concerning the dependency across the different risks in order to identify the parameters (see, e.g., Van den Berg, 2005). Frequently, such risks are assumed to be independent conditional on the observed covariates (see, e.g, Yashin *et al*., 1986). Yet in an analysis of cause-specific mortality risk, this latter assumption may be unrealistic (see, e.g., Mackenbach *et al*., 1995; Vaupel and Yashin, 1999). We therefore allow for dependency between cause-specific mortality risks by including the individual random effect specified in equation (1). A more general specification, such as different random effects for each risk, is impossible because of data limitations: it would require, among other things, at least three continuous covariates. However, one important aspect of the model given in equation (1) is that it contains only one continuous covariate (standardized household income) which, together with the proportionality between age pattern, covariates, and the random effect imposed on mortality risk, ensures identification of the random effect distribution. For formal discussion of the identifiability of mixed proportional hazards in competing risks models, we refer to Heckman and Honoré (1989) and Abbring and Van den Berg (2003).

Our model also allows for different impacts of the random effect for each cause-specific mortality risk and we choose $\alpha_1=3-\alpha_2-\alpha_3$ as a normalization.[12] The identification of the α parameters in equation (1) is guaranteed by the fact that medical examiners report more than one cause of death for about one-third of deaths (see table 2). As regards the likelihood function in equation (2), this information on multiple

[12] Only their relative sizes are separately identified from the variance parameter (of the random effect). As an alternative we could set one of these three parameters equal to 1. This does, of course, not affect the empirical results.

causes of death means that $m_j(i)$ can be equal to 1 for more than one j for individual i. A conceptually similar approach is adopted by Mackenbach *et al*. (1999) in their analysis of gains in life expectancy in the Netherlands in which they take into account competing causes of death. Finally, the model includes a separate control for labor market status at age 58 to ensure that the associations between the pathways to retirement (measured by years in the different labor market statuses from age 59 onward) and cause-specific mortality risk are identified solely from labor market transitions after age 58.

4. Estimation Results

The estimation results from the model outlined above are given in table 3. In the following discussion we use a 5% level of significance. For all three causes of death, women have a lower mortality risk than men, and mortality risk is higher among singles than married individuals. Individuals in the more recent birth cohorts have a lower mortality risk from CVD. Household income is more strongly negatively associated with the mortality risks from CVD and other diseases than with that from cancer, and homeownership is more strongly negatively associated with the mortality risk from other diseases than with that from either cancer or CVD. Finally, disability is the only pathway that has a significant (and positive) association with mortality risk later in life and for all three causes of death. The significant and relatively large estimated standard deviation of the random effect (at the bottom of the table) suggests an important role for unobserved individual-specific characteristics.[13]

Nevertheless, although the parameter estimates in table 3 provide insights into the direction and relative size of the associations between the covariates and the cause-specific mortality risks, they offer no clear insights into the quantitative association. We therefore use these estimates to predict the cause-specific probabilities of a reference individual who has died by a certain age, conditional on surviving up to age 65, with specific values assigned to the covariates.[14] Here, we take as a reference a male born in 1931, who is married at age 65, has a median standardized household income, lives in a rented accommodation, and who stayed employed up to the statutory retirement age of 65. First, we predict the cause-specific probabilities of the reference individual having died by ages 70, 75, and 80 (see table 4); next, we change his characteristics one at a time and report the resulting changes in the cause-specific probabilities of his having died by age 75 (see table 5).

As table 4 shows, with age there is a strong increase in the probability of the man having died and a decrease in the relative importance of cancer as the cause of death. Specifically, cancer accounts for about half of deaths by age 70 but only about one-third by age 80. The relative importance of CVD, however, remains fairly constant with age, and the relative importance of other diseases rises. As the first line of table 5 (like that of table 4) shows, by age 75, the reference male has a 13%

[13] Not reported in this paper is the finding that excluding random effects affects the parameter estimates. For instance, it yields an underestimated age effect that may reflect the fact that with age, individual mortality risk increases more than (aggregate) population mortality risk.

[14] These calculations are based on Monte Carlo simulations. In a competing risk setting in discrete time, two events can occur at the same time; however, by using random assignment in the simulation, we allow for only one cause of death (cancer, CVD, or another disease).

probability of having died and this can be disentangled in a 5% probability of having died from cancer, a 4% probability of having died from CVD, and a 4% probability of having died from another disease.

In contrast, a woman with the same characteristics as the reference man has about a 9 percentage point lower probability of having died by age 75 (table 5). The reduction in mortality is of similar size for all three causes of death. Moreover, compared to the reference individual, who is married at age 65, a single individual has a two times higher probability of having died by age 75, an increase related primarily to CVD and other diseases. Individuals that are widowed at age 65 have about a 9 percentage point higher probability of having died by age 75, primarily related to other diseases. The younger birth cohorts, however, have a lower probability of having died by age 75, due mainly to a lower mortality risk from CVD.

The probability of having died by age 75 is almost twice as high among individuals in the first quartile of the income distribution than among individuals in the fourth quartile.[15] Interestingly, this difference is strongest for the mortality risk from CVD but insignificant for that from cancer. Furthermore, homeowners have a 3.6 percentage point lower probability of having died by age 75, primarily in relation to the mortality risk from other diseases.

Finally, to assess the impact of pathways to statutory retirement on cause-specific mortality (at the bottom of table 5), we examine the change in the probability of having died by age 75 for individuals not employed in the three years preceding statutory retirement (i.e., at ages 62–64)[16] using a reference individual who was employed at those ages. We find, for example, that individuals in early retirement

[15] Calculation: 13.25%+4.66% versus 13.25%-3.86%.

[16] Three years is an arbitrary choice; we could equally choose, for instance, two or four years.

during the three years preceding statutory retirement have no increased probability of having died by age 75, no matter the cause of death. The only pathway that is significantly associated with the probability of having died by age 75 is being on disability during the three years preceding statutory retirement. Compared to those who remain employed, these individuals have an almost twofold increase in the probability of having died by age 75 from any of the three causes of death.

5. Summary and Conclusions

In this paper, we examine to what extent pathways to statutory retirement other than employment are associated with adverse health conditions, as measured by increased cause-specific mortality risk during retirement (i.e., from the statutory retirement age of 65 onward). For this purpose, we estimate a dependent competing risks model using administrative data from the 1996–2007 waves of the Income Panel Study of the Netherlands supplemented with medical records on multiple causes of death.

The main empirical findings can be summarized as follows. Standardized household income is negatively associated with the mortality risks from CVD and other diseases but not with that from cancer. This finding is in line with observations for the U.S., such as, for instance, Cutler *et al*. (2006) and Smith (1999). Younger birth cohorts also have a lower mortality risk primarily related to a lower mortality risk for CVD. Our simulation results show that, conditional on being alive at age 65, the probability of having died by age 75 is about 13% for our reference individual—a male, born in 1931, who is a renter with median income and remained employed up to the statutory retirement age of 65. Although this probability is not significantly different for an individual with the same characteristics who from age 62 is early retired, unemployed, self-employed, or nonparticipating, it is about twice as high for an individual with the same characteristics who draws disability insurance benefits from the age of 62. These results hold for all causes of death. We therefore conclude that, in line with the findings for Germany (Brockman *et al*., 2009), cause-specific mortality risk, is not associated with early retirement and positively associated with being on disability.

Taken together, our findings suggest that, overall, the disability insurance scheme in the Netherlands does, as intended, a good job of selecting individuals with reduced employability due to health conditions. This finding in turn implies that the effectiveness of policies aimed at increasing employment among the 55+ population may, on average, not be adversely affected by the health conditions of nonemployed individuals other than those on disability.

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Table 1   Cause-specific mortality rates by socioeconomic group

	Sample proportion	*Cause-specific mortality rate* [a)] All causes	Cancer	CVD [b)]	Other diseases
	%	%	%	%	%
All	100.0	2.1	0.9	0.6	0.6
Gender					
Men	48.4	2.7	1.2	0.8	0.7
Women	51.6	1.5	0.7	0.4	0.4
Marital status at age 65					
Single	12.7	2.8	0.9	1.0	0.9
Widowed	11.9	2.4	1.0	0.6	0.8
Married	75.4	1.9	0.9	0.5	0.5
Birth cohort					
1931-1935	38.9	2.4	1.0	0.7	0.6
1936-1942	61.1	1.6	0.8	0.4	0.4
Homeowner at age 65					
No	49.9	2.5	1.0	0.7	0.8
Yes	50.2	1.6	0.8	0.5	0.3
Labor market status					
At age 58					
Employed	29.3	1.9	1.0	0.5	0.4
Self-employed	7.6	2.2	1.5	0.4	0.3
Unemployed	11.2	2.4	0.9	0.9	0.7
On disability	13.1	3.2	1.1	1.0	1.1
Early retired	14.4	2.0	0.9	0.5	0.6
Nonparticipating	24.4	1.5	0.7	0.4	0.4
At age 62					
Employed	10.6	2.0	0.9	0.6	0.5
Self-employed	5.8	2.1	1.4	0.4	0.3
Unemployed	8.9	2.3	0.9	0.8	0.7
On disability	14.3	3.3	1.2	1.1	1.0
Early retired	36.6	2.0	1.0	0.5	0.5
Nonparticipating	23.7	1.4	0.6	0.4	0.4
Standardized household income	Sample mean (€)				
1st quartile	11,208	3.0	1.1	1.0	0.8
2nd quartile	15,438	2.0	0.9	0.5	0.6
3rd quartile	19,251	1.7	0.9	0.4	0.4
4th quartile	32,320	1.6	0.8	0.4	0.4

a) The mortality rate is defined as the probability of death within one year (in %).
b) CVD = cardiovascular diseases

Table 2 Multiple causes of death

Cell: number of deaths		Secondary cause of death		
Primary cause of death		Cancer	CVD [a)]	Other diseases
Cancer	512	22	56	135
CVD	329	11	73	112
Other diseases	306	9	68	158
All causes	1,147	42	197	405

a) CVD = cardiovascular diseases

Table 3 Estimation results

Dependent variable: Cause-specific mortality risk	**Cancer**		**CVD**		**Other diseases**	
*Covariate**	Parameter estimate	(Standard error)	Parameter estimate	(Standard error)	Parameter estimate	(Standard error)
Age	0.258	(0.031)	0.311	(0.041)	0.406	(0.051)
Birth cohort	-0.011	(0.023)	-0.105	(0.028)	-0.057	(0.028)
Woman	-1.109	(0.171)	-1.474	(0.214)	-1.610	(0.221)
Single at age 65	0.436	(0.184)	0.892	(0.211)	1.125	(0.217)
Widowed at age 65	0.516	(0.200)	0.419	(0.248)	0.821	(0.243)
Logarithm of income at age 65	-0.307	(0.146)	-0.958	(0.187)	-0.855	(0.191)
Homeowner at age 65	-0.254	(0.130)	-0.276	(0.155)	-0.555	(0.160)
Years self-employed between ages 58 and 64	0.025	(0.115)	-0.099	(0.161)	0.010	(0.155)
Years unemployed between ages 58 and 64	-0.010	(0.083)	-0.115	(0.103)	-0.109	(0.099)
Years on disability between ages 58 and 64	0.219	(0.094)	0.228	(0.099)	0.293	(0.093)
Years nonparticipating between ages 58 and 64	-0.031	(0.079)	-0.179	(0.109)	-0.161	(0.110)
Years in early retirement between ages 58 and 64	-0.009	(0.057)	-0.113	(0.071)	-0.096	(0.073)
Standard deviation random effect, σ	2.866	(0.120)				
α_1	0.832	(0.065)				
α_2	1.030	(0.093)				
α_3	1.139	(0.114)				
Log-likelihood value	-7916.5					
Number of individuals	9618					

* The model also includes a constant and dummy variables for the different labor market statuses at age 58 (see section 3).

Table 4 Cause-specific mortality by age, conditional on being alive at age 65 for a reference individual [a)]

	All causes		Cancer		CVD [a)]		Other diseases	
Probability of having died	%	(Standard error)	%	(Standard error)	%	(Standard error)	%	(Standard error)
by age 70	2.90	(0.63)	1.43	(0.43)	0.94	(0.43)	0.53	(0.29)
by age 75	13.25	(2.67)	5.15	(1.36)	4.17	(1.38)	3.93	(1.46)
by age 80 [b)]	51.04	(7.68)	16.31	(3.84)	14.51	(4.39)	20.22	(5.40)

[a)] The reference individual is a male, born in 1931, married at age 65, with a median standardized household income, living in a rented accommodation at age 65, and who remained employed up to the statutory retirement age of 65.
[b)] This is an out-of-sample prediction (the oldest individual in our sample is 76 years of age).

Table 5 Cause-specific mortality probabilities by socioeconomic status

	Cause-specific probability of having died by age 75 (conditional on being alive at age 65)							
	All causes		**Cancer**		**CVD [a)]**		**Other diseases**	
	%	(Standard error)	%	(Standard error)	%	(Standard error)	%	(Standard error)
Reference individual	13.25	(2.67)	5.15	(1.36)	4.17	(1.38)	3.93	(1.46)
Differences from the reference individual								
	% point	(Standard error)	% point	(Standard error)	% point	(Standard error)	% point	(Standard error)
Gender								
Man [b)]	0.00		0.00		0.00		0.00	
Woman	-9.24	(1.92)	-3.23	(0.86)	-2.98	(0.97)	-3.03	(1.11)
Marital status								
Married [b)]	0.00		0.00		0.00		0.00	
Single	13.95	(3.38)	2.25	(1.25)	4.68	(1.99)	7.02	(2.19)
Widowed	9.03	(3.22)	2.65	(1.31)	1.79	(1.43)	4.59	(2.19)
Birth cohort								
1931 [b)]	0.00		0.00		0.00		0.00	
1936	-2.81	(1.27)	-0.21	(0.55)	-1.56	(0.68)	-1.04	(0.62)
1941	-4.63	(2.09)	-0.38	(1.03)	-2.49	(1.02)	-1.76	(0.99)
Household income								
1st quartile	4.66	(1.23)	0.65	(0.37)	2.14	(0.74)	1.87	(0.74)
Median [b)]	0.00		0.00		0.00		0.00	
4th quartile	-3.86	(1.04)	-0.72	(0.38)	-1.63	(0.55)	-1.51	(0.62)
Accommodation								
Renter [b)]	0.00		0.00		0.00		0.00	
Homeowner	-3.55	(1.26)	-1.00	(0.61)	-0.89	(0.57)	-1.66	(0.67)
Labor market status at ages 62-64, conditional on being employed until age 62								
Employed [b)]	0.00		0.00		0.00		0.00	
Self-employed	0.03	(3.71)	0.66	(1.89)	-0.97	(1.60)	0.34	(2.12)
Unemployed	-2.07	(2.32)	0.05	(1.17)	-0.97	(1.00)	-1.15	(1.04)
On disability	12.67	(3.77)	4.53	(2.16)	3.21	(1.82)	4.93	(1.55)
Nonparticipating	-3.26	(2.41)	-0.32	(1.10)	-1.49	(1.01)	-1.45	(1.07)
Early retired	-2.14	(1.82)	-0.01	(0.81)	-1.18	(0.82)	-0.95	(0.90)

a) CVD = cardiovascular diseases

b) The reference individual is a male, born in 1931, married at age 65, with a median standardized household income, living in a rented accommodation at age 65, and who remained employed up to the statutory retirement age of 65.